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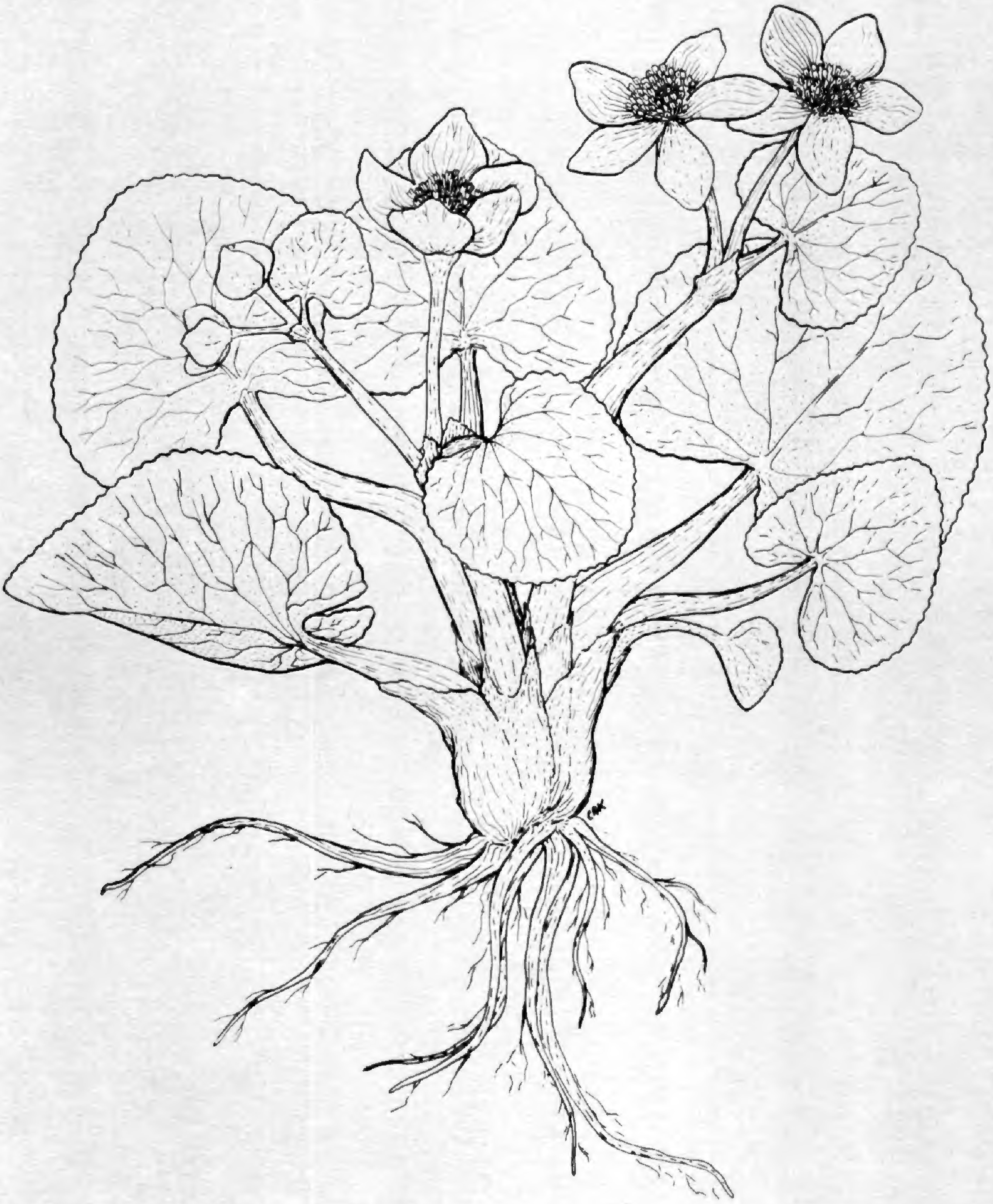

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Cover illustration

Caltha palustris L., known to Thoreau as "Cowslip" and commonly called Marsh Marigold, is a low perennial herb which provides a bright accent to wet woods and meadows, swamps, bogs, and other wet places across the northern United States and Canada and south along the Appalachians to the Carolinas and Tennessee.

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TAXONOMIC REVISION OF CENTRATHERUM AND PHYLLOCEPHALUM (COMPOSITAE:VERNONIEAE)

L. KATHERINE KIRKMAN[1]

Centratherum has generally been treated as a widely distributed tropical genus of the tribe Vernonieae, family Compositae, found in Central and South America, the West Indies, Australia, the Philippines, India, and Java. Willis (1973) recognized approximately 20 species for the genus. A historical record of about 90 names associated with this genus since it was first described by Cassini in 1817 complicates its taxonomic history. For the most part, descriptions of taxa have been scattered in the literature. DeCandolle excluded Old World species from *Centratherum*, placing them in the genus *Decaneurum* (1834). However, the basis for his classification was not presented. Bentham's revisionary treatment followed (1873) and united the two taxa into the single genus *Centratherum,* a group having large pedunculate heads subtended by foliaceous bracts, and uniseriate pappus bristles. While *Centratherum* species have been treated in various geographical floras, no comprehensive evaluation of the group has been undertaken since that of Bentham and Hooker.

The tribe Vernonieae is highly diversified, but is basically characterized by discoid heads, basally sagittate anthers, and long, slender, hirsute styles flattened on the inner side (Jones, 1977). As noted by Jones, delimitation of the genus *Centratherum* is nebulous, as is that of numerous other genera of the tribe (many of which are very small or monotypic), and the genus itself is in need of comprehensive taxonomic treatment.

The present revisionary study involves a traditional herbarium-

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based analysis of the gross-morphologic characters combined with pollen and chromosome studies. The goal is to understand better the taxonomic status and phylogenetic position of this complex.

MORPHOLOGICAL AND CYTOLOGICAL EVIDENCE

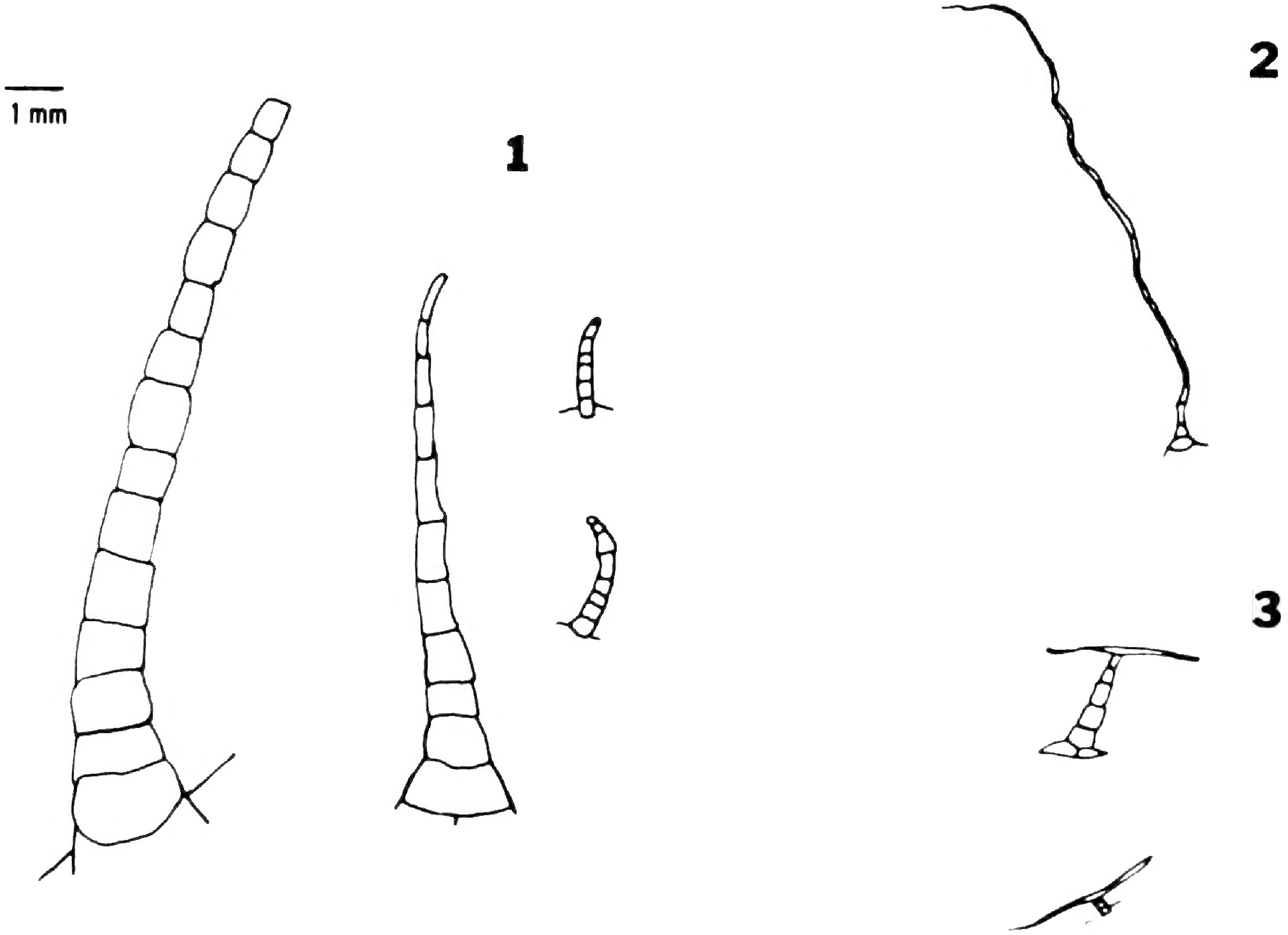
Herbarium specimens were obtained on loan from B, BLAT, BM, BR, BRI, CA, F, G, GH, K, L, LE, LP, M, MO, MPU, NSW, NY, OXF, P, RB, S, SP, SRGH, TEX, UB, and US. Morphological characteristics, such as the length and width of leaves and phyllaries, length of achenes, pappus, style, corolla, involucre, and shape of bracts were recorded for at least ten specimens per country for each taxon (when possible). Otherwise, all available specimens were measured and scored. Means and ranges for the measurements were calculated for each character.

Trichomes. Leaf trichomes were examined after clearing. Leaves from herbarium specimens were cleared in 1% aqueous NaOH at 60° C and transferred to 75% lactic acid at 60° C. Next, the leaves were stained in safranin and fast green and mounted in Hoyer's solution.

Camera lucida drawings of characteristic trichomes are presented (Figs. 1–3). Three types of trichomes were found. T-shaped and uniseriate trichomes, which occur in *Vernonia* as described by Faust and Jones (1973), are also found on species of *Centratherum* from the New World, Philippines, and Australia. All specimens from the Philippines (= *C. punctatum* Cass. ssp. *fruticosum* (Elmer) Kirkman) have both t-shaped and uniseriate trichomes on the veins of the lower leaf surface, the petiole and the peduncle, and rarely, t-shaped trichomes on the upper leaf surface. *Centratherum confertum* Kirkman also has both trichome types present on the leaves, stems, and petioles. Specimens from Australia (= *C. punctatum* Cass. ssp. *australianum* Kirkman) and some from South America (= *C. punctatum* Cass. ssp. *punctatum*) have t-shaped trichomes on the stem only.

Notably, only the Old World species have on the lower leaf surface a type of hair termed by Payne (1978) as flagelliform. Both New World and Old World species have uniseriate trichomes, but such hairs on Old World species are much longer.

Pollen. Pollen samples of each taxon were acetolyzed by



Figures 1–3. Camera lucida drawings of trichomes types of *Centratherum* and *Phyllocephalum*, 10 × : **1.** flagelliform (*Phyllocephalum*); **2.** uniseriate (both genera); **3.** t-shaped (*Centratherum*).

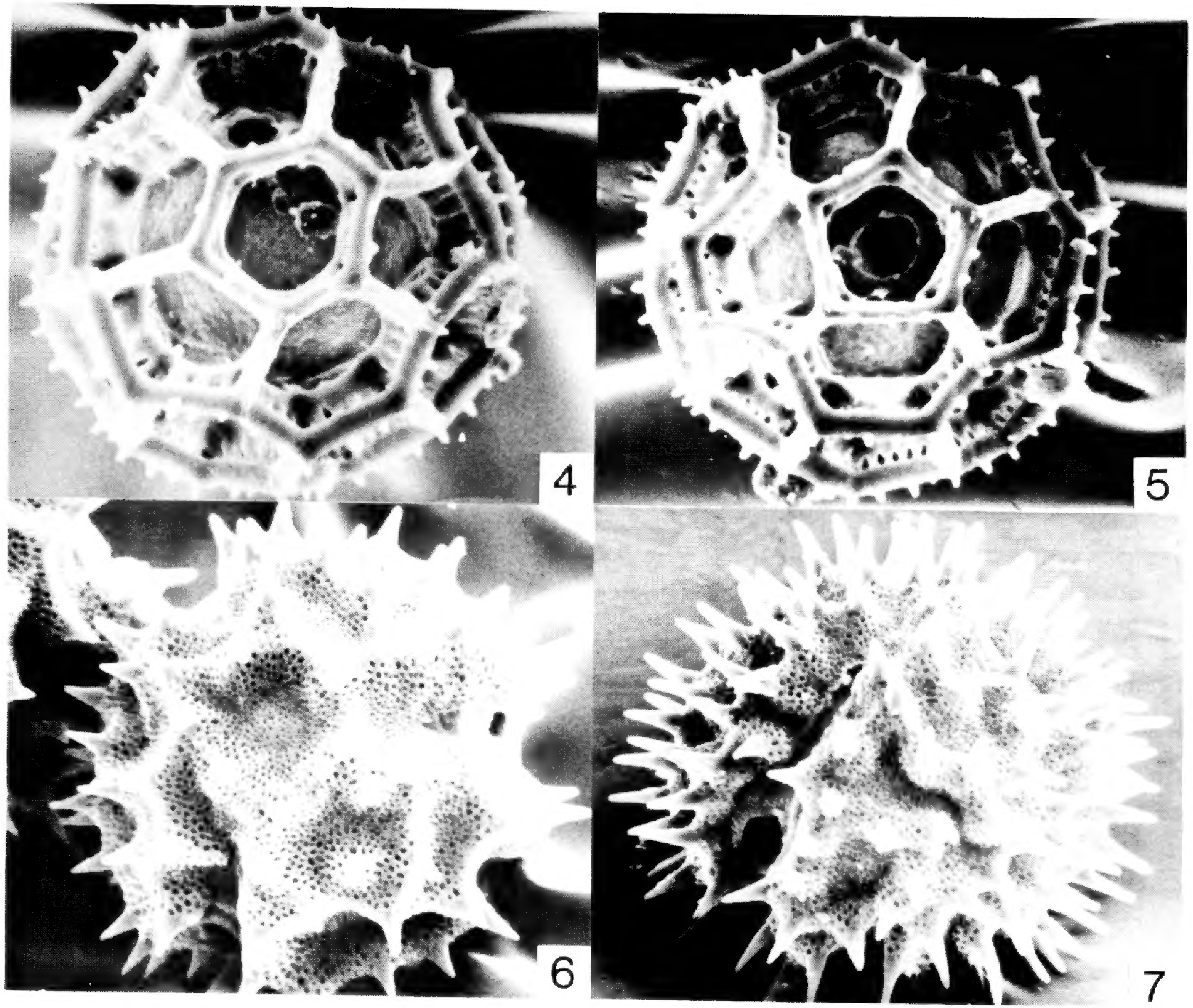
Erdtman's procedure (1966) prior to examination by scanning electron microscopy. Major morphological differences were found between *Centratherum* pollen grains of the New World and those of the Old World. This variation in pollen morphology was previously noted by Kingham (1976). However, one of the species she examined, *C. angustifolium* (Benth.) Adams, is actually a *Vernonia*.

Basically, two types of pollen grains were found. Species of *Centratherum* from India and Java have polyhedral-shaped tricolporate pollen grains with minute spines approximately 1 μm in length along pronounced muri. This type of grain lacks micropuncta. In contrast, New World and Australian species have tricolporate, echinolophate pollen grains (spines up to 5 μm) with a continuous micropunctate tectum (Fig. 4–7).

For examination with light microscope under oil immersion, acetolyzed pollen grains were mounted in glycerin jelly on glass slides. Diameters (spine tip to spine tip at the equatorial view) of 25 pollen grains were measured per sample. The diameter measurements of the spiny pollen grains ranged from 37 to 70 μm. Polyhedral-shaped pollen varied from 47–60 μm in diameter.

Chromosome numbers. Previous reports of chromosome numbers for *Centratherum* include $n = 9$ for *C. rangacharii* Gamble and *C. phyllolaenum* (DC.) Benth. (both = *Phyllocephalum scabridum* (DC.) Kirkman) (Mehra & Remanandon, 1969; Shetty, 1967). Published counts of *C. punctatum* Cass. and *C. muticum* (H. B. K.) Less. (= *C. punctatum* Cass.) indicate $n = 16$ (Coleman, 1970; Gadella et al., 1969; Turner & King, 1964) and $n = 32$ (Jones, 1977). Using the usual acetocarmine squash technique, chromosome numbers of $n = 16$ and $n = 32$ were determined for *C. punctatum* from Brazilian accessions grown from seed in the greenhouse, supporting the report of polyploidy in the *C. punctatum* complex from South America (Fig. 8–9, 10). Some variation is recognizable in bract shape among the greenhouse specimens from South America that have different ploidy levels; however, herbarium specimens demonstrate a continuum between these different involucral phyllaries and no significance is attached to this variation.

Pollen stainability. Pollen fertility was estimated for the greenhouse accesions by determining percentage of pollen stained with 1% aniline blue in lactophenol for 24 hours. A minimum of 150 grains was counted for each slide. Darkly stained pollen grains were considered fertile and lightly stained or unstained grains were scored



Figures 4–7. Scanning electron photomicrographs of *Centratherum* and *Phyllocephalum* pollen grains. **4.** Type A pollen, equatorial view, ca. 50 μm. **5.** Type A polar view. **6.** Type B pollen, equatorial view, ca. 55 μm. **7.** Type B polar view.

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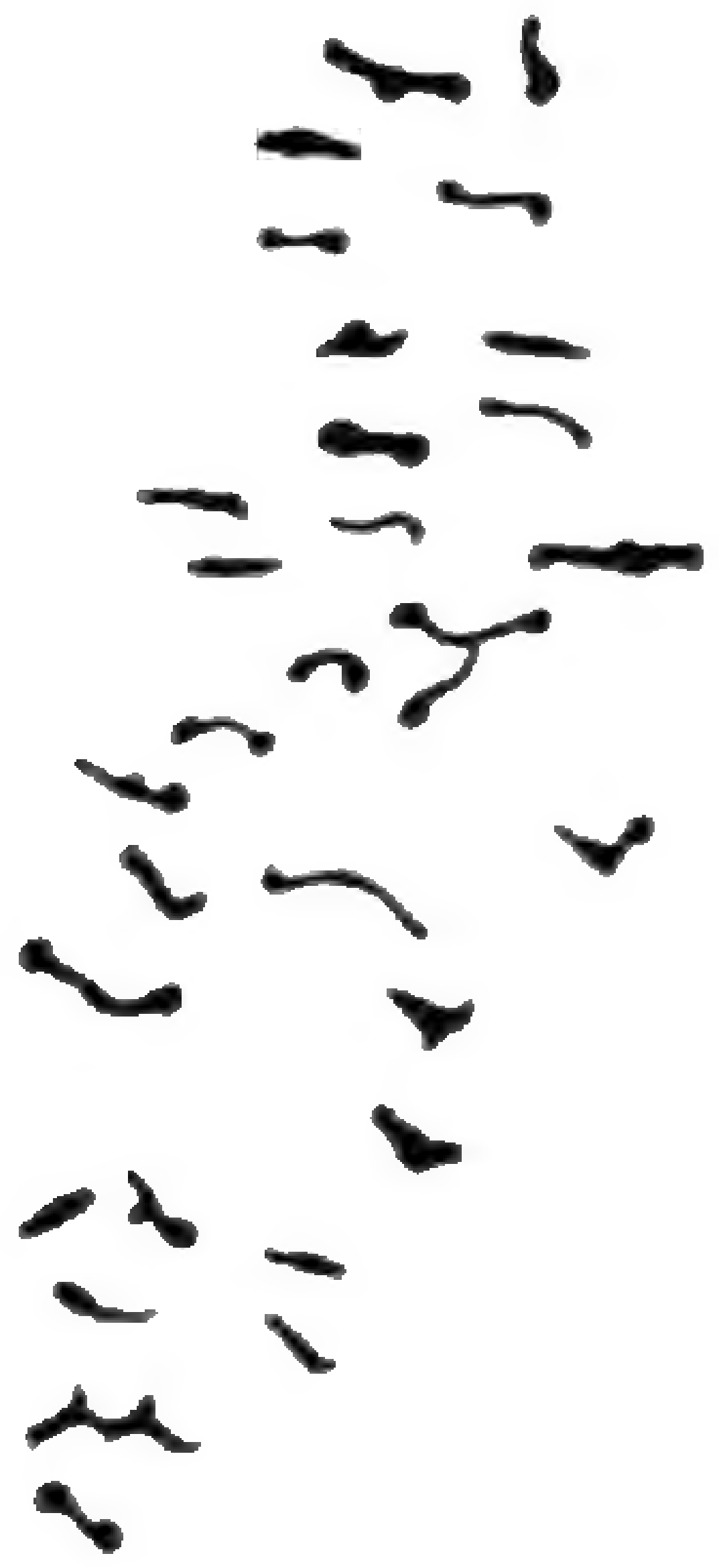

Figures 8–9. Camera lucida drawings of PMC with chromosomes. **8.** *C. punctatum* ssp. *punctatum*, $n = 16$; 1000 ×: Voucher: *Jones 22674.* **9.** *C. punctatum* ssp. *punctatum*, interpretation of photo in Fig. 10.

Figure **10.** Photograph of PMC with chromosomes of *C. punctatum* ssp. *punctatum*, *n* = 32; 1000 ×; Voucher: *Kirkman 78–11* GA.

infertile. The sample (*Jones 22682*) having a chromosome number of $n = 16$ had a mean of 57.9% fertile pollen ranging from 41.8–90.9%. Samples (*Kirkman 78-11* and *Jones 22674*) having chromosome number $n = 32$ had means of 28.9% and 34.3% with respective ranges of 17.2–48.8% and 25.3–43.2%. Estimated fertility of pollen from plants grown from self-fertilized achenes averaged 26%, ranging from 16.2–41.4%. The parent of the plant had a chromosome number $n = 32$. This small sample suggests that polyploids in *Centratherum* have a lower pecentage of viable pollen than the plants of a lower ploidy level.

GENERIC CONCEPTS

The fact that the genus *Centratherum* as defined by Bentham has two types of pollen grains geographically correlated with chromosome number strongly suggests that the taxon is heterogeneous.

A strikingly parallel situation is found in the closely related genus *Vernonia*. Chromosome counts reported in New World species include $n = 17$, 34, 51, and 68, whereas Old World species have chromosome numbers of $n = 9$ or 10 and polyploids of 18, 20, and 30 (Jones, 1977). Among the various types of *Vernonia* pollen grains, two resemble the polyhedral *Centratherum* pollen. The polyhedral-shaped *Vernonia* pollen is found in S.E. Asia and Africa, whereas the corresponding spiny *Vernonia* pollen grains are found throughout the range of the genus (S. B. Jones, personal communication). The value of palynology as an aid to the systematics of *Vernonia* has been demonstrated by Jones (1970) and Keeley and Jones (1977). Although pollen morphology alone is not a definitive criterion for taxonomic decisions, it is of value in interpreting phylogenetic relationships in conjunction with other characters.

The genus *Centratherum* has traditionally been held together by characteristics of leafy outer involucral bracts and caducous pappus bristles. However, in view of the evidence obtained from pollen grain morphology, chromosome numbers, geographical distribution and morphological differences (Table I), it is likely that two taxa having different pollen types were independently derived from *Vernonia* and that their common characters are due to convergent evolution rather than to development from a common ancestor. Based on the presented evidence indicating a polyphyletic origin of the group, generic distinction of the respective taxa is proposed, i.e., *Centratherum* from the New World, Australia, and Philippines, and *Phyllocephalum* from India and Java.

Summary of Generic Character Differences

	Centratherum	*Phyllocephalum*
Reported chromosome number	$n = 16, 32$	$n = 9$
Leaf trichome types	t-shaped, uniseriate	flagelliform, uniseriate
Pollen type	spiny	polyhedral
Distribution	New World, Australia, Philippines	India, Java

SPECIES CONCEPTS

In this revisionary study, species and subspecies are delimited mainly by megamorphological characters. Field population studies and further biosystematic studies are needed to assess variability within species as well as to verify suspected hybrids (by putative parent crosses and backcrosses.) Greenhouse-grown *Centratherum punctatum* ssp. *punctatum* ($n = 32$) self-fertilizes and produces viable offspring. The percentage of fertile achenes to the total number of achenes per head averaged 3.7%, ranging from 0–9.8%. Accessions of *C. punctatum* ssp. *punctatum* ($n = 16$) averaged .068% fertile achenes due to self-fertilization. These plants self-fertilize rarely or not at all.

TAXONOMIC TREATMENT OF PHYLLOCEPHALUM

Phyllocephalum Bl., Bidjr. fl. Ned. Ind. p. 888. 1826. TYPE SPECIES: *P. frutescens* Bl.

Decaneurum DC. ex Wight, Contrib. bot. ind. p. 7–8. Oct. 1833. TYPE SPECIES: *D. reticulatum* DC. ex Wight.

Herbs or subshrubs; stems glabrous, hispid, or woolly. Leaves alternate, petiolate or sessile; blades elliptic to obovate, acute to acuminate at the apex, obtuse or attenuate at the base, marginally serrate and sometimes revolute, pubescent or rugose above, puberulous to tomentose beneath. Inflorescences terminal on axillary branches (rarely spikelike). Heads with numerous florets, involucre cylindric-campanulate; phyllaries imbricate in several series, glabrous to long ciliate, the inner membranaceous, the outer foliaceous. Pappus of bristles, stramineous to reddish, deciduous. Corollas tubular, reddish-purple (infrequently white). Achenes ribbed, obconic.

Phyllocephalum is a genus of three species found in India and Java. Their distribution is shown in Fig. 11.

1. Leaves white-tomentose beneath, nerves not conspicuously raised. .... 1. *P. scabridum.*
1. Leaves either white-tomentose beneath with conspicuously raised nerves, or merely puberulous.
    2. Leaves sessile, margins of blades revolute; India 2. *P. indicum.*
    2. Leaves with petioles 0.5–2 cm long, margins of blades not revolute or only minutely so; Java .... 3. *P. frutescens.*

1. **Phyllocephalum scabridum** (DC. in Wight) Kirkman, *comb. nov.*

Ampherephis mollis Wall., cat. n. 2957. 1831. nom. nud.

Decaneurum scabridum DC. in Wight, Contrib. bot. ind. p. 7. 1834. TYPE: *Wight cat. n. 1392* (LECTOTYPE here designated: LE!. ISOLECTOTYPE: BR! 1393 apparently mislabeled on herbarium sheet at BR.)

D. epilejum DC. in Wight, Contrib. bot. ind. p. 7. 1834. TYPE: *Wight cat. n. 1393* (LECTOTYPE here designated: K!. ISOLECTOTYPES: BM!, G!, OXF!).

D. molle (Wall.) DC. var. *scabridum* DC., Prod. **5:** 66. 1836.

D. molle (Wall.) DC. var. *epilejum* DC., Prod. **5:** 66. 1836.

D. phyllolaenum DC., Prod. **7:** 264. 1838. TYPE: *Roux s.n.* (LECTOTYPE here designated: G-DC, as microfische!. ISOLECTOTYPE: G!).

Gymnanthemum molle (DC.) Sch.-Bip., in Walp. Rep. **2:** 948. 1843.

G. phyllolaenum (DC.) Sch.-Bip., in Walp. Rep. **2:** 948. 1843.

Decaneurum courtallense Wight, Icon. **3**(4): 6 tab. 1081. 1846. TYPE: the illustration.

Centratherum molle (Wall.) B. & H., Gen. Pl. **2:** 225. 1873.

C. phyllolaenum (Wall.) B. & H., Gen. Pl. **2:** 225. 1873.

C. courtallense (Wight) B. & H., Gen. Pl. **2:** 225. 1873.

C. molle (Wall.) B. & H. var. *epilejum* (DC.) Clarke, Comp. Ind. p. 4. 1876.

C. tenue Clarke, Comp. Ind. p. 4. 1876. TYPE: INDIA: Concan, *Law s. n.* (LECTOTYPE here designated: K!. ISOLECTOTYPES: GH!, L!).

C. hookeri Clarke, Comp. Ind. p. 4. 1876. TYPE: INDIA: Bombay: Concan, *Law s. n.* (LECTOTYPE here designated: P!. ISOLECTOTYPE: L!).

C. ritchiei Hook., Fl. Brit. Ind. p. 228. 1881. TYPE: INDIA: Canara, no collector cited *93a* (LECTOTYPE here designated: BM!. ISOLECTOTYPE: G!).

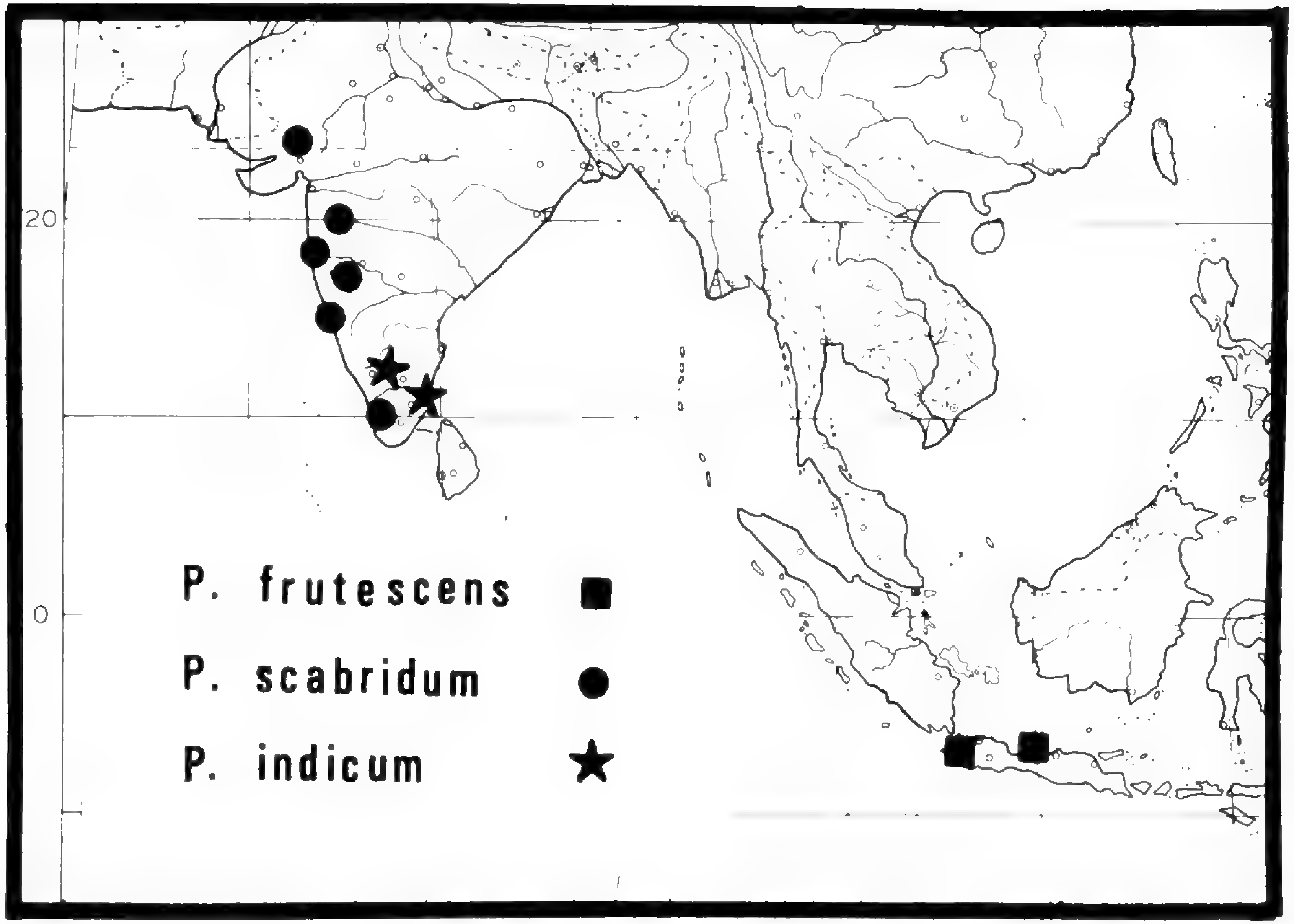

Fig. 11. Distribution of *Phyllocephalum scabridum*, *P. indicum*, and *P. frutescens*.

C. metzianum Sch.-Bip. ex Hook., Fl. Brit. Ind. p. 228. 1881. Type: INDIA: Canara, *Metz 175* (LECTOTYPE here designated: P!. ISOLECTOTYPES: BM!, G!, L!, LE!, MPU!, NY!, OXF!, P!, S!, UC!, US! Only the specimen from LE had the collector's name on the label).

C. rangacharii Gamble, Kew Bull. p. 338. 1920. Type: INDIA; Tinnevelly District, *Rangachari 13195* (LECTOTYPE here designated: K!).

Suffrutescent, erect herb; stems glabrous to hispid, furrowed when dry. Leaves evenly scattered on stem; petioles indistinct to 4 cm long; leaf blades elliptic to obovate, acute to acuminate at the apex, attenuate at the base, 3.5–15.5 cm long, 3.5–9 cm broad, serrate on the margins, hispid above, white-tomentose beneath. Inflorescences terminal on axillary branches (rarely spikelike). Heads with many florets; peduncles 0–8.5 cm; involucre cylindric-campanulate, 0.5–1.5 cm long; phyllaries imbricate in several series, glabrous to long-ciliate, loosely appressed, greenish; innermost phyllaries 6–10 mm long, linear, membranaceous, tips acute to cuspidate, occasionally reddish, the intermediate ones intergradient from membranaceous to foliaceous, the outer foliaceous. Pappus bristles stramineous to reddish, often extremely numerous, 2–6.5 mm long. Corollas 7–11.5 mm long, purplish (infrequently white). Achenes 1.5–3 mm long, cylindric to obconic, ribbed. $n = 9$.

Native to India. Flowering and fruiting from June to October.

Representative specimens examined include: INDIA: Concan, *Stocks s. n.* (BM, MPU, L, NY, P, US). Kerala: Portland abandoned estate, Thenmala, no collector cited *17* (K). Madras: Tinnevelly (Tirunelveli) Hills, no collector cited *4009* (BM). Myosore: North Kanara, *Talbot 1319* (K); Canara, *Stocks 132* (P). Rajasthan: Mount Abu, *Raizada 20594* (L).

This species is highly variable in size, shape and pubescence of the leaves, resulting in many past nomenclatural proposals. The variation observed from herbarium specimens does not appear to be correlated with geographical distribution and therefore does not warrant subspecific classification.

2. **P. indicum** (Less.) Kirkman, *comb. nov.*

Ampherephis indica Less., Linnaea **6**: 686. 1831. Type: *Leehenault s. n.* (HOLOTYPE: probably not extant. NEOTYPE here designated: *Noton s.n.* G-DC as I-DC microfiche!).

Decaneurum reticulatum Wight, Contrib. bot. ind. p. 7. 1834. Type: *Wight 1391.* (LECTOTYPE here designated: K!. ISOLECTOTYPES: BM!, BR!, G!, NY!, P!).

Rolfinkia centaurioides Zenker, Pl. Ind. 13, tab. 14. 1837. Type: the illustration!

Gymnanthemum reticulatum (Wight) Sch.-Bip. ex Walp. Rep. **2**: 948. 1843.

Centratherum reticulatum (Wight) B. & H., Gen. Pl. **2**(165); 225. 1873.

C. indicum (Less.) Fischer, Kew Bull. p. 44. 1940.

C. mayurii Fischer, Kew Bull. p. 45. 1940. TYPE: *Mayuranathan s. n.* The holotype for this species is apparently not extant; however, the description indicates the specimen is *P. indicum*.

Shrub; stems crisply-hairy pubescent especially near inflorescence, channeled when dry. Leaves sometimes crowded; petioles lacking; leaf blades elliptic, acute at the apex (revolute margin giving blunt appearance), obtuse at base, 3–6 cm long, 1.5–3 cm broad, margins revolute, appearing scalloped, hirsute, often rugose above, dirty-white tomentose beneath with light brown crisped hairs on conspicuously raised veins. Inflorescences terminal on axillary branches, usually subtended by leaves similar to cauline ones. Involucre campanulate, 1.5–1.8 cm long; phyllaries loosely appressed, imbricate; inner phyllaries 9.5–15 mm long, linear, straw-colored, membranaceous, fringed at the tips; outer ones 5–9 mm long, ovate, foliaceous, constricted, membranaceous at the base, ciliate, tips acuminate to mucronate. Pappus straw-colored, bristles 3–4 mm long. Corollas (10.7) 11–16.2 mm long, purple. Achenes 3–3.4 mm long, obconic, ribbed.

This species occurs in southern India along weedy roadsides and shady areas. Flowering and fruiting occur from May to October.

Representative specimens examined include: INDIA: Madras: In Montibus Nilagiri, *Hohenacker 1036* (BM, G, GH, K, L, M, MPU, S); Nilghiri, *Wight 1534* (GH, L, M, NY, S).

This species appears to be very closely related to and sometimes resembles *P. frutescens,* but can be distinguished by its sessile leaves and revolute leaf margin.

3. **P. frutescens** Bl., Bidjr. fl. Ned. Ind. p. 888. 1826. TYPE: None cited. (LECTOTYPE here designated: JAVA, *Blume 1400.,* L!. ISOLECTOTYPE: L!).

Decaneurum frutescens (Bl.) DC., Prod. **5:** 66. 1836.

Gymnanthemum frutescens (Bl.) Sch.-Bip. ex Walp. Rep. **2:** 948. 1843.

Decaneurum javanicum Miq. in Pl. Jung, p. 496. 1853. TYPE: Malabar, *Junghin s. n.* (HOLOTYPE: L!).

Centratherum frutescens (Bl.) Boerlage, Handleiding **2:** 234. 1899.

Decaneurum frutescens (Bl.) DC. var. *javanicum* (Miq.) Koster, Blumea **1:** 379. 1935.

Decaneurum frutescens (Bl.) DC. var. *papandaianense* Koster, Blumea **1:** 379. 1935. TYPE: *Went s. n.* (HOLOTYPE: L!).

Herb; stems puberulous to woolly, deeply grooved or sometimes slightly flattened upon drying. Leaves cauline, even spaced; petioles usually distinct, 0.5–2 cm long; leaf blades elliptic, widest at the middle, acuminate at the apex, obtuse at the base, 5–13 cm long, 1.5–3.9 cm broad, margins serrate, occasionally slightly enrolled but marginal teeth protrude, blades puberulous to villous above, puberulous to brown-white tomentose beneath. Heads solitary or in clusters of 2 or 3 heads on axillary branches. Heads with numerous florets; involucre campanulate, 0.8–1.5 cm long; phyllaries imbricate, loosely appressed, brownish when dried; inner phyllaries 6.4–10.4 mm long, linear, membranaceous, tips mucronulate, outer ones ovate to elongate, ciliate, distally foliaceous, basally membranaceous, tips mucronulate to cuspidate, intergrading to the inner. Pappus bristles straw-colored, 1.9–3.5 mm long. Corollas 8.1–12 mm long, purple. Achenes 2.5–3.7 mm long, obconic, ribbed.

Java; mountainous, humid forests and water edges. Flowering and fruiting all year.

Representative specimens examined: JAVA: *Blume 146* (BM). Preanger: G. Papandajan, Boshranden, *Van Steenis 12227* (GH, L). Priangan: G. Patoeha, W., *Van Steenis 4427* (L).

This species is extremely variable. Some specimens are very similar to *Phyllocephalum indicum* in regard to leaf shape and tomentose lower leaf surface, while others appear almost glabrate. A continuum of leaf characteristics is evident in herbarium specimens studied, which does not support subspecific classification within *P. frutescens*.

TAXONOMIC TREATMENT OF CENTRATHERUM

Centratherum Cass., Dict. Sci. Nat. 7: 384. 1817. TYPE SPECIES: *C. punctatum* Cass.

Spixia Schrank, Pl. Rar. Hort. Monac. tab. 80. 1819. TYPE SPECIES: *S. violacea* Schrank.

Ampherephis H. B. K., Nov. Gen. Sp. Pl. 4: 31. 1820. TYPE SPECIES: *A. mutica* H. B. K.

Amphibecis Schrank, Syll. Ratisb. 1: 86. 1824. TYPE SPECIES: *A. violacea* Schrank.

Crantzia Vell., Fl. Flum. Ic. 8, tab. 153. 1827. TYPE SPECIES: *C. ovata* Vell.

Herbs or subshrubs, often-branched stems glabrescent to villous.

Leaves alternate, petiolate to sessile; petioles often indistinct; blades ovate, linear, or oblanceolate, obtuse to sub-acute at the apex, cuneate to attenuate at the base, margins serrate or lobed, blades glabrous, punctate, or pubescent above and beneath. Heads terminal on axillary branches, occasionally 2 or 3 clustered together, many-flowered, sessile; involucre cylindric-campanulate, 8–25 mm wide; phyllaries in several series, outer foliaceous, intergrading to firm scales, tips variable, rounded to long-awned. Pappus bristles straw-colored, deciduous, occasionally absent. Corollas tubular, 5-lobed, reddish-purple, glandular, tube sometimes pubescent. Achenes cylindric to obconic. $n = 16, 32$.

Centratherum is a genus of two species found in the tropics of the New World, Australia, and the Philippines. Their distribution is shown in Fig. 12.

1. Achenes less than 3 mm long.
    2. Leaves serrate, teeth with minute mucro; South and Central America and Philippines.
        3. Phyllaries membranaceous; New World. .... 1a. *C. punctatum* ssp. *punctatum.*
        3. Phyllaries indurate at the base; Philippines. .... 1b. *C. punctatum* ssp. *fruticosum*
    2. Leaves shallowly lobed; Australia. ... 1c. *C. punctatum* ssp. *australianum.*
1. Achenes 3 mm or longer.
    4. Leaves mostly linear or at least many times longer than wide (rarely elliptical), blunt at apex; phyllaries awned; S. America. .... 2. *C. confertum.*
    4. Leaves rhombic to elliptic, broadly acute at apex; phyllaries not awned; Philippines. .... 1b. *C. punctatum* ssp. *fruticosum.*

1. **Centratherum punctatum** Cass., Dict. Sci. Nat. **7:** 384. 1817. TYPE: none cited. (NEOTYPE here designated: BRAZIL: Maranhão: Loreto, *Eiten 4042* SP!. ISONEOTYPE: BRI!, G!, NY!, US!).
Synonymies and typifications are given under subspecific heading.

Sprawling to erect herb, suffrutescent with age; stems strigose, often ridged upon drying. Leaves cauline, often crowded, short petiolate to sessile; blades ovate to elliptic, spatulate, or rhombic,

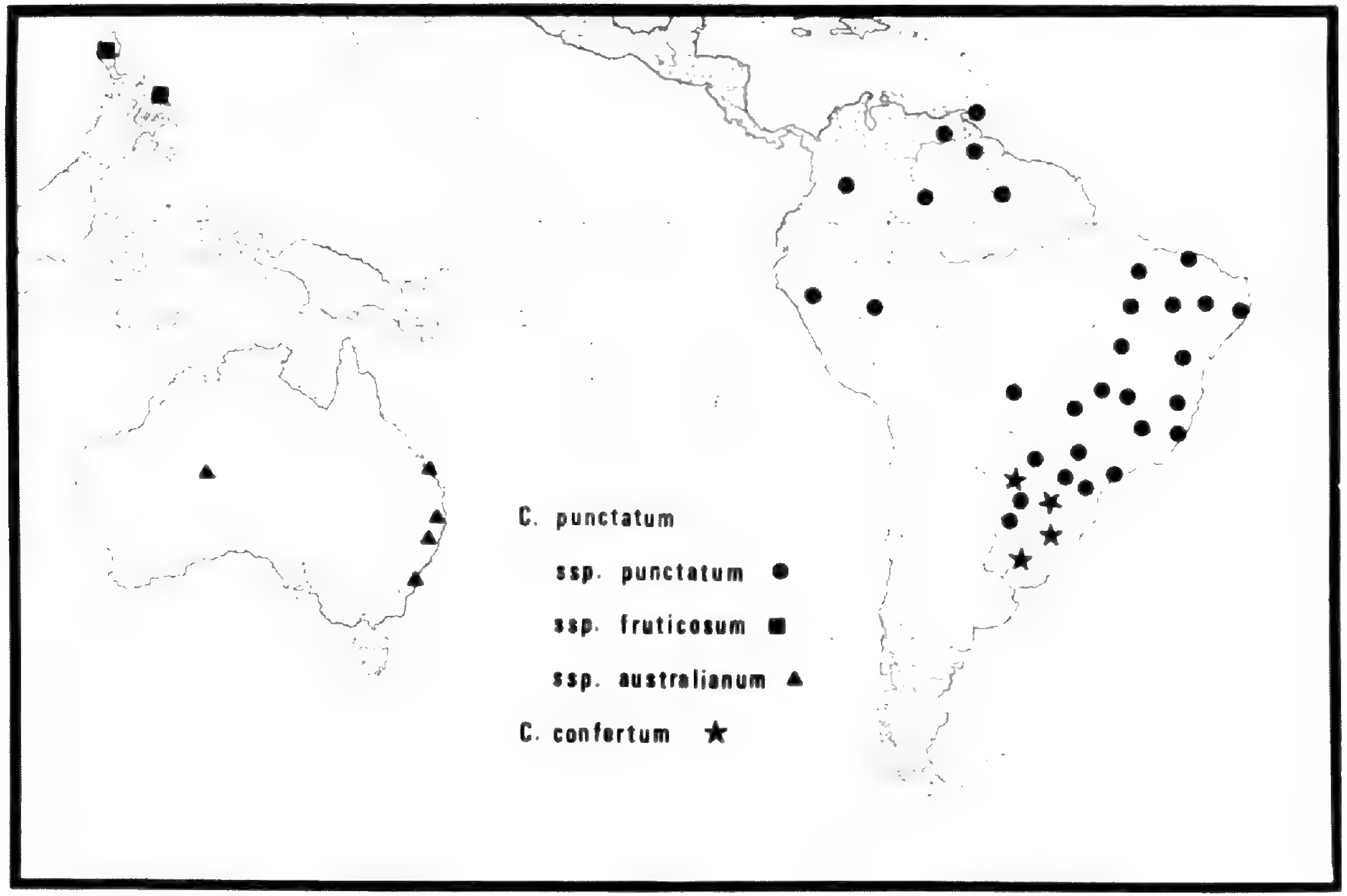

Fig. **12.** Distribution of *Centratherum punctatum* ssp. *punctatum*, *C. punctatum* ssp. *australianum*, *C. punctatum* ssp. *fruticosum*, and *C. confertum*.

obtuse to broadly acute at the apex, cuneate to attenuate at the base, 1–8.3 cm long, 0.5–3.9 cm broad, margins serrate or shallowly lobed, often ciliate, glandular punctate, often pubescent (especially on veins) above and beneath. Inflorescences of terminal, many-flowered heads. Involucre cylindric-campanulate; phyllaries imbricate in several series, outer ones foliaceous. Pappus bristles straw-colored, deciduous. Corollas 5–14.2 mm long. Achenes cylindric to obconic.

Three subspecies of *Centratherum punctatum* have been distinguished in the key. Their distributions are shown in Fig. 12.

The three taxa, although distinct, appear to be very closely related and are probably derived from one source; and are therefore accorded subspecific designation rather than specific rank. It is likely that they were originally dispersed along trade routes between Europe and the Orient. Merrill (1954) discusses the probable introduction of tropical American plants into the Philippines and Australia via definite trade routes which were established by the Portugese in 1500 A.D. and the Spaniards in 1565 A.D., and which lasted for 250 years. These geographically distinct taxa have become somewhat differentiated yet have maintained a close resemblance to each other. Specific recognition would tend to obscure their close phylogenetic relationship.

a. **Centratherum punctatum** Cass. ssp. **punctatum**.

Spixia violacea Schrank, Pl. Rar. Hort. Monac. tab. 80. 1819. TYPE: the illustration!

Ampherephis aristata H. B. K., Nov. Gen. Sp. **4:** 31. 1820. TYPE: none cited. (LECTOTYPE here designated: *Bonpland s. n.* P, seen as photo TEX!. ISOLECTOTYPE: P!).

Ampherephis mutica H. B. K., Nov. Gen. Sp. **4:** 31. 1820. TYPE: none cited. [LECTOTYPE here designated: Herb. H. B. K., (no collector cited), P, as photo GH!].

Amphibecis violacea Shrank, Syll. Ratisb. **1:** 86. 1824. TYPE: none cited.

Crantzia ovata Vell., Fl. Flum. Ic. **8**, tab. 153. 1827. TYPE: the illustration!

Ampherephis pulchella Cass., Dict. Sci. Nat. **57:** 346. 1828. TYPE: *d'Urville and Lesson s. n.*, not seen.

A. pilosa Cass., Dict. Sci. Nat. **57:** 346. 1828. TYPE: same as *A. mutica* H. B. K. (Cassini merely suggested a more "descriptive" name).

Centratherum brevispinum Cass., Dict. Sci. Nat. **57:** 346. 1828. TYPE: same as *A. aristata* H. B. K.

C. longispinum Cass., Dict. Sci. Nat. **57:** 346. 1828. TYPE: same as *C. punctatum* Cass.

Ampherephis intermedia Link, Abbild. **5** tab. 29. 1829. TYPE: not seen.
Centratherum muticum (H. B. K.) Less., Linnaea **4:** 320. 1829.
C. intermedium (Link) Less., Linnaea **4:** 320. 1829.
C. pulchellum (Cass.) Steud., Nom. Bot. ed. **2.** p. 324. 1840.
C. punctatum Cass. var. *parviflorum* Baker in Mart. Fl. Bras. **6**(2): 12. 1873. TYPE: BRAZIL: Bahia, *Blanchet 3689* (LECTOTYPE here designated: K!. ISOLECTOTYPES: BR!, F!, G!, LE!, MO!, P!).
C. holtoni Baker in Mart. Fl. Bras. **6**(2): 12. 1873. TYPE: BRAZIL: Ibague, *Holton 301* (HOLOTYPE: K!).
C. brachylepis Sch.-Bip. ex Baker in Mart. Fl. Bras. **6**(2); 12. 1873. TYPE: BRAZIL, *Martius 461* (LECTOTYPE here designated: M! as photo GH!, NY!, TEX!. PARATYPE: K!. ISOPARATYPES: G!, GH!, LE!).
Baccarodes holtonii (Baker) O. Ktze., Rev. Gen. **1:** 320. 1891.
B. brachylepis (Sch.-Bip. ex Baker) O. Ktze., Rev. Gen. **1:** 320. 1891.
B. violaceum (Schrank) O. Ktze., Rev. Gen. **1:** 320. 1891.
B. punctatum (Cass.) O. Ktze., Rev. Gen. **1:** 320. 1891.
B. muticum (H. B. K.) O. Ktze., Rev. Gen. **1:** 320. 1891.
Centratherum aristatum non Cass., Index Kew. **1:** 478. 1895.
C. punctatum Cass. var. *foliosa* Chod., Bull. Herb. Boissier **2**(2): 298. 1902. TYPE: PARAGUAY: Capibuy, *Hassler 4378*. (LECTOTYPE here designated: BM!. ISOLECTOTYPES: G!, K!, NY!, P!).
C. punctatum Cass. ssp. *camporum* Hass. var. *viscosissimum* Hass. f. *foliosum* (Chod.) Hass., Feddes Repert. Spec. Nov. Regni Veg. **12:** 369. 1913.
C. punctatum Cass. ssp. *camporum* Hass. var. *viscossissimum* Hass. f. *brachyphyllum* Hass., Feddes Repert. Spec. Nov. Regni Veg. **12:** 369. 1913. TYPE: PARAGUAY: In regione vicine Igatimi, *Hassler 4768* (LECTOTYPE here designated: GH!. ISOLECTOTYPES: BM!, G!, MO!, MPU!, NY!, P!, S!).
C. punctatum Cass. ssp. *camporum* Hass. var. *longipes* Hass., Feddes Repert. Spec. Nov. Regni Veg. **12:** 369. 1913, TYPE: PARAGUAY, *Fiebrig 4532* (LECTOTYPE here designated: B, as photo GH!, TEX!. ISOLECTOTYPES: G!, GH!, K!, L!, M!, US!).
C. vioalaceum (Schrank) Gleason, N. Amer. Fl. **33:** 49. 1922.
C. camporum (Hass.) Malme var. *longipes* (Hass.) Malme, Arkiv. Bot. 24A **6:** 15. 1931.

Sprawling to erect herb, suffrutescent with age; stems strigose, often deeply grooved upon drying. Leaves cauline, often crowded; short to indistinctly petiolate; blades ovate to elliptic to spatulate, obtuse at the apex, cuneate to attenuate at the base, (1)2–7 cm long, (0.5)0.8–3 cm broad, marginally serrate and often ciliate, glandular-punctate, often sparsely pubescent (especially on veins) above and beneath. Heads terminal, many flowered, solitary or occasionally 2–3 clustered together, peduncles 2–7 cm long. Involucre cylindric-campanulate, 0.5–1.2 cm long; phyllaries imbricate in several series, glandular, membranaceous, the outer foliaceous, greenish, the inner purplish, rounded to aristate (when awned, awns to 3 mm). Corollas

5–8(10) mm long, glandular. Achenes (1.2)1.6–2.6 mm long, 8–10 ribbed, occasionally with minute pubescence on ribs. Pappus bristles numerous, stramineous, deciduous, 1.5–2.8(3.5) mm long, or rarely absent. n = 16, 32.

South and Central America and the West Indies; pastures and waste places. Flowering all year. Sometimes cultivated as an ornamental.

Representative specimens examined: ARGENTINA: Corrientes: Estancia Tuyuti, Itati, edge of woodland by the river, *Pederson 5530* (GH, LP, P, S, US). Misiones: Candelaria, Loreto, *Montes 1785* (F, SP, US). BOLIVIA: Velasco: Longlais, *Kuntze s. n.* (NY). BRAZIL: Acre: Estrada Alemanha, Cruzeiro do Sul, roadside, *Prance et al. 11965* (F, G, GH, M, MO, NY, S, US). Amazonas: Rio Curuquetê, vicinity of Cachoeira, Santo Antonio, *Prance et al. 14359* (F, GH, NY, S, US). Bahia: *Rose 20136* (NY, US). Ceará: Acude, São Bento Municipio de Maranguape, wet places below dam, *Drouet 2191* (F, NY, S, US). Espirito Santo: Afonso Cladio, *Pereira 9856* (M). Federal District: Lagôa Feia, ca. 10 km E of Sobradinho, elevation 1000 m, *Irwin, Souza, Santos 13168* (NY, SP, UB, US). Goiás: Serra dos Pirineus, Capoeira, ca. 12 km S. of Corumbá, *Irwin, Souza, Santos 10956* (NY, S, UB). Maranhão: Municipio de Lorêto, "Ilha Balsas": region between the Rios Balsas and Parnaiba, *Eiten & Eiten 4712* (NY, SP, US). Matto Grosso: Corumba, *Malme 3012* (GH, S). Minas Gerais: Faxenda do Paraiso, Pau de Paina, grazed hillside, above stream, *Mexia 5388* (F, GH, NY, MO, S, UC, US). Pará, *Martius s. n.* (G). Paraná: Parque Nacional do Iguacú, near Aranha, roadside at edge of forest, *Lindeman & de Haas 3403* (GH, NY, US). Pernambuco: Vitoria de Sto. Antão, *Tavares s. n.* (US). Piauhy: Floriano to Oeiras, wet swampy places, *Swallen 4161* (GH, US). Rio de Janeiro: vicinity of Monte Serrat, Mt. Itatiaya, Estacão Biolôgica, roadside weed, *Smith 1588* (F, GH, S, US). Santa Catarina: Mina Velha, Garuva, S. Francisco do Sul, *Reitz & Klein 4.993* (NY, UC, US). São Paulo: Municipio de Caraguatatuba; at station of Reserva Florestal, 3.5 km NNW of Caraguatatuba, at base of Serra do Mar. Along path in secondary forest, *Eiten & Eiten 2845* (US). BRITISH GUIANA: Dorusfruit, Berbice R., *Morgan 3* (K, NY). COLOMBIA: Departmento Tolima, sterile fields, Piedras, *Haught 2405* (NY, US). PARAGUAY: Alto Paraná, *Fiebrig 5374* (BM, G, GH, K, US). Caaguazú, *Hassler 8892* (G, GH, MO, NY, S, UC). Caazapa: Borja, open camps, *West 8518* (UC). Guaira: Villarrica, gregarious in humid thickets (forests), *Jorgenson 3479* (F, GH, MO, NY, S, US). Misiones: Estancia La Soledad Santiago, dry, rough grasslands, *Pederson 4321* (BR, G, GH, MO, NY, S, US). Paraguari: Camino Ipacaray-Pirayú, *Schinini 4296* (LP). PERU: no locality cited, open roadside spot, *Woytkowski 7643* (MO). VENEZUELA: Amazonas: Orinoco Delta, *Bond, Gillin, & Brown 133* (NY, US). Bolívar: woods, northwest of Upata on road to San Felix, between Upata and Altagracia, *Steyermark 57694* (F, US). Monagras: rocky open slopes between Caripe and San Augustin, *Steyermark 61781* (F, MO, NY, US). Sucre: rocky limestone, steep slopes along headwaters of Rio Manzanares (Rio de la Cuesta) along highway between Cumanacoa and Cocollar, *Steyermark 62431* (F, US). WEST INDIES: Trinidad: Blanchisseuse village, north coast on banks, *Broadway 9149* (BM, TEX).

This subspecies is variable in regard to involucral bract shape and size of heads and leaves. The large number of synonyms for this taxon is a reflection of the variability within the group. Prior to a comprehensive examination of numerous herbarium specimens, distinct taxa were recognized in the extreme polymorphological characters. Observation of a continuum of characters without a corresponding geographical distributional pattern indicates a variable taxonomic unit.

1b. **Centratherum punctatum** Cass. ssp. **fruticosum** (Elmer) Kirkman, *comb. nov.*

C. fruticosum Elmer Leafl. Philipp. Bot. **1:** 88. 1906. TYPE: *Cuming 1556* (LECTOTYPE here designated: G!. ISOLECTOTYPE: K!, LE!).

Herb, suffrutescent with age; stems hispid, becoming glabrate. Leaves crowded, short internodes often appear fascicled; petioles up to 0.8 cm long, often indistinct; leaf blades rhombic, sometimes elliptic, broadly acute at the apex, attenuate and hispid at the base, (1.5)2–8.3 cm long, (0.5)1–3.9 cm broad, margins serrate, darkened above when dried, glandular-punctate above and below, canescent, minutely villous on nerves beneath with uniseriate and t-shaped hairs. Inflorescences terminal on axillary branches. Heads with many florets; peduncles 3.5–10.5 cm; involucre cylindric-campanulate, 0.8–1.2 cm long; phyllaries imbricate in several series, loosely appressed, often glandular, stramineous to green, the inner ones (6.1)7.5–10.6 mm long, linear, membranaceous, 3-veined in lower half, scarious and purple colored at the tips, the intermediate ones 2.8–6 mm long, pandurate, indurate at base, at the tip foliaceous to scarious, mucronate. Pappus bristles straw-colored, 2.4–3.9 mm long. Corollas 8.5–14.2 mm long, purple, glandular hairs on tips of corolla limb. Achenes 2.5–3.9 mm long, glabrous, finely ribbed.

The Philippines; on mountain slopes. Flowering and fruiting all year.

Representative specimens examined. PHILIPPINES: Rizal, Mt. Canumay, Luzon, *Ramos 13769* (G, S). Trinidad Valley, Mt. Province, mountain road on hilltop, *Quisumbing 18823* (L).

This subspecies is distinguished by large achenes and phyllaries with a strong indurate base.

1c. **Centratherum punctatum** Cass. ssp. **australianum** Kirkman *ssp. nov.* TYPE: AUSTRALIA: New South Wales, Sydney, *Vickery 23846* (HOLOTYPE: NSW!. ISOTYPES: L!, MO!).

Herba erecta. Caulis ramosus, usque ad 0.5–1 cm altus, puberulus Folia 1.9–6 cm longa, 0.6–2 cm lata, lobis apice obtusis vel subacutis, basi attenuatis. Capitula ramos axillares terminantia. Involucra 0.5–1 cm longa. Phyllaria acuminata vel aristata, margine ciliata. Pappi setae straminei. Achaenia glabra, 2–2.6 mm longa.

Supine-erect herb, 0.5–1 m tall; stems puberulous, grayish, slightly ridged. Leaves evenly spaced, sometimes crowded at intervals; petioles 0–1.2 cm long, often indistinct; leaf blades bluntly serrate to lobed, oblanceolate to spatulate, subacute to blunt at the apex, attenuate at the base, 1.9–6 cm long, 0.6–2 cm wide, glabrous, gland-dotted above and beneath; t-shaped and nonglandular uniseriate trichomes on leaves, stems and petioles. Inflorescences terminal to axillary branches, often dichotomously branched. Heads many-flowered; peduncles 4–13 cm. Involucre cylindric-campanulate, 0.5–1 cm long; phyllaries imbricate in several series, loosely appressed at maturity, membranaceous, golden brown, the tip often dark brown or reddish, the inner ones 5–7 mm long, pandurate, glandular, the tip often fringed, narrower than the base, intermediate ones 1–1.7 mm long, triangular or occasionally constricted at middle, glandular, the tip acuminate to spine tipped, the margin slightly ciliate. Pappus bristles stramineous, 2–3 mm long. Corollas 4.2–6 mm long, purple, glandular hairs at the tip. Achenes 2–2.6 mm long, glabrous, ribbed.

Australia (New South Wales, Queensland and Northern territory); on rocky slopes, roadsides and *Eucalyptus* forests. Flowering and fruiting from February to May.

Representative specimens examined: AUSTRALIA: Queensland: Belmont near Brisbane, *White 6671* (GH, K, S). New South Wales: West of Wingham on Bulga Road, *Vickery 23846* (L, MO). Northern Territory: Mt. Lindsay, *Boorman 139922* (NSW).

The narrow, oblanceolate to spatulate leaves with bluntly serrated or shallowly lobed margins are distinctive.

2. **Centratherum confertum** Kirkman, *nom. nov.* TYPE: PARAGUAY: Regione fluminis Yhu, *Hassler 9572* (LECTOTYPE here desig-

nated: K!. ISOLECTOTYPES: BM!, G!, GH!, MO!, MPU!, NY!, P!, S!, UC!).

C. punctatum Cass. ssp. *camporum* Hass. var. *albicans* Hass., Feddes Repert. Spec. Nov. Regni Veg. **12:** 369. 1913. TYPE: PARAGUAY: Regione fluminis Yhu, *Hassler 9572* (LECTOTYPE here disignated: K!. ISOLECTOTYPES: BM!, G!, GH!, MO!, MPU!, NY!, P!, S!, UC!).

C. camporum (Hass.) Malme var. *albicans* Hass., Arkiv. Bot. 24A **6:** 15. 1931.

Herb, from thickened rootstock, 15–60 cm; stems usually with grayish-white appressed pubescence. Leaves very crowded, appearing fascicled; petioles lacking; blades linear and oblanceolate (rarely elliptical), obtuse and serrate at the apex, attenuate at the base, linear ones 0.5–2 cm long, 0.1–0.3 cm wide, the oblanceolate ones 1.1–3.6 cm long, 0.2–2 cm broad, margins dentate, punctate above and beneath, grayish-white with appressed pubescence. Inflorescences terminal on axillary branches. Heads with many florets; peduncles 3–6 cm long; involucre cylindric-campanulate, 3.5–8 cm long; phyllaries imbricate in several series, loosely appressed, purplish with scattered glandular hairs; the inner ones 4–7.7 mm long, linear, membranaceous, purplish, tips mucronate; the outer ones 3–6 mm long, the intermediate ones intergradient with outer foliaceous ones, base indurate, constricted below the middle, distally foliaceous. Pappus bristles straw-colored, 1.8–3 mm long. Corollas 6.8–13 mm long, purple, glandular, tube pubescent. Achenes (3.3)3.5–4.6 mm long, ribbed.

Argentina, southern Brazil, and Paraguay. Flowering and fruiting occur from October to January.

Representative specimens examined include: ARGENTINA: Corrientes: Berón de Astrada, Loc Ruta Nac. No. 12, Yahape (21 km W de Itá Ibaté), *Krapovickas, et al. 16549* (UC); Concepción, Tabay, *Arbo 10* (P), *Arbo 876* (LP); General Paz, *Ibarrola 3549* (BM, F, K, RB); General Paz, *Ibarrola 3594* (S); Ituzaingó, Estancia Puerto Valle, *Pederson 2956* (P, S, US); Mburucuyá, Estancia Santa Teresa, *Pederson 512* (BR, G, K, MO, P, S, US); *Krapovickas 13622* (G, LP, MO, RB). Santa Fé: Mocove, *Venturi 122* (G, GH, UC, US); Reconquista, *Burkart 5717* (F); Roe Camino de Reconquista, *Job 787* (S); *Parodi 11160* (F, NY). BRAZIL: Rio Grande do Sul: Belisanio, *Rau 88* (RB); Cruz Alta, *Malme 1109* (S), *Pereira 8585* (K, LP, M, RB), *Rambo 50019* (S); Gomez, *Bornmüller 266* (GH); Tupaceretan, *Archer 4433* (B, US); Tupaceretan, *Rambo 9911* (SP). PARAGUAY: Cordillera do Altos, *Fiebrig 496* (BM, F, G, GH, L). Corrientes, *Hassler 5881* (G).

This species appears to be variable in length and width of leaves. From observation of herbarium specimens, I suggest that it may hybridize with *C. punctatum* ssp. *punctatum*; however, hybridization has not been experimentally demonstrated. Population studies in the field and crossing experiments are needed.

DOUBTFUL AND EXCLUDED SPECIES

Gymnanthemum fimbrilliferum Cass., Dict. Sci. Nat. **10:** 109. 1817. This species is the type of genus *Gymnanthemum*, which was, along with the genus *Phyllocephalum*, united into the single genus *Decaneurum*. *Decaneurum* was later transferred to *Centratherum*. *Gymnanthemum fimbrilliferum* is a *Vernonia*, and therefore is not only excluded as a species from the genus *Centratherum*, but also eliminated as priority for a generic name of the Old World taxa.

Wightia formosa Spreng. This species was never validly published; it was merely cited by DeCandolle in Prod. **5:** 67. 1836 "as correspondence".

Centratherum grande (DC.) Nob, Mem. Couronnes Autres Mem. Acad. Roy. Sci. Belgique p. 53. 1895. This species is a *Vernonia*.

C. englerianum Muschler, Bot. Jahrb. **46:** 57. 1911. It is doubtful that this species is *Phyllocephalum*. The type specimens are apparently not extant and according to Bot. Jahrb. Syst. **53:** 367, 1914, Muschler, besides being declared insane, is reported to have falsified much of his data, including that for *C. englerianum*.

C. burmanicum Gamble, Kew Bull. p. 90. 1915. This species is not *Phyllocephalum*. The large solitary heads are reminiscent of *Phyllocephalum*, but the leaves do not have the correct pubescence and the involucral bracts do not resemble stem foliage.

C. angustifolium (Benth.) Adams, J. W. Afr. Sci. Ass. **3:** 122. 1957. This species is a *Vernonia*.

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THE FLORA OF CUTTYHUNK ISLAND, MASSACHUSETTS:

WITH AN ANALYSIS OF VEGETATIONAL CHANGES OVER THE PAST HALF CENTURY

Sharman D. O'Neill[1]

Cuttyhunk Island lies at 41° 25′ N. latitude, 70° 56′ W. longitude at the westernmost end of the Elizabeth Islands. These islands extend south-west from Woods Hole, Massachusetts, in two parallel ridges and include seven main islands as follows: Nonamessett, Uncatena, Naushon, Pasque, Nashawena, and Cuttyhunk, with Penikese located one mile north of Cuttyhunk (see Figure 1.). The geological origin of the Elizabeth Islands has been investigated by Woodworth and Wigglesworth (1934) and by Chamberlain (1964). According to these studies, Cuttyhunk and the other Elizabeth Islands were formed by a recessional moraine during the Wisconsin Glacial Stage of the Pleistocene. They are believed to date from approximately 14,000 years before present (Flint, 1971).

The flora of Cuttyhunk Island was first studied as part of the larger flora of the Elizabeth Islands (Fogg, 1930). No additional study of the Cuttyhnk flora had been done until the present investigation. The goal of this investigation has been to compile a second flora of the vascular plants of Cuttyhunk and then to interpret the floristic and vegetational changes that have occurred there over the past half century based on a comparison of the two floras and in light of the theoretical considerations of island biogeography.

TOPOGRAPHY

Cuttyhunk Island is shaped like a one-clawed lobster approximately two and one-half miles long and three-quarters of a mile across at its widest point. It consists of a central portion with two smaller necks of land at the eastern end (see Figure 2.). The island has two large salt water lagoons, Cuttyhunk Pond and Gosnold Pond. A small islet, Gosnold Islet, is located within the latter. Both ponds are subject to severe barrier beach erosion.

The main portion of Cuttyhunk Island is dominated by a central morainal hill that reaches a maximum elevation of approximately 42

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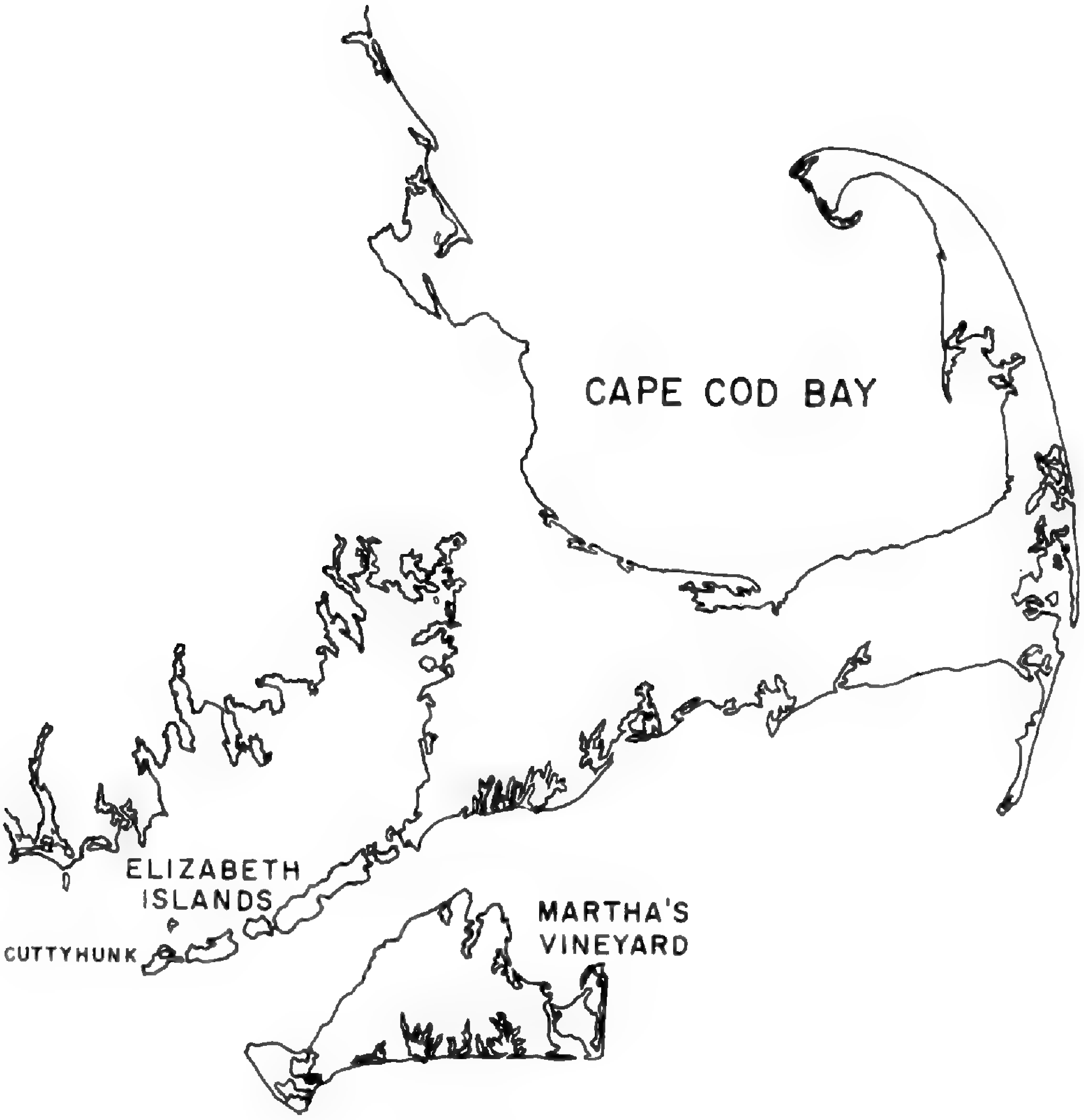

Figure 1. **Cape Cod and the Elizabeth Islands**

meters above sea level on Lookout Hill (Woodworth & Wigglesworth, 1934). The entire island exhibits a topography of morainic knobs and ridges. Cliffs are found along the north and south shores and were probably located on the west shore as well until recently.

Severe storms and hurricanes of the present century have caused considerable loss of land at the southwestern end of the island and along Canapitsit Neck. In 1938, a 12-foot tidal wave and 90 mile per hour winds destroyed an extensive area along South Beach. In 1944, a hurricane with winds up to 100 miles per hour struck the island, severely eroding the narrow barrier beach that partially encloses

Gosnold Pond so that by 1972 the returning tides had clearly divided this barrier beach in one location along the north shore permitting the invasion of salt water. Sheep Pond, the smaller pond adjacent to Gosnold Pond, contained fresh water until 1956 when the narrow sand bar separating it from Gosnold Pond was eroded away by a storm.

Cuttyhunk has a number of smaller ponds maintained by the water table 6 to 32 feet above sea level (Strahler, 1966). While most of these ponds are seasonal and occur in morainal depressions, four are apparently man-made ponds. Several small brackish ponds are located just behind the north shore of Copicut Neck. Salt marshes are situated in the lee of barrier beaches and near salt water ponds.

That Cuttyhunk Island was formerly connected to the neighboring island of Nashawena by a narrow sandy isthmus can be surmised from a description left by the historian and chronicler, M. John Brereton, who stated in 1602 that the circumference of "Elizabeth's Isle" was "sixteen English miles at the least in compass; for it containeth many pieces or necks of land, which differ nothing from several islands..." (Brereton, 1602, p. 88.). The earliest known chart of Cape Cod and the New England islands prepared in 1720 likewise depicted Cuttyhunk and Nashawena as one large island joined by a thin barrier beach (Woodworth & Wigglesworth, 1964).

Cuttyhunk itself was also undoubtedly larger in 1602 when Brereton made his description; he had described Gosnold Pond as being about three miles in circumference, a size far too great for that of the present day pond. The pond's boundaries may have lain farther north in 1602. Since this earlier description erosion has driven the barrier beach inwards.

HISTORICAL RECORD AND LAND USE

The recorded history of Cuttyhunk Island began on May 25, 1602, when the English explorer, Bartholomew Gosnold, decided to found a settlement on the western end of Cuttyhunk on Gosnold Islet.

Gosnold's chronicler and historian, M. John Brereton, left an account of the mature forest species present on Cuttyhunk at the time of colonization in 1602:

> "This island is full of high timbered oaks, their leaves thrice so broad as ours; cedars, straight and tall; beech, elm, holly, walnut trees in abundance, the fruit as big as ours, as appeared by those

> we found under the trees, which had lain all the year ungathered; hasle-nut trees, cherry trees. . .; sassafras trees, great plenty all the island over, a tree of great price and profit; also, divers other fruit trees, some of them with strange barks of an orange color, in feeling soft and smooth like Velvet: in the thickest parts of these woods, you may see a furlong or more round about." (Brereton, 1602, p. 88–89)

A second chronicler in Gosnold's party, Gabriel Archer, described Cuttyhunk as follows:

> "It is overgrown with wood and rubbish, viz. oaks, ashes, beech, walnut, witch-hazel, sassafras and cedars, with divers other of unknown names. The rubbish is wild pease, young sassafras, cherry-trees, vines, eglantines, gooseberry bushes, hawthorn, honeysuckles, with others of like quantity. The herbs and roots are strawberries, raspberries, ground-nuts, alexander, surrin, tansy, etc. without count." (Archer, 1602, p. 77)

Apparently the settlers ate berries and herbs or salads (Gookin & Barbour, 1963), and at one point, a food shortage forced Gosnold's company into eating "Alexander, Sorrell pottage, and ground nuts". Gosnold's men deforested the island, carrying the wood back to England, and established the precedent for future land use.

It is apparent that land use has been directly responsible for the general vegetational aspect of Cuttyhunk for over a hundred years. Fogg (1930) observed during his collection trips that Cuttyhunk was largely open hillsides and meadows with the aspect of bleak grassy downs, "exposed to the full blast of winds from the Atlantic". He also stated that "within the memory of no living inhabitant have there been trees on Cuttyhunk or Penikese, except the few which have been planted by the hand of man".

At that time most of the land was under cultivation, or used as pasturage for grazing cows and sheep. Several of the 11 grass species collected by Fogg were species of high forage quality. Sheep had been raised on Cuttyhunk ever since the Cuttyhunk Club imported several hundred head sometime after 1869. Before the importation of sheep, early farmers grazed cows on uncultivated land. A 1942 Geological Survey map of Cuttyhunk depicts the island as entirely denuded except for patches probably representing swampy lowlands along the southwest bottom half of the island and in one area on Copicut Neck.

According to an account of Gookin and Barbour (1963), the western part of the island was given over to the grazing sheep just

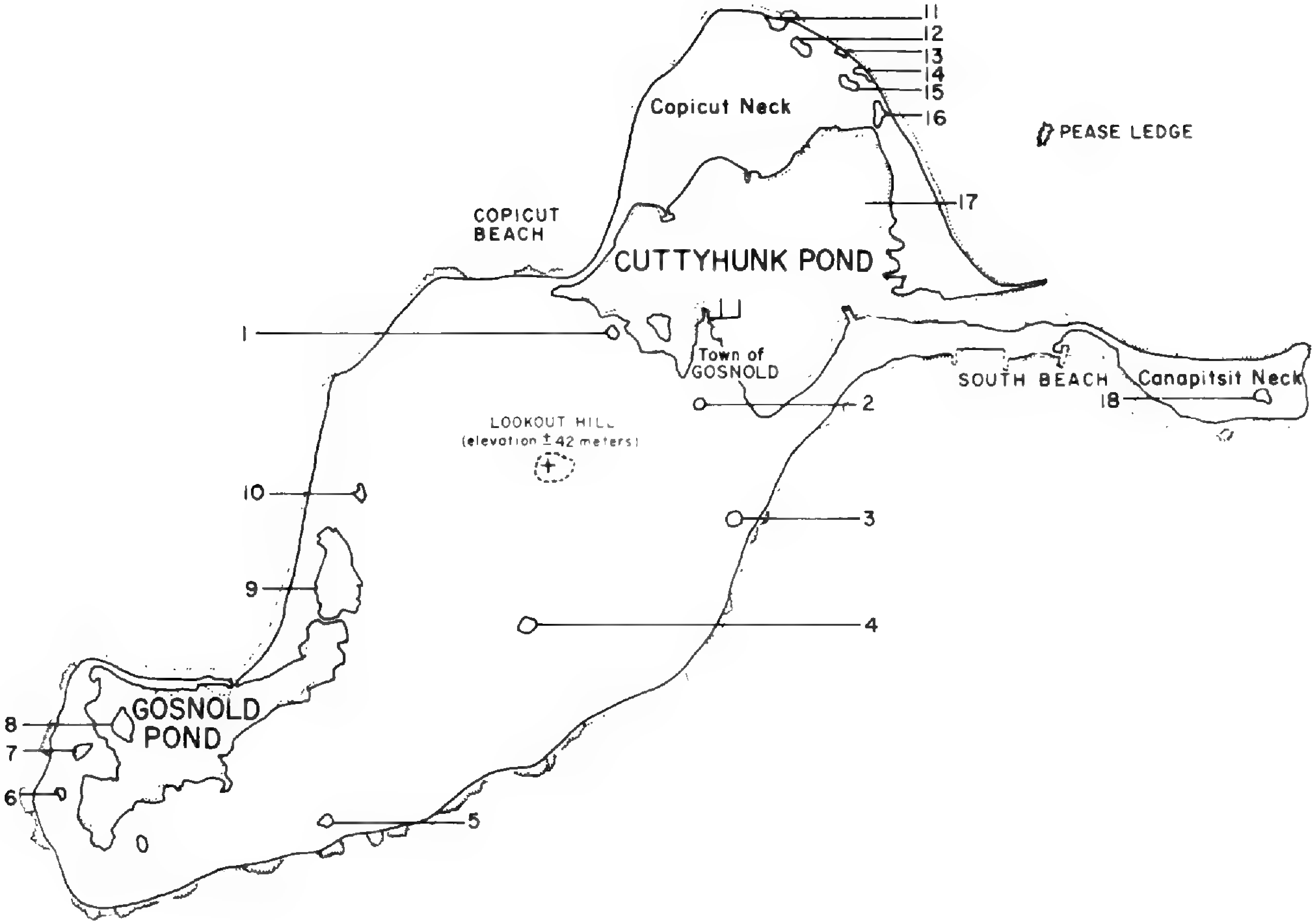

Figure 2. **Cuttyhunk Island. 1.** Pickerelweed Pond **2.** Tilton's Pond **3.** Town Water Supply Reservoir **4.** Dump Pond **5.** Spaulding's Pond **6.** Fresh Water Pond 1 **7.** Fresh Water Pond 2 **8.** Gosnold Pond (also known as Westend Pond) **9.** Sheep Pond (also known as Wash Pond) **10.** *Decodon-Osmunda-Typha* Pond **11.** Cattail Pond **12.** *Hibiscus* Pond **13.** Brackish Pond 1 **14.** Brackish Pond 2 **15.** Toad Pond **16.** Salt Marsh Pond **17.** Cuttyhunk Pond **18.** Canapitsit Marsh

about twenty-five to thirty years ago. They described the vegetational character of Cuttyhunk during the 1950's in this manner:

> "There is a startling contrast between the Cuttyhunk that Bartholomew Gosnold knew and named Elizabeth's Isle and the island as it appears today. The whole of the western part of the island is now a treeless plain, recently given over to the grazing of sheep, bred in experiments to obtain finer grades of wool. Before that this plain was under cultivation, even including the little islet in the lake..." (Gookin & Barbour, 1963, p. 142)

The western and central parts of Cuttyhunk Island are currently protected from further development and agricultural practices as a conservation area, so that about two-thirds of the central section of the island has now reached a shrub stage in relatively uninterrupted succession. Cuttyhunk's current conservation area also provides a suitable habitat for large populations of white-tail deer (*Odocoileus virginianus*) and cottontail rabbits (*Sylvilagus transitionalis*).

In 1974, there were approximately 21 families or about 52 permanent residents on Cuttyhunk. The total population in the summer is well over 500 people as a result of tourism. In the past the chief professions of the island residents were piloting, cod fishing, lobstering, and farming (Haskell, 1950). Today's residents no longer farm or raise livestock, and instead summer tourism has become an important source of income.

MATERIALS AND METHODS

The 1923 flora of Cuttyhunk Island (Fogg, 1930) consisted of 134 species of which 21 were non-native. Fogg included species collected earlier by the following collectors: F.W. Pennell (1911), S.N.F. Sanford (1917), W.R. Taylor (1919), and E.W. Hervey (no date). Although omitted in the 1923 flora, these species are listed in Fogg (1930).

No similar botanical or ecological investigation had been conducted until the present study. During a series of 12 field trips in the summer and fall of 1974, specimens of 266 species were collected in identifiable condition. Collection trips were made on the following dates: June 28; July 7, 10, 14, 17, 24–26; August 4, 13–15, 20, 24–26; September 8–10, and October 10.

VEGETATION

Beach Community

Cuttyhunk is surrounded by several categories of beaches: cobble, sand, and a mixture of cobble, gravel, and sand. True beach vegetation occurs only on the sandy beaches of the two necks at the eastern end of Cuttyhunk. Here the beach vegetation is distributed in fairly discrete belts beginning at the drift line and proceeding inland to the furthest limits of the storm tides. Plants established in these belts include: *Atriplex patula, Cakile edentula, Chenopodium album, Erechtites hieracifolia, Solidago sempervirens, Suaeda maritima, S. linearis,* and *Zostera marina.* On exposed sandy area, the dominant species are *Ammophila breviligulata, Solidago sempervirens, Lathyrus japonicus, Myrica pensylvanica,* and *Rosa rugosa. Phragmites australis* and *Artemisia stelleriana* are also locally abundant in dense clumps.

Salt Marsh Community

The salt marsh community on Cuttyhunk consists of mostly shallow areas on Cuttyhunk Pond near the Gosnold Marina, on the northern shores of Gosnold and Sheep Ponds, and a third near a salt pond on Copicut Neck (see Figure 2.). Specimens collected from these sites are listed in Table 1. All species throughout marked with an asterisk were also present in the 1923 flora (Fogg, 1930).

Several other salt marsh species, *Plantago oliganthos, Salicornia bigelovii,* and *S. europaea*, were restricted to a small tidal pond (Pond 16) on the cobble north shore of Copicut Neck. A sizable brackish pond in the same area (Pond 11) was enclosed by a thick marginal zone of *Typha latifolia.* Other species typical of damp shores, salt pond borders, and brackish marshes include *Galium tinctorium, Lindernia anagallidea, Ptiliminium capillaceum, Ranunculus cymbalaria,* and *Teucrium canadense.*

Table 1. Abundant species of salt marshes. Species also included in the 1923 flora (Fogg, 1930) are noted by an asterisk.

Distichlis spicata	*Sagina procumbens*
*Eleocharis smallii**	*Salicornia virginica**
Juncus canadensis	*Spartina alterniflora*
*J. gerardi**	*S. patens*
Limonium nashii	*Spergularia rubra**

Fresh Water Marsh Community

This community consists of many species also found in both the pond and swamp-shrub communities. Those species significantly abundant in fresh water marsh areas are listed in Table 2.

Table 2. Abundant species of fresh water marshes.

Decodon verticillatus	*Osmunda cinnamomea**
Dryopteris noveboracensis	*Phragmites australis*
*D. thelypteris**	*Scirpus cyperinus**
Iris versicolor	*Scutellaria epilobifolia**
*Juncus acuminatus**	*Teucrium canadense*
*Lycopus uniflorus**	*Typha latifolia*
Onoclea sensibilis	*Woodwardia areolata**

Pond Edge Community

There are between 15 and 17 small ponds ranging from salt to fresh water. Most of the smaller ponds on Cuttyhunk are seasonal: all but one of the fresh water ponds of natural origin were nearly dry by midsummer.

The vegetation of the fresh water ponds appeared to be distributed along a gradual gradient of water depth, forming concentric zones of vegetation. The surfaces of all ponds were free from floating macrophytes. In the centers of those ponds that retained a substantial depth of water, *Myriophyllum humile* and *Prosperpinaca palustris* were often collected. Floating-leaved anchored aquatics were likewise restricted to those ponds with an adequate supply of water (Ponds 1,2). Common plants of this zone included *Nymphaea odorata* and *Nuphar variegatum*, with both *Pontederia cordata* and *Hydrocotyle umbellata* more restricted in their total distribution.

Most of the Cuttyhunk ponds are no deeper than one meter, so that the wetland vegetation around ponds often consisted entirely of the

Table 3. Emergent anchored species of the pond community.

Carex crinita	*J. pelocarpus*
C. comosa	*J. effusus**
*C. filiculmis**	*Phragmites australis*
C. odoratus	*Scirpus americanus*
C. diandrus	*S. cyperinus**
Eleocharis obtusa	*Sparganium americanum*
*Juncus acuminatus**	*S. eurycarpum*

anchored emergents listed in Table 3. Most of the shallow ponds supported abrupt transition zones around their perimeters. Characteristic species collected here are listed in Table 4. Many of the moist pond bottoms were covered by a green layer of the liverwort, *Riccia*, and later by dense mats of vascular plants as the water evaporated. *Ludwigia palustris* formed colonies on the bottoms of most ponds. In other drier areas, pond bottoms have been colonized by grasses including *Echinochloa crusgalli, Glyceria obtusa,* and *Panicum dichotomiflorum,* all invaders since the earlier flora. The border of one Cuttyhunk pond (Pond 10) has developed into a fen and supports an anchored marginal mat of *Decodon verticillatus, Osmunda cinnamomea,* and *Typha latifolia.* Several additional species have also established themselves near this area since the earlier flora. These are *Drosera rotundifolia, Equisetum arvense,* and *Lycopodium inundatum.*

Table 4. Characteristic species of the wetland ecotones.

Apios americana	*L. uniflorus**
Cyperus odoratus	*Onoclea sensibilis*
Decodon verticillatus	*Phragmites australis*
Dryopteris thelypteris	*Polygonum persicaria*
Glechoma hederacea	*P. punctatum*
Hibiscus moscheutos	*P. puritanorum*
Hypericum boreale	*P. scandens*
H. mutilum	*Prunella vulgaris*
H. virginicum	*Rumex maritimus*
Iris versicolor	*Scutellaria epilobifolia**
*Lycopus americanus**	*Teucrium canadense*

Grassland Community

Extensive grasslands are most prominent in the central section of the island. In all grassland areas, the dominant species is *Panicum virgatum* in association with *Agropyron repens, Agrostis stolonifera, A. tenuis, Anthoxanthum odoratum, Dactylis glomerata, Holcus lanatus,* and *Phleum pratense.* Also abundant in the grasslands throughout are *Juncus bulbosus, J. greenei,* and *J. tenuis.* About 15 less common grass species were also collected. Some of these species were previously cultivated for pasturage. A fairly common inhabitant of the grassland community, *Achillea millefolium,* has certainly increased since the earlier flora; Fogg noted the uncommon distribution of this species on Cuttyhunk in 1923.

The floristic composition of the grasslands community has reached a mixed herbaceous perennial stage. The most abundant grass, *Panicum virgatum,* was collected by Fogg from all the islands except Cuttyhunk. Another common grass, *Dactylis glomerata,* was collected previously only from Penikese. Both *Agrostis* species were collected throughout the grasslands in 1974; these species are also recent colonists of the Elizabeth Islands in general. *Anthoxanthum odoratum* and *Juncus greenei* are equally abundant and widely distributed. *J. greenei* was not collected by Fogg; however, he remarked its abundance on all the islands, and it may have been present on Cuttyhunk as well.

Andropogon scoparius, a characteristic grass of secondary succession in old-fields, was rather uncommon in the summer of 1974. Several *Panicum* species including *P. clandestinum, P. commutatum, P. oligosanthes* were collected mostly from unimproved road edges. Other species new to the grasslands are *Elymus virginicus, Eragrostis spectabilis, Festuca rubra, Poa annua, P. compressa,* and *P. pratensis.*

Table 5. Species collected from the edges of unimproved roads.

Anagallis arvensis	*O. stricta*
Hieracium florentinum	*Ranunculus bulbosus*
*Hypericum perforatum**	*Rudbeckia hirta**
Hypochoeris radicata	*Solidago nemoralis*
Juncus greenei	*S. rugosa**
*J. tenuis**	*S. tenuifolia*
Leontodon autumnale	*Spergularia rubra**
Oxalis europaea	*Taraxacum officinale*

Shrub Community

The shrub community now dominates almost all uninhabited sections of Cuttyhunk. In the central section of the island, the development and growth of the shrub community has resulted in the contraction of the open grasslands, giving the area a mosaic appearance.

Myrica pensylvanica has given the shrub community a special composition. This species has also increased in coastal communities, invaded the road edges, and become common in disturbed areas around Cuttyhunk Pond. *Myrica pensylvanica* is well known for its ability to survive the dessicating effects of windborn salt spray as well as mechanical damage from wind alone. It has been found that *M.*

pensylvanica has the special ability to fix atmospheric nitrogen, which substantially contributes to its success as a pioneer species in coastal succession (Morris et al, 1974).

Other shrub species have similarly increased in abundance, including *Clethra alnifolia* and *Viburnum dentatum.* Both *Rhus typhina* and R. *copallina* are now as abundant and widespread as *Myrica pensylvanica.* Neither of these two species were collected by Fogg. He noted the occurrence of *Rhus typhina* on Nashawena and Penikese as occasional in sheltered hollows and hillsides with *R. copallina* occupying open slopes and moist depressions (1930). *Ilex laevigata, I. verticillata, Robinia hispida, Rosa virginiana, Salix discolor,* and *Vaccinium corymbosum* are more limited in distribution.

In other areas around Gosnold, *Populus alba* has become a nuisance in lawns and roadsides. Attempts to eradicate this introduced species have proved unsuccessful. Three other cultigens, *Berberis thunbergii, Ligustrum vulgare,* and *Syringa vulgaris* have likewise escaped into the shrub community along roadsides in Gosnold and elsewhere.

The shrub community, like the grasslands, also supports many prostrate and ascending species. Few if any open fields and meadows are free from the low growth of *Rubus* subgenus *Eubatus* plants, including such representatives as *R. arenicola, R. flagellaris,* and *R. jaysmithii.* Other shrubescent vegetation collected in 1974 not reported in the earlier flora were *Lonicera japonica, Parthenocissus quinquefolia, Toxicodendron radicans, Rubus occidentalis, Smilax rotundifolia,* and *Vitis labrusca.*

Swamp-Shrub Community

The swamp-shrub community is most widespread on the western end of the main island in lowland regions. Swampy areas are also present in wet hollows on the northeastern side of Copicut Neck. The herb stratum of many swampy areas is dominated by *Osmunda cinnamomea.* Several ferns are new to the swamp community, including *Dryopteris noveboracensis, Osmunda regalis,* and *Onoclea sensibliis.* Other common herbs include *Iris versicolor* and *Scutellaria epilobifolia.* Other shrubs and small trees which have recently invaded swampy lowland regions are *Cephalanthus occidentalis, Decodon verticillatus, Ilex laevigata, I. verticillata, Prunus serotina, Pyrus floribunda, Salix discolor* and *Spirea tomentosa.*

Weed Community

Cuttyhunk supports a sizeable ruderal community of both indigenous and alien species occurring in roadsides, lawns, and abandoned fields in Gosnold, coastal waste areas near human activity, and disturbed inland areas. Some of the more common ruderals are listed in Tables 5-7.

Table 6. Species collected from the edges of improved roads in Gosnold.

*Achillea millefolium**
Aster ericoides
A. novi-belgii
Asclepias syriaca
Ambrosia artemisiifolia
A. psilostachya var. *coronopifolia*
Arctium minus
Cichorium intybus
Daucus carota
Digitaria sanguinalis
Erigeron canadensis
*Linaria canadensis**
L. vulgaris
Melilotus alba
M. officianlis
Oxalis stricta
Saponaria officinalis
Trifolium pratense
Vitis labrusca

Table 7. Species collected from coastal waste areas.

Achillea millefolium
Ambrosia artemisiifolia
*Cerastium vulgatum**
Cichorium intybus
Lepidium virginicum
Plantago lanceolata
P. major
Polygonum aviculare
Rumex acetosella
R. crispus

Two other disturbed habitats were remarked on Cuttyhunk during the present flora, each possessing a distinct assemblage of weedy species. Early in the summer of 1974, the dominant species at the town dump were *Chrysanthemum leucanthemum* and *Verbascum thapsus.* These were replaced as dominants as the season progressed by *Arctium minus, Anthemis cotula, Erechtites hieracifolia,* and *Matricaria matricarioides.* In late summer and early fall, *Solidago tenuifolia* was abundant around the dump's border. A second major disturbed area, the sandpit, supported several species not observed elsewhere: *Hypericum gentianoides, H. canadense,* and *Trichostema dichotomum* var. *linearis.* In addition, a single representative of *Datura stramonium* was observed in a disturbed area adjacent to a residential building. No specimen was collected. This latter plant is apparently rare on Cuttyhunk but was quite common in 1973 on neighboring Penikese (Lauermann & Burk, 1976).

CHANGES IN THE VEGETATION

The beach vegetation on Cuttyhunk has changed very little in the last 50 years. Most of the species collected by Fogg were still present in 1974, although both *Salsola kali* and *Arenaria peploides* were uncommon in both numbers and distribution. One major difference was the widespread occurrence of *Ammophila breviligulata* which Fogg had collected from Penikese but failed to note on Cuttyhunk, although it may have been present at that time as well.

Several other beach plants have invaded the drift zone including *Chenopodium album, Erechtites hieracifolia, Euphorbia polygonifolia, Polygonum maritimum,* and *Suaeda maritima.* A small colony of about twenty individual plants of *Glaucium flavum* has become established at the eastern end of the island. Fogg observed this species only on Naushon. Several hundred plants of *G. flavum* were observed on Penikese in 1973 (Lauermann & Burk, 1976). Other invaders since the earlier flora are *Erigeron canadensis, E. pusillus, E. strigosus, Teucrium canadense,* and *Polygonum aviculare.*

One of the more notable changes in the salt marsh vegetation since the 1923 collection has been the apparent loss of *Puccinellia paupercula* from the mud flats of Cuttyhunk Pond, possibly the result of frequent dredging of this shallow tidal lagoon. *Boehmeria cylindrica* also appears to be extinct around the borders of salt marshes and brackish ponds.

Salt marshes have recently been created around Sheep Pond. In 1956, and again in 1972, the sandy barrier separating Sheep Pond from Gosnold Pond was destroyed by severe storms, permitting the intrusion of salt water. An extensive salt marsh has developed at the eastern end. A third change in the salt marsh vegetation has been the invasion of *Distichlis spicata, Spartina alterniflora,* and *S. patens*— all dominant species of the salt marsh community (Teal & Teal, 1969).

Spartina pectinata, on the other hand, was not observed on Cuttyhunk during this investigation and appears to be displaced by the other *Spartina* species. Other colonists of the salt marsh community include *Eleocharis smallii, Hibiscus moscheutos, Limonium nashii, Sagina procumbens,* and *Salicornia bigelovii.*

The major changes in the pond vegetation over the past 50 years can best be explained by successional processes and changes in the water table. Once the seasonal ponds have dried, their bottoms are rapidly invaded by species that prefer drier substrates. In two dramatic cases of pond succession where conditions have become unsuitable for usual pond vegetation, the pond bottoms have been rapidly invaded. One former pond on Copicut Neck (Pond 12) now supports a dense stand of *Hibiscus moscheutos* while another West End pond (Pond 6) supports a dense stand of *Phragmites australis.*

Successional development has also resulted in the loss of many species from open wet lowlands and swamps. These species are listed in Table 8. The open moist hollows of the earlier collection have been closed by a shrub overstory in most areas.

Table 8. Species lost from wetland habitats since 1923.

Acorus calamus
Bartonia virginica
Carex howei
C. limosa
Elatine minima
Eriophorum tenellum
E. virginicum
Habenaria clavellata
H. lacera
Mentha crispa
Polygala cruciata
Rhexia virginica
Rhynchospora alba
Scirpus validus
Vaccinium macrocarpon

The irrupting whitetail deer (*Odocoileus virginianus*) population may also be responsible in part for the sizeable reduction in the number of *Carex* species collected from pond margins. In 1974, the estimated size of the deer population had reached 150 individuals. In most pond areas, the *Carex* inflorescences were observed to have been cropped, presumably by these deer, by August.

Changes in pond salinity may account for many losses of wetland species. A boreal sedge, *Eleocharis uniglumis,* had been at the southernmost limit of its range around Sheep Pond during the earlier collection but was not observed in 1974. *Menyanthes trifoliata* and *Vallisneria americana* have also been lost from the Sheep Pond area. The change in salinity of Gosnold Pond may be responsible for other losses. *Cladium mariscoides* has been lost from the sandy beaches bordering both these ponds.

In general, Fogg collected approximately 46 species from moist fresh water habitats between 1923 and 1928; 24 of these species are now extinct on Cuttyhunk. However, the number of invasions exceeds the number of extinctions of species typical of pond borders and wetland regions since no less than 32 species have invaded these areas since the earlier flora.

There has been a considerable increase in the number of grass species in the grassland community. Fogg listed nine grass species characteristic of this community in the earlier flora. Only two of these have been lost: *Calamagrostis canadensis* and *Paspalum ciliatifolium.* This latter species was formerly abundant in distribution. Overall the grasslands exhibit an increased diversity; at least 21 grass species have invaded this community since the earlier collection.

The decrease in abundance of several non-grass species in the grassland community is indicative of the change in the vegetational structure of Cuttyhunk resulting from old field succession. Fogg noted *Hypoxis hirsuta* as "abundant on open, sandy slopes and knolls at the west end of Cuttyhunk." *Hypoxis hirsuta* is now uncommon even in open fields. *Ranunculus acris* and *Sisyrinchium atlanticum* exhibit the same pattern change in abundance while *S. graminoides* had disappeared altogether.

Several other species have also become extinct as a result of successional development. *Asplenium felix-femina, Dennstaedtia punctilobula, Linum striatum* and *Viola fimbriatula* were previously common on the open hillsides. Several *Carex* species have likewise disappeared. Fogg collected *Carex debilis* from "moist hollow on the hillsides." These moist hollows are now filled in with shrub vegetation. *Carex longii* is no longer "frequent in open grassland" nor are *C. silicea* and *C. swanii* found on dry hillsides (Fogg, 1930). Up until about 10 to 20 years ago, Cuttyhunk residents burned the grasslands over most of the island in order to encourage the growth of nutritionally valuable forage species. A type of grazing succession ensued which partially determined the floristic content of the remaining grasslands today.

So far succession following fire in the grasslands seems to have reached a point in which the invasion of the shrub community into the mature grasslands is well advanced. Thus, the vegetational changes since the earlier botanical work of Fogg are predominantly related to the gradual cessation of burning, cultivating, and pasturing the grasslands. The most marked difference observable from comparison of old photographs and descriptions with the present vegetation is in the extent of the shrub community in relation to the grasslands. Most of this change in the grasslands probably occurred within the first fifteen years after the cessation of these agricultural practices. This can be deduced in part from a photograph taken in the early 1960's which documents the presence of a dense shrub layer already covering the west end and Gosnold Islet (Dorothy Merrill, pers. comm.). It is widely believed that the shrub stage usually dominates the vegetational aspect of old fields for about 16 to 20 years after abandonment.

The western half of the island has undergone considerable successional change over the last two decades and has achieved a mature shrub stage. It is assumed that a similar change occurred on Copicut Neck since the vegetational character of this peninsula today is also dominated by the shrub layer with very few fields remaining open.

The number of woody species in the shrub stratum has tripled since the earlier flora. Fogg collected eight shrub species representing approximately 6% of the total flora. By 1974, this number had increased to about 40 woody species so that these shrub species now represent approximately 15% of the total species number.

A remarkable number of species in the weed community have invaded Cuttyhunk since the 1923 collection. Some of these species are new to the Elizabeth Islands in general, such as *Oxalis corniculata* and *O. stricta.* A specimen of *Ambrosia psilostachya* DC. var. *coronopifolia* (T.&G.) Farw. in fruiting condition was collected from a disturbed area near the Gosnold Marina. This species, although previously reported for Martha's Vineyard and Nantucket, is still of rare and local occurrence in New England. Other species formerly rare or restricted in distribution to the inner islands have since spread to the outermost island. This is particularly true for weedy species. For instance, *Phytolcca americana* was rare on Pasque in 1923 but is now common on both Cuttyhunk and Penikese (Lauermann & Burk, 1976).

Table 9. Number of native and non-native species in each flora and the ratio of non-native/native species.

Collection	Total Species	Native Species	Non-native Species	Ratio non-native/nat
1923	134	113	21	.19
1974	263	182	81	.44

One of the major changes in the flora of Cuttyhunk has been the addition of many alien species to the weed community itself. The number of non-native species on Cuttyhunk has markedly increased as is shown by the data in Tables 9 and 10. Fogg collected 21 non-native species out of a total of 134 species. These 21 alien species represent 15.67% of the total flora. Out of a total of 263 species collected in 1974, 81 species were non-native. These 81 species constitute 30.80% of the total flora. As Table 9 indicates, the number of non-native species in the flora of Cuttyhunk has increased about four-fold since the 1923 collection. The ratio of non-native/native species has likewise increased from .19 to .44 over the past 50 years.

Table 10. Percent of native and non-native species in each flora.

Collection	Percent native species	Percent non-native species
1923	84.33%	15.67%
1974	69.20%	30.80%

Table 11. Total number of species, genera, and families for each flora

Collection	Species	Genera	Families
1923	134	99	42
1974	263	166	61

DISCUSSION AND BIOGEOGRAPHIC CONSIDERATIONS

It has long been thought that the Elizabeth Islands would never reach a naturally reforested state. One visitor to Cuttyhunk in 1903 expressed a common sentiment:

> "We can hardly believe that the island was ever wooded, for the only trees there are two rows of silver poplars that form a shady lane..." (Watson, 1903, p. 9)

Fogg (1930) described the original climax vegetation of the Elizabeth Islands as stands of *Fagus grandifolia* interspersed with other climax forest species including *Acer rubrum, Carya alba, Cornus florida, Hamamelis virginiana, Nyssa sylvatica, Ostrya virginiana, Prunus serotina, Quercus alba, Q. velutina,* and *Sassafras albidum.*

He blamed the lack of natural reforestation of these islands on the stressful climatic conditions of the New England coast, particularly the high velocity winds, which he believed restricted the vegetation to a scrub growth stage. He assumed that a post-Pleistocene land bridge had enabled more successful migrations of forest species in past geologic time. Fogg also felt that because of Cuttyhunk's final position in the island chain this island's central grasslands suffered the most of all the Elizabeth Islands from the Atlantic winds. Furthermore, he dismissed the browsing of sheep as having limited importance in maintaining the disturbed condition of these islands. In agreement with Fogg, Woodworth and Wigglesworth (1934) stated that "trees cannot survive except in the lee of some protective barrier of lower, hardier bushes, or of hills." More recently Gookin and Barbour (1963, p. 142) have stated that "strong, salt-laden winds sweep over the place [Cuttyhunk] now [1950's] and keep it barren except for grass."

The southwest winds that blow over Cuttyhunk certainly do have a harsh effect on the vegetation. Yet it appears that the role of wind alone in maintaining a deforested state on Cuttyhunk has been overemphasized while the importance of land usage and other agricultural practices have been overlooked. In fact, Oosting and Billings (1942) have shown that wind-born salt spray is the chief factor controlling coastal vegetation and not the high velocity wind in itself. Several aspects of the salt spray community described by Boyce (1954) for Cape Cod are also evident on Cuttyhunk.

Only 25–35 years at the most have elapsed in most areas on Cuttyhunk Island since the cessation of agricultural practices. In this comparatively short time, Cuttyhunk seems to have already reached an advanced shrub stage. Moreover, the island apparently has not equilibrated with respect to either total species number or successional stage. At its present point in successional development, Cuttyhunk's subclimax vegetation continues to sustain large populations of whitetail deer (*Odocoileus virginianus*) and cottontail rabbits (*Sylvilagus transitionalis*). The feeding preferences of both these species and the size of their populations will certainly influence the course of sere development and the character of plant communities on Cuttyhunk in the future if left unmanaged.

As of 1974, the deer population had increased unchecked by natural predators or hunters to an estimated 150 deer in an area of approximately two square miles. The rabbit population is also sizeable and unchecked by predators. The deer have created a management problem throughout the island. They have been accused of cropping the crowns of newly planted trees and of pilfering vegetables from local gardens. Unless some management practice is implemented, it seems inevitable that their browsing of the natural woody vegetation as well as their trampling of the shrub community will retard and possibly reverse any successional progress in the near future. Several residents have begun to plant trees enclosed in protective fences to encourage the development of a forested island.

It seems likely that artificial reforestation of Cuttyhunk will be necessary if present ecological conditions and lack of adequate propagule source areas do indeed make it difficult for climax tree species to colonize the island. The problem of reforestation remains to be solved by time and vegetational recovery. Few tree species were found on Cuttyhunk in the summer of 1974. On Copicut Neck, abandoned orchards of *Pyrus malus* have taken on an open woodland aspect. *Acer rubrum* and *Salix babylonica* had been planted around Gosnold and have successfully naturalized in disturbed areas and roadsides. Scattered specimens of *Prunus serotina* and *Pyrus floribunda* were also observed. Isolated *Sassafras* seedlings have also been reported.

For the first time since 1602 parts of Cuttyhunk Island are advancing towards a naturally reforested state relatively unperturbed by agricultural practices. Yet it is more than likely that the species composition of such a forest stage will be substantially different from the original vegetation described by Fogg.

Furthermore, the marked invasion of ruderal vegetation reflects the increase in disturbance on this island occasioned by civilization and increased human activity. Cuttyhunk apparently offered fewer opportunities for the invasion of alien species during Fogg's investigation. Undoubtedly there were fewer houses at the eastern end of the island and only unimproved roads in the 1920's at the time when Fogg did his collecting. In contrast, waste places and roads paved for automobile traffic were fairly common at the eastern end of the island in 1974.

Table 12. Total flora at each collection period with invasions, extinctions, and persisting species since 1923

Collection	Number of Species
1923	134
extinctions since 1923	62
1974	
persisting since 1923	72
invasions since 1923	192
Total	264

The mode of transportation to the island has changed considerably since Fogg's visits as well. Modern day Cuttyhunk is serviced by two ferries and two sea-planes, all agents for seed dispersal. Three of these passenger vehicles leave from metropolitan New Bedford daily. Although cars cannot be transported on the ferries, at least a dozen motor vehicles are already present on Cuttyhunk. The vehicles further transport tramp species to various parts of the island. Other alien species have apparently been introduced by fructivorous birds and sea fowl.

The vegetational changes and the future trend of succession on Cuttyhunk can also be considered in light of theoretical island biogeography. MacArthur and Wilson (1963) found that islands exhibit certain quantifiable patterns dependent upon an individual island's area, species diversity, and distance from the source of dispersing species. Islands that are far from source regions are less saturated with species than islands that are near. In fact, areas like Cuttyhunk may actually exhibit floristic impoverishment in terms of native species as compared with the mainland. This is a consequence of the poor dispersal ability of many native species over water barriers. Thus, far islands usually have fewer species than do similar sized islands nearer to the source region of dispersing species. Secondly, the species number decreases more on small islands, where the extinction rate is higher, than on large islands with increasing distance from the source. This latter prediction may partly account for the lower species diversity and higher extinction rate of species on Peninkese (Lauermann & Burk, 1976) in comparison to Cuttyhunk.

The species diversity of an island biota can be interpreted as an equilibrium between immigration and extinction (MacArthur & Wilson, 1967). In early successional stages, the rate of immigration exceeds the rate of extinction; however, the rate of immigration declines as rapidly dispersing species become established and fewer colonists are new to the flora. An equilibrium is eventually established between immigration and extinction. Penikese appears to have reached an equilibrium between immigration and extinction under the present ecological conditions (Burk & Lauermann, 1976); Cuttyhunk has still not reached a floristic equilibrium. On the other hand, over the past 50 years, immigration has markedly increased. Table 11 contains the total number of species, genera, and families for both the 1923 and 1974 floras. The total number of species has approximately doubled while the number of genera and families has likewise increased substantially since the earlier flora. Table 12 shows the total flora at each collection period with invasions, extinctions, and persisting species since 1923. The number of persisting species slightly exceeds the number of extinctions, but the number of invasions is almost four times greater than the number of extinctions and more than twice the number of persisting species.

The Simpson Index of Resemblance (Simpson, 1956) has been used to calculate the degree of similarity and difference between the two floras. The value obtained is not influenced by species equitability. The Simpson Index is calculated by $100c/n_1$ in which c represents the number of taxonomic units common to the two floras and n_1 the total number of units in the smaller of the two floras. Table 13 contains the Simpson Index of Resemblance between 1923 and the 1974 floras of Cuttyhunk. Species composition has changed dramatically since 1923. A Simpson Index computed to compare the 1974 flora of Cuttyhunk and the 1973 flora of the neighboring island of Penikese emphasizes a difference between these two areas as well. Cuttyhunk is successionally more developed than Penikese even though Penikese appears to have reached a floristic equilibrium (Lauermann & Burk, 1976).

Table 13. The Simpson Index of Resemblance comparing the two major collections on Cuttyhunk, and the 1974 collection with the 1973 collection on Penikese.

Collection compared	Resemblance ($100^{c}/n_1$)
1923 and 1974	53.7
1974 Cuttyhunk flora and 1973 Penikese flora	67.6

The extinction rate on Cuttyhunk is further lowered as a consequence of larger island area, which permits the establishment of larger founding populations than can be established on Penikese. MacArthur and Wilson (1967) state that habitat diversity, and not area alone, is the ultimate regulator of species diversity. Area can be correlated with environmental diversity so that in combination these two variables can account for variation in species number. A larger island usually supports a larger flora because it is usually more environmentally complex than a smaller island at an equal distance from source regions. As a corollary, the predicted rate of extinction is lower on larger islands since population densities there are usually higher. Again this appears to be the situation on Cuttyhunk and Penikese. Cuttyhunk has greater vegetational complexity than Penikese, certainly indicating the important role of habitat diversity in the control of floristic diversity. Perhaps for these reasons Cuttyhunk can support a more diverse flora with greater structural complexity than its less elevated, smaller neighbor Penikese.

THE 1974 FLORA

The following list contains 192 species new to the flora of Cuttyhunk collected during the present study. Nomenclature is based on Fernald (1950), Bailey (1924) for several cultivated species, and Hodgdon and Steele (1966) for *Rubus* subgenus *Eubatus*. Species that have become extinct since the 1923 flora are listed in Appendix I. The order of both lists follows Fernald (1950) for families, with genera within families and species within genera treated alphabetically.

In addition to the 264 species in the total flora number, five specimens representing distinct taxa were collected in unidentifiable condition. Three of these species are believed to be species of *Ranunculus*, *Rubus*, and *Vicia*. All specimens collected in this investigation have been deposited in the herbarium of Smith College (SCHN).

EQUISETACEAE

Equisetum arvense L. rare near Pond 10

LYCOPODIACEAE

Lycopodium inundatum L. rare near Pond 10

OSMUNDACEAE

Osmunda regalis L. rare in swampy lowlands

POLYPODIACEAE

Dryopteris noveboracensis (L.) Gray common in swampy thickets and pond margins
Onoclea sensibilis L. common in moist hollows and shady thickets, especially in southwest section

PINACEAE

Juniperus communis L. single specimen above the sandpit
J. virginiana L. single specimen on Copicut Neck
Picea glauca (Moench) Voss. cultivated in Gosnold
Pinus resinosa L. cultivated in Gosnold
P. sylvestris L. cultivated in Gosnold

TYPHACEAE

Typha latifolia L. common around Ponds 6, 7, 10, and 11

SPARGANIACEAE

Sparganium americanum Nutt. common emergent in ponds
S. eurycarpum Engelm. uncommon in ponds on Copicut Neck

ZOSTERACEAE

Zostera marina L. abundant along drift line

GRAMINEAE

Agrostis stolonifera L. abundant throughout grasslands in July and August
A. tenuis Sibth. abundant in grasslands in late June
Ammophila breviligulata Fern. abundant on sandy beaches, especially on Canapitsit Neck and Copicut Beach
Andropogon scoparius Michx. uncommon in grasslands on southwest side of island
Anthoxanthum odoratum L. abundant in grasslands
Danthonia spicata (L.) Beauv. fairly common in grasslands on southwest side
Dactylis glomerata L. abundant in grasslands in late June and early July
Digitaria sanguinalis (L.) Scop. uncommon is disturbed area
Distichlis spicata (L.) Greene locally common in salt marsh near Pond 16
Echinochloa crusgalli (L.) Beauv. locally abundant in marsh (Pond 18) on Canapitsit Neck
Elymus virginicus L. locally common Copicut Neck near ponds at eastern end
Eragrostis spectabilis (Pursh) Steud. uncommon along roadside on Copicut Neck
Festuca rubra L. uncommon in grasslands
Glyceria obtusa (Muhl.) Trin. uncommon in swamp near Pond 4 behind dump
Holcus lanatus L. common throughout grasslands
Lolium perenne L. (det. by H. Ahles) occasional
Panicum commutatum Schultes occasional along roadsides
P. clandestinum L. occasional along roadsides
P. dichotomiflorum Michx. locally abundant in muddy and sandy pond bottoms
P. oliganthes Schultes uncommon along unimproved roads
P. virgatum L. most abundant grassland species throughout by late summer
Phragmites australis Trin. locally abundant in marsh on Canapitsit Peninsula, near beach on Copicut Neck, and in Pond 6
Poa annua L. uncommon in grasslands
P. compressa L. uncommon in grasslands
P. pratensis L. uncommon in grasslands
Spartina alterniflora Loisel. abundant in salt marshes
S. patens (Ait.) Muhl. abundant in salt marshes and border of brackish pond

CYPERACEAE

Carex pennsylvanica Lam. uncommon
C. rosea Schkuhr uncommon
Cyperus diandrus Torr. abundant in moist muddy and sandy pond bottoms in association with *Panicum dichotomiflorum*
C. odoratus L. locally common around ponds
Eleocharis obtusa (Willd.) Schultes abundant emergent of pond borders throughout
Scirpus cyperinus (L.) Kurth. uncommon around ponds

COMMELINACEAE

Commelina communis L. single specimen on edge of "Bay View Road"

JUNCACEAE

Juncus acuminatus Michx. abundant around Ponds
J. canadensis J. Gay abundant in salt marshes and brackish areas
J. greenei Oakes & Tuckerm. common throughout
J. pelocarpus May. (det. by H. Ahles) common in sandy pond marshes and marsh
J. tenuis Willd. abundant in open soils, road edges, hillsides throughout

PONTEDERIACEAE

Pontederia cordata L. locally abundant in Pond 1

LILIACEAE

Maianthemum canadense Desf. rare in marsh around Sheep Pond (Pond 9)
Smilax rotundifolia L. uncommon in shrub layer

AMARYLLIDACEAE

Hypoxis hirsuta (L.) Civille uncommon in grasses between shrubby thickets on western half of the island

IRIDACEAE

Iris versicolor L. fairly common in swamps and pond borders

SALICACEAE

Salix babylonica L. single specimen next to dump, also cultivated in Gosnold
S. discolor L. rare in shrub community

MYRICACEAE

Myrica pensylvanica Loisel abundant throughout in hollows and on hillsides

POLYGONACEAE

Polygonum aviculare L. common in road edges around Gosnold
P. glaucum Nutt. restricted to sandy-cobble beaches
P. pensylvanicum L. border of Pond 1 and in field adjacent to Pond 5
P. persicaria L. common around ponds
P. punctatum Ell. abundant in swamps and around ponds
P. puritanorum Fern. abundant in swamps and around ponds
P. scandens L. rare in Pond 12 and on cobble shore of Gosnold Pond (Pond 8)
Rumex crispus L. abundant in sandy waste area near Gosnold Marina
R. maritimus L. rare on Canapitsit Neck
Rumex sp. probably *obtusifolius* L. (det. by H. Ahles)

CHENOPODIACEAE

Chenopodium album L. abundant drift line plant on Cuttyhunk Pond (Pond 17)
Salicornia bigelovii Torr. locally common in tidal pond (Pond 16) on cobble north shore of Copicut Neck

Suaeda maritima (L.) Dumort. abundant drift line species along sandy border of Cuttyhunk Pond (Pond 17)

PHYTOLACCACEAE

Phytolacca americana L. uncommon in tension zones

AIZOACEAE

Mollugo verticillata L. uncommon along road edges

CARYOPHYLLACEAE

Sagina procumbens L. (det. by H. Ahles) locally abundant on sandy border of Gosnold Pond (Pond 8)

Saponaria officinalis L. restricted to field near Bosworth House

Stellaria graminea L. uncommon

RANUNCULACEAE

Ranunculus bulbosus L. common in grasslands and in unimproved roads

R. cymbalaria Pursh. locally abundant on borders of Gosnold Pond (Pond 8) and Cattail Pond (Pond 11)

BERBERIDACEAE

Berberis thunbergii D.C. a garden escape along roadsides in shrubby thickets

LARDIZABALACEAE

Akebia quinata Decne. a garden escape along roadside in Gosnold

PAPAVERACEAE

Glaucium flavum Crantz. common on beaches

CRUCIFERAE

Barbarea verna (Mill.) Ashers. uncommon at town dump

Capsella bursa-pastoris (L.) Medic. rare near Gosnold Marina in waste area

Raphanus raphanistrum L. uncommon on Canapitsit Neck in waste areas and around foundation of the Old Boat House

Rorippa islandica (Oeder) Borbas uncommon at town dump

Sisymbrium officinale (L.) Scop. var. *leiocarpum* D.C. (det by H. Ahles)

DROSERACEAE

Drosera rotundifolia L. a single colony in clearing next to Pond 10

ROSACEAE

Geum canadense Jacq. uncommon in wet lowlands

Potentilla egedei Wormsk. (det. by H. Ahles) rare in marsh around Sheep Pond (Pond 9)

Prunus serotina Ehrh. uncommon on western side of island

Pyrus floribunda Lindl. (det. by H. Ahles) uncommon in swamp along road to West End

P. communis L. cultivated species along the main street, "Broadway"

P. malus L. in abandoned orchards on Copicut Neck and on main island

P. prunifolia Willd. in abandoned orchards on Copicut Neck

Rosa sp. probably *wichuriana* Crépin. (det. by H. Ahles) a garden escape forming a shrubby thicket at the "Crossroads"

Rubus allegheniensis Porter. uncommon in grasslands

R. arenicola Blanch. fairly common in open fields and hillsides

R. bifrons Vest. (det. by H. Ahles) locally abundant in patches on Copicut Neck and elsewhere in shrub community

R. flagellaris Willd. abundant in open grasslands throughout

R. jaysmithii Bailey common in grasslands

LEGUMINOSAE

Melilotus alba Desr. a single specimen observed in road edge near Gosnold Marina

M. officinalis (L.) Lam. a single specimen observed in field behind the Allen House

Robinia hispida L. in shrub community near sandpit and on Copicut Neck

R. pseudo-acacia L. cultivated species in Gosnold

Trifolium pratense L. common in fields, roadsides, lawns, and waste areas at the eastern end of the island

OXALIDACEAE

Oxalis europaea Jord. roadsides, waste areas, and in pavement cracks of Gosnold streets

O. stricta L. along road to West End and waste areas in Gosnold

POLYGALACEAE

Polygala polygama Walt. uncommon in open sandy areas

EUPHORBIACEAE

Euphorbia polygonifolia L. common on sandy-cobbly beaches above high tide mark

ANACARDIACEAE

Rhus copallina L. common in dense thickets throughout with *R. typhina*

R. typhina L. one of the most abundant species in dense thickets and copses throughout

Toxicodendron radicans (L.) Gillis common in grasslands

AQUIFOLIACEAE

Ilex laevigata (Pursh) Gray rare in shrub layer

I. verticillata (L.) Gray rare on Copicut Neck

ACERACEAE

Acer pseudo-platanus L. a cultivated species near the Bosworth House Inn in Gosnold

A. rubrum L. small population around "Paint Shack" near two planted trees

VITACEAE

Parthenocissus tricuspidata (Sieb. & Zucc.) Planch. along "Broadway" growing on stone fences

P. quinquefolia (L.) Planch. uncommon in shrub layer

Vitis labrusca L. in patch along road edge near the "Crosroads" and locally abundant in patch near sandpit on southwest side of the island

MALVACEAE

Hibiscus moscheutos L. locally abundant on Copicut Neck in Pond 12 and in marsh at eastern end; also planted on border of Pond 3

GUTTIFERAE

Hypericum boreale (Britt.) Brickn. common around ponds

H. canadense L. found only at sandpit

H. gentianoides (L.) BSP. limited in distribution to sandpit

H. mutilum L. uncommon around ponds

H. virginicum L. most abundant species of this genus around ponds

VIOLACEAE

Viola lanceolata L. uncommon in border of Pond 1

V. papilionacea Pursh garden escape near the Allen House

LYTHRACEAE

Decodon verticillatus (L.) Ell. common in swamps, pond borders, and moist hollows throughout

ONAGRACEAE

Epilobium glandulosum Lehm. collected only from damp thicket behind town dump near Pond 4

Oenothera biennis L. uncommon along roadside on Canapitsit Neck and around foundation of Old Boat House

UMBELLIFERAE

Hydrocotyle umbellata L. collected only from Pond 1 in shallow water

Ptiliminium capillaceum (Michx.) Raf. rare on border of brackish Pond 11 on Copicut Neck

ERICACEAE

Vaccinium corymbosum L. uncommon in shrub layer

PLUMBAGINACEAE

Limonium nashii Small (det. by H. Ahles) locally abundant in salt marsh on Cuttyhunk Pond (Pond 17)

OLEACEAE

Ligustrum vulgare L. garden escape into shrub community along roadsides in Gosnold, in central grasslands, and on cobble north shore of Copicut Neck

Syringa vulgaris L. garden escape into shrub community

ASCLEPIADACEAE

Asclepias syriaca L. (det. by H. Ahles) common only on road edges in Gosnold, especially at the "Crossroads"

CONVOLVULACEAE

Convolvulus sepium L. occasional in grassy road edges

LABIATAE

Glechoma hederacea L. occasional on pond borders

Lycopus rubellus Moench common along southwest side of the island including the town dump and sandpit, and on the brackish borders of ponds on Copicut Neck

Nepeta cataria L. restricted to cobble shore of Sheep Pond (Pond 9)

Prunella vulgaris L. uncommon on grassy borders of ponds

Teucrium canadense L. abundant throughout in moist thicket, swamps, pond borders, and in cobble shore on Copicut Neck

Trichostema dichotomiflorum L. locally abundant at sandpit only

SOLANACEAE

Datura stramonium L. rare in disturbed area near residence

Petunia hybrida Viln. uncommon garden escape in road edge on Canapitsit Neck

Solanum dulcamara L. common along roads in Gosnold

S. americanum Mill (det. by H. Ahles) uncommon in cobble border of Gosnold Pond, and along edge of unimproved road to the West End

SCROPHULARIACEAE

Gratiola aurea Muhl. locally abundant on bottom of Pond 3

Linaria vulgaris Hill. uncommon in field near the Allen House Inn

Lindernia anagallidea (Michx.) Pennell uncommon on shore of Copicut Neck

Verbascum thapsus L. locally abundant at town dump and on Copicut Isthmus

BIGNONIACEAE

Catalpa bignonioides Walt. single cultivated specimen on southeast side

PLANTAGINACEAE

Plantago major L. common in waste areas and road edges

RUBIACEAE

Cephalanthus occidentalis L. locally abundant in swamp on Copicut Neck

Galium tinctorium L. (det. by H. Ahles) common in marshes and pond borders

CAPRIFOLIACEAE

Lonicera japonica Thunb. abundant in thickets, woodland edges, and roadsides throughout

Viburnum dentatum L. common in shrub layer throughout

COMPOSITAE

Ambrosia artemisiifolia L. common in waste areas and road edges especially in Gosnold

A. psilostachya DC. var. *coronopifolia* (T. & G.) Farw. (det. by H. Ahles) rare in waste area near marina

Arctium minus (Hill) Bernh. locally abundant at town dump

Aster pilosus Willd. (det. by H. Ahles) rare in road edge near Fisherman's Pier

A. ericoides L. (det. by H. Ahles) uncommon in pavement of "Road to the Lookout" near the library

Bidens tripartita L. (det. by H. Ahles) occasional

Chrysanthemum leucanthemum L. locally abundant on Copicut Isthmus and at town dump

Chrysopsis falcata (Pursh) Ell. uncommon along road to the West End

Cichorium intybus L. abundant in coastal waste areas and road edges in Gosnold

Cirsium arvense (L.) Scop. common in grasslands and grassy road edges

C. discolor (Muhl.) Spreng rare on north shore of Copicut Neck

C. horidulum Michx. rare on sandy border of Gosnold Pond (Pond 8)

C. muticum Michx. common in grasslands

C. pumilum (Nutt.) Spreng. (det. by H. Ahles) common in grasslands

Erechtites hieracifolia (L.) Raf. abundant drift line plant on sandy border of Cuttyhunk Pond (Pond 17); also common in coastal waste areas and at dump

Erigeron canadensis L. abundant in coastal waste areas especially near the Coast Guard Station on Canapitsit Neck

E. annuus (L.) Pers. (det. by H. Ahles) rare in road edge in Gosnold

E. pusillus Nutt. common in coastal waste areas near Gosnold

E. strigosus Muhl. rare in tension zone on Canapitsit Neck

Gnaphalium obtusifolium L. common in sandy tension zones on Canapitsit Neck and Copicut Beach

G. uliginosum L. tension zone on Canapitsit Neck

Hieracium florentinum All. uncommon along unimproved roads

Hypochoeris radicata L. uncommon along unimproved roads

Leontodon autumnalis L. uncommon along unimproved roads

Matricaria matricarioides (Less.) Porter (det. by H. Ahles) common

Pluchea purpurascens (Sw.) DC. uncommon in field adjacent to Pond 5 only

Solidago nemoralis Ait. uncommon along inland road edge

S. tenuifolia Pursh. abundant in grasslands and along road edges throughout

Sonchus asper (L.) Hill. uncommon on sandy and cobbly beach beyond high tide line on Canapitsit Neck

Taraxacum officinale Weber. uncommon along unimproved roads and grasslands

Xanthium echinatum Murr. common on Copicut Isthmus only

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APPENDIX I

Vascular plant species of the 1923 flora of Cuttyhunk Island collected by Fogg (Fogg, 1930) not collected during the present study.

POLYPODIACEAE

Athyrium felix-femina (L.) Roth
Dennstaeditia punctilobula (Michx.) Moore

OPHIOGLOSSACEAE

Ophioglossum vulgatum L.

ZOSTERACEAE

Potamogeton perfoliatus L. var. *bupleuroides* (Fern.) Farw.
Ruppia maritima L. var. *longipes* Hagstrom

HYDROCHARITACEAE

Vallisneria americana Michx.

GRAMINEAE

Calamagrostis canadensis (Michx.) Beauv.
Paspalum ciliatifolium var. *muhlenbergii* (Nash) Fern.
Puccinella paupercula (Holm) Fern. & Weatherby
P. fasciculata (Torr) Bickn.
Spartina pectinata Link.

CYPERACEAE

Carex debilis Michx. var. Rudgei Bailey
C. hormathodes Fern.
C. howei Mackwnzie
C. laevivaginata (Kubert) Mack.

C. limosa L.
C. lupulina Muhl.
C. silicea Olney
C. spicata Huds.
C. swanii (Fern.) Mack.
Cladium mariscoides (Muhl.) Torr.
Eleocharis uniglumis (Link.) Schultes
Eriophyllum tenellum Nutt.
E. virginicum L.
Rhynchospora alba (L.) Vahl.
Scirpus validus vahl.

ARACEAE

Acorus calamus L.

JUNCACEAE

Juncus articulatus L. var. *obtusatus* Engelm.
J. dichotomus Ell. var. *platyphyllus* Wiegand

IRIDACEAE

Sisyrinchium graminoides Bicknell

ORCHIDACEAE

Habenaria clavellata (Michx.) Spreng.
H. lacera (Michx.) Lodd.

URTICACEAE

Boehmeria cylindrica (L.) S.W. var. *drummondiana* Wedd.

CRUCIFERAE

Nasturtium oficinale R. Br.

LEGUMINOSAE

Vicia villosa Roth.

LINACEAE

Linum striatum Walt.

POLYGALACEAE

Polygala cruciata L.

ELATINACEAE

Elatine minima (Nutt.) F. & M.

VIOLACEAE

Viola fimbriatula Sm.

MELASTOMALEAE

Rhexia virginica L.

ONAGRACEAE

Epilobium palustre L. var. *monticola* Hausch.

UMBELLIFERAE

Sium suave Walt.

ERICACEAE

Rhododendron viscosum (L.) Torr.
Vaccinium macrocarpon Ait.

PRIMULACEAE

Lysimachia terrestris (L.) BSP.

GENTIANACEAE

Bartonia virginica (L.) BSP.
Menyanthes trifoliata L. var. *minor* Michx.

LABIATAE

Mentha crispa L.

SCROPHULARIACEAE

Veronica peregrina L.

PLANTAGINACEAE

Plantago aristata Michx.

COMPOSITAE

Anaphalis margaritaceae (L.) B. & H.
Antennaria neglecta Greene
Aster multiflorus L.
Solidago stricta Ait.

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SYNOPTIC CLASSIFICATION AND POLLEN MORPHOLOGY OF *VERNONIA* (COMPOSITAE: VERNONIEAE) IN THE OLD WORLD

Samuel B. Jones, Jr.

This paper is the second in a series of two papers presenting a synoptic classification and describing the pollen morphology of *Vernonia.* The first paper treated the New World taxa (Jones, 1979b). This paper considers the genus in the Old World, i.e., Africa and southeastern Asia, and should be regarded as a tentative working classification.[1] Its purpose is to delimit biologically meaningful groups within *Vernonia,* thereby creating smaller "natural" groupings of a manageable size for subsequent revisionary studies. Such revisionary work will eventually lead to a refinement of this classification. Without the system proposed it would be difficult, if not impossible, to examine effectively such a large and unwieldy genus. Further, since many of the taxa are rather wide ranging, studies confined to limited geographic areas would not clarify the basic problems in *Vernonia.* Hence, the preliminary treatment presented here and in the previous work represent an attempt to bring order to the chaos that currently exists in *Vernonia.*

Smith (1969) first observed differences in the pollen morphology of the Old World Section *Stengelia* and later emphasized the heterogeneous nature of the section (Smith, 1971). Keeley and Jones (1977) subsequently demonstrated the usefulness of pollen morphology in classification of the West Indian Vernonias. Cognizant of the utility of this character, the treatment of both New World (Jones, 1979b) and Old World taxa relies heavily on pollen features, although other sources of evidence were also used. Thus, while emphasizing palynology, the system presented here actually represents a synthesis of several types of sytematic data, including phytochemistry (Harborne & Williams, 1977), cytotaxonomy (Jones, 1979a) and cytogenetics (Jones, 1977). These, along with classical megamorphology, have led to the taxonomic concepts outlined here.

Techniques of pollen analysis are described in the first paper

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[1] Mention should be made of two recent and noteworthy floristic treatments of *Vernonia* in Africa by Hilliard (1977) and Wild (1978). Although not providing a general system of classification, their keys have proved to be workable for the purpose of identification.

(Jones, 1979b) and thus will not be repeated. Species names cited are taken directly from the herbarium labels unless an obvious error was detected. Micrographs of the six types of *Vernonia* pollen grains are shown in Figure 1.

SYNOPSIS OF THE CLASSIFICATION AND POLLEN MORPHOLOGY OF THE OLD WORLD VERNONIAS

Taxon	Pollen Type
Subgenus *Orbisvestus*	ACEF (rarely B)
Section *Orbisvestus*	A (rarely B)
Subsection *Orbisvestus*	A (rarely B)
Subsection *Strobocalyx*	A (rarely B)
Subsection *Gongrothamnus*	A
Subsection *Pawekianae*	A
Subsection *Hilliardianae*	A
Subsection *Urceolatae*	A
Subsection *Turbinellae*	A
Subsection *Distephanus*	A
Subsection *Centrapalus*	A
Section *Stengelia*	C
Section *Tephrodes*	E
Subsection *Tephrodes*	E
Subsection *Lepidella*	E
Subsection *Oocephalae*	E
Subsection *Glutinosae*	E
Subsection *Bechium*	E
Section *Azureae*	F

Vernonia Schreb.

Subgenus **Orbisvestus** S. B. Jones, *subgen. nov.*

Herbae annuae perennesve, frutices vel arbores; inflorescentiae corymbosae-paniculataevel reductae ad capitulae solitaria; capitula flosculis ca 1 40; involucra campanulata vel urceolata; pappus biserialis vel raro uniserialis; corollae purpureae, roseae, azureae, vel luteae-aurantiaceae. Chromosomatum numerus: $n = 9, 10, 18, 20, 30$. Pollinis granum typus A, C, E, et F vel raro B. TYPE SPECIES: *Vernonia karaguensis* Oliver and Hiern.

Geographical distribution: Africa, Madagascar, Indian subcontinent, southeastern Asia and associated islands to Australia.

The genus *Vernonia* consists of two subgenera, i.e., subgenus *Vernonia* in the New World and subgenus *Orbisvestus* from the tropical and subtropical Old World. Subgenus *Vernonia* has a chromosome number of x=17; whereas, subgenus *Orbisvestus* is dibasic with x=9, 10 (Jones, 1979b).

The two subgenera also differ in chemical constituents. The New and Old World species of *Vernonia* can be distinguished on the basis of their sesquiterpene lactones, which are of a simpler type in New World species (Harborne & Williams, 1977). This chemical evidence supports the hypothesis that the genus *Vernonia* has two major groups: the Old World, i.e., Africa and southeastern Asia, and the New World.

Differences are also apparent in the distribution of pollen grain types (Keeley & Jones, 1979): Pollen types E and F are found only in the subgenus *Orbisvestus;* Type D only in subgenus *Vernonia;* and Type B only in subgenus *Vernonia* with the exception of a few species in the Old World. Pollen types A and C are found in both subgenera, with type A being the most common.

A few species of *Vernonia* in subsection *Orbisvestus* have yellow to orange corollas. This corolla color is not known in subgenus *Vernonia* from the New World.

Section **Orbisvestus**

Pollen type: A, rarely B.

Geographic distribution: Old World tropics.

Subsection **Orbisvestus**

Herbaceous perennials to semi-shrubs or shrubs, 2 dm to 5 m tall, stems leafy; heads usually numerous; corollas reddish-purple; inner pappus of bristles, outer pappus of short bristles or small scales; pollen type A, rarely B.

Geographical distribution: Savannas from north central to southern Africa, also in Madagascar.

Chromosome number: $n = 9$ (2 species examined), $n = 10, 20$ (1 species examined).

Comments: This is a large, perhaps heterogeneous series, that merits further study.

Pollen type: A (two species have B). Pollen grains were examined from the following specimens:

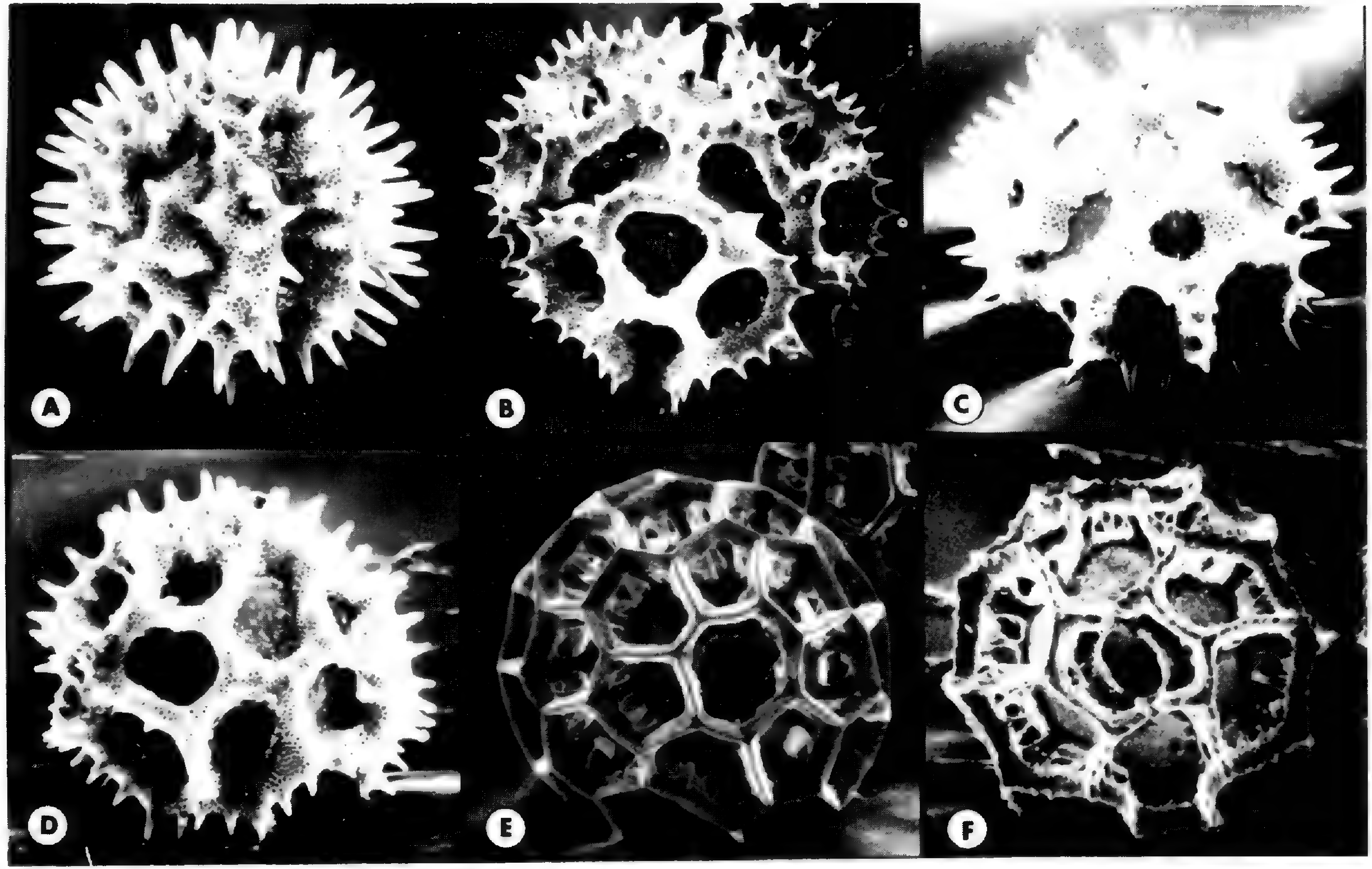
A
B
C
D
E
F

Figure 1. The six types of *Vernonia* pollen grains. **Type A:** echinate to subechinolophate, tricolporate with a continuous, micropunctate tectum, spines on the ridges or muri of the subechinolophate grains; **Type B:** echinolophate, tricolporate, with discontinuous micropunctate tectum, germinal furrows elongated, and separated at the poles by coincident muri, with spines generally pronounced on muri, but occasionally reduced, lacunae regularly or irregularly spaced, no polar lacunae present (paired poral lacunae may occur on this type as on type C); **Type C:** echinolophate, tricolporate, with a discontinuous micropunctate tectum, germinal furrows pronounced, spines on the muri or reduced in some, lacunae irregularly spaced, polar lacunae prominent, paired poral lacunae occur in some grains; **Type D:** echinolophate, triporate, with a discontinuous micropunctate tectum, spines generally pronounced on muri, occasionally reduced, lacunae regularly spaced, some of unequal size, germinal pores surrounded by a ridge; found only in the New World; **Type E:** lophate or subechinolophate, semi-tectate with elevated geometrically arranged muri, supported by conspicuous colummelae, lacunae regularly spaced, germinal pores without distinguishing features; **Type F:** echinolophate to lophate, semi-tectate with geometrically patterned elevated muri, with conspicuous colummelae, lacunae regularly spaced, germinal pores with interrupted biparted muri (types E and F are found only in the Old World).

Vernonia amaniensis Muschler, Tanzania: *Renvoize and Abdallah 1627* (K). **V. antandroy** Humbert, Madagascar: *Decary 2712* (K). **V. bamendae** C. D. Adams, Cameroun: *Keay 28410* (K). **V. blumeoides** Hook., Nigeria: *Hepper 1642* (K). **V. brachylaenoides** S. Moore, Zambia: *Richards 20506* (K). **V. brachyscypha** Baker, Madagascar: *Hildebrandt 3635* (K). **V. campanea** S. Moore, Kenya: *Drummond and Hemsley 4763* (K). **V. cinerascens** Sch.-Bip., United Arab Republic (Egypt): *Schabetai 1409* (K). **V. cistifolia** O. Hoffm., Malawi: *Pawek 2380* (K). **V. cockburniana** Balf. f., Socotra I.: *Smith and Lavranos 179* (K). **V. colorata** Drake, Tanzania: *Vesey-Fitzgerald 6795* (K). **V. crataegifolia** Hutchins., Republic of South Africa: *Tyson 1242* (K). **V. diversifolia** Bojer ex DC., Madagascar: *Decary 270* (K). **V. erythromarula** Klatt, Madagascar: *Humbolt 625* (K). **V. galpinii** Klatt, Republic of South Africa: *Hilliard 5075* (K). **V. hildebrandtii** Vatke, Kenya: *Bally and Smith B14342* (K). **V. holstii** O. Hoffm., Malawi: *Pawek 12734* (GA). **V. hormilantha** S. Moore, Kenya: *Jeffery 759* (K). **V. karaguensis** Oliver & Hiern, Kenya: *Bally and Smith 14782* (K). **V. klingii** O. Hoffm. & Muschler, Sierra Leone: *Morton and Gledhill SL. 1049* (K). **V. leopoldi** Vatke, Somalia: *Gillett 5346* (K). **V. luembensis** DeWild. & Muschler, Zambia: *Sanane 408* (K). **V. milanjiana** S. Moore, Ethiopia: *Jackson 1943* (K). **V. monocephala** Harv., Republic of South Africa: *Mogg 34407* (K). **V. multiflora** DeWild., Zambia: *King 158* (K). **V. myriocephala** A. Rich., Uganda: *Chandler 311* (K). **V. oxyura** O. Hoffm., Malawi: *Chapman 355* (K). **V. pectoralis** Baker, Madagascar: *Baron 3293* (K). **V. philippsiae** S. Moore, Somalia: *Wood 1972* (K). **V. polytricholepis** Baker, Madagascar: *Perrier 2838* (K). **V. porphyrolepis** S. Moore, Zambia: *Richards 9503* (K). **V. potamophila** Baker, Republic of the Congo: *Robyns 4157* (K). **V. pteropoda** Oliver & Hiern, Kenya: *Perdue and Kibuwa 8342* (K). **V. richardiana** Pichi-Sermolli, Ethiopia: *Gillett 14851* (K). **V. rugosifolia** DeWild., Cameroun: *Bonghey GC10411* (K). **V. sciaphila** S. Moore, Zambia: *Smith and Richards 4665* (K). **V. sculptifolia** Hiern, Zambia: *Drummond and Cookson 6242* (K). **V. sereti** DeWild., Ethiopia: *Meyer 8163* (K). **V. stuhlmannii** O. Hoffm., Tanzania: *Welch 235* (K). **V. turbinata** Oliver & Hiern, Kenya: *Tweedie 3328* (K). **V. umbratica** Oberm., Republic of South Africa: *Strey 7966* (K). **V. undulata** Oliver & Hiern, Nigeria: *Gbile and Daramola 63208* (K). **V. unionis** Sch.-Bip. ex Walp., Ethiopia: *Pappi 77* (K). **V. urticaefolia** A. Rich., Ethiopia: *Meyer 8175* (K). **V. usumbarensis** O. Hoffm., Tanzania: *Faulkner 4609* (K). **V. wollastoni** S. Moore, Kenya: *Verdcourt 1666* (K). **V. zanzibarensis** Less., Tanzania: *Tanner 2883* (K).

B type pollen: **Vernonia bipontiai** Vatke, Ethiopia: *Ashe 73* (GA). **V. corymbosa** Less., Republic of South Africa: *Burchell 4354* (K).

Subsection **Strobocalyx** (Bl. ex DC.) S. B. Jones, *stat. nov.*

Section *Strobocalyx* Bl. ex DC. Prod. **5:** 21. 1836.
TYPE SPECIES: *Vernonia arborea* Buch.-Ham.
Strobocalyx (Bl. ex DC.) Sch.-Bip. Pollichia **18 19:** 170. 1861.
Monosis section *Eumonosis* DC. Prod. **5:** 77. 1836.
Punduana Steetz ex Peters, Mossambique Bot. part **6:** 345. 1862 1864.

Shrubs to trees; inflorescences large paniculate, with many heads; heads from few to ca. 20 flowered; phyllaries deciduous when achenes mature; corollas whitish or pinkish to reddish-purple; outer pappus of bristles which are sometimes flattened.

Geographical distribution: Africa, Madagascar, and southeast Asia, usually in tropical forests.

Chromosome number: $n = 9$ (1 species examined), $n = 10$ (3 species examined).

Comments: This subsection is characterized by the deciduous phyllaries and the large paniculate inflorescences.

Pollen type: A (two species have type B). Pollen grains were examined from the following specimens:

Vernonia ampla O. Hoffm., Ethiopia: *Polunin 11599* (K). **V. amygdalina** Delile, Ethiopia: *Polunin 11602* (K). **V. antanala** Humbert, Madagascar: *Perrier 18126* (K). **V. appendiculata** Less., Madagascar: *Perrier 696* (K). **V. arborea** Buch-Ham., China: *Rock 10603* (US). **V. auriculifera** Hiern, Ethiopia: *Mooney 5449* (K). **V. baroni** Baker, Madagascar: *Bally 8335* (K). **V. brachycalyx** O. Hoffm., Rwanda: *Troupin 6510* (K). **V. chapelieri** Drake, Madagascar: *Humbolt 508* (K). **V. conferta** Benth, Sierra Leone: *Deighton 1070* (K). **V. delapsa** Baker, Madagascar: *Humbert 3843* (K). **V. francavillana** Oliver & Hiern, Ethiopia: *Meyer 7677* (K). **V. frondosa** Oliver & Hiern, Cameroun: *Leeuenberg 5047* (K). **V. glaberrima** Welw. ex O. Hoffm., Ghana: *Hepper and Morton A3047* (K). **V. homollei** Humbert, Madagascar: *Humbert 6453* (K). **V. livingstoniana** Oliver & Hiern, Republic of the Congo: *Tufen 140* (K). **V. mespilifolia** Less., Republic of South Africa: *Pegler 329* (K). **V. myriantha** Hook. f., Cameroun: *TWM 1227* (K). **V. nuxioides** O. Hoffm. & Muschler, Tanzania: *Greenway 4669* (K). **V. podocoma** Sch.-Bip. ex Schweinf. & Asch., Republic of South Africa: *Thorncroft 19165* (K). **V. rhodopappa** Baker, Madagascar: *Hildebrandt 3621* (K). **V. rubicunda** Klatt, Madagascar: *Humbert 1088* (K). **V. secundifolia** Bojer ex DC., Madagascar: *Baron 4358* (K). **V. subuligera** O. Hoffm., Tanzania: *Greenway and Kanuri 11989* (K). **V. theophrastifolia** Schweinf. ex Oliver & Hiern, Ethiopia: *Meyer 7803* (K). **V. thomsoniana** Oliver & Hiern ex Oliver, Cameroun: *Keay FHI 28521* (K). **V. titanophylla** Brenan, Ghana: *Lock and Hall GC 43493* (K).

B type pollen: **Vernonia volkeriaefolia** DC., India: Kew number *1247175* (K). **V. aplinii** Hemsl., Burma: *Robertson 114* (K).

Subsection **Gongrothamnus** (Steetz) S. B. Jones, *stat. nov.*

Gongrothamnus Steetz ex Peters, Reise Mossamb. Bot. 336. 1862.
TYPE SPECIES: *Gongrothamnus divaricatus* Steetz.

Erect to scandent shrubs; leaves various, usually dull green above; inflorescences compact corymbose-paniculate; corollas yellow to orange; pappus in two series, inner of bristles, outer of short flattened bristles.

Geographical distribution: South-central Africa, Madagascar, and southeastern Asia.

Chromosome number: $n = 10$ (1 species examined).

Comments: The yellow to orange corollas of this group have often caused these species to be treated as a separate genus.

Pollen type: A. Pollen grains were examined from the following specimens:

Vernonia angolensis N. E. Brown, Angola: *Gossweiler 10944* (K). **V. auriantiaca** N. E. Brown, Malawi: *Pawek 11501* (GA). **V. forrestii** Anthony, China: *Rock 17347* (US). **V. garnieriana** Klatt, Madagascar: *Bernardi 11068* (K). **V. henryi** Dunn, China: *Forrest 21069* (US). **V. lutea** N. E. Brown, South-West Africa: *Leistner 5909* (K). **V. sublutea** Ell., Madagascar: *Mabberley 956* (K). **V. vitellina** N. E. Brown, Republic of South Africa: *Codd 6076* (K).

Subsection **Pawekianae** S. B. Jones, *subsect. nov.*

Frutices ramosissimae ad scandentes vel herbae perennes; folia basibus cordatis, truncatis vel late cuneatis rotundatisve; inflorescentiae corymbosae-paniculatae. TYPE SPECIES: *Vernonia angulifolia* DC. Named in honor of Mrs. Jean Pawek, prodigious collector of Vernonieae and other taxa in Malawi.

Scandent, much branched shrubs or perennials; leaves with cordate, truncate, or rounded to cuneate bases; inflorescences corymbose-paniculate; heads relatively small, phyllaries acute-acuminate to rounded-cuspidate.

Geographical distribution: Southern Africa.

Chromosome number: $n = 9$ (1 species examined).

Comments: A distinctive group of largely scandent perennials, generally having broad leaves and distinct leaf bases.

Pollen type: A. Pollen grains were examined from the following specimens:

Vernonia andohii C. D. Adams, Ghana: *Fishlock 20* (K). **V. angulifolia** DC., Republic of South Africa: *Strey 10971* (K). **V. anisochaetoides** Sond., Republic of South Africa: *Hanagan 269* (K). **V. biafrae** Oliver & Hiern, Liberia: *Amshoff 2430* (K). **V. malacophyta** Baker, Madagascar: *Perrier 19865* (K). **V. syringifolia** O. Hoffm., Malawi: *Pawek 5729* (K). **V. tufnellae** S. Moore, Uganda: *Purseglove 580* (K).

Subsection **Hilliardianae** S. B. Jones, *subsect. nov.*

Plantae herbae perennes, parvae; folia albida pilosa; inflorescentiae corymbosae-paniculatae vel diminutae; capitula parva, 8–15 flosculis; phyllaria lanceolata. TYPE SPECIES: *Vernonia oligocephala* (DC.) Sch.-Bip. The name honors Dr. O. M. Hilliard, student of the Compositae of Natal (Hilliard, 1977).

Small herbaceous perennials; foliage and stems whitish pilose; inflorescences corymbose-paniculate or reduced; heads small, few flowered; phyllaries lanceolate; outer pappus small, flattened scale-like bristles; achenes usually pubescent.

Geographical distribution: Grassland species of tropical and southeastern Africa.

Chromosome number: $n = 9$ (1 species examined).

Comments: This is a rather natural group of grassland species. The plants, however, are variable in leaf size and shape and the number of species is probably inflated.

Pollen type: A. Pollen grains were examined from the following specimens:

Vernonia calyculata S. Moore, Tanzania: *Geilinger 2795* (K). **V. dregeana** Sch.-Bip. ex Walp., Republic of South Africa: *Werdermann and Oberdieck 1204* (K). **V. hirsuta** Sch.-Bip. ex Walp., Republic of South Africa: *Hilliard 5602* (GA). **V. natalensis** Sch.-Bip. ex Walp., Ethiopia: *Mooney 5250* (K). **V. oligocephala** (DC.) Sch.-Bip. ex Walp., Malawi: *Robson 223* (K). **V. pinifolia** Less., Republic of South Africa: *Long 34* (K). **V. smithiana** Less., Cameroun: *Amshoff 2535* (K).

Subsection **Urceolatae** S. B. Jones, *subsect. nov.*

Frutices ad 1–4 m altis; inflorescentiae corymbosae-paniculatae; involucra urceolata, phyllariis arcte imbricatis. TYPE SPECIES: *Vernonia sphaerocalyx* O. Hoffm.

Shrubs, 1–4 m tall; stems tomentose when young; leaves elliptic to lanceolate, tomentose beneath; inflorescences corymbose-paniculate; involucres urceolate, phyllaries tightly appressed; outer pappus of short, flattened scale-like bristles; achenes glabrate to glandular or rarely sparsely pubescent.

Geographical distribution: South-central Africa.

Chromosome number: none reported.

Comments: A well marked group of shrubs characterized by urceolate involucres.

Pollen type: A. Pollen grains were examined from the following specimens:

Vernonia elisabethvilleana DeWild., Republic of the Congo: *Ritschard 1609* (K). **V. exsertiflora** Baker, Republic of the Congo: *Lisowski 373* (K). **V. fraterna** N. E. Brown, Zambia: *Richards 5114* (K). **V. goetzeana** O. Hoffm., Tanzania: *Polhill and Paulo 1692* (K). **V. sphaerocalyx** O. Hoffm., Tanzania: *Eggeling 6502* (K).

Subsection **Turbinellae** S. B. Jones, *subsect. nov.*

Herbae perennes; inflorescentiae corymbosae-paniculatae; involucra campanulata, phyllariis tomentosis; pappi setae 2-seriales complanatae; achenia pilosa. TYPE SPECIES: *Vernonia lampropappa* O. Hoffm.

Herbaceous perennials; seams tomentose becoming glabrate with age; leaves ovate to elliptic, tomentose, reticulate-veined beneath;

inflorescences corymbose-paniculate; involucres campanulate, phyllaries tomentose; pappus bristles in 2 series, flattened; achenes pilose.

Geographical distribution: South-central Africa.

Chromosome number: none reported.

Comments: a group characterized by tomentose phyllaries and flattened pappus bristles.

Pollen type: A. Pollen grains were examined from the following specimens:

Vernonia eremanthifolia O. Hoffm., Angola: *Faulkner A81* (K). **V. lampropappa** O. Hoffm., Burundi: *Van der Ben 1999* (K). **V. trusurilla** S. Moore, Zambia: *Richards 24450* (K). **V. turbinella** S. Moore, Zambia: *Sanane 467* (GA).

Subsection **Distephanus** (Cass.) S. B. Jones, *stat. nov.*

Section **Distephanus** (Cass.) Benth. & Hook. 2:228. 1873.

Distephanus Cass., Bull. Soc. Philom. 1817:151. 1817. TYPE SPECIES: *D. populifolius* (Lam.) Cass. = *V. populifolia* (Lam.) Spreng.

Shrubs, often scandent, or small trees, rarely somewhat herbaceous; leaf blades variable but usually elliptic to ovate; inflorescences terminal paniculate-corymbose or axillary paniculate-corymbose; corollas usually glandular, lobes sometimes hairy; pappus of bristles 2-seriate, sometimes slightly flattened.

Geographical distribution: Indian sub-continent, southeastern Asia, islands of Indian Ocean, Philippines, and Australia.

Chromosome number: $n = 20$ (1 species examined).

Comments: This is not a distinctive group of Vernonias. It is classified largely on the basis of geography and pollen type. Further study may result in redefinition of the subsection.

Pollen type: A. Pollen grains were examined from the following specimens:

Vernonia anceps Clarke, Ceylon: *Grierson 1056* (US). **V. andersonii** Clarke, Vietnam: *Petelot 2080* (US). **V. blanda** DC., India: *Parry 585* (K). **V. celebica** (Bl.) DC., Philippines: *Ramos 1915* (K). **V. cuneata** Less., Australia: *Brass 19291* (K). **V. cylindriceps** Clarke, Thailand: *Garnett 629* (K). **V. elaeagnifolia** DC., Thailand: *Zimmermann 101* (US). **V. extensa** DC., China: *Rock 7909* (US). **V. florescens** Elmer, Philippines: *Elmer 17998* (K). **V. lancifolia** Merr., Philippines: *Vanoverbergh 689* (K). **V. papillosa** Franch., China: *Henry 9502* (K). **V. populifolia** (Lam.) Spreng., Mauritius Islands: *Ayres 1848* (K). **V. salvifolia** Wight, India: *Wight 1522* (K). **V. solanifolia** Benth., Vietnam: *Petelot 2350* (US). **V. sylvatica** Dunn, China: *Henry 11051* (K). **V. wallichii** Ridley, Malaysia: *Sinclair 40742* (K). **V. wightiana** Arn., Ceylon: *Moldenke 28299* (US). **V. zeylanica** (L.) Less., Ceylon: *Fosberg 50322* (US).

Subsection **Centrapalus** (Cass.) S. B. Jones *stat. nov.*

Centrapalus Cass., Dict. Sci. Nat. **7:** 382. 1817. TYPE SPECIES: *Centrapalus galamensis* Cass.

Xipholepis Steetz ex Peters, Mossambique Bot. part **6:** 344. 1862–1864. *Xipholepis silhetensis* Steetz ex Peters.

Section *Xipholepis* (Steetz) Benth. & Hook., Gen. Pl. **2:** 229. 1873.

Coarse annuals to perennial herbs or semishrubs; leaves variable; inflorescences of single terminal heads to branched corymbose-paniculate clusters; heads relatively large; phyllaries variable; corollas blue to purple; achenes with brownish pubescence.

Geographical distribution: Grasslands and successional habitats south of the Sahara into South Africa.

Chromosome number: $n = 9$ (2 species examined).

Comments: This is a well marked group distinguished by achenes with brownish pubescence.

Pollen type: A. Pollen grains were examined from the following specimens:

Vernonia africana Druce, Republic of South Africa: *Saunders s.n.* (K). **V. afromontana** R. E. Fries, Kenya: *USDA PI 321654* (GA). **V. catumbensis** Hiern, Zambia: *Milne-Redhead 594* (K). **V. denudata** Hutchins. & B. L. Burtt, Tanzania: *Richards 7031* (K). **V. duemmeri** S. Moore, Uganda: *Chandler 1877* (K). **V. fastigiata** Oliver & Hiern, Mozambique: *Pedrogas 259* (K). **V. gerrardi** Harv., Republic of South Africa: *Hilliard and Burtt 7493* (K). **V. inulaefolia** Steud., *Andrews A1963* (K). **V. kamerunensis** Mattf., Cameroun: *Coboner 9421* (K). **V. kirkii** Oliver & Hiern, Zambia: *Mutimushi* 2169 (K). **V. lukamaensis** DeWild., Republic of Congo: *Quarre 261* (K). **V. pauciflora** (Willd.) Less., Tanzania: *Batty 1084* (GA). **V. praemorsa** Muschler, Tanzania: *Richards 15808* (K). **V. purpurea** Sch.-Bip. ex Walp., Tanzania: *Richards 27066* (GA). **V. quartiniana** A. Rich., Ethiopia: *Fries et al. 436* (K). **V. schweinfurthii** Oliver & Hiern, Rwanda: *Troupin 4112* (K). **V. sutherlandi** Harv., Republic of South Africa: *Hutchinson 2248* (K). **V. temnolepis** O. Hoffm., Angola: *Henriques 1030* (K). **V. wakefieldii** Oliver, Kenya: *Greenway and Kanuri 12706* (K). **V. zambesiaca** S. Moore, Zambia: *van Rensburg 2920* (K).

Section **Stengelia** (Sch.-Bip. ex Walp.) Benth. & Hook. Gen. Pl. **2:** 227. 1873.

Subsection *Stengelia* Sch.-Bip. ex Walp. Repert. Bot. Syst. **2:** Suppl. 1, 946. 1843. TYPE SPECIES: *Vernonia adoensis* Sch.-Bip. ex Walp. [See Smith (1971) for a history of section *Stengelia*.]

Herbaceous perennials to shrubs; leaves alternate or forming a basal rosette; heads borne single and terminal, or in reduced clusters, or in paniculate to corymbose inflorescences; phyllaries various, green or sometimes white to purple; corollas with relatively long tubes, whitish to purplish; inner pappus generally long, slightly flattened or filiform, outer pappus usually short and scale-like.

Geographical distribution: Continental Africa south of the Sahara Desert to Natal, South Africa and in the Indian subcontinent.

Chromosome number: $n = 10$ (9 species examined).

Comments: This is a distinctive and well marked Old World group.

Pollen type: C. This is the only group in the Old World with C type pollen. Pollen grains were examined from the following specimens: **Vernonia abyssinica** Sch.-Bip. ex Hochst., Ethiopia: *USDA PI 320083* (GA). **V. acrocephala** Klatt, Cameroun: *Baver 23* (K). **V. adoensis** Sch.-Bip. ex Walp., Zambia: *Sanane 755* (GA). **V. albicans** DC., India: *Ramamoorthy 1951* (US). **V. anthelmintica** (L.) Willd., India: *Mooney 4183* (K). **V. bracteosa** O. Hoffm., Tanzania: *Renvoize and Abdallah 1926* (K). **V. chthonocephala** O. Hoffm., Nigeria: *Hepper 1775* (K). **V. filigera** Oliver & Hiern, Ethiopia: *Schimper 1530* (K). **V. filipendula** Hiern, Zambia: *USDA PI 321669* (GA). **V. guineensis** Benth., Cameroun: *Daramola 40609* (K). **V. hymenolepsis** A. Rich., Ethiopia: *USDA PI 320091* (GA). **V. lancibracteata** S. Moore, Rhodesia: *Ashby 20165* (K). **V. lasiopus** O. Hoffm., Sudan: *Sillitoe 196* (K). **V. nimbaensis** C. D. Adams, Sierra Leone: *Gledhill 359* (K). **V. praecox** Welw. ex O. Hoffm., Republic of the Congo: *Quarre 2533* (K). **V. procera** O. Hoffm., Nigeria: *Lely P 179* (K). **V. pumila** Kotschy & Peyr., Uganda: *Purseglove P 1256* (K). **V. quangensis** O. Hoffm., Angola: *Gossweiler 9526* (K). **V. rigidifolia** Hiern, Zambia: *Milne-Redhead 3086* (K). **V. schimperi** DC., Arabia: *Botta 1838* (US). **V. schirensis** Oliver & Hiern, Republic of South Africa: *USDA PI 32-2705* (GA). **V. stenolepis** Oliver, Tanzania: *Pielou 168* (K). **V. subaphylla** Baker, Zambia: *Milne-Redhead 3414* (K). **V. subsessilis** DC., Union of Burma: *Rock 7839* (US). **V. vallicola** S. Moore, Botswana: *Winter and Marais 4745* (K).

Section **Tephrodes** DC. Prodr. 5:24. 1833. TYPE SPECIES: *Vernonia cinerea* (L.) Less.

Annual or perennial herbs, native to Africa, southeastern Asia and associated archipelagos, with type E pollen grains.

Subsection **Tephrodes.** TYPE SPECIES: *Vernonia cinerea* (L.) Less.

Annual or perennial herbs; leaves variable; inflorescences variable, corymbose-paniculate to greatly reduced and with only a few heads; involucres campanulate; phyllaries imbricate; pappus biserriate, inner pappus of bristles, outer pappus of very small scales, bristles, or scale-like bristles; achenes variable.

Geographical distribution: Africa, southeastern Asia and associated archipelagos.

Chromosome number: $n = 9$ (9 species examined), $n = 18$ (2 species examined).

Comments: This rather large group of annual and perennial species may be heterogeneous; however, additional data, i.e., chemistry, chromosome numbers, etc., are needed prior to further classification. At best, this is a tentative grouping.

Pollen type: E. Pollen grains were examined from the following specimens:

Vernonia adenocephala S. Moore, Zambia: *Mutimushi 3373* (K) **V. amoena** S. Moore, Tanzania: *Polhill and Paulo 2244* (K). **V. amplexicaulis** Baker, Ethiopia: *Burger 908* (K). **V. aschersonii** Sch.-Bip., Somalia: *Aule 65* (K). **V. atriplicifolia** Spach, Muscat & Oman: *Fiennes B 11* (K). **V. attenuata** DC., Thailand: *Hansen and Smithinard 12722* (K). **V. bainesii** Oliver & Hiern, Rhodesia: *Hanofan 3046* (K). **V. bracteata** Wall., China: *Henry 12498* (K). **V. buchanani** Baker, Zambia: *Fanshawe 287* (K). **V. camporum** A. Cheval., Ghana: *Morton 25136* (K). **V. chinensis** (Lam.) Less., Philippines: *Williams 352* (K). **V. chloropappa** Baker, Malawi: *Pawek 11494* (GA). **V. cinerea** Less., Ghana: *USDA PI 318818* (GA). **V. cistifolia** O. Hoffm., Republic of the Congo: *Ghesquiere 4267* (K). **V. congolensis** DeWild. & Muschler, Burundi: *Lewalle 5406* (K). **V. cryptocephala** Baker, Somalia: *Newbould 786* (K). **V. curtisii** Craib & Hutchins., Malaysia: *Corner 37834* (K). **V. dalzelliana** J. R. Drumm & Hutchins., India: *Browne 6249* (K). **V. daphnifolia** O. Hoffm., Republic of the Congo: *Robyns 4385* (K). **V. divergens** Edgew., India: *Saldanha 12223* (US). **V. elmerii** Merr., Philippines: *Merrill 793* (K). **V. erigeroides** DC., Timor Islands: *Kew number 1247175-252* (K). **V. fysoni** Calder, India: *Bourne 1831* (K). **V. hindei** S. Moore, Kenya: *Bally and Smith 14755* (K). **V. hoffmanniana** Hutchins. & Dalziel, Tanzania: *Milne-Redhead and Taylor 9828* (K). **V. hookeriana** Arn., Ceylon: *Grierson 1015* (US). **V. indica** Clarke, India: *Saldanha 15785* (K). **V. jugalis** Oliver & Hiern, Ethiopia: *Burger 3175* (K). **V. junghuhniana** Koster, India: *Backer 20237* (K). **V. kandtii** Muschler, Tanzania: *Tanner 5565* (K). **V. kenteocephala** Baker, Madagascar: *Perrier 12146* (K). **V. kerrii** Craib., Thailand: *Srensen, Larsen & Hansen 1602* (K). **V. kingii** Clarke, Thailand: *Hansen, Seidenfaden, & Smitinand 10862* (K). **V. kivuensis** Humbert & Staner, Burundi: *Lewalle 124* (K). **V. lanceolata** Mattf., New Guinea: *Brass 23756* (K). **V. loloana** Dunn, China: *Henry 12375* (K). **V. mecistophylla** Baker, Madagascar: *Perrier 3127* (K). **V. moluecensis** (Bl.) Miq., Timor Islands: *Tsm 8780* (K). **V. nestor** S. Moore, Malawi: *Pawek 11739* (GA). **V. nyassae** Oliver, Tanzania: *Richards 7874* (K). **V. obionifolia** O. Hoffm., South West Africa: *Giess 3449* (K). **V. ornata** W. A. Talbot, India: *Ambo 7044* (K). **V. pandurata** Hort. Vindob. ex Link, Republic of the Congo: *Devred 149* (K). **V. patula** (Ait.) Merr., Hong Kong: *Taam 1830* (US). **V. pectiniformis** Wight, India: *Rodin 8133* (K). **V. peninsularis** Clarke, India: *Wight 1529* (K). **V. perrottetii** Sch.-Bip. ex Walp., Cameroun: *Hepper 3991* (K). **V. philipsoniana** Lawalree, Tanzania: *Harwood 34* (K). **V. plumbaginifolia** Fenzl, Nigeria: *Meikle 1343* (K). **V. polysphaera** Baker, Malawi: *Pawek 5256* (K). **V. revoluta** Hein., India: *Royle 233* (K). **V. rogersii** S. Moore, Mozambique: *Faulkner 298* (K). **V. rosburghii** Less., India: *Royle sn.* (K). **V. saligna** DC., India: *Wenger 304* (K). **V. scariosa** Arn., Ceylon: *Grierson 1060* (US). **V. sculptifolia** Hiern, Zambia: *Lanarl 124* (K). **V. setigera** Arn., Ceylon: *Moldenke 28289* (US). **V. smaragdopappa** S. Moore, Congo: *Lisowski 361* (K). **V. somalensis** Franch., Somalia: *Bally B 10999* (K). **V. squarrosa** Less., Thailand: *Sahol 662* (US). **V. steetziana** Oliver & Hiern, Zambia: *Wilberforce 176* (K). **V. sutepensis** Kerr, Thailand: *Larsen 8794* (K). **V. teres** Clarke, Nepal: *Banerjee 3039* (US). **V. uncinata** Oliver & Hiern, Somalia: *Glover and Gilliland 412* (K).

Oliver & Hiern, Zambia: *Wilberforce 176* (K). **V. sutepensis** Kerr, Thailand: *Larsen 8794* (K). **V. teres** Clarke, Nepal: *Banerjee 3039* (US). **V. uncinata** Oliver & Hiern, Somalia: *Glover and Gilliland 412* (K).

Subsection **Lepidella** (Oliver & Hiern) S. B. Jones. *stat. nov.*

Section *Lepidella* Oliver & Hiern, Fl. Trop. Afr. 3: 267. 1877.

TYPE SPECIES: *Vernonia petersii* Oliver & Hiern.

Annual or perennial herbs, 1 to 9 cm in height; pappus biseriate, inner of bristles, outer of relatively large scales; achenes 5-angled or ribbed, papillose between the ribs.

Geographical distribution: South-central Africa.

Chromosome number: $n = 10$ (2 species examined) and $n = 9$ (1 species examined).

Comments: The outer pappus and 5-angled, papillose achenes serve as distinctive features of this subsection.

Pollen type: E. Pollen grains were examined from the following specimens:

Vernonia aemulans Vatke, Malawi: *Pawek 12735* (GA). **V. ambigua** Kotschy & Peyr., Cameroun: *Hepper 3938* (K). **V. centauroides** Klatt, Republic of South Africa: *Garcia 11927* (K). **V. fontinalis** S. Moore, Buruni Territory: *Lewalle 5359* (K). **V. ianthina** Muschler, Republic of the Congo: *Witte 582* (K). **V. jelfiae** S. Moore, Zambia: *Sanane 822* (K). **V. karongensis** Baker, Tanzania: *Thulin and Mhoro 857* (K). **V. petersii** Oliver & Hiern, Zambia: *Sanane 1265* (GA). **V. ugandensis** S. Moore, Uganda: *Maitland s.n.* (K). **V. viatorum** S. Moore, Zambia: *Robinson 3775* (K). **V. violacea** Oliver & Hiern, Tanzania: *Richards 8448* (K). **V. violaceo-papposa** DeWild., Zambia: *Richards 4388* (K).

Subsection **Oocephalae** S. B. Jones, *subsect. nov.*

Herbae perennes, rhizomate accrescenti; folia linearia vel linearia-oblonga; inflorescentiae corymbosae-paniculatae; involucra urceolata, phyllariis tomentosis; pollinis grana typus E. TYPE SPECIES: *Vernonia oocephala* Baker.

Perennial herbs from an enlarged rootstock, 0.7 1.2 m tall; leaves linear, or linear-oblong; inflorescences corymbose-paniculate; involucres urceolate, phyllaries tightly appressed, densely tomentose to only slightly tomentose; corollas creamy to reddish-purple; inner pappus of slightly plumose bristles, outer pappus of scale-like bristles to small scales.

Geographical distribution: South-central Africa.

Chromosome number: none reported.

Comments: A distinctive group. The species appear to need revision.

Pollen type: E. Pollen grains were examined from the following specimens:

Vernonia luteo-albida DeWild., Zambia: *Hutchinson and Gillett 3611* (K). **V. oocephala** Baker, Nigeria: *Jackson 309* (K). **V. stachelinoides** Mart. ex Baker, Republic of South Africa: *Codd 2874* (K). **V. stenocephala** Oliver, Zambia: *Richards 21417* (K).

Subsection **Glutinosae** S. B. Jones, *subsect. nov.*

Frutices; folia palmatim nervata; inflorescentiae reductae; corollae luteae, lobis pubescentibus. TYPE SPECIES; *Vernonia glutinosa* DC.

Shrubs; leaves palmately veined with 3–5 main veins, elliptic-lanceolate to orbicular, tomentose to glandular beneath; inflorescences reduced and compact; involucres broadly campanulate, phyllaries densely to lightly tomentose; corollas yellow, lobes pubescent; pappus straw-colored, of uni- or biseriate bristles; achenes pubescent.

Geographical distribution: Madagascar.

Chromosome number: none reported.

Comments: A distinctive and well marked group.

Pollen type: E. Pollen grains were examined from the following specimens:

Vernonia glutinosa DC., Madagascar: *Humbert 12255* (K). **V. ochroleuca** Baker, Madagascar: *Haine 13* (K). **V. poissonii** Humbert, Madagascar: *Mabberley 882* (K). **V. trinervis** Drake, Madagascar: *Schlieben 8174* (K).

Subsection **Bechium** (DC.) S. B. Jones, *stat. nov.*

Bechium DC., Prodr. **5**: 70. 1836 TYPE SPECIES: *B. capiforme* DC.

Herbaceous annual or perennial; stems with reddish, capitate trichomes; inflorescences corymbose-paniculate or reduced; branches with capitate trichomes; phyllaries in 2–3 series, with capitate trichomes.

Geographical distribution: Madagascar.

Chromosome number: none reported.

Comments: This is the only group of Vernonias with stalked, capitate trichomes. It is tempting to treat this group at the generic level; however, "one character taxonomy" would not serve its best interest.

Pollen type: E. Pollen grains were examined from the following specimens:

Vernonia bojeri Less., Madagascar: *Perrier 3255* (K). **V. nudicaulis** Less., Madagascar: *Hildebrandt 3843* (K). **V. praetensis** Klatt, Madagascar: *Mabberley 894* (K). **V. rhodolepis** Baker, Madagascar: *Hildebrandt 3551* (K).

Section **Azureae** S. B. Jones, *sect. nov.*

Herbae perennes, accrescentes e caudicibus crassis lignosis; corollae azureae; pollinis grana typus F. Type species: *Vernonia glabra* Vatke.

Perennial herbs, from stout woody root-stocks, 2 dm to 2 m tall; leaves variable but generally linear-lanceolate to oblanceolate; inflorescences corymbose-paniculate to solitary and terminal; heads relatively large; phyllaries linear-lanceolate, loosely imbricated in several series, tips long acuminate; corollas blue; pappus bristles variable, bi-seriate, sometimes slightly plumose.

Geographical distribution: South-central Africa.

Chromosome number: $n = 10, 20, 30$ (3 species examined) 1 of these species has cytotypes of $n = 10, 20$, or 30).

Comments: A group of perennial herbs characterized by their enlarged woody root-stocks, blue flowers, and unique pollen grain type.

Pollen type: F.

Pollen grains were examined from the following specimens:

Vernonia djalonensis A. Cheval., Guinea: *Jacques-Felix 7065* (K). **V. gerberaeformis** Oliver & Hiern, Tanzania: *Richards 26235* (K). **V. gardneri** Thw., Ceylon: *Alston 1667* (K). **V. glabra** Vatke, Rhodesia: *Pope 1359* (GA). **V. hockii** DeWild. & Muschler, Zambia: *Brenan and Greenway 7921* (K). **V. infundibularis** Oliver & Hiern, Uganda: *Hoaws 736* (K). **V. melleri** Oliver & Hiern, Zambia: *Sanane 1147* (GA). **V. Migeodi** S. Moore, Cameroun: *Letouzey 6648* (K). **V. obconica** Oliver & Hiern, Zambia: *Mutimushi JMM 3763* (K). **V. parishii** Hook. f., Thailand: *Hosseus 458* (K). **V. pogosperma** Klatt, Uganda: *Purseglove P 2094* (K). **V. rosenii** R. E. Fries, Zambia: *Kornas 86* (K). **V. subplumosa** O. Hoffm., Zambia: *Mutimushi 3315* (K). **V. superba** O. Hoffm., Zambia: *Sanane 406* (GA). **V. usafuensis** O. Hoffm., Tanzania: *Brenan and Greenway 8206* (K).

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TAXONOMIC REVISION OF PIPTOCOMA CASS. (COMPOSITAE: VERNONIEAE)

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Piptocoma Cass. (Compositae: Vernonieae) is a small genus of shrubs distributed in the West Indies from Hispaniola eastward to the island of Virgin Gorda (Figure 1). The genus has traditionally been maintained as separate from *Vernonia* Schreb. on the basis of pappus and anther characters, and from *Pollalesta* H.B.K. on the basis of achene characters (Bentham & Hooker, 1873; Engler & Prantl, 1894). *Piptocoma* is usually considered to be closer to *Pollalesta* than to *Vernonia* (Bentham & Hooker, 1873; Engler & Prantl, 1894).

The genus was first described by Cassini in 1817; however, the type species, *Piptocoma rufescens,* was not published until 1818. In 1825, Sprengel applied the name *Eupatorium domingense* to this same species. Lessing (1829) named a new species from Brazil, *P. lychnophoroides,* which is now known as *Lychnophora trichocarpha* Spreng. In 1863, Shultz-Bipontinus transfered *P. rufescens* Cass. to the genus *Oliganthes* Cass. with the resultant change of name to *O. rufescens* (Cass.) Sch.-Bip. New World species formerly assigned to the genus *Oliganthes* are now considered to belong to the genus *Pollalesta* (Aristeguieta, 1963; Stutts, In press).

Gleason (1919) described a second taxon in the genus, *Piptocoma rufescens* var. *latifolia.* Urban (1931) described a new species, *P. antillana.* Liogier (1968, 1971) named three new species, these being *P. samanensis, P. dentata,* and *P. ekmanii.* The name *P. subscandens* Urban & Ekman was found on several herbarium sheets referable to *P. samanensis* Liogier but no literature citation was found, therefore it is considered to be a nomen nudum.

This revision of *Piptocoma* was done in connection with a recent revision of *Pollalesta* H.B.K. (Stutts, In press). The treatment presented here is based primarily on morphological characters supplemented by palynological and chemosystematic data. No living material was available for cytological analysis.

Herbarium specimens were borrowed from the following herbaria: B, BM, F, G, GH, K, M, MO, NY, S, UC, and US. Analysis of numerous morphological characters showed that certain features are diagnostic of the various taxa. These characters are inflorescence type, achene length/width ratio, number of florets per head, and various leaf characters.

Pollen samples were removed from selected specimens of each taxon and acetolized by the procedures of Erdtman (1966). The grains were examined utilizing both light microscopy and scanning electron microscopy. All taxa were found to have essentially identical pollen grains of a subechinolophate, triporate type with prominent spines, being ca. 45–50 μm in diameter, spine tip to spine tip. This type of pollen grain is refered to as Vernonieae type A and is considered by Jones (1979) to be primitive for the tribe.

A survey of leaf flavonoids of those taxa recognized in this treatment was carried out. Procedures used were those of Giannasi (1975). Unfortunately, the flavonoid survey was severely limited due to the fact that no living materials could be obtained and the number of herbarium specimens from which fragments could be removed was quite low. Only one sample each of *P. samanensis* and *P. rufescens* was available for analysis. Seven samples of *P. antillana* were available.

A total of twenty-two compounds were separated as discrete spots on paper chromatograms. Most of these, however, were present only in very low quantities. The combination of lack of materials and low concentrations of most flavonoids resulted in only four of the twenty-two compounds present being tentatively identified. All four were quercetin compounds. Harborne and Williams (1977) had previously reported the occurrence of unspecified flavonols in two taxa of *Piptocoma.*

Piptocoma rufescens and *P. antillana* are very similar in their flavonoid profiles although *P. antillana* exhibits variation in its minor constituents. *Piptocoma samanensis* exhibits a reduced flavonoid profile.

Obviously no broad conclusions can be reached from what little flavonoid data is available at this time. Spectral data, R_f values, color reactions, and tentative identities of the various compounds are recorded in Tables 1, 2 and 3. Composite chromatograms for the various taxa are given in Figure 2.

Based on the results of this study three taxa are recognized within the genus *Piptocoma: P. rufescens, P. antillana,* and *P. samanensis.*

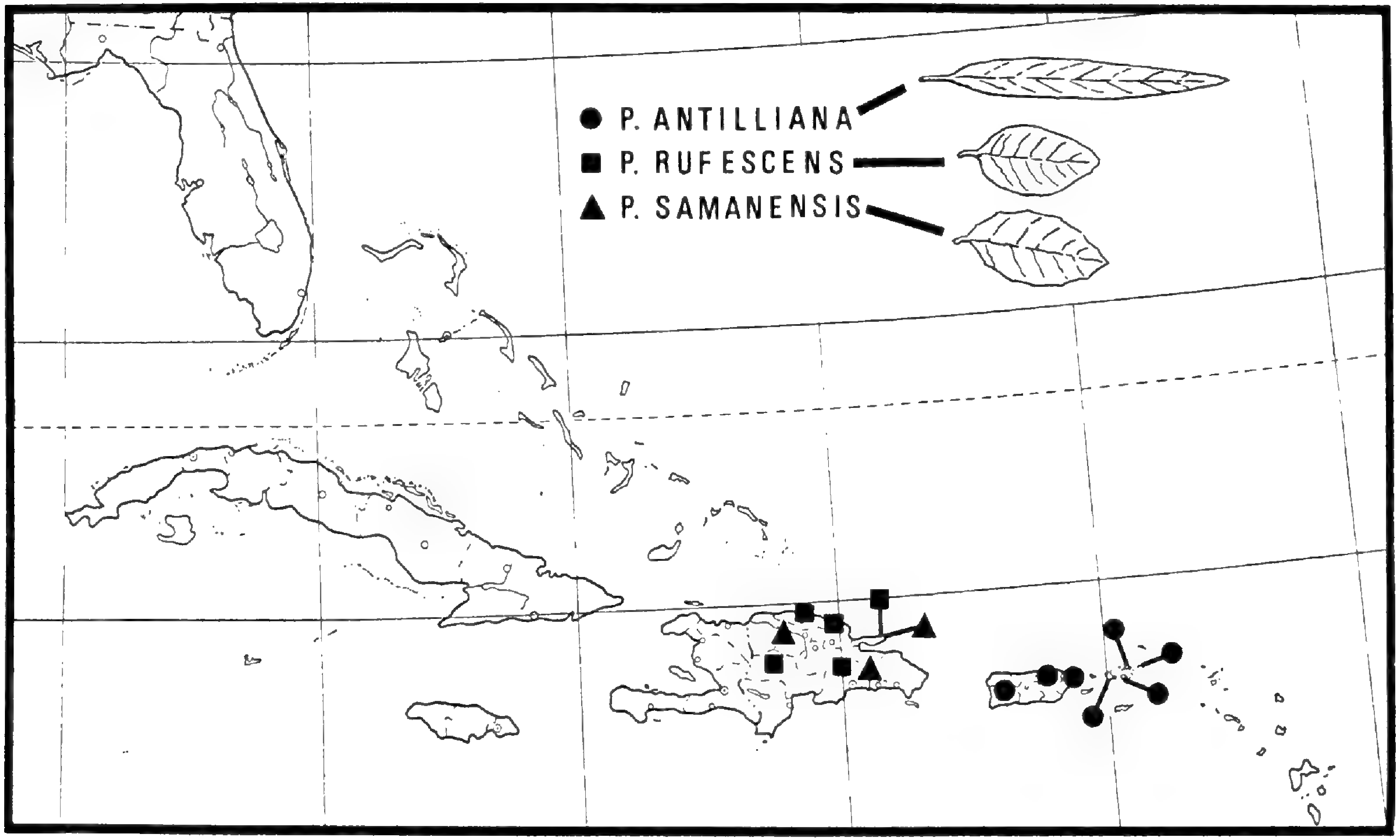

Figure 1. Distribution of *Piptocoma*. Circles = *P. antillana;* squares = *P. rufescens;* triangles = *P. samanensis.*

Table 1. R_f Values, Color Properties, and Tentative Identities of Leaf Flavonoids of Piptocoma

Spot No.	Identity	R_f Values		Color	
		TBA	HOAc	UV	UV+NH_3
1	Quercetin-3-0-methyl ether	.78	.28	P	Y
2	unknown	.82	.27	P	Y
3	unknown	.74	.09	P	Y
3b	unknown	.71	.05	P	Y
4	Quercetin	.57	.04	Y	Y
4a	unknown	.58	.06	Y	Y
5	Quercetin-3-0-glucoside	.55	.53	P	Y
6	Quercetin-3-0-glycoside	.55	.31	P	Y
7	unknown	.26	.20	P	Y
8	unknown	.33	.12	Y	Y
9	unknown	.29	.22	Y	Y
10	unknown	.24	.16	Y	Y
11	unknown	.17	.12	Y	Y
12	unknown	.16	.75	P	Y
13	unknown	.29	.50	P	Y
14	unknown	.39	.06	P	Y
15	unknown	.29	.71	P	Y
16	unknown	.78	.08	Y	Y
17	unknown	.33	.39	P	Y
18	unknown	.39	.34	P	Y
19	unknown	.22	.66	P	Y
20	unknown	.55	.24	P	Y

TAXONOMIC TREATMENT

Piptocoma Cass., Bull. Soc. Philom. Paris Ser. 3. **4:** 10. 1817.

Shrubs, usually diffusely branched, young stems tomentose. Leaves alternate, petiolate; blades oval to lanceolate, rounded to acuminate at the apex, cuneate to cordate at the base, becoming glabous above, stellate-tomentose below, punctate-glandular both above and below, margins entire to subangular and toothed. Inflorescences terminal, corymbose or glomerate, of 6–many heads. Heads with 4–12 florets, pedunculate or sessile; involucres more or less cylindric, 3.5–8.5 mm long, 2–5 mm wide; phyllaries imbricate, in 4–6 series, rounded at the apex; receptacle flat to subconvex, naked. Corollas tubular, 5-lobed, reddish-purple, 5–8 mm long, lobes glandular-dotted; stamens 5, anthers basally sagittate; style branches slender. Pappus biseriate, straw-colored; inner series of 10–15 bristles; outer series of ca. 10 distinct to partially united pales 0.5–1.8

Table 2. Spectral Data for Piptocoma Leaf Flavonoids.

Spot No.	MeOH	$+AlCl_3$	$+AlCl_3/HCl$	+NaOMe	+NaOAc	$+NaOAc/H_3BO_3$
1	*352*	*428*	*390*	*408*	*384*	425s
	266s	273	363	*269*	*267*	*370*
	252		295s			*264*
			273s			
			262			
4	*372*	*455*	*427*	DEC.	*394*	460s
	292	320s	362		333	*380*
	255	*272*	295s		274	287
			263			273s
						263
4a	*348*	*432*	403s	N.A.	*385*	435s
	268s	325s	*360*		305s	*360*
	258s	*270*	300			303s
		278s				
5	*360*	*437*	*405*	*414*	*394*	450s
	303s	329	366	320	325	*378*
	257	303s	298s	*273*	*274*	296s
		274	*270*			*261*
6	350s	*438*	*399*	*398*	*382*	*355*
	340	357	335	*275*	*270*	
	298s	305s	298s			
	270s	*274*	*270*			
	255					

DEC. = decomposed; N.A. = not available; s — shoulder or inflection

mm long. Achenes obconic, 5-angled, glabrous, 2–5 mm long, 0.7–1.7 mm wide, length/width ratio (1.7) 2–4 (4.2). TYPE SPECIES; *Piptocoma rufescens* Cass.

KEY TO THE SPECIES OF PIPTOCOMA

a. Inflorescences glomerate; leaf margins subangular and toothed. .... 1. *P. samanensis*

a. Inflorescences corymbose; leaf margins entire .... b.

  b. Length/width ratio of mature achenes (2.8)3–4(4.2); heads with (6)10(12) florets; leaf blades oval to elliptic, length/width ratio (1.2)2.1(3.2); Hispaniola ... 2. *P. rufescens*

  b. Length/width ratio of mature achenes (1.7)2–2.5(2.7), heads with (4)6(7) florets; leaf blades lanceolate to elliptic, length/width ratio (2)3.6(6); Puerto Rico and adjacent Virgin Islands .... 3. *P. antillana*

1. **Piptocoma samanensis** Liogier, Brittonia **20:** 153. 1968. TYPE: DOMINICAN REPUBLIC: Peninsula de Samana, Pan de Azucar, *Ekman 15847* (HOLOTYPE NY!; Isotypes F!, GH!, K!, S!, US!).

Piptocoma dentata Liogier, Mem. New York Bot. Gard. **21:** 153. 1971. TYPE: DOMINICAN REPUBLIC: Puerto Plata, Loma del Puerto, *Liogier 15546* (Holotype NY!; Isotypes GH, IJ, P, US).

Piptocoma subscandens Urban & Ekman, nomen nudum.

Shrub, up to 3 m tall. Petioles ca. 4 mm long; leaf blades elliptic to oval, 2.5–5.5 cm long, 1–3.2 cm wide, length/width ratio 1.5–2, more or less acute at the apex, cuneate to rounded at the base, margins subangular and toothed with 1–2 teeth per cm. Inflorescences glomerate, of 6–18 heads. Heads with (5)10(12) florets, sessile; involucres 6–8 mm long, 2–5 mm wide. Corollas 5–7 mm long. Inner pappus of 10–15 bristles, 3.5–5 mm long; outer pappus 0.5–1.2 mm long. Achenes 3.5–5 mm long, 1.2–1.7 mm wide, length/width ratio (2.5)3–3.5(3.8).

This species is known to occur only on the island of Hispaniola being found most often on exposed sites in rocky, calcareous soil. Flowering and fruiting occur from June to August.

Representative specimens: DOMINICAN REPUBLIC: Peninsula de Samana, Pan de Azucar, *Ekman 14878* (F, GH, K, S). Loma del Puerto, Pedro Garcia, *Liogier 15067* (GH, NY, P, US). Los Haitises, Pilancon, Bayaguana, *Liogier & Liogier 18877* (NY).

2. **Piptocoma rufescens** Cass., Bull. Soc. Philom. Paris Ser. 3. **5:** 58. 1818. TYPE: HISPANIOLA: *Desportes s.n.* (Holotype P).

Eupatorium domingense Spreng., Systema Vegetabilium, Ed. 16(=Ed. 17) 3: 412. 1825. TYPE: HISPANIOLA: *Bertero 731* (Holotype P).

Oliganthes rufescens (Cass.) Sch.-Bip., Pollichia **20–21**: 338–339. 1863.

Piptocoma ekmanii Liogier, Mem. New York Bot. Gard. **21:** 153–154. 1971. TYPE: DOMINICAN REPUBLIC: Puerto Plata, Arroyo Frances, *Ekman 14393* (Holotype NY!; Isotypes B!, F!, G!, GH!, K!, S!).

Shrub, up to 3 m tall. Petioles 3–7 mm long; leaf blades oval to elliptic, 2–10.5 cm long, 1.5–5.6 cm wide, length/width ratio (1.2)2.1(3.2), rounded to acute at the apex, rounded to cordate at the base, margins entire. Inflorescences densely corymbose, of numerous heads. Heads with (6)10(12) florets, pedunculate, involucres 5–8.5 mm long, 2–4 mm wide. Corollas ca. 7.5 mm long. Inner pappus of ca. 10 bristles, 2.7–4.2 mm long; outer pappus 0.7–1.8 mm long. Achenes 2–4.5 mm long, 0.7–1.4 mm wide, length/width ratio (2.8)3–4(4.2).

Table 3. Distribution of Leaf Flavonoids in Piptocoma.

Taxon sample	Compound No. 1	2	3	3b	4	4a	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
P. samanensis:																						
Ekman 14878	X	X	X	X	X	X	X		X					X		X						X
P. rufescens:																						
Ekman 14910	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X						
P. antillana:																						
Robertson 22	X	X			X	X	X	T		X			X	X	X		X					
Britton 273	X	X			X	X	X	X		X			T	T			T					
Fishlock 10	X	X	X		X	X	X		X	X			T	X			T		T	T	T	
Wagner 855	X	X			X	X	X	X		X			T		T		T					
Eggers 397	X	X			X	X	X			X		X	X	X	X						X	
Heller 1177	X	X			X	X	X	X		X		X	X	X	T							
Liogier 9878	X	X			X	X	X	X		X			X	T				X				

T — present in trace amounts only.

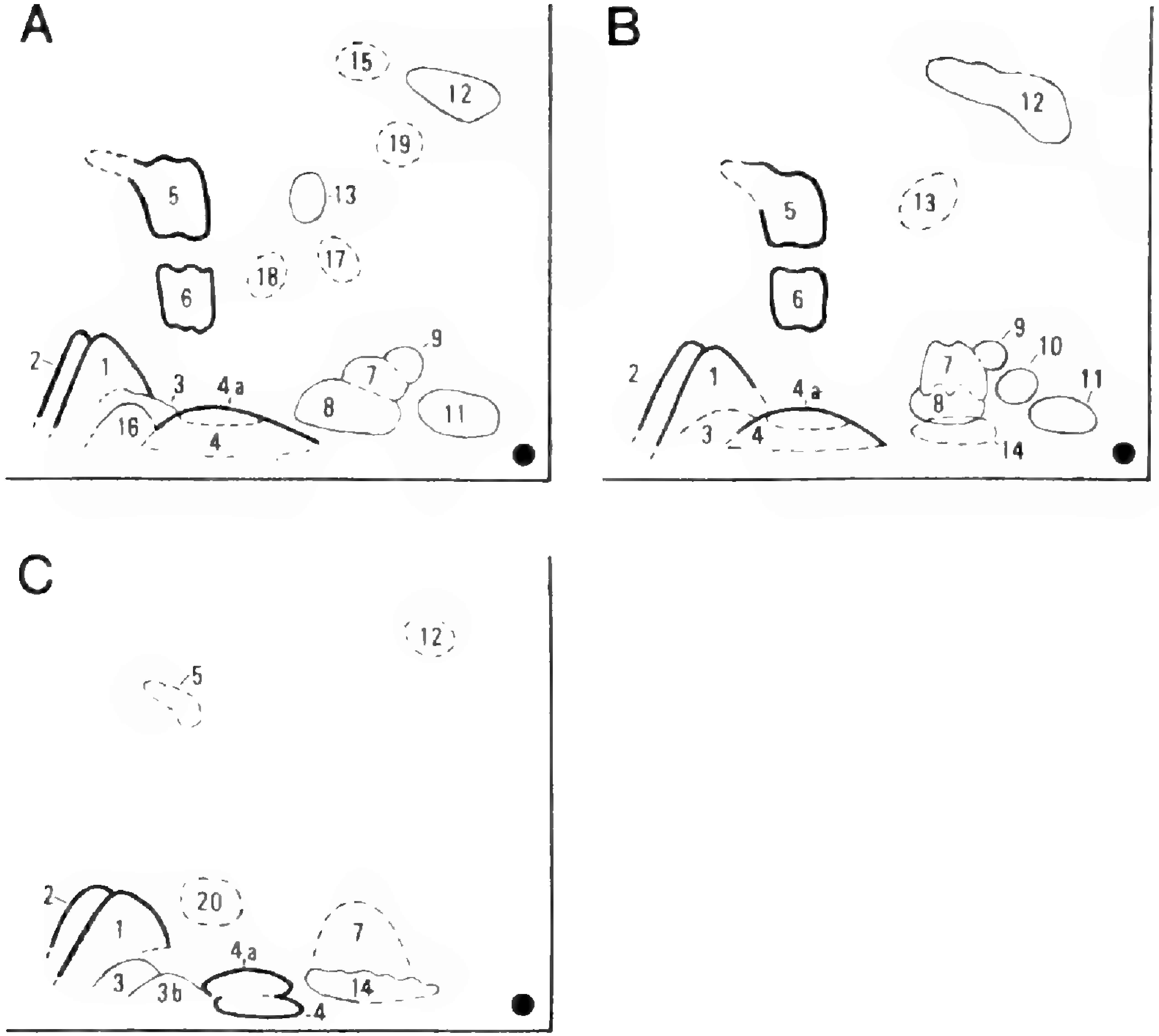

Figure 2. Composite chromatograms of *Piptocoma* leaf flavonoids. A = *P. antillana*; B = *P. rufescens*; C = *P. samanensis*. Heavy lines denote major components. Dashed lines denote trace compounds.

This species is known to occur only on the Island of Hispaniola, being found on serpentine hills. Flowering and fruiting occur from March to December.

Representative specimens: HAITI: Depto. du Nord, Grande Ville, Morne Bois Pin, *Ekman 2895* (F, GH, K, NY, S, US). DOMINICAN REPUBLIC: Peninsula de Samana, Cabo Samana, *Ekman 14910* (B, S, US). Gaspar Hernandez, *Liogier 16522* (F, GH, NY, US). Sierra Prieta, *Liogier 17396* (NY, US).

3. **Piptocoma antillana** Urban, Ark. Bot., Band 23A, **11:** 50–51. 1931. TYPE: ST. THOMAS: Water Island, *Eggers & Toepffer 475* (Holotype B; Isotypes G!, GH!, M!).

Piptocoma rufescens Cass. var. *latifolia* Gl., Bull. Torrey Bot. Club **46**: 251. 1919. TYPE: ST. THOMAS: Water Island, *Britton, Britton, & Shafer 104* (Holotype NY!; Isotype US!).

Shrub, up to 2.5 m tall. petioles 3–8 mm long; leaf blades lanceolate to elliptic, 2.5–9 cm long, 0.9–3 cm wide, length/width ratio (2)3.6(6), acuminate to rounded at the apex, cuneate at the base, margins entire. Inflorescence corymbose, of numerous heads. Heads with (4)6(7) florets, pedunculate; involucres 3.5–6 mm long, 2–4 mm wide. Corollas ca. 8 mm long. Inner pappus of ca. 10 bristles, 2.7–6 mm long; outer pappus 0.5–1.2 mm long. Achenes 2.4–3.5 mm long, 0.9–1.2 mm wide, length/width ratio (1.7) 2–2.5(2.7).

This species occurs on Puerto Rico and adjacent Virgin Islands being found in coastal thickets and similar areas. Flowering and fruiting occur from March to December.

Representative specimens: PUERTO RICO: Cabosa de San Juan, *Sintenis 1899* (BM, F, K, M, NY, S, US). Fajardo, Las Croabas lighthouse, *Wagner 1613* (BM, GH). ST. THOMAS: Water Island, area of the sound, *D'Arcy 376* (BM). ST. JOHN: Coral Bay, *Raunkiaer 1916* (MO, S, US). TORTOLA: Salt Island, *Britton & Shafer 845* (F, K, NY, US). VIRGIN GORDA: North Sound, *Fishlock 10* (NY, US).

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THE GENUS ONCIDIUM SW. (ORCHIDACEAE) IN THE BAHAMA ARCHIPELAGO.

Ruben P. Sauleda and Ralph M. Adams

The neotropical genus *Oncidium* is represented in the flora of the Bahama archipelago by two sections, the section Oncidium represented by *Oncidium bahamense* Nash ex Britton and Millspaugh, *Oncidium lucayanum* Nash ex Britton and Millspaugh, and *Oncidium sasseri* Moir and the section Oblongata Kzl. represented by *Oncidium floridanum* Ames. Two of these species, the equitants, *O. lucayanum* and *O. sasseri* are endemic to the Bahama Islands. The following data are results of our ongoing study of the taxonomy and ecology of the Orchidaceae of the Bahama archipelago and comprise the first modern comprehensive treatment of the genus in the Bahamas since Britton and Millspaugh (1920).

TAXONOMIC TREATMENT

Oncidium Sw., in Vet Akad. Handl. Stockholm **21:** 239, Sept. 1800.

Epiphytic, epilithic, or terrestrially occurring rhizomatous plants. Stem pseudobulbous or leafy, enclosed by distichous or leaf bearing sheaths and with one to three terminal leaves. Leaves usually conduplicate basally, equitant, flat, or terete, thinly coriaceous to fleshily coriaceous or rigid. Inflorescence lateral, racemose or paniculate, solitary to many flowered. Flowers showy or inconspicuous, opening simultaneously or serially. Sepals subequal, spreading or reflexed, free or lateral sepals connate. Petals similar to sepals or larger. Lip entire or three- or multi-lobed, adnate to the base of the column, crest at base of disc consisting of a variously tuberculate callus. Column short, thick, usually with auricles or wings on either side of the stigma and a fleshy plate below the stigma. Anther terminal, operculate, incumbent. Pollinia 2, sulcate on distinct linear stipe with a small gland.

Lectotype: *Epidendrum variegatum* Sw. (Garay, Taxon **19:** 44, 1970).

KEY TO THE SPECIES IN THE BAHAMA ISLANDS

1. Pseudobulbs inconspicuous, poorly developed; leaves triquetros, margin serrulate, crenulate or crenate; lateral sepals connate

nearly to apex 2
2. Rhizome stoloniferous 3
3. Leaves yellow-green to olive-green with minute reddish-purple spots .... *O. Sasseri*
3. Leaves olive-green to bronzy-purple without spots .... *O. bahamense*
2. Rhizome short, plants caespitose .... *O. lucayanum*
1. Pseudobulbs large, compressed; leaves conduplicate to flat, margin entire; lateral sepals free .... *O. floridanum*

1. **Oncidium bahamense** Nash ex Britton & Millspaugh, Bahama Fl. **97.** 1920. (Fig. 1).

Oncidium variegatum Sw. var *bahamense* (Nash) Withner, Orchidata 6(6). 1966. TYPE: Grand Bahama, Bahama Islands, *Brace 3689*. (Holotype: NY. Isotypes: F, US)[1].

Oncidium sylvestre auct. non Lindl.: Northrop, Mem. Torrey Bot. Club. **12:** 30, 1902; Cogn. in Urban, Symb. Ant. 6:655, 1910.

Plant epilithic or epiphytic, rhizomatous, to 65 cm tall; roots numerous, slender, canescent to velamentous; primary stem or rhizome stoloniferous, repent, decumbent, wiry, remotely several sheathed, scarious, ovate-triangular, acute, to 11 mm long, 4 mm wide; secondary stem modified into remotely produced pseudobulbs, to 12 cm apart, to 9 mm long, 4 mm wide, flattened, completely enclosed by 5–10 distichous leaves; leaves coriaceous, distichous, imbricated, produced at intervals along pseudobulb, olive-green to bronzy-purple, conduplicate, recurved, lanceolate, acute, to 14 cm long, 8 mm wide, margin cartilaginous and serrulate; inflorescence lateral, to 64 cm tall, peduncle slender, erect, distantly several sheathed, racemose or rarely paniculate above, 4–25 flowers; floral bracts minute, lanceolate, acute, to 2 mm long, 1 mm wide; ovary pedicellate, slender, to 18 mm long; sepals white to greenish-white, basal 2/3 with reddish-brown spots; dorsal sepal spatulate, basally clawed to attenuate, concave, emarginate, acute or apiculate, to 4 mm long, 2 mm wide; lateral sepals oblanceolate, concave, acute, connate nearly to apex, to 5 mm long, 3 mm wide; petals white to greenish-white, basal 1/2 with reddish-brown spots or bars, spatulate to ligulate, basally clawed to attenuate, concave, acute, margin undulate, to 6 mm long, 3 mm wide; labellum three-lobed, white,

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[1] All specimens cited have been examined unless otherwise noted.

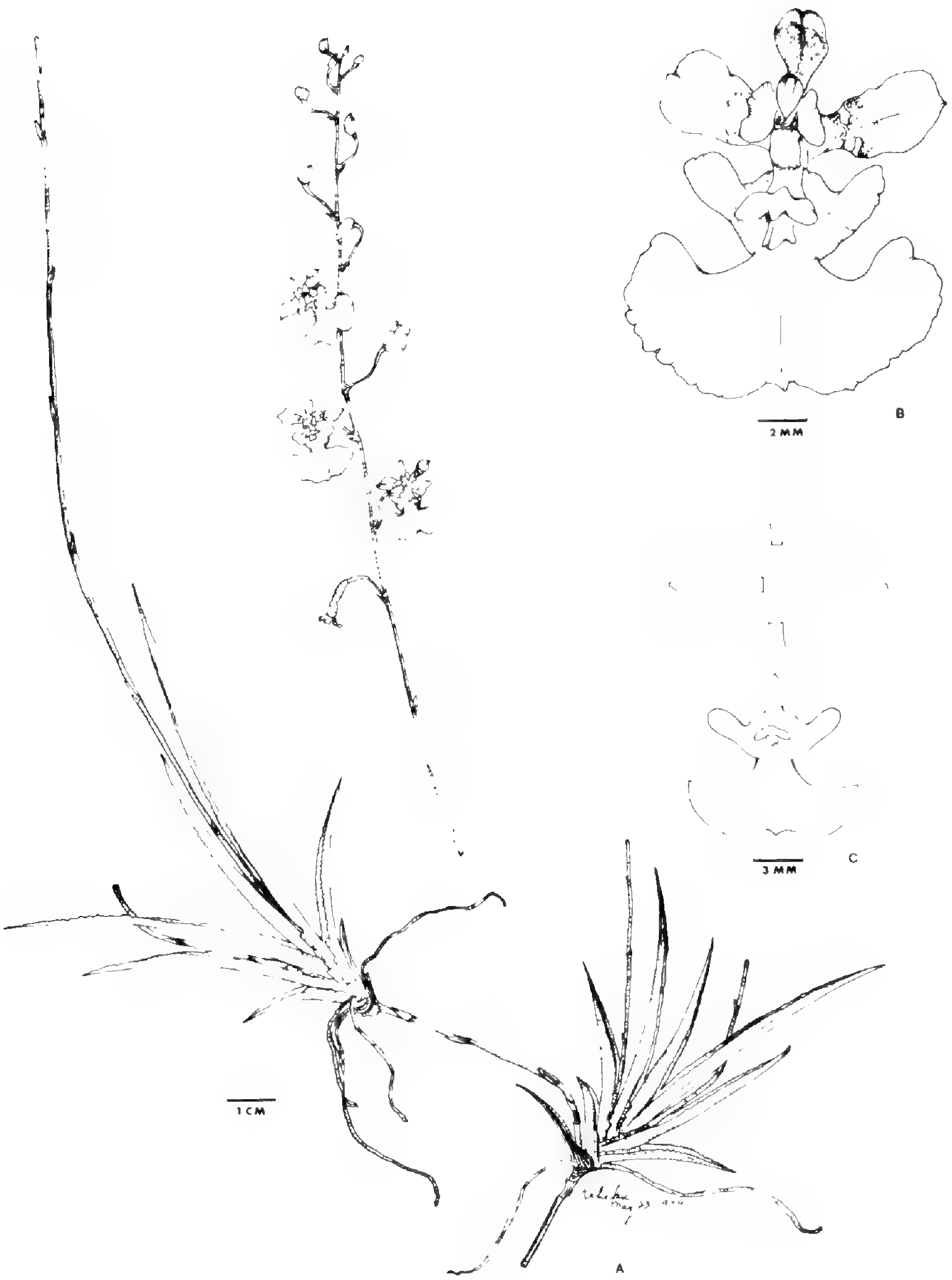

Figure 1. *Oncidium bahamense* Nash ex Britton & Millspaugh. A. Flowering plant. B. Flower, frontal view. C. Sepals, petals and labellum, frontal view.

occasionally with pink tint, to 12 mm long, 15 mm wide, lateral lobes basal, linear-elliptic to orbicular, obtuse to broadly rounded, reflexed, margin irregularly crenulate, midlobe separated from lateral lobes by a short isthmus with brown spots, midlobe reniform, cordate or broadly obovate, deeply emarginate, usually with an apicule in the sinus, margin irregularly crenulate, callosity on isthmus variable, yellow-orange with reddish-brown spots, usually provided with two anterior and three larger posterior tubercles; column stout, erect, to 3 mm long, 2 mm wide, with expanded lateral wings projecting from apex, white or pink, ovate, base obtuse, apex acute, irregularly lobed, to 1.1 mm long, 0.6 mm wide, anther white, apex purplish-brown; capsule pendent, to 15 mm long, 8 mm wide.

DISTRIBUTION IN THE BAHAMA ISLANDS: **Great Abaco,** June 1886, *Herrick s.n.* (NY); Snake Cay road, low coppice, 12 April 1979, *Sauleda & Correll 2316* (FAU). **Andros,** island coppice, 9 mi. N.W. of Fresh Creek, 16 April 1977, *Sauleda 1827* (SEL), *1828* (W), *1830* (US), *1832* (P), *1834* (NY), *1837* (S), *1839* (MO), *1841* (LE), *1842* (L), *1843* (K), *1846* (FAU), *1847* (F), *1848* (BR), *1849* (BM), *1850* (B), *1851* (AMES); London Creek, 5 May 1890, *Northrop & Northrop 543* (NY); Conch Sound, 22 May 1890, *Northrop & Northrop 543, 587* (NY); Mastic Point, May 1890, *Northrop & Northrop 587* (NY). **Grand Bahama**, Eight Mile Rocks, 16 April–8 May 1905, *Brace 3689* (F, NY, US).

ADDITIONAL DISTRIBUTION: Florida, (*Sauleda s.n.*, FAU).

REPRODUCTIVE PERIOD: March–August

ECOLOGY: On the island of Andros, *Oncidium bahamense* is found predominantly growing terrestrially in pine needle litter in island and high coppices.[2] Occasionally it is found growing epiphytically. On Great Abaco *O. bahamense* occurs sympatrically with *O. lucayanum* and *O. sasseri,* all growing epiphytically in low coppices. Occasionally *O. bahamense* is found growing terrestrially. Host plants include *Pithecolobium guadalupense* Chapm., *Coccoloba diversifolia* Jacq., *Reynosia septentrionalis* Urban, and *Psidium longipes* (Berg) McVaugh.

Oncidium bahamense is entirely restricted to the Bahama Islands except for a small population growing in northern Palm Beach County and Martin County on the Florida peninsula. This population is restricted to a xeric acid Pineland habitat, within which was located an old cemetery where the species may have been introduced by early travelers from the Bahamas.

ADDITIONAL COMMENTS: In the protologue, Britton and Millspaugh

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[2] For a detailed treatment of Bahamian habitats, see Sauleda and Adams, 1979.

described *Oncidium bahamense* as having, "a raceme of yellow flowers". Their confusion was probably generated by not having seen living material, having examined only herbarium specimens.

2. **Oncidium floridanum** Ames, Sched. Orch. **7:** 13. 1924. (Fig. 2). HOLOTYPE: Dade Co., Florida, *Eaton 957* (AMES).

Oncidium sphacelatum auct. non Lindl.: Ames, Contrib. Orch. Fl. So. Fla. **22,** 1904; Britton & Millspaugh, Bahama Fl. 97, 1920; Small, Fl. Miami **59**, 1913.

Plant epilithic, rarely epiphytic, to 145 cm tall; roots numerous, thick, canescent to velamentous; primary stem or rhizome short, stout, creeping or ascending, enclosed by scarious imbricating sheaths; secondary stem modified into pseudobulbs, clustered, oblong to ovate, compressed, ancipitous, to 14 cm long, 5 cm wide, partially enveloped by 3–6 distichous leaf-bearing sheaths, apically 1–3 leaved; leaves fleshy to coriaceous, narrowly linear-oblong to ligulate, subobtuse to acute, to 105 cm long, 2.5 cm wide; inflorescence lateral, to 142 cm tall, peduncle slender, suberect, distantly several sheathed, racemose to paniculate above, 16–85 flowers; floral bracts ovate to lanceolate, acute to acuminate, to 8 mm long, 2 mm wide; ovary pedicellate, slender, to 2.6 cm long; sepals yellow with brown spots, lanceolate to elliptic, acute, basally clawed to attenuate, concave, margin undulate, to 18 mm long, 4 mm wide; petals yellow with brown spots, ovate to elliptic, acute, basally clawed, margin undulate, to 14 mm long, 5 mm wide; labellum three-lobed, yellow, to 14 mm long, 9 mm wide, lateral lobes basal, orbicular, obtuse, margin reflexed, entire or crenulate, midlobe separated from lateral lobes by a short isthmus with brown spots, midlobe cordate to reniform, shallowly emarginate with apicule in sinus, margin entire or crenulate, callosity on isthmus variable, yellow-orange with reddish-brown spots, provided with 2–4 anterior and 2–4 posterior tubercles connected by a central ridge; column short, erect, to 5 mm long, 2 mm wide, with expanding lateral wings projecting from apex, yellow, ligulate, margin crenulate, to 2 mm long, 1 mm wide, anther yellow; capsule pendent, to 3 cm long.

DISTRIBUTION IN THE BAHAMA ISLANDS: **Great Abaco,** Marsh Harbor, 16 Dec. 1904, *Brace 1722* (NY); Eight Mile Bay, 26 Dec. 1904, *Brace 1850* (F), *1883* (F, NY); Abaco Heights, low coppice, 11 April 1979, *Sauleda & Correll 2259* (FAU), *2271* (FAU); Snake Cay road, low coppice, 12 April 1979, *Sauleda & Correll 2315* (FAU). **Bimini Group,** South Bimini, near airport, 21 April 1979, *Sauleda 2328* (FAU); North Bimini,

Figure 2. *Oncidium floridanum* Ames. A. Plant and basal portion of inflorescence. B. Inflorescence, distal portion. C. FLower, frontal view. D. Sepals, petals and labellum, frontal view.

in coppice north of town, 21 April 1979, *Sauleda 2342* (FAU). **Berry Islands,** Great Harbor Cay, low coppice, end of Stede Bonnet road, 12 May 1979, *Sauleda & Correll 2467* (USF); Anderson Cay, north end, 12 May 1979, *Sauleda & Correll 2490* (FAU). **Andros,** high coppice, 6 mi. N.W. of Love Hill settlement, 10 May 1975, *Sauleda 1035* (AMES); island coppice, 9 mi. N.W. of Fresh Creek, 6 Feb. 1977, *Sauleda 1541* (FTG); rock scrub, 8 mi. south of Fresh Creek, 15 Oct. 1976, *Sauleda 1145* (FAU); mangrove swamp around lake, 1 mi. N.W. of Love Hill settlement, 16 April 1977, *Sauleda 1868* (FAU); low coppice, 2 mi. north of Love Hill settlement, 16 April 1977, *Sauleda 1879* (F); Mangrove Cay, near Moxy Town, 22 July 1978, *Sauleda & Correll 2145* (B); Mangrove Cay, near water tower, 23 July 1978, *Sauleda & Correll 2155* (MO), *2156* (P); Mangrove Cay, 18 Aug.–10 Sept. 1906, *Brace 4975* (F, NY); road to Conch Sound, 12 March 1907, *Brace 6814* (F, NY); Mastic Point, 19–28 March 1907, *Brace 6991* (F); Conch Sound, 3 March 1890, *Northrop & Northrop 405* (NY); Mars Bay, 5 July 1890, *Northrop & Northrop 602* (NY); Mastic Point, 1 June 1890, *Northrop & Northrop* 602 (NY); Lisbon Creek, Mangrove Cay, 16–19 Jan. 1910, *Small & Carter 8493* (F, NY, US); Deep Creek, 20–22 Jan. 1910, *Small & Carter 8632* (F, NY); coppice near Staniard Creek, 1–3 Feb. 1910, *Small & Carter 8885* (F, NY, US), *8871* (NY). **Crooked Island,** Stopper Hill coppice, 9–23 Jan. 1906, *Brace 4827* (F, NY). **Grand Bahama,** Eight Mile Rocks, 16 April–8 May 1905, *Brace 3677* (F, NY); pinelands Eight Mile Rocks, 5–13 Feb. 1905, *Britton & Millspaugh 2453* (F, NY). **New Providence,** on the ground, Maiden Head Coppice, 24 Aug. 1904, *Britton & Brace 243* (F, NY, US); pineland and scrub along Harold Road, north of Harold Pond, 3 Aug. 1960, *Webster & Samuel 10839* (US). **San Salvador,** hillside coppice, 12–13 March 1907, *Britton & Millspaugh 6118* (F, NY).

GENERAL DISTRIBUTION. **Florida,** *Eaton 957,* AMES; **Cuba,** *Acuna 4401,* NY.

REPRODUCTIVE PERIOD: Flowers from April–October.

ECOLOGY. This species is found growing terrestrially in soil pockets in Pleistocene limestone. The habitats in which it occurs are high coppice, low coppice, island coppice, rock scrub, mangrove swamp, and pine forest.

ADDITIONAL COMMENTS: Small and Carter first discovered *Oncidium floridanum* in southern Florida in 1903. This species was confused with *O. sphacelatum* until 1924 when Ames described it as a distinct species. The species was considered endemic to southern Florida until Luer (1972) recognized that the Bahamian population was conspecific with the Florida population.

3. **Oncidium lucayanum** Nash ex Britton & Millspaugh, Bahama Fl. **98.** 1920. (Figs. 3–4). TYPE: Bahama Islands, Andros, Fresh Creek, 10 June 1890, *Northrop & Northrop 647* (HOLOTYPE, NY. ISOTYPE, F).

Oncidium lucayanum Nash ex Britton & Millspaugh var. *aureum* Moir, Fla. Orch. **16**(3): 115, 1973. TYPE: Bahamas, reference made to photograph in Moir & Moir, Var. Onc. **43,** 1970; no herbarium specimen known.

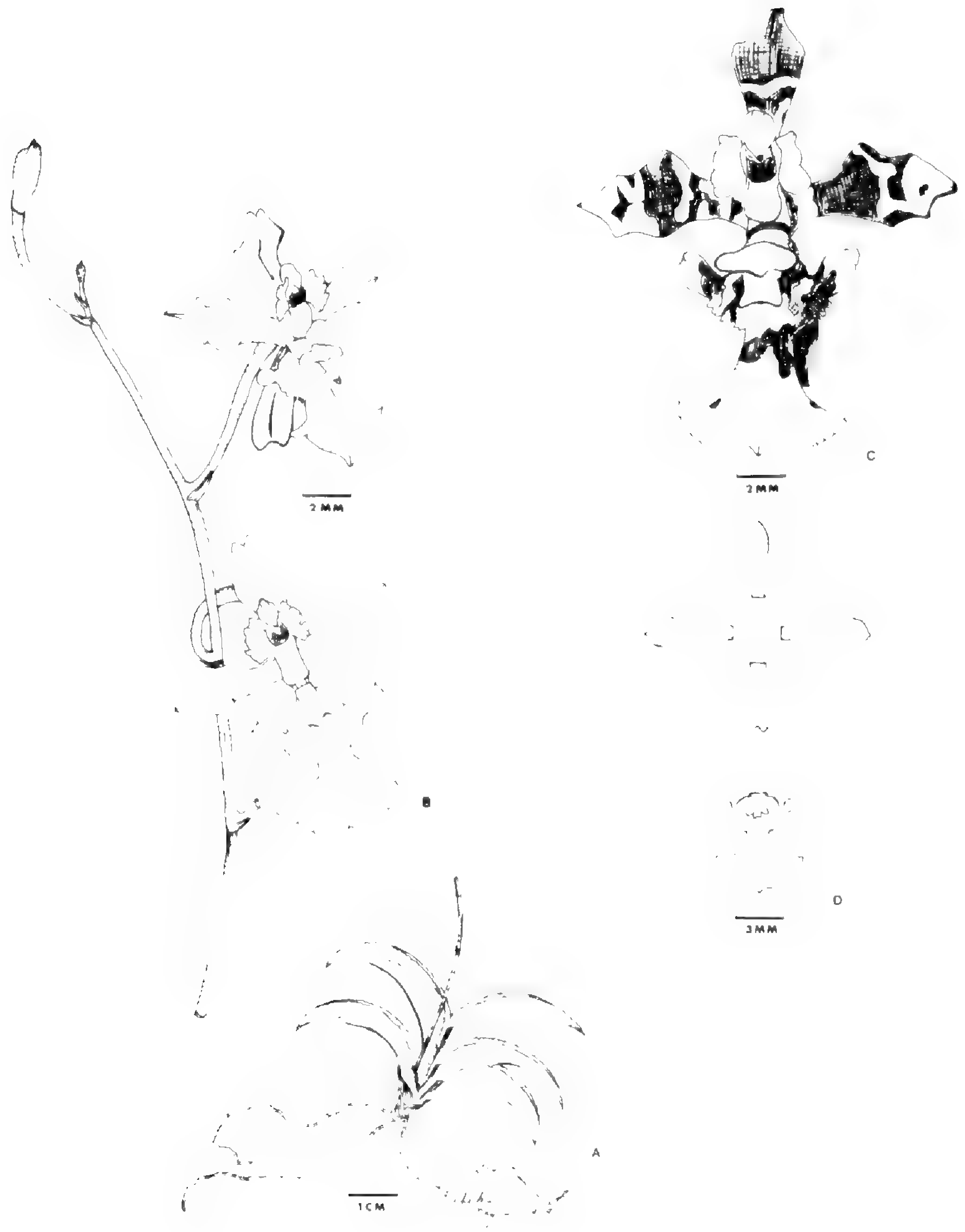

Figure 3. *Oncidium lucayanum* Nash ex Britton & Millspaugh. A. Plant. B. Inflorescence, distal portion. C. Flower, frontal view. D. Sepals, petals and labellum, frontal view.

Oncidium lucayanum Nash ex Britton & Millspaugh var. *purpureum* Moir, Fla. Orch. **16**(3): 115, 1973. Type: Abaco, Patterson, 1963; no herbarium specimen known.

Oncidium lucayanum Nash ex Britton & Millspaugh var. *rubiginosum* Moir, Fla. Orch. **16**(3): 115, 1973. Type: Abaco, Osment, 1971; no herbarium specimen known.

Oncidium leiboldi auct. non Rchb. f.: Cogn. in Urban, Symb. Ant. **6**: 658–659, 1910.

Oncidium variegatum auct. non Sw.: Cogn. in Urban, Symb. Ant. **6**: 656–657, 1910; Northrop. Mem. Torrey Bot. Club **12**: 30, 1902.

Plant epiphytic, rhizomatous, to 65 cm tall; roots numerous, slender, velamentous; primary stem or rhizome short, wiry, enclosed by imbricating scarious sheaths; secondary stem modified into pseudobulbs, clustered to 3 mm long, 1 mm wide, flattened, completely enclosed by 5–12 distichous leaves; leaves coriaceous, distichous, imbricated, produced at intervals along pseudobulb, yellow-green to olive-green, usually with minute reddish-purple spots, conduplicate, linear-falcate, acute, to 12 cm long, 8 mm wide, margin cartilaginous crenate; inflorescence lateral, to 62 cm tall, peduncle slender, erect, distantly several sheathed, racemose or rarely paniculate above, 1–60 flowers; floral bracts minute, lanceolate, acute, to 3 mm long, 1 mm wide; ovary pedicellate, slender, to 18 mm long; sepals yellow, with reddish-brown or purplish-brown spots; dorsal sepal subspatulate to oblanceolate, basally clawed to attenuate, concave, emarginate, acute or apiculate, to 8 mm long, 4 mm wide; lateral sepals oblanceolate, concave, acute, connate nearly to apex, to 7 mm long, 1 mm wide; petals white, yellow, or pink, with reddish-brown or purplish-brown spots, subspatulate to oblanceolate, basally clawed to attenuate, acute, margin undulate, to 8 mm long, 5 mm wide; labellum three-lobed, white, yellow, pink, or red, occasionally with reddish-brown or reddish-purple spots, to 12 mm long, 18 mm wide, lateral lobes basal, orbicular to linear-orbicular or obovate, obtuse to acute, reflexed, margin irregularly crenulate, midlobe separated from lateral lobes by a short isthmus with reddish-brown or purplish-brown spots, margin fringed, midlobe reniform, cordate, broadly obovate or flabellate, rounded, acute or deeply emarginate occasionally with an apicule in the sinus, margin entire, undulate or irregularly crenulate, callosity on isthmus variable, yellow with irregular brown spots, usually provided with 2–3 anterior and 2–3 posterior tubercles; column short, erect, to 4 mm long, 2 mm wide, with expanded lateral wings projecting from apex, white, yellow, pink, or reddish purple, ovate, base obtuse, apex acute, irregularly lobed, margin irregularly crenate, to 1.0 mm long, 0.6 mm wide, anther yellow; capsule pendent, to 15 mm long, 8 mm wide.

DISTRIBUTION IN THE BAHAMA ISLANDS: **Great Abaco,** Great Cistern, 14 Dec. 1904, *Brace 1674* (F, NY); on mangroves, Marsh Harbor, 21 Dec. 1904, *Brace 1845* (F, NY); opposite Cherokee settlement, 31 Dec. 1904, *Brace 1993* (F); Abaco Heights, low coppice, 11 April 1979, *Sauleda & Correll 2260* (FAU); *2273* (FAU). **Andros,** mangrove swamp around lake 1 mi. N.W. of Love Hill settlement, 10 May 1975, *Sauleda 1034* (AMES); low coppice, 2 mi. N.W. of Love Hill settlement, 16 April 1977, *Sauleda 1869* (FAU); Fresh Creek, 10 June 1890, *Northrop & Northrop 647* (F, NY); coppice, Crow Hill, 23–24 Jan. 1910, *Small & Carter 8664* (F, NY). **Grand Bahama,** Pinders' Point, 5–13 Feb. 1905, *Britton & Millspaugh 2523*, (F, NY); coastal coppice, Golden Grove, 5–13 Feb. 1905, *Britton & Millspaugh 2729* (F, NY). **Great Inagua,** South of Alfred Sound, 30 May 1974, *Proctor & Gillis 33846.* (IJ).

REPRODUCTIVE PERIOD: Flowers from May–August.

ECOLOGY: This endemic species is found growing epiphytically on *Rhizophora mangle* L., *Ateramnus lucidus* (Sw.) Rothm., *Byrsonima cuneata* (Turez) P. Wilson, *Coccoloba diversifolia* Jacq., *Conocarpus erectus* L., *Eugenia confusa* DC, and *Pithecolobium guadalupense* Chapm. The habitats in which it occurs are mangrove swamp and low coppice.

ADDITIONAL COMMENTS: *Oncidium lucayanum* is a highly variable species, varying significantly in flower size, shape, and color (see Fig. 4). This variability has generated taxonomic confusion as evidenced by the publication of three varietal epithets. Our field observations have demonstrated that the numerous morphs comprise a gene pool with unrestricted flow, each morph being pollinated indiscriminately, by the bee *Centris versicolor* (Fabricius). Additionally, experimental selfing crosses of two of the morphs (Fig. 4A & 4D) have produced all of the forms currently found in the natural populations. For this reason, all varietal epithets are relegated to synonymy.

4. **Oncidium sasseri** Moir, Fla. Orch. **18**(4): 155–157. 1975. (Fig. 5)
HOLOTYPE: Abaco, Bahama Island, *Sasser s.n.* (AMES).

Plant epiphytic, rhizomatous, to 42 cm tall; roots numerous, slender, velamentous; primary stem or rhizome stoloniferous, repent, wiry, remotely several sheathed, scarious, ovate, acute, to 9 mm long, 4 mm wide; secondary stem modified into remotely produced pseudobulbs to 5 cm apart, to 6 mm long, 3 mm wide, flattened, completely enclosed by 3–6 distichous leaves; leaves coriaceous,

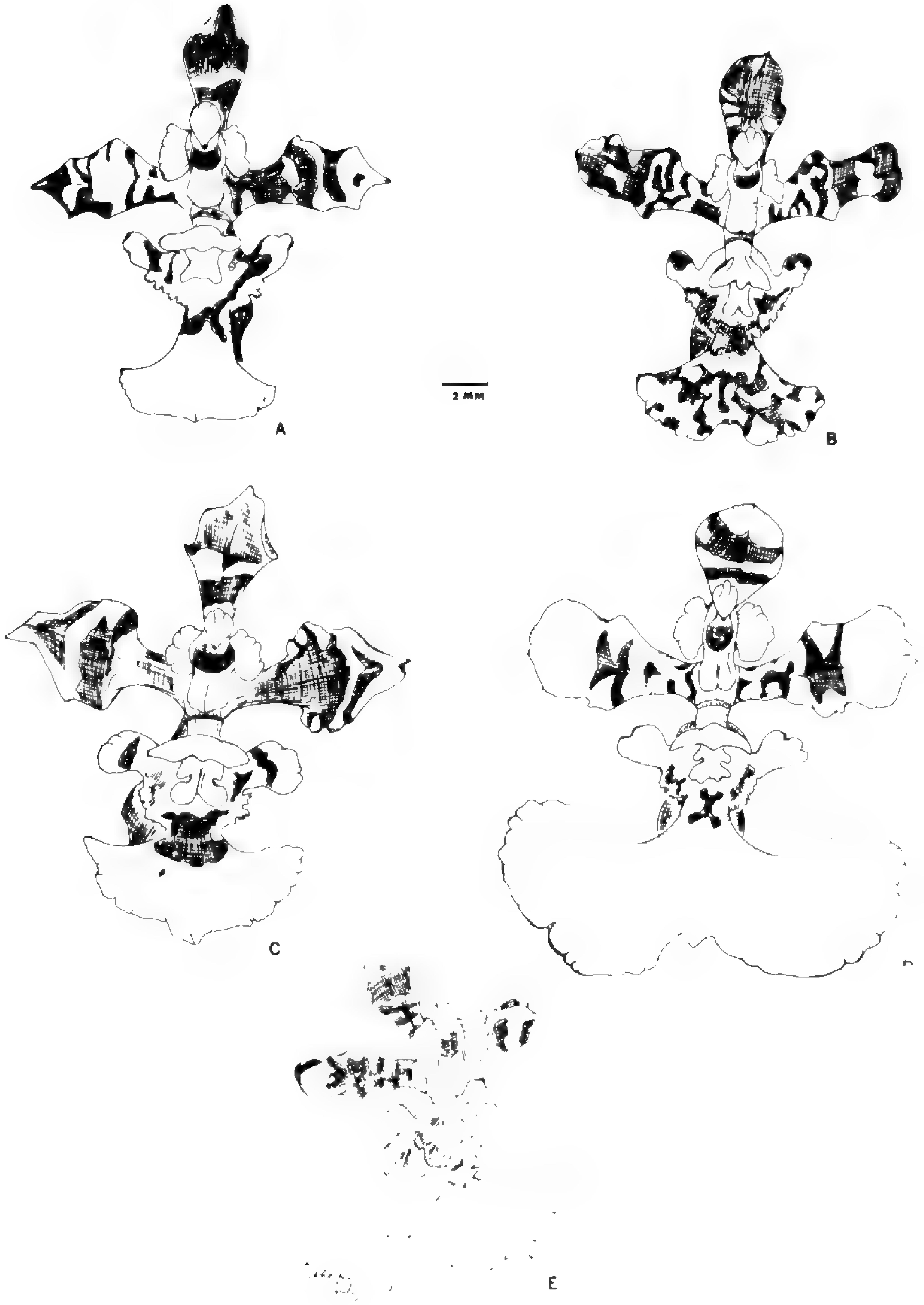

Figure 4. Five representative morphs of *Oncidium lucayanum* Nash ex Britton & Millspaugh commonly found in natural populations. A. White flower with brown markings. B. White flower with purple markings. C. White flower with brown markings. D E. Yellow flower with brown markings.

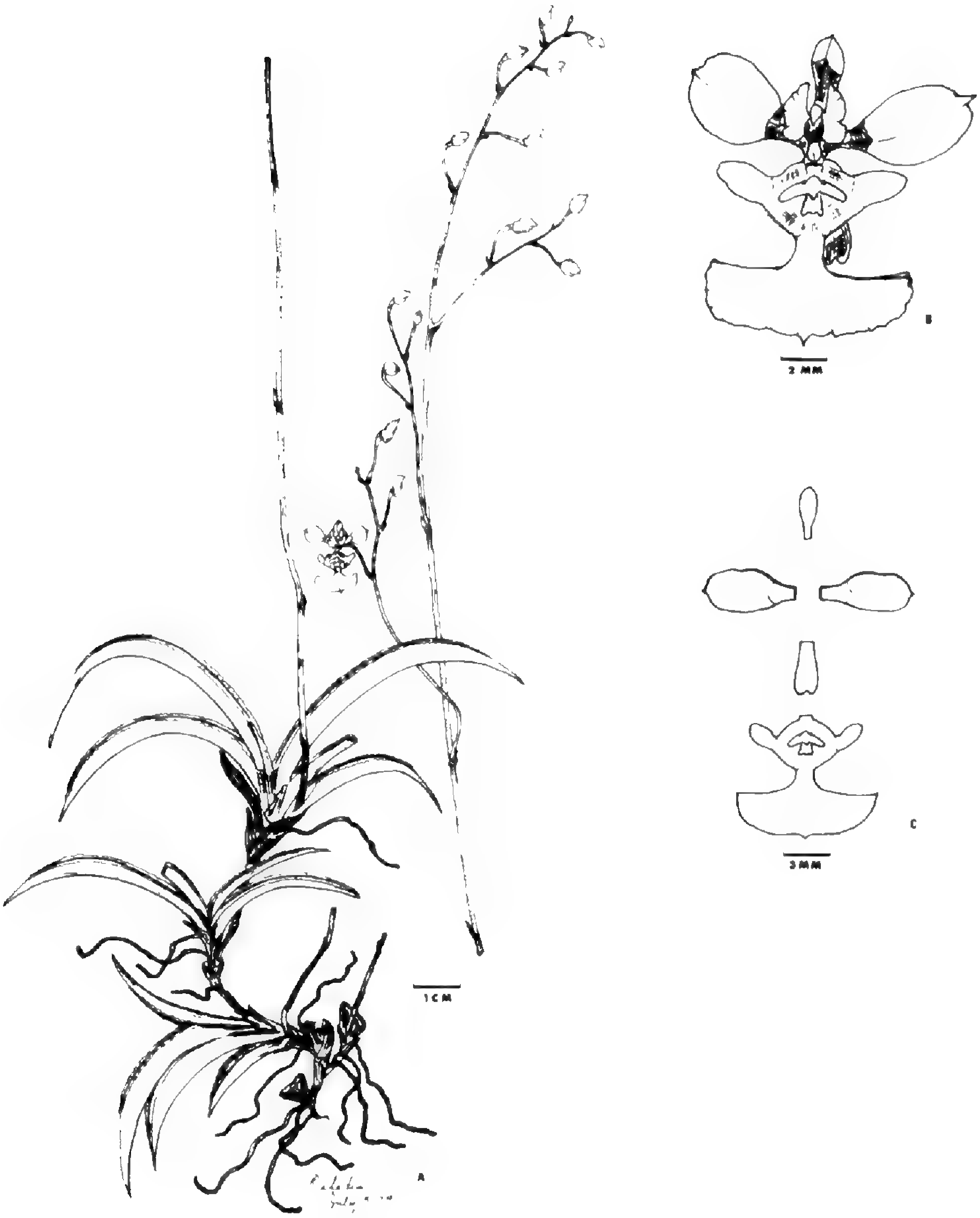

Figure 5. *Oncidium sasseri* Moir. A. Flowering plant. B. Flower, frontal view. C. Sepals, petals and labellum, frontal view.

distichous, imbricated, produced at intervals along pseudobulb, yellow-green to olive-green, with minute reddish-purple spots, conduplicate, linear-falcate, acute, to 8 cm long, 8 mm wide, margin cartilaginous, crenate; inflorescence lateral, to 28 cm tall, peduncle slender, erect, distantly several sheathed, racemose, 2–20 flowers; floral bracts linear-lanceolate, acute, to 3 mm long, 1 mm wide; ovary pedicellate, slender, to 16 mm long; sepals white, occasionally tinged with pink, basal 2/3 with reddish-brown spots; dorsal sepal oblanceolate to subspatulate, concave, emarginate to acute, basally clawed, to 8 mm long, 2 mm wide; lateral sepals oblanceolate, concave, acute, connate nearly to apex, basally clawed, to 6 mm long, 1 mm wide; petals white, occasionally tinged with pink, basal 1/3 with reddish-brown spots, oblanceolate, orbicular, or ligulate, acute to apiculate, basally clawed, margin undulate, occasionally irregularly crenulate, to 8 mm long, 4 mm wide; labellum three-lobed, white, occasionally tinged with pink, to 10 mm long, 12 mm wide, lateral lobes basal, orbicular to elliptic, obtuse to broadly rounded, reflexed, margin irregularly crenulate, midlobe separated from lateral lobes by a short isthmus, with reddish-brown spots, margin fringed, midlobe broadly obovate or flabellate, emarginate with an apicule in the sinus, margin undulate, entire or irregularly crenulate, callosity on isthmus yellow-orange with reddish-brown spots, usually provided with two anterior and two posterior tubercles connected by a central ridge; column short, erect, to 4 mm long, 2 mm wide, with expanding lateral wings projecting from apex, white or pink, lanceolate, base obtuse, apex acute, margin minutely crenulate, to 1.2 mm long, 0.8 mm wide, anther purple; capsule pendent, to 10 mm long, 5 mm wide.

DISTRIBUTION IN THE BAHAMA ISLANDS: **Great Abaco,** Abaco Heights, low coppice, 11 April 1979, *Sauleda & Correll 2261* (FAU), *2272* (FAU); *Sasser s.n.* (AMES). **Andros,** low coppice, 2 mi. north of Love Hill settlement, 16 April 1977, *Sauleda 1860* (FAU).

REPRODUCTIVE PERIOD: Flowers April–August

ECOLOGY: This endemic species is found growing epiphytically on *Byrsonima cuneata* (Turez) P. Wilson, *Conocarpus erectus* L., and *Eugenia confusa* DC, in high coppice, low coppice, and mangrove swamp.

ACKNOWLEDGMENTS

We would like to thank the Directors, Curators, and Staff members of the herbaria cited throughout the text for their cooperation and help. Thanks are especially due to Dr. Donovan S. Correll for the generous donation of his time and knowledge. We acknowledge the expertise of Rebeka Sauleda who prepared the illustrations. This research was supported in part by donations and grants from the Tropical Orchid Society, the Dallas/Ft. Worth Orchid Workshop, and the Florida Caribbean Orchid Association.

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AUTECOLOGICAL ASPECTS OF *DIAPENSIA LAPPONICA* L. IN NEWFOUNDLAND

ROBIN T. DAY[1] AND PETER J. SCOTT

Diapensia lapponica L. is an arctic-alpine species that is adapted to cool windswept habitats and reaches its southeastern limit in North America in Newfoundland and New England (Fig. 1). It can survive immersion in liquid nitrogen (196° C., Sakai and Otsuka, 1970) and it grows in the most exposed and windswept habitats of Mt. Washington, New Hampshire (Tiffney, 1972) where the world's windspeed record was recorded at 374 km/hr (Bliss, 1963).

Damman (1976) suggests that this species is restricted to areas with cool summer temperatures. In addition, competition and pedology appear to be important in restricting its distribution. This species is most often found on acid soils; however, it is also common at Trout River in western Newfoundland on the serpentine soils which have toxic and low nutrient properties that exclude many of the potential competitors. In other areas, competitors may be eliminated or reduced by conditions during the fall, winter, and spring: soil disruption during the frequent freeze-thaw cycles, and abrasion and dessication caused by high winds. Where climate and soil do not maintain a low vegetation, *Diapensia lapponica* clumps are invaded and overgrown by competing species.

Diapensia lapponica plants form domes or mats, and growth form studies by Day (1978) suggest that in addition to being adapted to destructive windy habitats these forms act as solar heat traps. In vertical section, domed growth forms have a hemispherical shape (Fig. 3) while mat forms are flattened. During 1977 the microhabitat of *Diapensia* was monitored with nine temperature probes recording at half-hour intervals (Grant Miniature Recorder Model D). On sunny spring days the leaf surface of a small *Diapensia* plant often exceeded the temperature of any other object in the environment by as much as 8° C at 8:00 a.m. and by progressively lesser amounts until 3:00 p.m. (daylight savings time). In addition, the soil beneath these plants was the warmest location in the environment from 8:00 p.m. to

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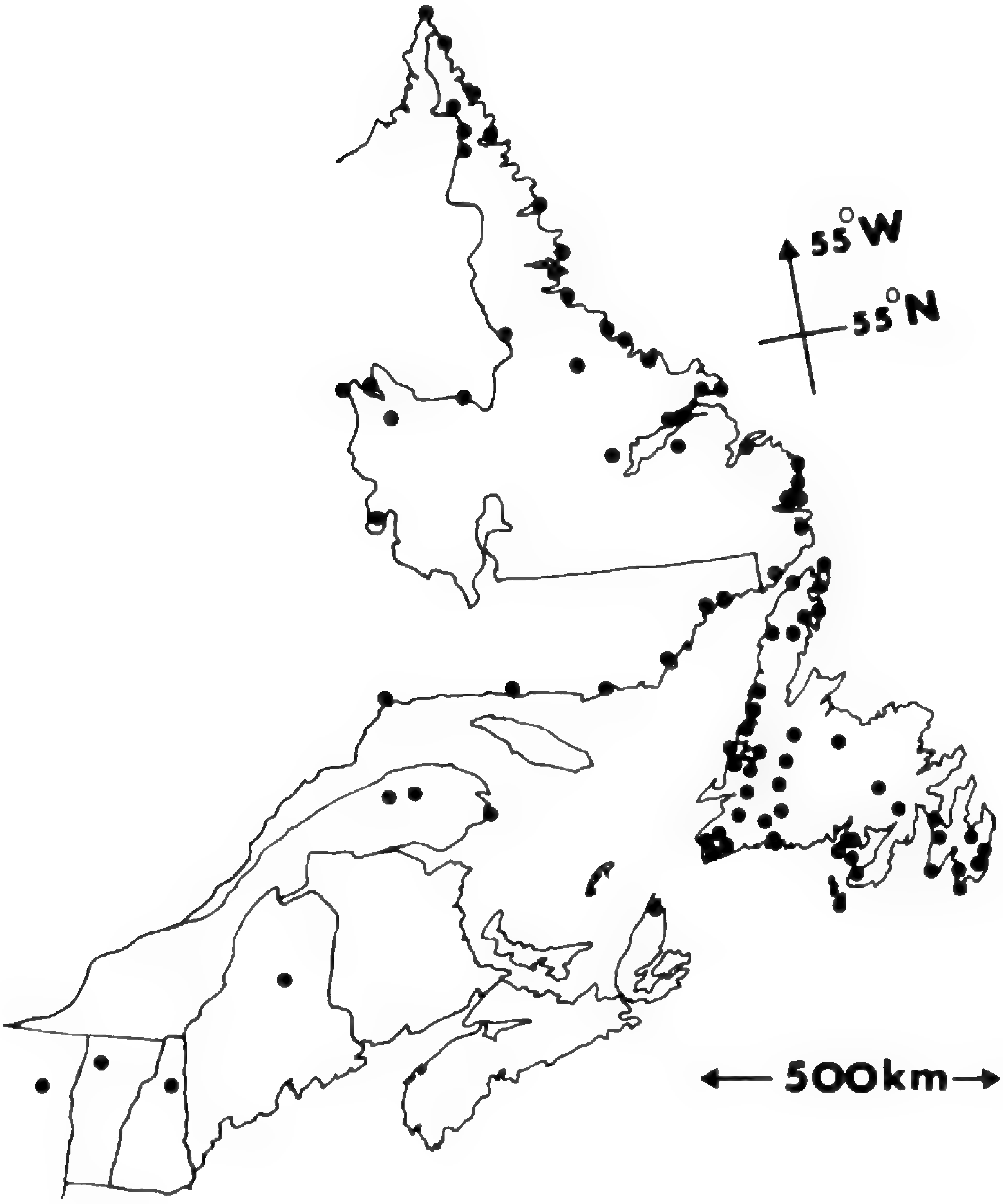

Figure 1. Distribution Map of *Diapensia* in Northeastern North America.

midnight. These observations certainly support a heat trap hypothesis. At low altitudes and in coastal areas without frequent fogs the trapping of excess heat would be damaging if respiration or transpiration could not be controlled. Perhaps it is *Diapensia's* inability to control these functions at high temperatures that restrict it in its southern range to habitats with cool summer temperatures like the exposed hill tops and foggy coastal fringes of Newfoundland. The difficulties with cultivating *D. lapponica* at Oxen Pond Botanic

Park in St. John's and elsewhere in the world (Blakelock, 1952; Griffith, 1964) can probably be attributed to excess heating of these growth forms at lower altitudes.

The distribution maps of *Diapensia lapponica* (Figs. 1 & 2) are primarily an extension of the work of Damman (1976). The additional sites of interest are St. Pierre and Brunette Island, St. Shotts, Point Lance, and Barachois Park in Newfoundland. The major source of information was the Agnes Marion Ayre Herbarium of Memorial University of Newfoundland (NFLD). The collections of the Federal Agriculture Station and Newfoundland Forest Research Centre in St. John's were also examined. Because *Diapensia* is so unmistakable in the field, verbal reports were accepted from trained botanists. In addition, the following literature sources were used: Lysaght, 1971; Hounsell and Smith, 1966; Damman, 1976; Smith and Erskine, 1954; Hustich and Pettersson, 1943; Fernald, 1907; and Rousseau, 1974.

AN AUGUST-BLOOMING POPULATION OF *DIAPENSIA LAPPONICA* L.

In mid-May 1975 it was observed that flower buds were present on some plants but absent from others on the Hawke Hills of the Avalon Peninsula. The buds opened in June and the mature plants that did not bloom then flowered in August. This August-blooming population was considered a local anomaly until Mr. Richard Cannings (pers. comm.) reported that most of the *Diapensia lapponica* plants at Cape St. Mary's bloomed in August and that the June-blooming plants were in the minority. Observations (1975–1979) show that June-bloomers flower from May 19 to June 20 with a peak in the first week of June, and August-bloomers flower from June 29 to August 29 or later with a peak in the first week of August. There is no overlap of blooming periods.

A review of the available herbarium material from Newfoundland was undertaken and by examining for the presence or absence of flowers and flower buds and the condition of the fruit it was possible to designate a specimen as being a June- or an August-bloomer. August-blooming populations have been documented from the following locations on the island of Newfoundland (Fig. 2). *West Coast Sites:* —1. Gregory Plateau; 2. Weebald Island. *Avalon Peninsula Sites:* 3. Peters River; 4. Doe Hills, Isthmus of Avalon; 5.

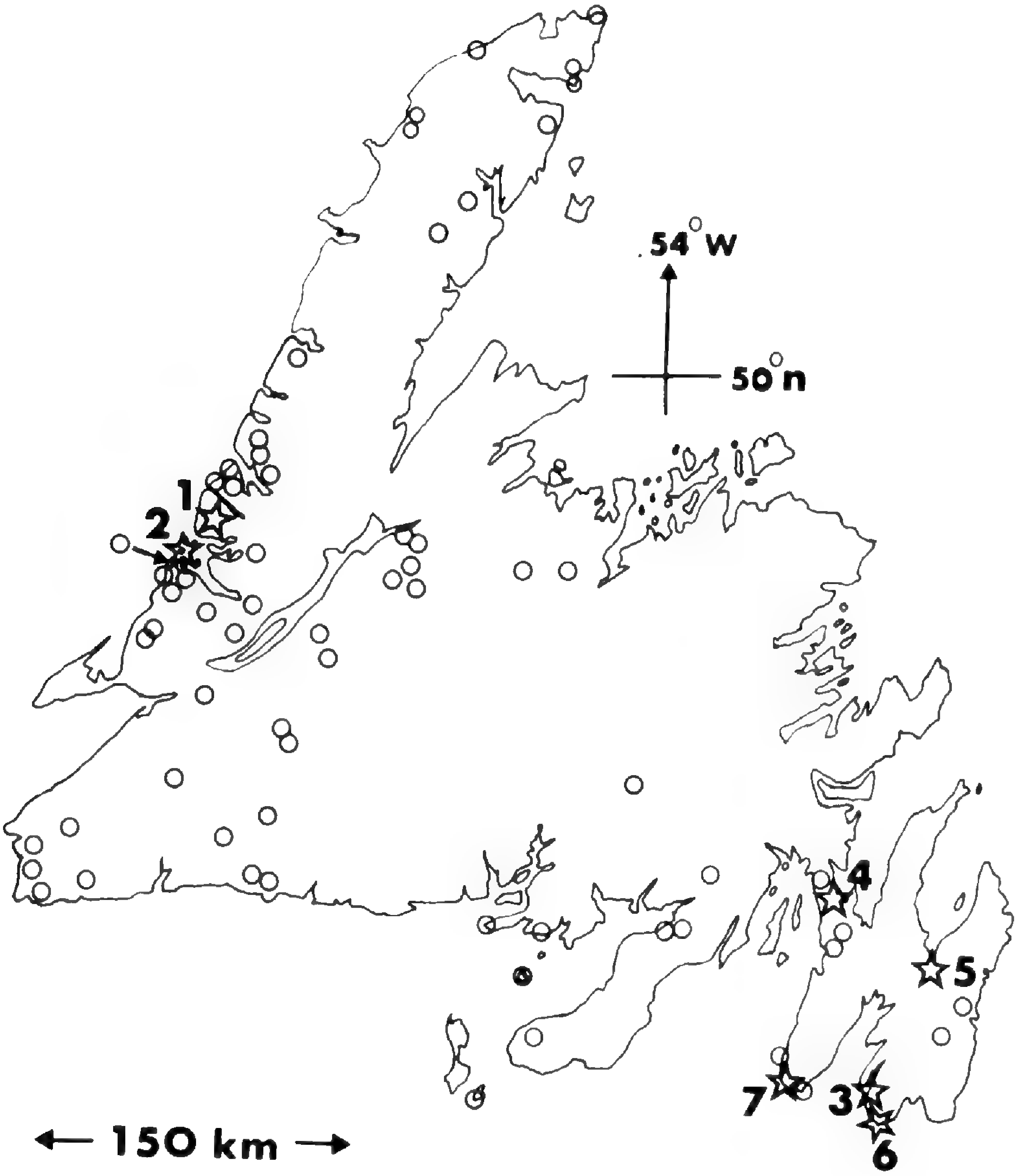

Figure 2. Distribution map of *Diapensia* on the island of Newfoundland. Circles represent *D. lapponica* sites and stars indicate populations with August-blooming plants. Numbers are referred to in the text.

Hawke Hills, south of Holyrood; 6. St. Shotts; 7. Cape St. Mary's.

The phenology of the two populations at Hawke Hills was recorded from 1975 to 1979 and plants of both population types maintained their characteristic blooming periods through the five years of observation. There may be as many as fifty flowers/year on very large plants with each flower giving rise to a mean production of 121 seeds/capsule. This production is never actually realized because an infection of the seeds and capsules by the Pyrenomycete *Apiothyrium arcticum* Petrak (identified by M.P. Corlett of Agriculture Canada Research Branch, Biosystematics Research Institute, Ottawa) leads to a mortality of approximately 40% of the seeds. Furthermore it was discovered that the June-blooming plants formed their flower buds in the previous year while the August-blooming plants formed theirs in the same year as flowering. A similar situation is known for separate arctic and alpine populations of *Saxifraga cernua* L. (Wehrmeister & Bonde, 1977). June-bloomers disperse their seeds in late summer while the August-bloomers release their seeds in the winter when they can potentially be dispersed by blowing over the snow crust. The capsules from the August bloom were found projecting through the snow, dehisced, and with mature seed on January 7, 1978 at the Hawke Hills. Eleven days after thawing, seeds collected on December 19, 1978 from August-blooming plants were germinated. These observations affirm the biological significance of the August bloom for *Diapensia lapponica*.

The authors presently believe that August-blooming is typically found in most, if not all, populations of *Diapensia lapponica* on the island of Newfoundland, as all known *Diapensia* locations visited have had August-blooming plants. The August-bloomers can be found in mixed or separate groups on a series of knolls within any one locality and so one would assume some degree of geographically-induced reproductive isolation—one of the first steps in speciation.

A review of the literature shows that August-blooming has not been reported for *Diapensia lapponica* (Table 1); however, Dr. W. H. Drury (College of Atlantic, Bar Harbor, Maine) and Dr. R. E. Graber (Northeastern Forest Experiment Station, U.S. Forest Service, Durham, New Hampshire) have both stated (pers. comm.) that a late bloom occurs on Mt. Washington, New Hampshire.

Second blooming periods have been reported for a number of other arctic-alpine species with the usual flowering period in the spring and an anomalous one later in the summer. Aleksandrova (1961) found that *Ranunculus sulphureus* Sol. and *R. sabinei* R. Br. bloom in spring (June 26 to July 12) and late summer (August 10 to 25) but he does not make it clear if individual plants flower twice or if two separate populations exist. Löve (1963) suggests that this situation is temperature-controlled. Gjaerevoll (1967, p. 14) reports that in central Alaska *Rhododendron lapponicum* (L.) Wahlenb. "was frequently seen flowering for the second time in August".

Table 1. Flowering Period of *Diapensia lapponica* L. in Various Areas of its Distribution.

Authority	Flowering Information	Location
Bliss, 1962	June 1959	Mt. Washington, New Hampshire
Harris, 1940	. . . past flowering by the middle of July and often before July 4th.	Presidential Range, New Hampshire
Weeden, 1968	1962 to 1967 inclusive Earliest start 31 May Latest start -9 June Average start—6 June	Central Alaska
Ohwi, 1965	June to July	Japan
Petersen, 1912	Start 12 June Start—13 June	Greenland Scoresby Sound Karajak (in the west)
Fernald, 1950; Gleason, 1952	June, July	Northeastern North America
Fiedler, 1939	23 June	Abisko, Sweden
Tikhomirov & Gavrilyuk, 1966	June to July	Bering Coast of Chukhi Peninsula

INDIVIDUAL PLANTS OR POPULATIONS?

Individual plants of *Silene acaulis* L. bloom twice. Mr. B. S. Jackson observed that two plants of *S. acaulis* which had been transplanted from Cape St. Mary's, Newfoundland in 1972, bloom twice a year at Oxen Pond Botanic Park, St. John's, Newfoundland. The second blooming consists of fewer flowers than the first. The second blooming may be temperature-controlled as in *Ranunculus* or the longer-than-normal growing season at its southern range limit may permit or, perhaps, induce the second blooming. Cultivars and native clones of *Rubus idaeus* L. show a parallel phenology.

Anomolous phenologies were thought to be environmentally induced. In his discussion of relic species, Cain cites Wulff (1932, 1943) as providing. . ."a series of instances of lack of harmony between some species and their conditions. This lack of harmony shows itself in relic species, in lack of co-ordination between periodicity of growth and rhythms of climate, in incomplete life cycles, in the dying out of relic species, etc.". (Cain, 1944, p. 20–21). Whether the second blooming could be considered adaptive or not would depend upon whether or not it produces viable seeds.

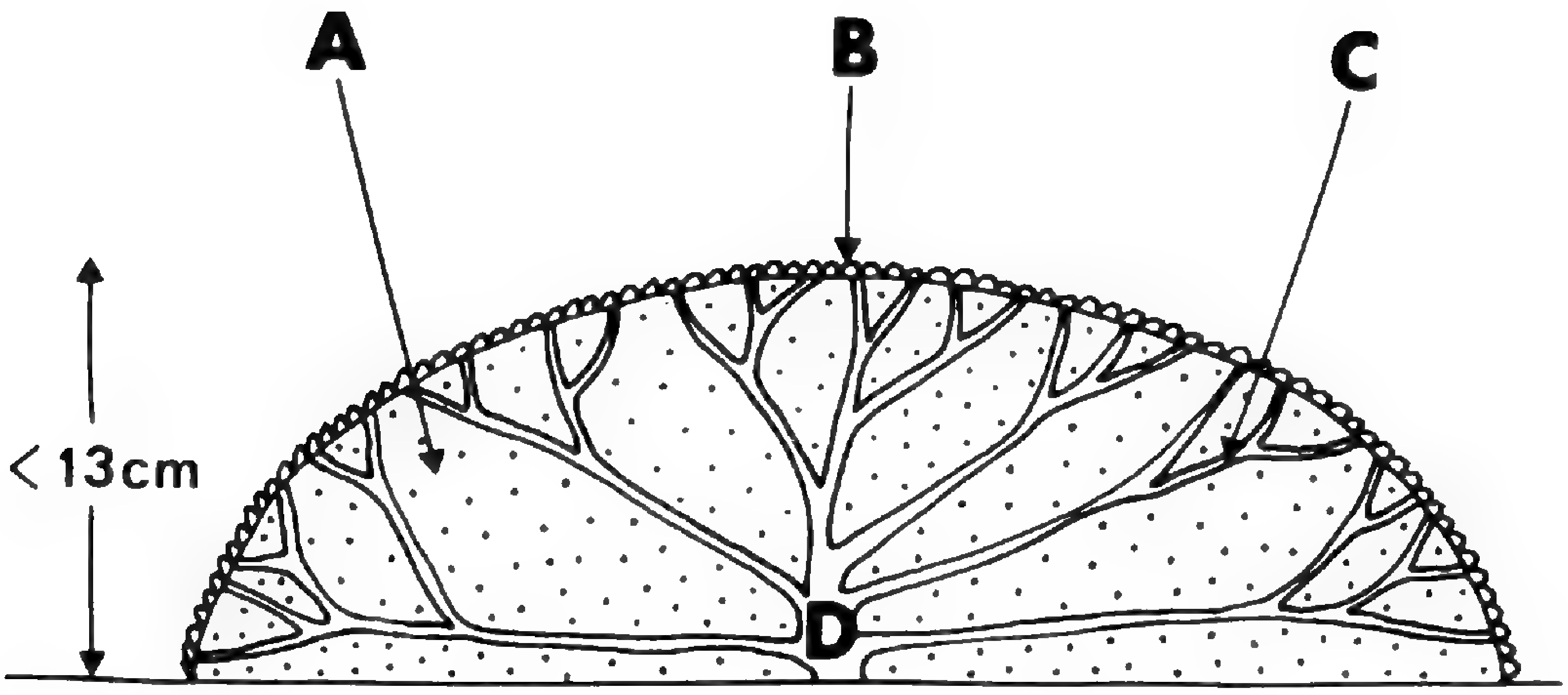

Figure 3. Cross-section of the domed growth form of *Diapensia lapponica* L., illustrating supporting dead leaves (A), superficial shell of living leaves (B), long thin branches (C), and main stem (D).

Anomolous flowering periods may be produced by environmental conditions alone or may be genetically determined as may be the case with *Diapensia lapponica.* This has not been determined yet because of the difficulties in culturing the species. While it could be argued that microclimate instead of genetics would determine the blooming period of the individual, the occurrence of both types in a microhabitat at the Hawke Hills, Doe Hills, and Cape St. Mary's would suggest otherwise.

Day (1978) speculates about the origin and evolution of the August-blooming population and the question of recognizing it as a new biological species (*sensu* Grant, 1971) arises. The two populations appear to be reproductively isolated since there is no overlap in blooming periods; however, does this isolation persist beyond one generation? Can a June-blooming plant produce August-bloomers and *vice versa*? If this were the situation then gene flow could occur over several generations and the concept of a new biological species would not be applicable. Alternately, the two blooming periods may be controlled by one or several genes. Such a situation has been found in *Rosa* spp. (Semeniuk, 1971; Svejda, 1977) and *Fragaria* spp. (Anonymous, 1937) which exhibit recurrent blooming. Until the inheritance of the blooming periods in *Diapensia lapponca* has been determined, no taxonomic treatment can be suggested.

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CHANGE OF STATUS FOR *PHYSOSTEGIA VIRGINIANA* VAR. *LEDINGHAMII* (LABIATAE) AND EVIDENCE FOR A HYBRID ORIGIN

Philip D. Cantino

Physostegia virginiana (L.) Benth. and *P. parviflora* Nutt. ex Gray have long been known from central Canada. The existence in the region of a third taxon intermediate between these two was noted by Boivin (1966), who recognized it as var. *ledinghamii* of *P. virginiana*. The taxon was earlier treated as a distinct species (Fraser & Russell, 1953), but the name has never been validly published at that rank. I am now raising the taxon to the species level on the basis of evidence that it is a tetraploid derivative of a hybrid between *P. parviflora* and *P. virginiana*.

Physostegia ledinghamii (Boivin) Cantino, *comb. et stat. nov.*

Physostegia ledinghamii Boivin ex Fraser & Russell, Annot. List Pl. Sask. 36. 1953. Nom. nud.

Physostegia virginiana var. *ledinghamii* Boivin, Nat. Canad. **93:** 574. 1966. HOLOTYPE: Saskatchewan, Swift Current District, Cabri, "15 milles au nord, platière sablonneuse de la Saskatchewan du Sud," 28-VII-1952, *Boivin & Alex 9978* (DAO).

Representative specimens. CANADA. **Alberta:** Fort Saskatchewan, *Turner 4979* (ALTA); Manola, 26-VII-1968, *Rusconi s.n.* (ALTA); Clyde, *McCalla E2692* (ALTA). **Manitoba:** Le Pas, 21-VII-1936, *Howe s.n.* (DAO, TRT, SCS). **Northwest Territories:** Salt River, *Loan 137* (DAO, ALTA, MO). **Saskatchewan:** Tisdale, *Breitung 1790* (DAO, ALTA, SMU); North Battleford, *Frankton 945* (DAO); Green Lake Village, *Harms 16792* (DAO, GH). UNITED STATES. **North Dakota:** Burleigh Co., Bismarck, *Metcalf 388* (US); McLean Co., Ft. Berthold Indian Res., *Heidenreich 210* (OKL).

The distributions of *Physostegia ledinghamii, P. parviflora,* and *P. virginiana* approach one another in North Dakota, southeastern Saskatchewan, and southwestern Manitoba (Figure 1). They have not been recorded from the same site but they grow in similar habitats along the edges of rivers, lakes, and ditches and could be expected to occur together at least occasionally in the region where their ranges come into contact.

The principal morphological distinctions among the three species

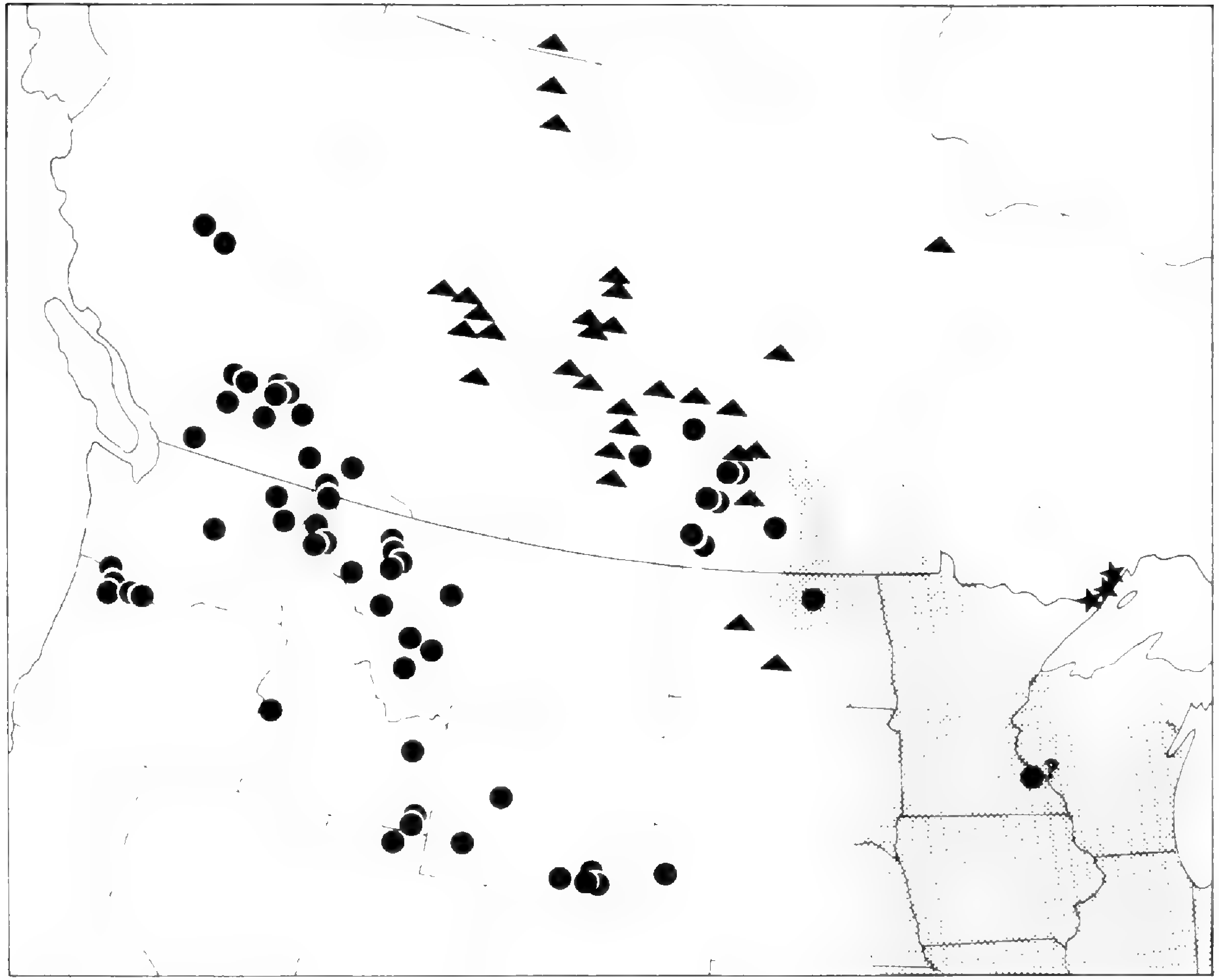

Figure 1. Distribution map of *Physostegia parviflora* (circles) and *P. ledinghamii* (triangles). The shaded area represents the northwesternmost portion of the range of *P. virginiana*. The stars represent specimens of uncertain affinities (see text). The question mark indicates a questionable record of *P. parviflora* (a single specimen with possibly incorrect locality data).

are summarized in Table 1. The percentages listed refer to the approximate percentage of the available herbarium specimens on which a given character state was found. The sample size varied by species and by character, but at least 30 specimens of each species were examined for every character except nutlet length. For the latter character, nutlets from at least 10 collections of each species were measured. The character states tabulated for *Physostegia virginiana* refer not to that species in its entirety, but only to the portion of its distribution that approaches the ranges of *P. parviflora* and *P. ledinghamii*—i.e., *P. virginiana* from Manitoba, western Ontario, the Dakotas, Minnesota, and northern Wisconsin. *Physostegia ledinghamii* resembles *P. parviflora* in one character (No. 1), *P. virginiana* in two characters (Nos. 3&8), and is intermediate between these two species in three characters (Nos. 2,6,&7). There are two size characters (Nos. 4&5) in which *P. ledinghamii* exceeds both *P. parviflora* and *P. virginiana* to some degree.

Table 1. **Distinguishing Characteristics of Physostegia parviflora, P. ledinghamii, and P. virginiana**

Characters	*P. parviflora*	*P. ledinghamii*	*P. virginiana*
1. Upper leaves clasp stem	always	always	no>95%
2. Stalked glands present on corolla	yes>90%	yes≈30%	no>95%
3. Length of flowers (on dried specimens)	(9–)11–16 mm	14–23 mm	14–23 mm
4. Length of longest nonglandular trichome on axis of raceme	.075–.15 mm	.14–.225 mm	.075–.15 (–.20) mm
5. Length of nutlets	2.1–3.3 mm	2.8–4.0 mm	2.5–3.2 mm
6. Some of the upper leaves are widest near base of blade	yes>95%	yes≈40%	no>95%
7. Upper leaves have one to three pairs of weak primary veins arising from base of blade	yes≈90%	no≈80%	no>95%
8. The majority of the stem leaves are bluntly toothed to entire	yes≈30%	never	never

Although there is overlap between *Physostegia ledinghamii* and *P. parviflora* in every character listed in Table 1, the two species are easily distinguished if the characters are used in combination. When the principal diagnostic characters are plotted on a scatter diagram (Figure 2), two clusters are apparent, connected by a small zone of overlap. Specimens represented by points within this zone of overlap have been identified to species on the basis of foliar characters listed in Table 1. It is significant that individuals of either species that exhibit a morphology approaching that of the other are no more frequent within the region of sympatry than outside of it. Of the five data points included in the zone of morphological overlap in Figure 2, only two of them represent specimens collected in the region of sympatry. Thus it would appear unlikely that the existence of morphologically intermediate individuals is due primarily to hybridization between *P. parviflora* and *P. ledinghamii.* Hybridization may be occurring occasionally, but if it were a common occurrence, the frequency of individuals with an intermediate morphology would be far greater within the region of sympatry than outside of it.

The apparent absence of extensive hybridization between *Physostegia parviflora* and *P. ledinghamii,* in spite of their partial sympatry and lack of any obvious ecological or temporal isolating mechanism, when considered with the intermediate morphology and geographic location of the latter, led me to suspect that *P. ledinghamii* might be a tetraploid hybrid derivative of *P. parviflora* and *P. virginiana*. The tetraploid nature of *P. ledinghamii* has been confirmed by cytological study of plants collected 8 miles south of Saskatoon, Saskatchewan (*V. L. Harms 27623*; voucher, GH). Using root tips pretreated in 8-hydroxyquinoline (procedure outlined by B. W. Smith in Radford, et al., 1974, pp. 251 252; originally adapted from Tijo & Levan, 1950), I obtained three counts of 2n=76 for *P. ledinghamii.* A photograph can be found in my doctoral thesis (1980) and will be published at a later date as part of a monograph of the genus. Both *P. parviflora* and *P. virginiana* have 19 pairs of chromosomes (Taylor & Brockman, 1966; Fedorov, 1969; Cantino, 1980).

The conclusion that *Physostegia ledinghamii* in its entirety is tetraploid must remain tentative, inasmuch as it is based on the chromosome number of a few members of a single population. However, when it is considered in conjunction with the morphological and geographical intermediacy of *P. ledinghamii*, this single tetraploid count lends support to the hypothesis of a hybrid origin for the species.

There are two characters in which *Physostegia ledinghamii* resembles neither of its putative parents. It has larger nutlets, and the trichomes in the inflorescence average slightly longer than those of *P. parviflora* or *P. virginiana* (Table 1). The higher ploidal level of *P. ledinghamii* may be responsible for the increased size of both structures. It is well known that polyploidy frequently results in an increase in cell size, and Stebbins (1950) mentions "few-seeded fruits" as one of the kinds of organs in which "gigas effects" of polyploidy are most likely to be seen. The trichomes of *Physostegia,* being simple structures consisting of very few cells, may be similarly prone to an increase in overall length due to an increase in the size of the component cells. It has been observed in *Matthiola incana* that colchicine-induced polyploid branches have larger trichomes than do diploid branches on the same plant (Emsweller & Ruttle, 1941).

Using a strictly phenetic species definition, one could argue that the degree of morphological distinction between *Physostegia ledinghamii* and *P. virginiana* is not sufficient to warrant recognition of the former at the species level. However, if my hypothesis about its origin is correct and its gene pool includes a substantial contribution from *P. parviflora,* it would seem more justifiable to treat it as an independent entity rather than grouping it with one of its parents. Such an approach is more justifiable from the standpoint of a "biological" species concept as well, inasmuch as the higher ploidal level of *P. ledinghamii* necessarily isolates it, at least to a degree, from *P. virginiana* and *P. parviflora.*

Although justifiable on evolutionary grounds, the recognition of *Physostegia ledinghamii* at the species level creates a practical problem in that it is distinguishable from *P. virginiana* and *P. parviflora* on the basis of relatively few morphological characters, none of them absolutely reliable. The limited morphological basis for distinguishing these species leaves in question the affinities of a group of specimens collected near Thunder Bay, Ontario (*Garton 1958,* NY, GH, TRT, DAO; *Garton 5733,* DAO; *Cormack & Mayall s.n.,* 15-VIII-1936, TRT, MICH; *Allin s.n.,* 16-VIII-1964, TRT). Most of the specimens have at least a few leaves that clasp the stem to some degree, although the NY specimen of *Garton 1958* does not. The trichomes on the axis of the inflorescence do not exceed 0.1 mm in some specimens but reach 0.15 mm in others. Thus some plants fall within the morphological limits of *P. ledinghamii* and others do not. Because these specimens (represented by stars in Figure 1) were collected more than 500 miles east of the otherwise known range of *P. ledinghamii,* but only about 100 miles from areas in northeastern

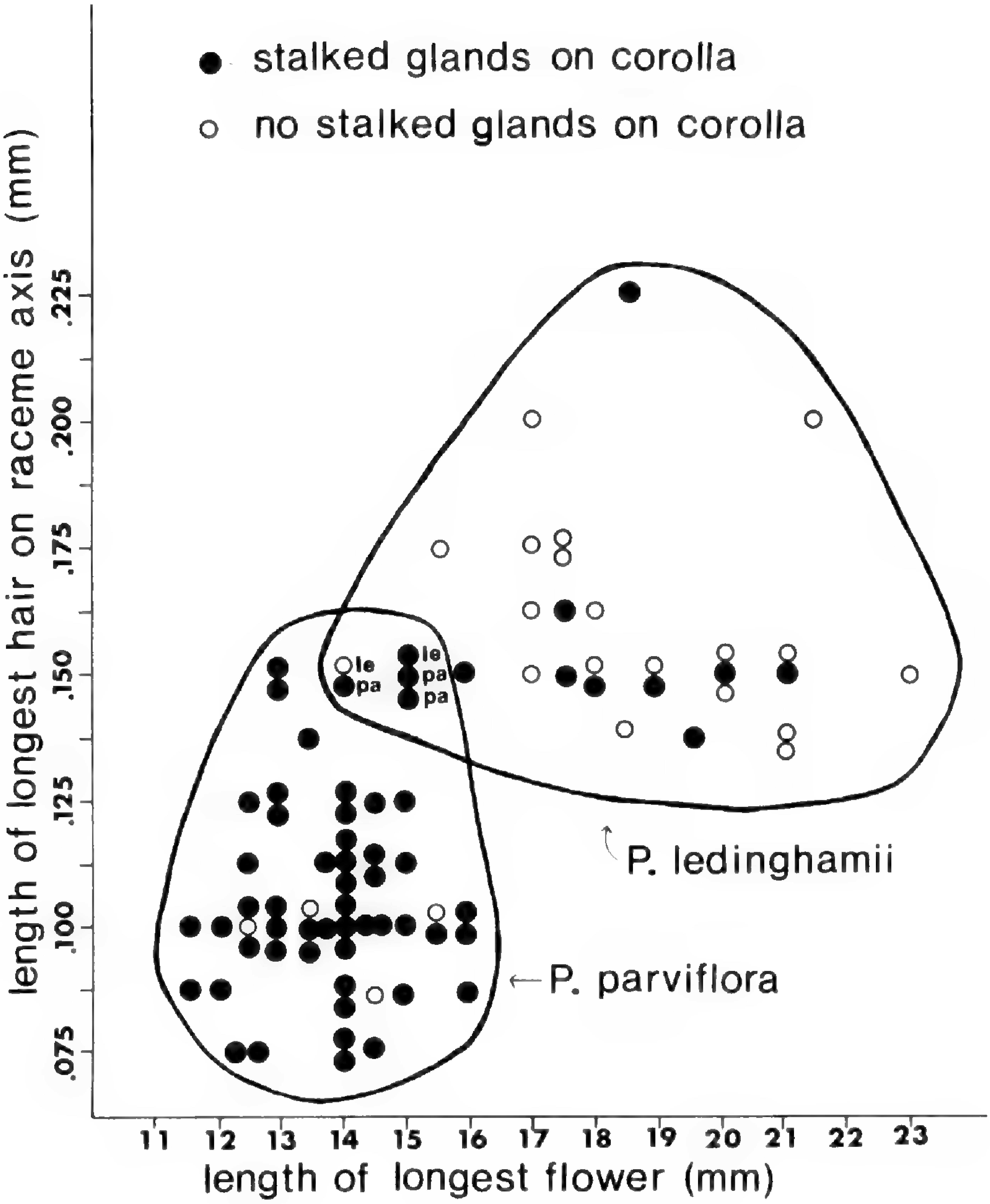

Figure 2. Graph of flower length vs. length of the longest nonglandular trichome on the raceme axis in *Physostegia parviflora* and *P. ledinghamii*. Each symbol represents a single herbarium specimen. In the zone of interspecific overlap, symbols labeled "le" represent *P. ledinghamii* and those labeled "pa" represent *P. parviflora*.

Minnesota where *P. virginiana* abounds, I suspect that they represent a form of the latter in which a clasping leaf base like that of *P. ledinghamii* has evolved in parallel. Clasping leaves are very rare in *P. virginiana* but are present on a few specimens collected from one locality in Ohio and one in North Carolina.

This hypothesis is lent some support by measurements of nutlet length. Few of the Thunder Bay specimens include nutlets, but those examined were 2.5–2.8 mm long, a length that is consistent with the range of variation in *Physostegia virginiana* but outside the known limits for *P. ledinghamii* (Table 1). As an alternative hypothesis, it is possible that the Thunder Bay plants represent a disjunct segment of the distribution of *P. ledinghamii,* which originated through long-distance dispersal or possibly by means of a second incident of hybridization between *P. parviflora* and *P. virginiana. P. parviflora* is not presently found anywhere near Thunder Bay, however. A few chromosome counts would do much to illuminate the situation. In the meantime, the bulk of the evidence supports a tentative assignment of the problematical specimens to *P. virginiana.*

ACKNOWLEDGMENTS

I am deeply indebted to Dr. Vernon L. Harms, of the University of Saskatchewan, for providing me with live material for cytological study. This paper is based on a portion of a thesis submitted to Harvard University in partial fulfillment of the requirements for the doctoral degree. I am grateful to Prof. Reed C. Rollins for his advice and support throughout the course of my doctoral research.

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NEW RECORDS OF *CAREX* IN MINNESOTA

GERALD A. WHEELER

In an earlier paper (Wheeler, 1979), I reported three species of *Carex* previously unknown from Minnesota. The present paper deals with four additional *Carex* taxa which previously had not been known from the state. Unless otherwise indicated, all collection numbers cited at the end of this report are my own. All specimens cited are deposited in the University of Minnesota Herbarium (MIN).

Carex hitchcockiana Dewey has been reported from Wisconsin (Mackenzie, 1935) and Iowa (Hartley, 1962; McGregor et al., 1977), but not from Minnesota. In June, 1978, Prof. Thomas Morley and I collected the plant in a deciduous woodland bordering the Mississippi River near St. Paul in Ramsey County. Later the same year, Prof. Morley collected it on the edge of a deciduous forest near Wykoff in Fillmore County and also in a deciduous forest near Lonsdale in Rice County. During the 1979 season, several collections of this species were made along the wooded banks of the Minnesota River in Carver, Scott, Le Sueur, Nicollet, Brown, and Renville counties. One additional collection was made on a wooded slope at Whitewater State Park in Winona County.

Although reported from Wisconsin (Hartley, 1962; Zimmerman, 1976) and Iowa (Mackenzie, 1935), *Carex oligocarpa* Schkuhr has not been reported from Minnesota. This plant was first collected in the state in the same deciduous woodland in Ramsey County where *C. hitchcockiana* was originally found, but at a later date. No additional Minnesota stations were found for *C. oligocarpa* in 1978, but during the 1979 field season several new stations for the species were discovered along the wooded banks of the Minnesota River in Carver, Scott, Le Sueur, Sibley, Nicollet, and Renville counties. Also in 1979, the plant was collected on wooded slopes at two locations in both Winona and Houston counties.

In Minnesota, *Carex hitchcockiana* and *C. oligocarpa* often grow together. They have also been reported as frequent woodland associates elsewhere (Hermann, 1940). Both were considered calciphiles or near-calciphiles by Mackenzie (1935) and this is indeed the case in Minnesota. The preferred habitats for both species in the state are on steep, north- and east-facing wooded slopes overlooking deep stream valleys and in moist, wooded ravines. They have also been found, though more rarely, in flat deciduous woodlands. In all cases, however, the soils involved were calcareous. Based on the presently known distributions for *C. hitchcockiana* and *C. oligocarpa*, the wooded bluffs along the Minnesota River provide the habitats for the northwesternmost stations for each of these species in the United States (Fernald, 1970; McGregor et al., 1977) and Canada (Scoggan, 1978).

Mackenzie (1935) reported *Carex bromoides* Schkuhr as occurring in Wisconsin, but not in Minnesota. In June, 1978, the species was discovered in a low, wet deciduous woods near Harris in Chisago County. Later the same year, the plant was found along the banks of the Kettle River near Askow in Pine County. During the 1979 field season, *C. bromoides* was found at several localities along the Kettle River in Pine and Carlton counties and in a low, wet deciduous woods in William O'Brien State Park in Washington County. In addition, in Pine County the plant has also been found along the banks of the Sand River near St. Croix State Park and in a floodplain woods of the St. Croix River on the Minnesota-Wisconsin border, 14 miles east of Cloverdale. Based on the presently known distribution of the species, the stations along the Kettle River in Pine and Carlton counties are the westernmost for it in the northern portion of the United States (Fernald, 1970) and in Canada (Scoggan, 1978). Specifically, the station on the Kettle River near the town of Kettle River in Carlton County represents the northwesternmost site for it in North America. It is interesting to note that although the species is presently unknown from Iowa, the plant ranges as far southwestward in the United States as Louisiana; also, one station is known from Hidalgo, Mexico (Hermann, 1974).

Mackenzie (1935) reported *Carex gynandra* Schwein. from Wisconsin, but not from Minnesota. Present-day manuals (Fernald, 1970; Gleason and Cronquist, 1963; Scoggan, 1978) treat this entity as a variety of *C. crinita,* i.e., *C. crinita* Lam. var. *gynandra* (Schwein.) Schwein. & Torr. They, too, do not include Minnesota within the range of the taxon. Although six specimens were on deposit at the University Herbarium prior to the beginning of this study of Minnesota *Carex* in 1974, all were labeled *C. crinita* (typical). Since 1974, the writer has collected both *C. crinita* var. *crinita* and *C. crinita* var. *gynandra* in Minnesota and has found that the two are well-marked and easily separated in the state. However, whereas *C. crinita* var. *crinita* is quite widespread in distribution and frequent in occurrence in Minnesota, *C. crinita* var. *gynandra* appears to be confined to the northeastern counties (Lake, St. Louis, and Carlton), where it is infrequent to occasional along the banks of streams and in wet meadows.

Distribution maps show the distribution, by county, of each of the four above discussed *Carex* taxa in Minnesota, Wisconsin, and Iowa. The closed black circles are based on specimens on deposit at the University of Wisconsin, the University of Iowa, Iowa State University,, and the University of Minnesota. The open circles represent records given by McGregor et al. (1977) which have not been verified by the writer.

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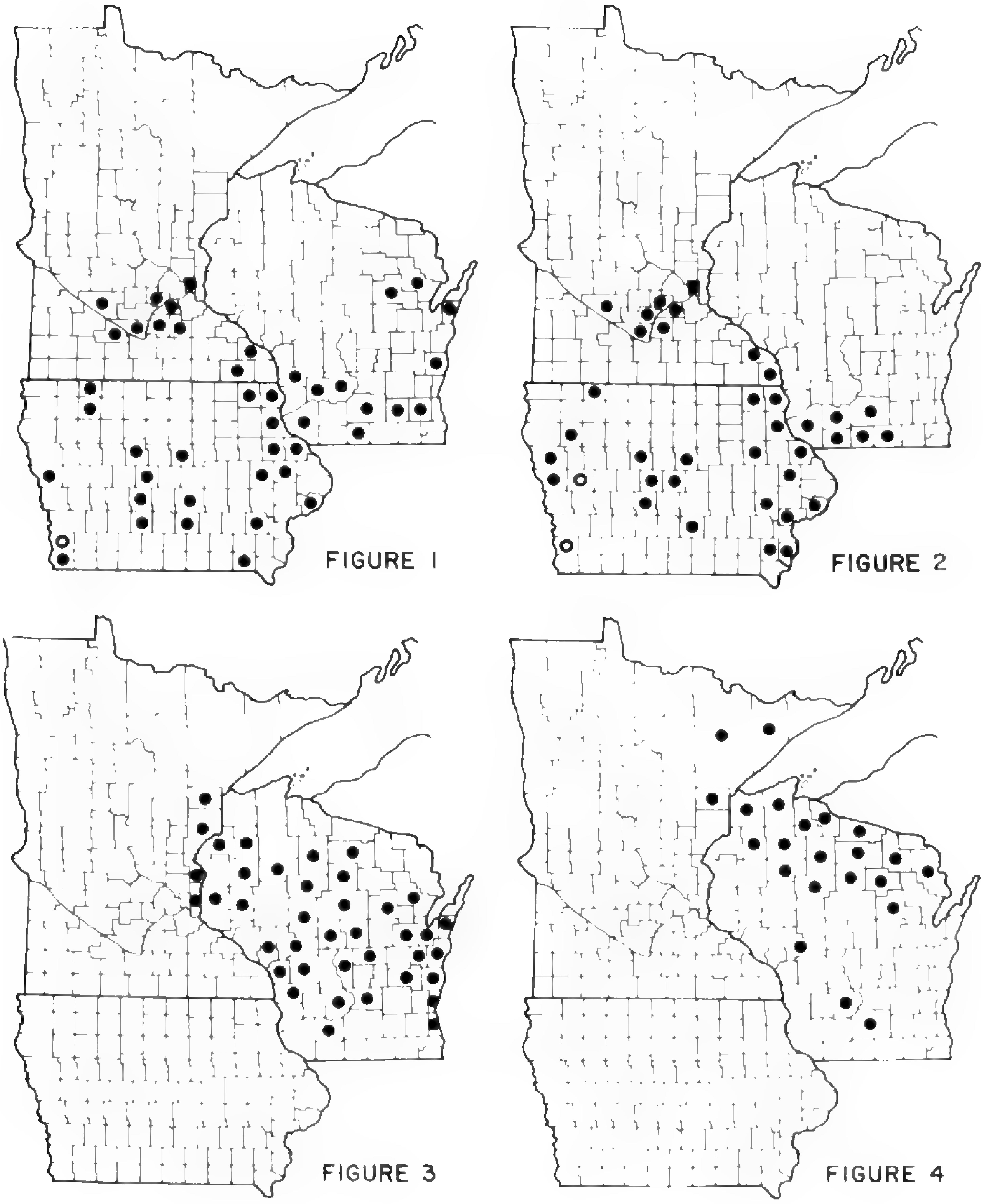
The writer wishes to thank the following individuals for their help: Prof. Gerald B. Ownbey for much valuable help with the manuscript; Prof. Thomas Morley for the enjoyable collecting trips; Dr. James H. Zimmerman, who supplied information on recent collections of these four taxa in Wisconsin; and the curators of those herbaria whose specimens were used in the preparation of the maps. Financial support for the field work from the Dayton Fund of the James Ford Bell Museum of Natural History is gratefully acknowledged.

REPRESENTATIVE COLLECTIONS

CAREX HITCHCOCKIANA Dewey. **Brown Co.:** Rte. 10, 0.25 mi. W. of its jct. with Rte. 4, 8.5 mi. N. of Sleepy Eye, T111N, R32W, Sec. 7, *4133*. **Carver Co.:** 6 mi. SW of East Union on Rte. 40, T114N, R24W, Sec. 30, *4406*. **Fillmore Co.:** near Wykoff, T103N, R12W, Sec. 19, *Morley 1361*. **Le Sueur Co.:** 15.5 mi. W. of New Prague on Rte. 19, T112N, R25W, Sec. 6, *3669*. **Nicollet Co.:** 6 mi. N. of St. Peter on Rte. 169, T111N, R26W, Sec. 16, *3768*. **Ramsey Co.:** near St. Paul, South Mississippi River Drive, T28N, R23W, Sec. 17, *2600*. **Renville Co.:** 0.25 mi. S. of Franklin, T112N, R34W, Sec. 11, *4061*. **Rice Co.:** near Lonsdale, T111N, R22W, Sec. 12, *Morley 1400*. **Scott Co.:** 9.5 mi. W. of New Prague on Rte. 19, T113N, R25W, Sec. 36, *3540*. **Winona Co.:** Whitewater State Park, 5.5 mi. N. of St. Charles on Rte. 74, T107N, R10W, Sec. 20, *3655*.



Carex distributions, by county, in Minnesota, Wisconsin, and Iowa. Figures 1 4. **1,** *Carex hitchcockiana;* **2,** *Carex oligocarpa;* **3,** *Carex bromoides;* **4,** *Carex crinita* var. *gynandra.*

CAREX OLIGOCARPA Schkuhr. **Carver Co.:** 6 mi. SW of East Union on Rte. 40, T114N, R24W, Sec. 30, *4410.* **Houston Co.:** 9 mi. SW of Reno, T101N, R5W, Sec. 15, *4229.* Beaver Creek Valley State Park, 4 mi. W. of Caledonia on Rte. 1, T102N, R6W, Sec. 5, *4237.* **LeSueur Co.:** 15.5 mi. W. of New Prague on Rte. 19, T112N, R25W, Sec. 6, *3666.* **Nicollet Co.:** 6 mi. N. of St. Peter on Rte. 169, T111N, R26W, Sec. 16, *3763.* **Ramsey Co.:** near St. Paul, South Mississippi River Drive, T28N, R23W, Sec. 17, *2625.* **Renville Co.:** 0.25 mi. S. of Franklin, T112N, R34W, Sec. 11, *4060.* **Scott Co.:** 6.5 mi. SW of Belle Plaine, T113N, R25W, Sec. 31, *3797.* **Sibley Co.:** 0.5 mi. W. of Henderson on Rte. 19, T112N, R26W, Sec. 11, *3704.* **Winona Co.:** just W. of Troy, near the jct. of Rte. 74 and Rte. 6, T105N, R10W, Sec. 30, *3533.* Whitewater State Park, 5.5 mi. N. of St. Charles on Rte. 74, T107N, R10W, Sec. 20, *3647.*

CAREX BROMOIDES Schkuhr. **Carlton Co.:** 5.5 mi. W. of Moose Lake, where Rte. 27 crosses the Kettle River, T46N, R20W, Sec. 21, *3909.* 1.5 mi. NW of Kettle River, where Rte. 73 crosses the Kettle River, T46N, R20W, Sec. 5, *3916.* **Chisago Co.:** Goose Creek, 3 mi. NE of Harris, T36N, R21W, Sec. 13, *Clements 1183.* **Pine Co.:** 2.5 mi. W. of Askow, where Rte. 23 crosses the Kettle River, T43N, R20W, Sec. 26, *2596.* 4.5 mi. E. of Hinckley, where Rte. 48 crosses the Kettle River, T41N, R21W, Sec. 23, *3711.* Rutledge, where Rte. 33 crosses the Kettle River, T44N, R20W, Sec. 34, *3893.* 1.5 mi. E. of Cloverdale, where Rte. 48 crosses the Sand River, T41N, R19W, Sec. 26, *3922.* 14 mi. E. of Cloverdale, where Rte. 48 crosses the St. Croix River, T41N, R17W, Sec. 24, *3951.* 0.5 mi. E. of Sandstone, where Rte. 123 crosses the Kettle River, T42N, R20W, Sec. 10, *4550.* **Washington Co.:** William O'Brien State Park, just N. of Marine on St. Croix on Rte. 95, T32N, R19W, Sec. 31, *4000.*

CAREX CRINITA Lam. var. GYNANDRA (Schwein.) Schwein. & Torr. **Carlton Co.:** 1 mi. NW of Holyoke and 1.5 mi. E. of Rte. 23, bank of the Net River, T46N, R16W, Sec. 17, *2548.* **Lake Co.:** 0.25 mi. S. of Silver Bay on Rte. 61, *c-67.* Encampment River, Rte. 61, *Lakela 4069.* **St. Louis Co.:** Front Lake, Kabetogama Peninsula, *Moyle 2606.* French River District, Smith Road, *Lakela 11262.*

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NOTES ON THE FLORA OF KENTUCKY
NEW AND INTERESTING PLANTS IN KENTUCKY

RAYMOND CRANFILL[1] AND MAX E. MEDLEY

The flora of Kentucky must rank as one of the most neglected in the Eastern United States. Our ability to turn up so many records in such a short time is indicative of this situation. All regions of the state merit intensive study, especially the south central counties, and the Western Coalfields, whose swampland vegetation is being extensively decimated by strip mining activities.

During the past two years, the authors have collected extensively throughout the state. This field work has revealed several new state records and many others only reported once or twice before.

A taxon is considered new to Kentucky if absent from the large national herbaria (MO, NY, GH); the in-state University herbaria, including the University of Kentucky as well as others; Memphis State University Herbarium, and from the publications of Braun (1943), Browne and Athey (1977a, 1978), and McFarland (1942). All citations are arranged alphabetically under family. The families are arranged according to Radford, Ahles, and Bell (1968). The nomenclature follows Radford, Ahles, and Bell (1968) and Steyermark (1963). All species here-to-fore unreported from Kentucky are designated by an asterisk.

POACEAE

Melica nitens Nutt. JESSAMINE CO.: Abundant along exposed limestone cliffs, associated with *Juniperus virginiana,* behind the National Cemetary, ca. 1.0 km west of US 27, *Cranfill 4407.* This is the first report of this species from Kentucky since that of Short, Peter, and Griswold (1833).

CYPERACEAE

Cyperus albomarginatus Mart. et Schrad. ex Nees. BALLARD CO.: Abundant along mud flat of empounded slough in the Ballard County Wildlife Area, *Cranfill 2804* (! R. Kral). Previously reported by Browne and Athey (1978).

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***Cyperus iria** L. BALLARD CO.: Ballard County Wildlife Refuge, *Cranfill 2805.* HICKMAN CO.: Sandy ditches along Ky 307 near Murphy's Pond, *Cranfill 3022.* FULTON CO.: Along roadside ditch, Ky 94, *Cranfill 3016.* CALLOWAY CO.: In moist seepage area adjacent to cemetery, Ky 651 north of Murray, *Cranfill 3058.* JEFFERSON CO.: Field off Knop's Cave, *Davies s.n.* A showy, rapidly spreading weed, native to the old world.

***Fimbristylis miliacea** (L.) Vahl. BALLARD CO.: Abundant along mud flats of empounded slough in Ballard County Wildlife Area, with *F. autumnalis* and *Cyperus albomarginatus, Cranfill 2803.* (! R. Kral). A common pest in the rice fields of Louisiana and Arkansas, previously reported no closer to Kentucky than s. central Tennessee and north-eastern Arkansas (Kral, 1971).

PONTEDERIACEAE

Pontederia cordata L. HARDIN CO.: Natural Pond along Ky. Lincoln Trail, now extirpated by development, no specimen. HART CO.: Abundant in 100 Acre Pond, *Cranfill 3537.* Although reported by McFarland, no duplicates remain to voucher its occurrence in the state due to the disastrous herbarium fire of 1948.

LILIACEAE

Maianthemum canadense (L.) Desv. HARLAN CO.: Large sandstone boulder in shade of yellow birches, Cumberland Mt., 5 mi east of Ewing, Va., elevation 1100 m, *Cranfill 2716.* BELL CO.: Along moist creek bank below Sand Cave, Cumberland Mountain, elevation 1000 m, *Cranfill 2783.* Previously reported by Browne and Athey (1977b) from Menifee County.

Trillium undulatum Willd. BELL CO.: In dry woods under *Rhododendron* and *Pinus rigida*, above Sand Cave, Cumberland Mt., elevation 1000 m, *Cranfill 2721.*

Veratrum parviflorum Michx. BELL CO.: Abundant in mesic woods above Martin's Fork on Cumberland Mt., near the White Rocks campsite, elevation 1000 m, *Cranfill 2725.* Previously reported only from Black Mountain (Harlan Co.) by Braun (1943).

ORCHIDACEAE

***Spiranthes magnicamporum** Sheviak. HARDIN CO.: Scattered at the base of shaley outwashes amongst grasses in a glade-prairie on the lip of Muldraugh's Hill, *Cranfill H-1664* (! Sheviak). This very late blooming orchid (October 22) is characterized by its lack of leaves at anthesis, as well as an odiferous, more compact inflorescence than *S. cernua.* Characteristic of the Prairie Peninsula, this record represents a considerable range extension southward from its nearest known stations in central Illinois and northern Indiana.

ARISTOLOCHIACEAE

***Hexastylis shuttleworthii** (B. & B.) Small BELL CO.: Infrequent on moist springy slopes under hemlock, white pine, and yellow birch along side slope of Shileleh Creek, Cumberland Mt., *Cranfill 2553.* Reed (1965) does not mention this species from Kentucky.

CARYOPHYLLACEAE

***Arenaria groenlandica** var. **glabra** (Michx.) Fern. HARLAN CO.: Cumberland Mt., sandstone exposures at the White Rocks, 5 km east of Ewing, Va., elevation 1100 m, *Cranfill 2722.*

***Paronychia argyrocoma** (Michx.) Nutt. HARLAN CO.: On sandstone exposures at the White Rocks, Cumberland Mt., 5 km east of Ewing Va., elevation 1100 m, *Cranfill 2715.*

Silene ovata Pursh HARLAN CO.: Pebbly talus at the south west end of the White Rocks, Cumberland Mt., 5 km east of Ewing, Va. *Cranfill 2723,*. Abundant. WARREN CO.; Southeast side of Shanty Hollow lake, *Nicely 3106.* This represents an amazing disjunct from the Cumberland Mountains.

Silene regia Sims. HARDIN CO.: Along Ky 720, weedy roadside with *Poa pratense* and *Silphium pinnatefidum, Cranfill H1036.* Previously reported by Braun (1943). The corolla possesses the most brilliant crimson of any of our native wildflowers.

RANUNCULACEAE

Aconitum uncinatum L. MENIFEE CO.: Sandy bank of the Red River about 2m above normal flow level, with *Xanthorhiza* and *Tsuga,* *Meijer & Cranfill s.n.* KNOX CO.: 2 km E of Corbin, between east fork of Lynn Camp Creek and the L. & N. Railroad Tracks, about 40 plants with 10 in flower, sandy alluvium of old creek terrace under river birch, *J. MacGregor & H. Bryan s.n.* Previously reported by Braun (1943) for Lewis County.

Thalictrum mirabile Small POWELL CO.: On or near rock ledge on medium to high levels, *C. Weller s.n.* WARREN CO.: Sandstone rockhouse, Shanty Hollow along the Green River, northwest corner of the County, *Nicely s.n.* An endemic of standstone rockhouses, so far limited to Kentucky and northern Alabama.

BRASSICACEAE

Leavenworthia uniflora (Michx.) Britt. HARDIN CO.: Cedar glade along Yates Chapel Rd., 1 km south of Howe Valley, *Cranfill H943.* PULASKI CO.: Rocky pasture on south side of Ky 1003, ca. 2 km east of its junction with Ky 80, *Cranfill 4239.* For the status of this plant, see Baskin and Baskin (1978).

SAXIFRAGACEAE

Boykinia aconitifolia Nutt. MCCREARY CO.: Sphagnum seep on sandstone cliff ledge, Eagle Falls, Cumberland Falls State Park, *Cranfill 2735.* Perhaps the same station as reported by Braun -the only known locality in Kentucky today.

ROSACEAE

***Sorbus arbutifolia** var. **arbutifolia** (L.) Heynhold MCCREARY CO.: In wet seepage area along small creek near junction of old and new US 27, *Cranfill & Medley 3441.* This species has been variously considered to be a *Pyrus* or an *Aronia*.

ACERACEAE

Acer pennsylvanicum L. PIKE CO.: Pine Mt. along Ky 197 in memsophytic woods at Blue Head Rocks, *Cranfill 2597.* HARLAN CO.: Cumberland Mt. on east slope below the White Rocks, *Cranfill 2732.* BELL CO.: Cumberland Mt. near White Rocks overlook, *Cranfill 2733a.*

MALVACEAE

***Sida hermaphrodita** (L.) Rusby GREENUP CO.: Along side creek of Gray's Branch near the Ohio River, *MacGregor & Bryan s.n.* This species, like *Paxistima canbyi,* appears to be a relict of the old Teay's River drainage system.

ONAGRACEAE

Oenothera linifolia Nutt. BRECKINRIDGE CO.: Over-grown pastures and barren area long abandoned county road bed, 0.2 to 0.5 mi south of Cedar Hill Cemetery, Irvington, *Ratliff 555*. (! P. Raven). Another ozarkian disjunct to the eastern Dripping Springs Escarpment.

***Proserpinaca pectinata** Lam. HARDIN CO.: In open marshy area of swamp forest, now being logged, just east of Walter Boone Rd., 0.5 km south of its junction with Ky 220, *Cranfill H1506.* A remarkable disjunct with nearest localities in Coffee County, Tennessee. Since this collection the site has been clear cut and is now extensively grazed.

BORAGINACEAE

***Onosmodium occidentale** Mack. LIVINGSTON CO.: Dry limestone slope, east of US 60, ca. 2 km north of Smithville, *Cranfill 4631.* TODD CO.; In pasture, north side of Cow Creek Rd., ca. 2 km east of Kirkmansville, *Cranfill 3051.* This species was not reported by Das (1965) for Kentucky.

SCROPHULARIACEAE

***Melampyrum lineare** Desv. BELL CO.: White Rocks overlook, Cumberland Mt., 5 km east of Ewing Va., *Medley & Cranfill 069–78.* There is an old record of this species from Menifee Co. in the herbarium at the University of Louisville collected by B. B. McInteer.

ASTERACEAE

Gutierrezia dracunculoides (D.C.) Blake TODD CO.: Abundant over some hundreds of acres of pastureland along Ky 171, ca. 8 km south of Allegre, *Cranfill 3121.* Although still rare in the state (see Baskin &

Baskin, 1972), this species has a potential to become a pernicious weed.

***Solidago radula** Nutt. HARDIN CO.: Along south side of Eastview-Summit Rd. in clearing near where the road crosses to the south of the L. & N. Railroad, *Medley & Cranfill 283–78*.

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TAXONOMIC AND NOMENCLATURAL NOTES ON FERNS

Rolla Tryon and Alice Tryon

In preparation of a treatment of the ferns of tropical America changes in the classification and related nomenclature have been made in genera of several families. The status of these in relation to the general classification will appear in our major work but preliminary notice of them is indicated here.

1. Additions are made to *Cheilanthes,* the largest genus of the xeric ferns, that will aid in recognition of infrageneric groups and will be helpful in revisionary work on this large complex. The changes have particularly resulted in a better definition of some other genera, *Pellaea, Notholaena,* and *Doryopteris. Notholaena* is recognized in a restricted sense for the predominently farinose species of America. Other species usually referred to *Notholaena* are placed in *Cheilanthes,* as well as some often referred to *Pellaea* or to *Doryopteris.*

Cheilanthes arequipensis (Maxon) R. & A. Tryon. *comb. nov., Notholaena arequipensis* Maxon, Smiths. Misc. Coll. **65** (8): 9. 1915.

Cheilanthes concolor (Langsd. & Fisch.) R. & A. Tryon, *comb. nov., Pteris concolor* Langsd. & Fisch., Icon. Fil. **19,** t. 21. 1810, *Doryopteris concolor* (Langsd. & Fisch.) Kuhn.

Cheilanthes decora (Brack.) R. & A. Tryon, *comb. nov., Doryopteris decora* Brack., U. S. Expl. Exped. **16:** 103. 1854.

Cheilanthes geraniifolia (Weath.) R. & A. Tryon, *comb. nov., Notholaena geraniifolia* Weath., Jour. Arn. Arb. **27:** 367. 1946.

Cheilanthes lonchophylla (Tryon), R. & A. Tryon, *comb. nov., Notholaena lonchophylla* Tryon, Contrib. Gray Herb. **179:** 19. 1975.

Cheilanthes Lozanii (Maxon) R. & A. Tryon, *comb. nov., Pellaea Lozanii* Maxon, Contrib. U. S. Nat. Herb. **10:** 500. 1908.

Cheilanthes Skinneri (Hook.) R. & A. Tryon, *comb. nov., Pellaea Skinneri* Hook., Sp. Fil. **2:** 141. 1858.

Cheilanthes venusta (Brade) R. & A. Tryon, *comb. nov., Notholaena venusta* Brade, Anais Primeira Reun. Sul-Amer. Bot. **2:** 7. 1940.

2. A rare species of *Cyrtomium* from Central and South America, originally described as *Phegopteris dubium,* is transferred from

Polystichum. This has anastomosing veins, multiseriate sori, and spores with compact, rather than reticulate perispore structure. These characters clearly relate it to *Cyrtomium* rather than *Polystichum* where it is commonly placed.

Cyrtomium dubium (Karst.) R. & A. Tryon, *comb. nov., Phegopteris dubia* Karst., Fl. Columb. **1:** 169, t. 84. 1861, *Polystichum dubium* (Karst.) Diels.

3. The current studies of the classification of the Hymenophyllaceae by K. Iwatsuki will undoubtedly provide new evidence for a reassessment of the genera. Discussions with Prof. Iwatsuki have indicated that several genera will be recognized in addition to *Hymenophyllum* and *Trichomanes* but the formal systematic arrangement awaits completion of his survey. For the present, Morton's treatment (Contrib. U. S. Nat. Herb. Nat. **38:** 153–214, 1968) is followed for the species that are placed in subgenera of either *Hymenophyllum* or *Trichomanes.* Other small or monotypic genera that do not appear to represent major lines of evolution seem better treated as subgenera. The following two changes in nomenclature are required.

Hymenophyllum subgenus **Hymenoglossum** (Presl) R. & A. Tryon, *stat. nov., Hymenoglossum* Presl, Hymen. 35. 1843.

Hymenophyllum subgenus **Rosenstockia** (Copel.) R. & A. Tryon, *stat. nov., Rosentockia* Copel., Gen. Fil. 36. 1947.

4. The genus *Microlepia* has strongly three-lobed, finely echinate spores that are clearly distinct from the verrucate-tuberculate, reticulate, or ridged spores of *Dennstaedtia.* The collection of *Forster,* at the British Museum representing the type of *Dennstaedtia flaccida* (Forst.) Bernh., the type species of *Dennstaedtia,* has echinate spores and thus is placed in *Microlepia.* This necessitates the conservation of the name *Dennstaedtia* T. Moore in order to avoid its replacement by the name *Sitobolium* Desv. The proposal for conservation has been made in Taxon **29:** 512. 1980. Some similarities of these genera in leaf architecture and and indusia suggest a close alliance; however, differences in chromosome numbers and in spores indicate a more distant relation. The following species of New Guinea is placed in the correct genus.

Microlepia concinna R. & A. Tryon, *nom. nov., Dennstaedia concinna* Rosenst., Hedwigia **56:** 349. 1915, not (Presl) Moore, 1857.

5. The distinction between *Odontosoria* and *Sphenomeris* has not been clear, for their species intergrade. It is recommended by Prof. K. U. Kramer, who has monographed the genera of lindseoid ferns, that these two should be merged. Our observations on these genera are in agreement and new combinations are provided for the following species.

Odontosoris Killipii (Maxon) R. & A. Tryon, *comb. nov., Lindsaea Killipii* Maxon, Contrib. Gray Herb. **165:** 74. 1947, *Sphenomeris Killipii* (Maxon) Kramer.

Odontosoria spathulata (Maxon) R. & A. Tryon, *comb. nov., Lindsaea spathulata* Maxon, Contrib. Gray Herb. **165:** 74. 1974, *Sphenomeris spathulata* (Maxon) Kramer.

6. Diversity within the genus *Pellaea* may be recognized in four sections: *Pellaea, Holcochlaena* Baker, *Platyloma* (J. Sm.) Hook. & Baker, and *Ormopteris*. The latter has not previously been placed in the position of a section.

Pellaea section **Ormopteris** (J.Sm) R. & A. Tryon, *stat. nov., Ormopteris* J. Sm., Hist. Fil. 281. 1875.

7. The peculiar Australian genus*Platyzoma* is treated in a separate tribe of the Pteridaceae. The unusual diverse leaves with two sterile forms as well as modified fertile pinnae and incipient heterospory are exceptional features of these plants. It is placed among the pteroids on the basis of the arrangement of the sporangia along but below the terminal part of the veins and the strongly ridged spores.

Pteridaceae tribe **Platyzomateae** (Nakai) R. & A. Tryon, *stat. nov.,* Platyzomataceae Nakai, Bull. Nat. Sci. Mus. Tokyo **29:** 4. 1950.

8. The large genus *Polystichum* contains several divergent species each of which has been recognized as a segregate genus. These four, *Papuapteris, Sorolepidium, Acropelta,* and *Plecosorus* represent only minor evolutionary developments within *Polystichum. Plecosorus* is an American genus with exindusiate sori borne near the more or less modified segment margin.

Polystichum speciosissimum (Kze.) R. & A. Tryon, *comb. nov.*, *Cheilanthes speciosissima* Kze., Analect. Pterid. **35.** 1837, *Plecosorus speciosissimus* (Kze.) Moore.

9. The following species was formerly treated in *Dryopteris* but the peltate indusium, anastomosing veins and imparipinnate lamina ally it very closely to *Stigmatopteris meniscioides.*

Stigmatopteris paludosa (Morton) R. & A. Tryon, *comb. nov.*, *Dryopteris paludosa* Morton, Bull. Torrey Bot. Club **66:** 50. 1939.

10. In *Tectaria* there is remarkable variation of characters that are usually stable and often afford distinguishing generic features, such as the venation, soral position, the indusium, and the type of stem and scales. Several small genera are sometimes recognized on the basis of these and other less important characters such as the architecture and dimorphism of the leaves. Among these in America only *Hypoderris* is significantly different from *Tectaria.*

Tectaria Amphiblestra R. & A. Tryon, *nom. nov.*, *Pteris latifolia* Willd., Sp. Pl. **5:** 370. 1810, not *Tectaria latifolia* (Forst.) Copel., *Amphiblestra latifolia* (Willd.) Presl.

Tectaria panamensis (Hook.) R. & A. Tryon, *comb. nov.*, *Dictyoxiphium panamense* Hook., Gen. Fil. t. 62. 1840.

Tectaria pedata (Desv.) R. & A. Tryon, *comb. nov.*, *Aspidium pedatum* Desv., Mém. Soc. Linn. Paris **6:** 244. 1827, *Camptodium pedatum* (Desv.) Fée.

Tectaria pinnata (C.Chr.) R. & A. Tryon, *comb. nov.*, *Camptodium pinnatum* C.Chr., Kungl. Svenska Vetenska Vetenskapakad. Handl. III, **16** (2): 37. 1937.

Tectaria prolifera (Hook.) R. & A. Tryon, *comb. nov.*, *Faydenia prolifera* Hook., Gen. Fil. t. 53B. 1840, *nom. nov.* for *Aspidium proliferum* Hook. & Grev. 1828, not R. Br. 1810; *Asplenium proliferum* Sw. 1788, not Lam. 1786; *Aspidium Hookeri* Sweet, 1830, *Faydenia Hookeri* (Sweet) Maxon not *Tectaria Hookeri* Brownlie, 1977.

11. The differences of *Trachypteris* and *Saffordia* in lamina architecture are insufficient to distinguish them considering the similarities of areolate venation, a marginal band of acrostichoid sporangia, and cristate spores.

Trachypteris induta (Maxon) R. & A. Tryon, *comb. nov., Saffordia induta* Maxon, Smiths. Misc. Coll. **16** (4): 2. 1913.

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NEW AND INTERESTING ADDITIONS TO THE FLORA OF NOVA SCOTIA

ROBERT K. PRANGE, CHRISTENE L. RAFUSE, AND ALBERT E. ROLAND

During the summer of 1979, a complete inventory was made of the A. E. Roland Herbarium, Nova Scotia Agricultural College (NSAC). Herbarium specimens of species were found which were new to the province, having been collected since the publishing of *The Flora of Nova Scotia* (Roland & Smith, 1969). Range extensions and new records of species already known were also noted.

SPECIES NEW TO NOVA SCOTIA

Trifolium medium L.—A.E. Roland, July 14, 1970; field at Durham, Pictou County. This species is naturalized from Europe and its previous distribution was "local, eastern Quebec to N.B. and Mass." (Fernald, 1970).

Collinsia parviflora Dougl.—A.E. Roland, June 26, 1970; Weed in strawberry field, Sydney River, Cape Breton County. Its natural distribution is given by Gleason (1952) as "Alaska to California, E. to Man. and S.D., Keweenaw Pt., Mich." He also notes that it is known from S. Ont. and Vt. where it may be introduced. The Nova Scotia collection is also an introduction and perhaps it will not persist.

Carduus nutans L.— R.K. Prange and S.G. Williams, July 20, 1978; abundant on roadside, North of Londonderry, Colchester County. Although Fernald (1970) gives its range as including Nova Scotia, Roland and Smith (1969) reported it as rare to scattered in east central N.B. and that no specimens had been collected in N.S. This is a persistent weed in other areas of Canada and will probably spread along roadsides much as *C. crispus* L. has spread through Cumberland Co. from its introduction at the Port of Pugwash.

RANGE EXTENSIONS AND NEW RECORDS

Cornus stolonifera Michx.—R.K. Prange, June 26, 1978; woods beside stream flowing into north end of Wentzell's Lake, near Bridgewater, Lunenburg Co. This collection is noteworthy because it is the first recorded station in the southwestern and Atlantic areas of the province which generally do not have the rich, alkaline soils that it prefers.

Vicia sepium L.—R.K. Prange, August 30, 1977; along a hedgerow, Great Village, Colchester County. The first and only previous collection was from the border of a field, Annapolis Royal, Annapolis Co. (Fernald, 1922).

Dirca palustris L.—A.E. Roland, October 5, 1971 and May 26, 1972; common in mixed hardwoods, hillside along brook, Milford, Hants County. Previous to this the species was only known from a single sterile bush near the St. Croix River, Newport, Hants Co. (Roland & Smith, 1969).

Polygonum Bistorta L.—C.L. Rafuse, June 9, 1979; along a stream running through the railway yard in Truro. This plant is an adventive from Europe and known only from E. Mass. and in Canada from two clumps in a field in Victoria Park, Truro, Colchester Co. (Fernald, 1922). Due to the lack of collections since then, Roland and Smith (1969) considered it doubtfully present and probably only a temporary escape from cultivation. Obviously it has persisted but has not spread very far.

Lepidium ruderale L.—K.S. Silver, May 24, 1979; from a wet field, Starr's Point, Kings County. Roland and Smith (1969) noted that this "is a rare plant and old collections have been seen from Windsor, Pictou and Sydney".

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NEW RECORDS OF TREE FERNS FROM VENEZUELA

JULIAN A. STEYERMARK AND FRANCISCO ORTEGA

Trichipteris steyermarkii Tryon (1972) was originally described from specimens collected by the senior author from the cloud-forested summits of Cerro de Humo and Cerro Patao, in the Peninsula of Paria, Estado Sucre, Venezuela, at altitudes of 1200–1300 meters. This portion of northeastern Venezuela is noteworthy for its endemic as well as relict flora. In addition to the numerous species known only from Trinidad and/or Tobago which are isolated here in these cloud forests, there are also significant elements of the flora which manifest an affinity with the Guayana-Amazonian region of southern Venezuela (Steyermark & Agostini, 1966, Steyermark, 1974, 1979). In some cases the same species, known elsewhere in southern Venezuela from the Guayana-Amazonian portion, is isolated on these cloud-forested summits, while in other instances the taxon has become differentiated into another species. In the present example, *Trichipteris steyermarkii* has become clearly isolated and separated from its closest relative, *T. sagittifolia* of Trinidad (Tryon, 1972) by the loss of bullate scales on the lower surface of the pinnules and by the absence of long slender spines at the base of the petiole.

During 1978 the junior author collected *T. steyermarkii* from Margarita Island, just north of continental South America. This is an interesting extension of range and is the second collection thus far known. The data for this collection, which was identified by Dr. Rolla Tryon, are as follows: Edo. Nueva Esparta: Isla de Margarita, La Sierra, Cerro Copei, alt. 900 m, selva húmeda, November 20, 1976, *Francisco Ortega 253* (GH, La Salle, VEN).

Cyathea arborea (L.) Sm., according to the latest revision of the genus by Tryon (1976), is a species of the Greater and Lesser Antilles. However, a specimen purported to have been collected from "Caracas", Venezuela by Bredemeyer, was indicated as the type of *Cyathea serra* Willd. (1810). The latter was placed in synonymy under *C. arborea* by Tryon, who stated that "The species is not known from Venezuela. The specimen may have been obtained from a cultivated plant, or more likely from Puerto Rico where Bredemeyer visited before going to Venezuela." Vareschi (1969) included *Cyathea arborea* in his treatment of the ferns for the Flora of Venezuela, but actually did not see any material of the species, stating "No pude encontrar ni una muestra en los herbarios examinados." On the basis of personal communication with Dr. Tryon, the species was omitted from the Flora of Avila (Steyermark & Huber, 1978), since Bredemeyer's "Caracas" locality was considered as an unlikely record.

In 1978 the junior author collected plants identified by Dr. Tryon as *Cyathea arborea* from Margarita Island, Venezuela, just north of continental South America. This specimen, thus, becomes the first authentic record for the species from Venezuela. The flora of Margarita Island manifests intimate affinities with that of the Greater and Lesser Antilles. Many taxa from the Antilles reach their southernmost limits of dispersal on Margarita Island, and are not known to extend farther south to continental South America. Such an example is found in the rubiaceous *Guettarda scabra* (L.) Lam., known from southeastern United States, Mexico, Central America, the Antilles, and south to Margarita Island, Venezuela. Actually, Margarita Island is geologically part of the Coastal Cordillera of northern Venezuela.

The data for the new Venezuelan collections are: Edo. Nueva Esparta: Isla de Margarita, La Sierra, Cerro Copei, alt. 800–900 m, 20 November, 1976, *Francisco Ortega 254*, "helecho arborescente de 5 m de altura, creciendo a orillas de la carretera, en sitios expuestos" (GH, La Salle, VEN).

In his revision of Cyathea (1976), Tryon states that "*Cyathea arborea* typically grows in montane forests, in humid ravines, along water courses and on mountain slopes, from sea level to 1200 m, usually 500–800 m. It frequently persists in cutover land, along forest border and in forest clearing. It is successful as pioneer species, often becoming established in disturbed habitats such as landslides, road cuts and spill and on abandoned lands."

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A LEMON-SCENTED PYCNANTHEMUM (LAMIACEAE)

PAUL D. SØRENSEN
AND
PENNY A. MATEKAITIS

Every botanist with field experience in northeastern North America will agree that the crushed leaves of the mountain mints (*Pycnanthemum spp.*) give off an unmistakable and perhaps unique odor. The odor remains a reliable diagnostic character for plants in the vegetative stages. It was, therefore, with some considerable surprise that we encountered a plant of *Pycnanthemum virginianum* that gave off an odor indistinguishable from that of a squeezed lemon—and not unlike *Melissa officinalis.* A cursory sample of other plants in this population, scattered over ca. 1.5 hectares, revealed several others that gave the citrus odor while the majority still yielded the familiar mountain mintiness. The two odors are so startingly different and distinctive that we believe it is worthwhile to propose the following intraspecific taxon:

Pycnanthemum virginianum f. **citriodora** *forma novum.* TYPUS: *Sørensen, Muller, & Matekaitis 7711A;* sandy sphagnous meadow at Pine Rock Preserve, 4 mi E of Oregon, Illinois, along Ill. highway 64; 27 August 1978. (Holotype: DEK!; Isotypes: DEK!)

Omnino *P. virginiani* simule, odore citroso autem differt.

The lemon-scented character occurs among several taxa of the Lamiaceae. We referred above to the Common Balm, *Melissa officinalis,* often called Lemon Balm. One can also cite *Monarda citriodora,* a plant of the southern plains of the U.S. and adjacent Mexico. However, we have found only one other intraspecific taxon representing a lemon-scented variant of an otherwise non-lemon-scented species, notably the common garden herb, *Thymus serpyllum* var. *citriodora.* We describe this new taxon at the rank of *forma* rather than that of *varietas* so as to lay emphasis on the fact that its occurrence so far as we know is limited to a mutation that has taken place in a single population. We have checked at random a token representation of *Pycnanthemum virginianum* populations in northern Illinois without finding a recurrence of the mutation. We welcome information from other workers in the field on whether populations elsewhere exhibit this variability.

Grieve (1931) reports that Prairie Bergamot (*Monarda citriodora*) yields a citral and a phenol that account for its lemon-scented character. Investigations presently underway on *Pycnanthemum virginianum* f. *citriodora* are planned to reveal 1) the nature of the odor-causing compounds and 2) the genetic system that has brought about the change

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HYDROCHARIS MORSUS-RANAE (HYDROCHARITACEAE): NEW TO THE UNITED STATES

Marvin L. Roberts, Ronald L. Stuckey, Richard S. Mitchell

The European Frogbit, *Hydrocharis morsus-ranae* L., is an alien aquatic vascular plant previously reported from North America only in Ontario and Quebec, Canada. Minshall (1940) stated that the species was introduced in 1932 to the Arboretum at the Central Experimental Farm, Ottawa, from Zurich, Switzerland. By 1936 the plants covered a very shallow small pond in the Arboretum, and three years later they had escaped into the Rideau Canal. Dore (1968), after making extensive field surveys to document the expansion of its range, showed that by 1967 Frogbit had spread downstream in the Rideau River wastershed, the Ottawa River, and the St. Lawrence River at and below Lake St. Louis.

In the United States, two colonies of *Hydrocharis morsus-ranae* have recently been discovered along the St. Lawrence River in New York. Specimens from the first locality were obtained on 13 September 1974, just south of Ogdensburg, St. Lawrence County (*F. M. Uhler s.n.*, NYS) and from the second on 10 September 1979, at Kring Point State Park, about 10 miles east of Alexandria Bay, Jefferson County (*M. L. Roberts 5133*, NYS, OS, PH). At the latter locality large mats of the plants were growing in water two to three feet deep. Associated species were *Ceratophyllum demersum, Lemna trisulca, Myriophyllum spicatum, Potamogeton perfoliatus,* and *Vallisneria americana.* The plants in the St. Lawrence River probably have spread from populations in the Rideau Canal. This canal system enters the St. Lawrence River and the eastern end of Lake Ontario only 35 miles west of (upstream from) Kring Point. Dore (1968) suggested that the canal system would be a very susceptible avenue to the rapid spread of aquatic weeds. At that time, *H. morsus-ranae* occurred in the canal only on the Ottawa River side of the canal summit. The species has not only spread into the St. Lawrence River, but it has also appeared about 14 miles inland, where plants have been obtained from a pond at a New York Department of Environmental Conservation wetlands preserve, between Rensselaer Falls and DeKalb Junction, St. Lawrence County (15 June 1977, *R. S. Mitchell & K. Dean 6032,* NYS). Additional spreading of the plants is to be expected on the Lake Ontario side of the canal summit.

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A NEW NAME FOR A PUERTO RICAN TREE FERN

David S. Conant

The species currently known as *Alsophila dryopteroides* (Cyatheaceae), an endemic of the central mountains of Puerto Rico, requires a new name. The Leningrad edition of the International Code of Botanical Nomenclature (1978) indicates that an incorrect compounding form is to be corrected (Art. 73.8) and therefore *Alsophila dryopteridoides* (Maxon) Tryon is a later homonym of *Alsophila dryopteridoides* Domin.

Alsophila aminta Conant, *nom. nov.* for *Cyathea dryopteridoides* Maxon, Amer. Fern Journ. **14**:99. 1925 (as *dryopteroides*).

Alsophila dryopteridoides (Maxon) Tryon, Contrib. Gray Herb. **200**:29. 1970 (as *dryopteroides*). Not *Alsophila dryopteridoides* Domin, Kew Bull. **1929**: 218 = *Trichipteris dicromatolepis* (Fée) Tryon.

This species is named for Aminta Kitfield Conant in recognition of her assistance in field studies of this tree fern in the mountains of Puerto Rico.

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BOOK REVIEW

AN ILLUSTRATED SYNOPTICAL FLORA OF BAJA CALIFORNIA[1]

REED C. ROLLINS

From a lifetime of field work in Baja California, studies in herbaria and libraries in the relevant places of the United States and Europe, and continuous research on the plants themselves at his home base, Stanford University, Professor Emeritus Ira L. Wiggins has brought together a magnificant book covering the higher plants of the 1300 kilometer peninsula. No other person excels Dr. Wiggins in knowledgee of the Sonoran Desert flora which covers most of Baja California. The present book is rooted in an earlier one, "Vegetation and Flora of the Sonoran Desert" by Forrest Shreve and Ira L. Wiggins, published in 1964. Wiggins did the "flora" part of that book.

The Baja California peninsula provides a marvelous range of plant habitats, from dry to moist islands off the adjacent Pacific Coast or in the Gulf of California, from dry to moist places in the lowland desert and from dry to moist sites in canyons and mountains. A series of rugged mountains run the length of the peninsula and reach an elevation of 3,090 meters at the highest peak, La Providencia. These are flanked by evergreen forests, mountain meadows, scattered lower ranges, chaparral, salt flats, vernal pools, and vast deserts. The rainfall varies tremendously in short distances. For example, coming mostly in the winter, the total average annual rainfall at San Felipe is about 6 centimeters, whereas at a station in the Sierra San Pedro Martir, less than 50 kilomters away, it varies from 75 to 90 centimeters. Similarly, but in summer, in the Cape Region, 5 centimeters at La Paz and 75 to 80 centimeters around the lagunas in the higher, northern parts of Sierra Victoria. With such a wide diversity of habitats, climate, and topography, coupled with the semi-isolation of the long peninsula and the isolation of its many islands, it is surprising that endemism in the flora is not higher than 23.2 per cent of the 2,958 species, subspecies, and varieties listed in the flora. For comparison, endemism for the same taxa in the flora of the

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[1] Wiggins, Ira J. *Flora of Baja California.* i-viii, 1 1025, 1980. Stanford University Press, Stanford, California. (Price: $65.00.)

California Province to the north is 47.7 per cent. However, such a curious plant as the "Boojum Tree," *Idria columnaris,* gives a weird aspect to the flora of parts of the peninsula and an illusion that the plants in general must be distinctive.

In the opening chapter, Wiggins gives a full and well-balanced description of Baja California including an excellent map and many place names. The physiography, including a table giving information on the many islands, the stratigraphy, historical geology, minerals and mining, drainage systems, soils, and climate are given for the peninsula in a brief and succinct way. An extended account of the major plant communities drawn largely from the earlier publication of Shreve and Wiggins, a section on endemism, one on botanical exploration, some notes on methods used in arriving at the taxonomic treatment, and a summary view of the flora complete the introductory material.

The flora itself occupies slightly more than 900 pages of the book. The treatment is synoptical in character. That is, there are short descriptions of all major taxa including the genera but whatever descriptive material there is for each species is included in the key to the species under each genus. If a genus is monotypic then a key is not required. Authors for the recognized species are given but there are no citations of publications and no synonymy. This appears to be a compromise to reduce as far as possible the bulk of printed matter. Some of the space thus saved is taken up by notes from the author. Freedom from a rigid form has permitted him to provide his personal knowledge of the particular plant being treated. These notes are a significant part of the work and in them are items not available elsewhere.

The arrangment of the flora does not follow any particular system except in broad outline. As is customary, the ferns and fern allies are first, followed by the gymnosperms, then the angiosperms. The dicotyledons are broken down to the Apetalae, Gamopetalae, and Polypetalae, and are presented in that order. The families and genera under the families are given alphabetically. The monocotyledons make up the final section of the flora. This is followed by reference material which includes a glossary of botanical terms and an index of botanical names.

The illustrations are drawn from a number of sources but many were done specifically for Flora of Baja California by Wiggins himself. At least one species in each genus is illustrated, and in genera with numerous species occuring on the peninsula usually several species have illustrations. The artist most frequently represented appears to be Jeanne Russell Janish, an excellent botanical illustrator.

The book was crafted for the Stanford University Press which by now has stamped a distinctive style upon its botanical publications. The paper and binding are of high quality and the format is unusually clear and readable. I did not search diligently for mistakes but none of a serious nature was detected. There are a few inconsistencies and it would be surprising in a work with so many minutia if some errors did not creep in. But it safe to say that the book is virtually mistake-free. This speaks very favorably for the author, his wife Dorothy who helped with the proof-reading, and the publisher.

The Flora of Baja California is a fitting monument to Professor Ira L. Wiggins, who has spent a lifetime devoted to botany in a high order of dedication that few ever achieve. I can attest to this first hand, for it was my privilege to work beside him in the Dudley Herbarium, then in the Natural History Museum on the Stanford campus, for a number of years, and to accompany him on a memorable six week field trip to the state of Sonora, Mexico, in 1941. His work habits, his insights into botanical and all manner of other matters are phenomenal. I salute him on the major accomplishment that brings this excellent book to the botanical public.

NOTICE OF PUBLICATION

Porsild, A. E., & W. J. Cody. *Vascular Plants of Continental Northwest Territories, Canada.* viii + 667pp. 1980. National Museums of Canada. Distributed by the University of Chicago Press. (Price: $85.00).

This is a comprehensive treatment of the ferns, fern allies, and flowering plants of the large area lying between Hudson Bay and Yukon Territory, and between 60° N Latitude and the Arctic coast. The main body of the work comprises keys, descriptions, and information on habitat and general distribution for the 1112 species known to be present in the area, as well as for several taxa not yet found but to be expected. 978 small but clear line drawings complement the descriptions, and dot distribution maps are provided for all the native species and many varieties. Also included are a brief description of the six main phytogeographic provinces of the area; a tabulation of the families, genera, and species; an excerpted history of botanical collection (including some harrowing times during early explorations and searches for the "Northwest Passage); a selected bibliography; a glossary; and an index.

NEW ENGLAND NOTES

TETRAPHIS GENICULATA: A NEW LOCATION FOR A RARE MOSS IN NEW ENGLAND

JANICE M. GLIME AND ROANA HOLCOMB

Forman (1962) mapped the distribution of *Tetraphis geniculata* Girg. in North America and encouraged bryologists to report more locations for this rare moss which has its southernmost known station in eastern North America in New Hampshire. Forman (1961) had earlier reported the first record of the species from the Mount Washington area near Crystal Cascades. His specimen was the fourth record for the state. In over 200 collections of *Tetraphis* made on Mount Washington, only one contained *T. geniculata.*

Forman (1962) summarized the known habitats for the species and suggested that it is most common on rotten coniferous wood in coniferous forests near water. For no less than 20% of the herbarium material examined by him, he noted that it occurred with *T. pellucida* Hedw.

We collected *Tetraphis geniculata* at Franconia Notch, New Hampshire, less than 100 m from the Flume and only a few meters from the path (*Glime 3158,* 27 May 1979). It was growing on rotting wood among plants of *T. pellucida* Hedw., and sporophytes of both species were present. The forest was predominately hemlock, *Tsuga canadensis* (L.) Carr. Flume Brook was 15–20 m from the place where the moss grew and the area was cool and damp.

When with sporophytes *Tetraphis geniculata* is distinguished by long, bent setae, which are roughened with papillae above the bend. Several patches were growing in a radius of 5 m, but we did not notice any plants elsewhere in the Notch or during two weeks collecting bryophytes at other places in New England.

A voucher specimen is in the Michigan Technological University Cryptogamic Herbarium.

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ANOTHER STATION FOR *CONOPHOLIS AMERICANA* (OROBANCHACEAE) IN NEW HAMPSHIRE

DAVID E. BOUFFORD

Conopholis americana (L.) Wallroth is rare in New Hampshire, being known from only four localities according to Storks and Crow (1978). Recent discovery of another specimen of *Conopholis* from New Hampshire in the Carnegie Museum of Natural History herbarium (CM) has yielded a fifth station.

In 1971 Dr. L. K. Henry, then Curator in the Section of Botany at the Museum, made a field trip to New Hampshire, where he collected approximately 370 specimens. Among his collections is a single sheet of *Conopholis* from Belknap County. The label data, unfortunately, are meager, giving only "New Hampshire, Belknap County, town of Meredith, *L. K. Henry,* 3 August 1971". This collection now brings to 4 (Belknap, Carroll, Cheshire, and Strafford) the number of counties from which *Conopholis* is known in New Hampshire.

In light of the recent finding of *Conopholis* by Henry Woolsey (pers. comm.) in Westmoreland, Cheshire County, it seems likely that additional stations for this plant may occur in the Connecticut River valley of southwestern New Hampshire. One particularly good possibility appears to be Mt. Wantastiquet in the town of Hinsdale, one of the few places in the state where rattlesnakes occur. The more southerly aspect of the vegetation and the relatively large numbers of species of *Quercus* on south and west facing slopes in the Connecticut valley of southwestern New Hampshire would seem to provide ideal situations where further populations of *Conopholis* could be found.

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SARRACENIA PURPUREA L. FORMA HETEROPHYLLA (EATON) FERNALD: NEW TO CONNECTICUT

James T. Robinson

The distribution of this form of *Sarracenia purpurea* ssp. *purpurea* is limited to the northeastern coastal and north-central portions of North America. Bell (1949) cited herbarium specimens from the following locations: Northampton, Mass. (type loc., Eaton, 1822); Main Arm, Bonne Bay, Newfoundland (Fernald & Long); Exploits River and Badger Brook, Newfoundland (Robinson & Schrenk); Young's Lake, Belle Isle, Annapolis Co., Nova Scotia (Fernald); and Forked River, New Jersey (Britton). More recently, the form has been found in northern Michigan (Case, 1956), Ontario (Korolas, 1977) and Minnesota (Griesbach, 1977).

On January 15, 1980, while exploring the frozen-over open bog in the Bolleswood Natural Area of the Connecticut Arboretum at Connecticut College, I counted 14 specimens of *Sarracenia purpurea* f. *heterophylla.* The specimens were all a distinct yellowish-green color, devoid of any red pigment. The individuals were scattered among typical red forms of the species and no forms intermediate between red and yellow were seen. Case (1956) reported orange-red forms in northern Michigan, yet apparently no such forms have ever been reported from northeastern North America. Given the distance separating eastern and central populations of the form, it may be that mutated genes causing intermediate color forms in central populations (Schnell and Mazrimas, 1972) are absent in eastern populations. As part of our long range ecological studies in this natural portion of the Arboretum, we will keep a yearly total of the number of individuals of *S. purpurea* f. *heterophylla* present in the bog.

A voucher specimen from this find is on file in the Graves Herbarium at Connecticut College.

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PYRUS SIEBOLDII (ROSACEAE) NATURALIZING IN MASSACHUSETTS

Ray Angelo

Along an old railroad bed that passes near the confluence of the Assabet and Sudbury Rivers in Concord, Massachusetts, are numerous seedlings of *Pyrus sieboldii* Reg. (Toringo Crabapple) with its distinctly 3-lobed shoot leaves. Nearby in the damp woods on both sides of the Assabet River one may find occasional individuals of this species that have matured into small trees about 3–4 meters high.

In the vicinity of Munroe Brook in Lexington, Massachusetts, this species is seeding into sandy waste areas adjacent to an old crabapple plantation. Seedlings have also been seen in Lincoln, Massachusetts, and on the grounds of the Arnold Arboretum in Jamaica Plain near plantations of crabapple.

Among the various crabapples that may be cultivated in New England, *Pyrus sieboldii* is the only species with the following combination of characters: shoot leaves 3- (occasionally 5-) lobed, blades 2.5–6 cm long, and fruit 6–8 mm thick with deciduous calyx (Rehder, 1940). The species is described and illustrated by Asami (1927) and also described by Rehder (1940). The mature specimens seen are apparently the tree form (forma *arborescens*) described by Rehder (1940) and introduced from Japan and Korea in 1892. None of the regional manuals or checklists cite this species for New England (including the recent Flora of Concord (Eaton, 1974)). An adaptation of the Asami illustration and leaf prints of this crabapple are presented in a recent field guide (Angelo, 1978).

A previously unidentified vegetative specimen collected in 1972 by

Richard J. Eaton and Henry K. Svenson from Halifax, Massachusetts, in the herbarium of the New England Botanical Club is apparently the first collection of this species in New England. Flowering and fruiting specimens, 7 May 1977 and 23 Sept. 1977, *R. Angelo,* from the same tagged tree, were collected in Concord, Massachusetts, and have been deposited in the herbaria of the Concord Field Station and the New England Botanical Club.

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DROSERA ANGLICA HUDS., NEW TO NEW ENGLAND

L. M. EASTMAN

After an absence of forty years, *Drosera linearis* Goldie was relocated at Crystal Bog, Crystal, Aroostook County, Maine in June 1978 by two Aroostook County residents, Sally Rooney and Candy McKellar (1979), while working on a survey project for Nature Conservancy.

On July 18, 1979, acting as guides, the two conservationists led Clotilde Straus, Harry Tyler, Susan Gawler, and myself to the above station which is located in an area known as Thousand Acre. Within a short time of our arrival, Dr. Straus observed another species of *Drosera* which was first thought to be *Drosera intermedia* Hayne. Closer examination of the plant, especially the stipules which were adnate to the petiole, showed the specimen to be *Drosera anglica* Huds. A number of these plants were observed growing in *Sphagnum* on the edge and in the middle of large, cool, muck holes. Other plants growing in association with *Drosera anglica* Huds. were *D. rotundifolia* L., *D. intermedia* Hayne, *D. linearis* Goldie, *Scirpus cespitosus* L., *Carex limosa* L., and *Scheuchzeria palustris* var. *americana* Fern.

On July 25, 1979, George Newman of Bedford, New Hampshire,

Fig. 1. *Drosera anglica* Huds. at Crystal, Maine

and I revisited the site. A few plants were collected; some were reproducing vegetatively. Tiny plants were observed growing from the center of mature leaves that had been submerged in water a case of gemipary.

At the present time this is the only known existing occurrence for *Drosera anglica* Huds. in New England. The nearest known stations are Gaspé County, Quebec and Bruce County, Ontario. Specimens and color photographs have been deposited in the herbaria of the New England Botanical Club and the University of Maine.

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Contrary to prior policy, Rhodora now requests that an abstract be supplied with all papers submitted except for very short articles and notes.

RHODORA **January 1981** **Vol. 83, No. 833**

CONTENTS

Taxonomic revision of Centratherum and Phyllocephalum (Compositae: Vernonieae)
L. Katherine Kirkman 1

The flora of Cuttyhunk Island, Massachusetts: with an analysis of vegetational changes over the past half century
Sharman D. O'Neill 25

Synoptic classification and pollen morphology of Vernonia (Compositae: Vernonieae) in the Old World
Samuel B. Jones 59

Taxonomic revision of Piptocoma Cass. (Compositae: Vernonieaa)
John G. Stutts and *M. A. Muir* 77

The genus Oncidium Sw. (Orchidaceae) in the Bahama Archipelago
Ruben P. Sauleda and *Ralph M. Adams* 87

Autecological aspects of Diapensia lapponica L. in Newfoundland
Robin T. Day and *Peter J. Scott* 101

Change in status for Physostegia virginiana var. ledinghamii (Labiatae) and evidence for a hybrid origin
Philip D. Catino 111

New records of Carex in Minnesota
Gerald A. Wheeler 119

Notes on the flora of Kentucky: New and interesting plants in Kentucky
Raymond Cranfill and *Max E. Medley* 125

Taxonomic and nomenclatural notes on ferns
Rolla Tryon and *Alice Tryon* 133

New and interesting additions to the flora of Nova Scotia
Robert K. Prange, Christene L. Rafuse, and *Albert E. Roland* . 139

New records of tree ferns from Venezuela
Julian A. Steyermark and *Francisco Ortega* 141

A lemon-scented Pycnanthemum (Lamiaceae)
Paul D. Sørensen and *Penny A. Matekaitis* 145

Hydrocharis morsus-ranae (Hydrocharitaceae): new to the United States
Marvin L. Roberts, Ronald L. Stuckey, Richard S. Mitchell . 147

A new name for a Puerto Rican tree fern
David S. Conant 149

Book review: An illustrated synoptical flora of Baja California
Reed C. Rollins 150

Notice of Publication 153

NEW ENGLAND NOTES:

Tetraphis geniculata: a new location for a rare moss in New England
Janice M. Glime and *Roanna Holcomb* 154

Another station for Conopholis americana (Orobanchaceae) in New Hampshire
David E. Boufford 155

Sarracenia purpurea L. forma heterophylla (Eaton) Fernald: New to Connecticut
James T. Robinson 157

Pyrus sieboldii (Rosaceae) naturalizing in Masschusetts
Ray Angelo 157

Drosera anglica Huds., new to New England
L.M. Eastman 158

Instructions to contributors to RHODORA . . . . . Inside back cover

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Cover illustration

Caltha palustris L., known to Thoreau as “Cowslip” and commonly called Marsh Marigold, is a low perennial herb which provides a bright accent to wet woods and meadows, swamps, bogs, and other wet places across the northern United States and Canada and south along the Appalachians to the Carolinas and Tennessee.

Original artwork by Carol Ann Kearns

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JOURNAL OF THE

NEW ENGLAND BOTANICAL CLUB

Vol. 83 April 1981 No. 834

A LIST OF THE DICOTYLEDONEAE OF BELIZE

John D. Dwyer and David L. Spellman

In 1975 David L. Spellman, John D. Dwyer, and Gerrit Davidse (1975) published a list of the Monocotyledoneae of Belize, listing as many collections dating from 1967 to 1975 as were available. The paper included a history of plant collecting in Belize with particular reference to the collecting carried on between 1972–1974 by botanists from the Missouri Botanical Garden. Most of the literature cited for the Monocotyledoneae is applicable to the present paper and is entered into the bibliography. We estimate that the list of the Dicotyledoneae includes about 90% of the species of the country. While a number of species on the list may be reduced to synonomy by specialists, these will be counterbalanced by additional species resulting from further botanical exploration of relatively unexplored areas such as the Maya Mountains.

Belize, in recent years, has experienced an influx of archaeologists and students of land resources. As occasionally their work includes a study of vegetation, several workers have collected herbarium material as vouchers, these being forwarded to the Missouri Botanical Garden for identification. On the other hand, there has been a decline in large scale collecting of herbarium material in Belize. The yield of new species from the 1972–1974 forays of the Missouri Botanical Garden, in which at least 6000 numbers of flowering plants were collected, has been remarkably low.

The authors are not encouraging a cessation of plant collecting in Belize any more than they would advocate that botanizing cease in the Republic of Panama because the Canal Zone has been covered so thoroughly. The flora of the Maya Mountains in Belize, for example, is not well known despite the fact that the maximum elevation is only 1150 meters. While the mountains are low, their summits are not readily accessible. The wetter areas of the southwestern corner of the country bordering on Guatemala are in need of extensive exploration. Collecting along the inner reaches of the Moho and Temash rivers may be rewarding, although there is now an influx of immigrants in these areas, resulting in a disturbance of the vegetation.

While Belize has only approximately 2500 species of Dicotyledoneae (our estimate), it possesses as much diversity of habitat at sea level as any country in Middle America. The savannas represent the most interesting biome, offering excellent opportunity for ecological study. The same may be said for the flora associated with the stands of *Pinus caribaea* in the vicinity of Mountain Pine Ridge (Cayo District) and Willow Bank near the Belize-Orange Walk Districts, as well as the adjacent second-growth deciduous forests merging with these pine stands. The relatively isolated forests between Millionario and Cuevas (Cayo District) is especially interesting. The area from Cuevas to the Sarstoon River near the Belize-Guatemala border, has not been adequately botanized. Collecting in the wet forests along the Hummingbird Highway, in the direction of Stann Creek (now called Dangriga), south of Belmopan, is profitable. While the cays have a rightful place in botanical studies, especially in ecology, they are not particularly attractive to collectors of flowering plants because of the few species occurring there. The mangrove swamps, while usually accessible by boat, and especially in the vicinity of Belize City, by road, have a limited number of species of flowering plants.

In the first quarter of this century a number of new species were described from Belize. Many of the types are not readily accessible, often making critical identification difficult. In the list we have attempted to include all species described in the literature which have been accepted by specialists.

In 1933–1934 William A. Schipp, an Australian and a professional plant collector, compiled a list of the flora of the Stann Creek and Toledo Districts of British Honduras. This was issued as a mimeographed catalogue: *Flora of British Honduras, Pricelist of Seeds and Herbarium Material.* Richard M. Lowden in *Taxon* (1970) discussed in detail Schipp's botanical exploration and collections in Belize. He pointed out that herbarium material was sold by Schipp in sets and that the bulk of the identification was done by Paul C. Standley: "The set of specimens sent to Paul C. Standley at the Field Museum of Natural History was retained without charge after identifications were made." As Standley did much of the identification, the importance of the Catalogue as a scientific contribution is obvious.

In studying Schipp's list, as well as Lowden's compilation of species described as new from the Schipp collections, we find that 138 species of Dicotyledoneae are listed, at least 44 of which have been reduced to synonomy by specialists. The names which have been accepted are included in our list. The holotypes of 112 of the 138 species are deposited in the Field Museum (F), while 12 are located in the herbarium of the University of Michigan (MICH). The remaining few holotypes are scattered in A, G, H, KW, NY, and S. Isotypes are found in several herbaria, principally in the University of Michigan and BRH.

Of the 138 species of Dicotyledoneae described as new from Schipp's collections, 94 were described by Paul Standley. Twenty-six of the 94, according to Lowden, have been reduced to synonomy. As pointed out, Standley's contribution to Schipp's Catalogue was great. The Catalogue was "to serve as a prelude to a more comprehensive work on the total British Honduran flora" (Lowden, loc. cit.). When Standley and Samuel C. Record (1936) published *The Forests and Flora of British Honduras*, Schipp did not proceed with his projected flora. While Standley and Record's work is important historically and contains numerous notes on Belize flowering plants, it is out of date and incomplete, listing only about 1100 species of Dicotyledoneae. This is less than one half the number in our list.

The *Flora* of Guatemala initiated in 1958 by Paul C. Standley and Julian A. Steyermark was completed in 1977. With few exceptions, the families in our list are found in the *Flora of Guatemala*. The latter includes Belize within its geographical limits and this has been of great help in preparing the present list.

In our list, after each family heading, we have placed in parentheses the reference in *Fieldiana* for treatment of the family.

Of the 120 families of Dicotyledoneae in Belize more than one third of the species fall into 11 families; the figure given after each family has been rounded off:

Leguminosae – 275 species
Compositae – 175
Rubiaceae – 135
Euphorbiaceae – 100
Melastomaceae – 85

Myrtaceae – 70
Piperaceae – 60
Moraceae – 55
Bignoniaceae – 50
Labiatae – 35
Lentibulariaceae – 25

Hopefully our list will assist those wishing to identify their Belize collections with speed and accuracy. Belize is an excellent country for those seeking an outdoor "classroom" in the taxonomy of tropical plants. The country is small and all the Districts are accessible by car and many by boat. Collecting permits, obtainable at the Forestry Dept. in Belmopan are required and should be applied for well in advance of the field trip.

The following are those who collected in Belize from 1967 to the present time. The abbreviation of the name of the collector, as used in this paper, is shown in parentheses. An asterisk before a collector's name indicates that the majority of collections are represented in the herbarium of the Missouri Botanical Garden. Numerous duplicates of the Belize collections of T. Croat, J. Dwyer, A. Gentry, and R. Liesner have been distributed to several herbaria.

* Arnason, John (A)
Boutin, Fred (B in B & S)
Bradley, E.O. (Bradley)
Burch, Derek (B)
Clark, W.J. (Clark)
Clevidence (Clev.)
Coffin (Cof.)
* Coomes, Robert (C in D & C)
* Crankshaw, William (Crank)
* Croat, Thomas (C)
* Dieckman, Rev. L. (Dieck.)
* Dwyer, John (D)
* Elias, Thomas (E in DEM)
Etheridge (Etheridge)
Fosberg, Raymond (Fos)
* Gentry, Alwyn (G)
Graham, Elizabeth (Graham)
Hunt, D.R. (H)
* Huston, John (Hus)

* Ives, Joseph (I)
* Jansen, David (J)
Kellman, M.C. (K)
Lambert, J. (Lambert)
Lazor, Robert (Laz)
* Leino, Philip (Leino)
* Liesner, Ron (L)
Linhart, Yon (Lin)
Long, Robert (Long)
McDaniel, Sydney (McD)
* Maxwell, Richard (M in DEM)
* Newey, Walter (N)
Pippin, Richard (P in D & P)
Pringle (Pringle)
Proctor, George (P)
Puleston, Dennis (Pul)
Sachet, M.H. (Sach)
Schlosser (S in B & S)
Sorenson, Paul (Sor)
Sousa, Mario (Sousa)
* Spellman, David (Sp)
* Stoddart, D.R. (St.)
Tyson, Edward (Tyson)
* Uck, Felix (Uck)
* Ugent, Donald (U)
Utley, John (Ut)
* Vaughn, Joseph (V in DSWV)
* Vanderveen, Bruce (V)
Weaver, R.E. (W in Wilb. & W)
Whitefoord, C. (WH)
Wilbur, T. (Wilbur)
* Wiley, Joseph (Wil)
* Wunderlin, Richard (W in DSWV)

The following are the abbreviations of two or more collectors who worked as a team:

A & L = Arnason & Lambert
B & S = Boutin and Schlosser
DEM = Dwyer, Elias and Maxwell
DSWV = Dwyer, Spellman, Wunderlin & Vaughn

D & C = Dwyer & Coomes
D & Dieck = Dwyer & Dieckman
D & L = Dwyer and Liesner
D & P = Dwyer & Pippin
Fos & Sach = Fosberg & Sachet
J & I = Jansen & Ives
L & D = Liesner & Dwyer
Sp & N = Spellman & Newey
Sp & St = Spellman & Stoddard
Wilb & W = Wilbur & Weaver

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to the Belize Government for permitting extensive collecting in the country, especially to the Hon. George Price, Premier of Belize, a naturalist in his own right, to Mr. H. Flowers, Chief Forestry Officer of Belize, to Mr. E.O. Bradley, Forester of Belize (now retired), to Rev. Leonard Dieckman S.J. of St. John's College, Belize, for his all-around assistance, and to Mrs. Meg Craig for her invaluable help. So many specialists have assisted the authors, either directly or indirectly, that it is impossible to express adequately our thanks by listing their names individually.

DICOTYLEDONAE OF BELIZE

ACANTHACEAE

Fieldiana 10 (3) : 328-461. 1974

Aphelandra aurantiaca (Schweidw.) Lindl.
A. deppeana Schlecht. & Cham. C23905; DEM 212, 403, 520: K 606; Leino 332, 357, 363, 377; McD & Clark 14358; P 29493, 29631; Sp 1969; U 83; Uck 17807; Wil 332, 357, 363, 377
A. repanda Nees
Barleria micans Nees
Blechnum brownei Juss. C24117; DEM 65; K526
Bravaisia grandiflora Donn. Sm. A & L 17152
B. tubiflora Hemsl.
Dicliptera assurgens (L.) Juss. McD 13070
D. sumichrasti Lindau
Elytraria imbricata (Vahl) Pers.
Hemigraphis alternata (Burm.f.) Anders.
Hygrophila guianensis Nees DEM 363, 508; McD 12999
Justicia sp. C 23899
J. assurgens (L.) Juss. A & L 12720; McD 13070

J. aurea Schlecht.
J. bartlettii (Leonard) Gibson
J. breviflora (Nees) Rusby C 23356, 23655, 23693; D 12660; DEM 408; Long 3290; McD 12884; P 30052; Sp 1908, 1992; V 582
J. campechiana Standl.
J. comata (L.) Lam. DEM 504
J. ensiflora (Standl.) Gibson
J. magniflora (Blake) Gibson
J. pectoralis Jacq. K 523; P 36011
J. spicigera Schlecht.
Louteridium chartaceum Leonard L & D 1485
L. donnell-smithii S. Wats. D & L 12313; P 30106, 36148
Mendoncia lindavii Rusby
M. retusa Turrill
Odontonema albiflorum Leonard P36153
O. callistachyum (Schlecht. & Cham.) Kuntze C 24169, 24312, 24383, 24523, 24845; D 9838, 12487; DEM 483; P 30097; Sp 1430; WH 1111
O. flagellum (Oerst.) Kuntze C 24228, 24317
O. glabrum Brandeg.
O. hondurensis (Lindau) Gibson P 30204
Pseuderanthemum tetrasepalum Blake
P. verapazense Donn. Sm.
Ruellia biolleyi Lindau D 12061
R. geminiflora H.B.K. DEM 223, 323; Hus 0661; P 30042; Sp 1577; Wil 368, 386A
R. harveyana Stapf DEM 569; P 30144, 36022; Sp 1577; WH 1085, 1208
R. matagalpae Lindau Sp 1371
R. nudiflora (Engelm. & Gray) Urb., sens. lat. A & L 17150; C 24586, 24981, 25981; P 29621
R. obtusata Blake
R. paniculata L. K 511
R. perducta Standl.
R. pilosa D 10155
R. pygmaea Donn. Sm.
R. sarmentosa Jacq. K 583
R. stemonanthoides (Oerst.) Hemsl. P 30096
Stenandrium pedunculatum (Donn. Sm.) Leonard
Teliostachya alopecuroides (Vahl) Nees
Thunbergia alata Bojer ex Sims
T. grandiflora Roxb.

AIZOCEAE

Fieldiana 4: 203 207. 1946

Mollugo verticillata L.
Sesuvium portulacastrum L. DEM 6, 8, 667 A; Fos & Sach 53835, 53878, 53910; Fos & St 53920; Hus 0508; J & L 1203; Sp & St 2136, 2291, 2386, 2493, 2505, 2516, 2538, 2547, 2548
Trianthema portulacastrum L.

AMARANTHACEAE

Fieldiana 4: 143–174. 1946

Alternanthera bettzickiana (Regel) Standl.
A. brasiliana (L.) Kuntze
A. dentata (Moen) Stuchl. ex Fries
A. jacquinii (Schrad.) Standl.
A. obovata (Mart. & Gal.) Millsp.
A. polygonoides (L.) R. Br.
A. pubiflora (Benth.) Kuntze
A. ramosissima (Mart.) Chodat K 689
A. sessilis (L.) R. Br.
Amaranthus caudatus L.
A. dubius Mart. A 17766; K505; Pul 7610, 7643
A. hybridus L.
A. spinosus L. DEM 152; K 434; McD 12918; P 30130
A. viridis L.
Celosia argentea L.
Chamissoa altissima (Jacq.) H.B.K. var. *altissima* A & L 17545; DEM 57
C. macrocarpa H.B.K. P 30243
Cyathula achyranthoides (H.B.K.) Moq. D & P 10104
Gomphrena decumbens Jacq. C 24104; DEM 64; Dieck 182; Long 3249; McD 12984; Wil 231
G. dispersa Standl.
G. globosa L.
Iresine celosia L. A & L 17260; C 23891, 24249; D 12682 A; D & L 12021, 12175; DEM 109; P 30331
I. diffusa H.B.K. A & L 17527; Fos & Sach 53888; K 509; L 187, 1493; Sp & St 2274
I. nigra Uline & Gray P 30060
Pfaffia grandiflora (Hook.) Fries DEM 363, 363 A, 576
P. hookeriana (Hemsl.) Greenm.
Philoxerus vermicularis (L.) R. Br. DEM 429; L 128; McD 13121; Sp 1475; Sp & St 2146, 2241, 2284, 2292, 2492, 2506, 2523, 2556
Pleuropetalum sp. C 24169
P. sprucei (Hook. f.) Standl.

ANACARDIACEAE

Fieldiana 6: 177–195. 1949

Anacardium occidentale L. Dieck 145; P 30040; Sp 1485; WH 1179
Astronium graveolens Jacq.
Mangifera indica L.
Metopium brownei (Jacq.) Urb. Cast. s.n. (1962); C 24914; Cof 107; D 11614; D & P 10026; DSWV 329; J & L 11624; Sp 1734; Wil 218
Mosquitoxylum jamaicense Krug & Urb. D 10794, 11539, 13048; P 29697, 29853; Sp 1886
Pistacia mexicana H.B.K.
Rhus striata R. & P. DEM 399
Spondias mombin L. G 7783; K 479

S. purpurea L. DEM 154; K 579; P 29793
S. radlkoferi Donn. Sm. C 23653, 24728, 24900; D 12599; Wil 547

ANNONACEAE

Fieldiana 4: 270 294. 1946

Anaxagorea guatemalensis Standl.
Annona cherimola Miller A & L 17119, 17620; Leino 250
A. glabra L. C 23825; D 10961; DEM 586
A. primogenia Standl. & Steyerm. P 29839
A. purpurea Moc. & Sesse D 9930; P 30341
A. reticulata L. C 24598; D 11582; D & L 12297; G 8040; L & D 1557; Leino 349; Sp 1973
A. scleroderma Safford
Cymbopetalum mayanum Lundell A & L 17523
C. penduliflorum (Dun.) Baill.
Desmopsis cf. *microcarpa* Fries Sp 1854
D. schippii Standl.
D. stenopetala (Donn. Sm.) Fries
Guatteria amplifolia Triana & Planch. D 11426; DEM 572; Leino 200
G. gaumeri Greenm. Leino 386, 388, 401
Malmea depressa (Baill.) Fries D 10768, 10918, 12042; Leino 246, 270
Oxandra proctori Lundell P 30104
Rollinia jimenezii Safford D 11299; G 7934, 8141, 8586, 8619
Sapranthus campechianus (H.B.K.) Standl. C 23556
Stenanona costaricensis Fries G 8165
Unonopsis pittieri Safford
Xylopia frutescens Aubl. C 24839; D 12671; D & L 12253; DEM 518; L & D 1607; Long 3233; P 29685, 35949

APOCYNACEAE

Fieldiana 8 (4) : 334 407. 1972

Allamandra cathartica L. 24150; D & L 12283; Hus 0652; U 20; WH 1146
Aspidosperma megalocarpon Muell. Arg. A & L 17005; G 8343; P 36160
A. cruentum Woods.
Cameraria latifolia L. A & L 17131; Hus 0563; P 30286; WH 1343; Wil 111
Catharanthus roseus (L.) G. Don U 35
Couma macrocarpa Barb. Rod.
Echites tuxtlensis Standl. D 12613
E. umbellata Jacq. U 51
E. yucatanensis Millsp. ex Standl.
Forsteronia myriantha Donn. Sm.
F. peninsularis Woods. D 10789
F. viridescens Blake C 24834
Lacmellea standleyi (Woods.) Monach.
Laubertia gentlei Lundell
L. peninsularis Woods.
Malouetia guatemalensis (Muell.-Arg.) Standl.

Mandevilla hirsuta (A. Rich.) Schum. D 11434, 12872

M. subsagittata (R. & P.) Woods. C 14263; D & Dieck 10425; DEM 41; G 8403; Hus 0546, 0640; P 29524; Sp 1566; Wil 125, 369, 400 D

Mesechites trifida (Jacq.) Muell.-Arg

Nerium oleander L. Sp & St 2331, 2452

Odontodenia macrantha (Roem. & Schult.) Mfg.

O. schippii Woods.

Plumeria obtusa var. *salicifolia* (C. Wright) Woods. D 12664

P. rubra L. Dieck 258; P 29887; Sp 2003; Sp & St 2474, 2550

Prestonia concolor (Blake) Woods. D 12528

P. mexicana DC. D 11632; G 7660; Sp 1906, 1920

P. schippii Woods.

Rauwolfia ligustrina Roem. & Schult. D 12425

R. tetraphylla L. C 24084; Hus 0584; P 30242, 30271; Sp 1810

Rhabdadenia biflora (Jacq.) Muell.-Arg. D 11285; Hus 0507; J & L 1177, 1181; Lin 146; P 29517; U 95, 100; Wil 143, 145, 480

Stemmadenia donnell-smithii (Rose) Woods. A & L 17061; D 10883; G 7664, 7783, 8315; Hus 0509; P 30085; Wil 406

Tabernaemontana amygdalifolia Jacq. DEM 404; G 8201; P 30249

T. arborea Rose DEM 85; P 36053

T. chrysocarpa Blake A & L 17638; D 10948 A, 12433, 12434, 12702; D & P 10067; Hus 0507, 0632; L & D 1641; McD 12864, 14487; P 30313, 36418; Sp 1528, 1858; Uck 17784; Ut 811; WH 1108, 1125; Wil 25, 406, 536

Thevetia ahouai (L.) DC A & L 17141; C 24134; D 9899; Dieck 148A; Hus 0591, 0644; Leino 7660; Long 3240; Sp 1585, 1860; U 16, 124; WH 1132; Wil 21

T. gaumeri Hemsl.

T. peruviana (Pers.) Woods. U 100, 130

Urechites andrieuxii Muell.-Arg D 11625, 12796; D & P !0065; G 7572, 8073; L & D 1651; Leino 320; McD 1309; WH 1282

AQUIFOLIACEAE

Fieldiana 6: 196 201. 1949

Ilex belizensis Lundell

I. gentlei Lundell

I. guianensis (Aubl.) Kuntze McD 14326

I. panamensis Standl. C 24191; D 12476, 12495, 12838; DEM 435; P 29663; Wil 326 A, 431

ARALIACEAE

Fieldiana 8 (1) : 1-21. 1966

Dendropanax sp. G 7993

D. arboreus (L.) Decne & Planch. A & L 17555; C 24764; D 9915 A, 12880; D & C 12962; D & Dieck 13021; D & L 12291, 12312; DEM 384 A; G 7708; McD & C 14329; P 29636; Sp 1942; WH 1227; Wil 20, 55

D. schippii (A.C. Sm.) A.C. Sm.

D. stenodontus (Standl.) A.C. Sm. C 24292, 24765; D 11128, 11297 A, 11489, 11535, 11589; G 8395

Didymopanax mortotoni (Aubl.) Decne & Planch.
Oreopanax sp. C 23720
O. capitatus (Jacq.) Decne & Planch.
O. guatemalensis Decne & Planch D 9989, 12516; G 7739, 7772
O. lachnocephalus Standl.
O. liebmannii Marchal
O. obtusifolius L.O. Wms. D 12312; Sp 2028
O. platyphyllus Marchal
O. xalapensis (H.B.K.) Decne & Planch. Sp. 1991

ARISTOLOCHIACEAE
Fieldiana 4: 93 101. 1946

Aristolochia sp. W 51A
A. sp. D 11322
A. chapmaniana Standl.
A. cordifolia Mutis ex H.B.K. D 11497; G 8620
A. grandiflora Sw. P 30342
A maxima Jacq. P 30038
A. pilosa H.B.K.
A. schippii Standl.
A. trilobata L.

AVICENNIACEAE
Fieldiana 9: 176-178. 1970 (as part of Verbenaceae)

Avicennia germinans L. D 12385; DEM 631; G 8560; Hus 0505; L 14, 58, 59, 90, 101; J & L 1108; P 36197; Sp & St 2225, 2297, 2419, 2481, 2498; U 48; Wil 150, 178

ASCLEPIADACEAE
Fieldiana 8 (4) : 407-472. 1972

Asclepias curassavica L. A & L 17294; C 24063, 24760, 24932, 24982; Clev 7517; DEM 112; Dieck 176; G 8215, 8401, 8498; Leino 313; P 29925, 30035; Sp 1454, 1750, 1809; U 5, 29; Uck 17801; Wil 53 A, 93, 129A
A. curassavica var. *flava* Kuntze V 665
Blepharodon mucronatum (Schlecht.) Decne. C 24807; D 12871; D & P 10055; DEM 452; G 7773, 8214, 8387; H 63; Hus 0528; McD 14497; Wil 359, 367
Cryptostegia madagascariensis Bojer ex Decne Dieck 452
Cynanchum chiapense (Gray) Standl. & Steyerm.
C. schlechtendalii (Decne.) Standl. & Steyerm. D 10402, 10706, 10937, 12774, 13074; D & L 12011; D & P 10093; Dieck 153; G 7640, 8571; McD 13082; Wil 192, 193
C. stenomeres Standl. & Steyerm. McD 14399; U 250; Wil 347
Fischeria scandens subsp. *oaxacana* (Standl.) Spellm. C 23349, 24363; D 12720; G 7673, 7748
Gonolobus cteniophorus (Blake) Woods. G 7579; Wil 544
G. dasystephanus (Blake) Woods.
G. edulis Hemsl.
G. fraternus Schlecht. A & L 17543; D 10964, 11220, 11446, 11477; Leino 306; Sp 1783, 1898, 1902

G. leianthus Donn. Sm. C 23657; D 9822, 9961, 10187, 11527, 11546; G 7751, 7675, 7806; Sp 1897; WH 1193; V 623
G. prasinanthus Donn. Sm.
G. salvinii Hemsl.
G. stenanthus (Standl.) Woods.
G. uniflorus H.B.K.
Marsdenia laxiflora Donn. Sm. D 11697
M. maculata Hook.f. G 8565
M. mayana Lundell
Matelea belizensis (Lundell & Standl.) Woods.
M. campechiana (Standl.) Woods. G 8393; L & D 1411
M. grandiflora (Standl.) Woods.
M. lanceolata (Decne.) Woods. C 23344; L 3271; Wil 413
M. micrantha L. O. Wms.
M. pusilliflora L. O. Wms.
M. tuerckheimii (Donn. Sm.) Woods.
M. velutina (Schlecht.) Woods. C 23661; D & P 10176; G 7753; Sp 1881, 1901
Sarcostemma bilobum Hook. & Arn. subsp. *bilobum*
S. clausum (Jacq.) Roem. & Schult. D & L 12050; L & D 1647
S. odoratum (Hemsl.) Holm

BALANOPHORACEAE
Fieldiana 4: 92 93. 1946

Helosis mexicana Liebm D 11696; WH 1187, 1315

BASELLACEAE
Fieldiana 4: 214 217. 1946

Boussingaultia leptostachya Moq.

BATIDACEAE

Batis maritima L. D 9526, 11403; Fos & Sach 53853; G 8570; J & I 1088, 1096; L 136; Sp & St. 2232, 2568; U 38, 41; Wil 74 A, 141, 177

BEGONIACEAE
Fieldiana 7 (1) : 157 185. 1961

Begonia glabra Aubl. C23321; D 10563, 10916; DEM 370; WH 1204
B. heracleifolia Schlecht. & Cham. B & S 5194
B. lindleyana Walp. L & D 1463; Sp 1985
B. nelumbiifolia S. & C. B & S 5042

BIGNONIACEAE
Fieldiana 10 (3) : 153 232. 1974

Adenocalymna apurense (H.B.K.) Sandw. D 12995
A. calderonii (Standl.) Seib. D 12789
Amphilobium paniculatum (L.) H.B.K. G 7796, 7949, 8091; L & D 1507
A. paniculatum var. *molle* (Schlecht. & Cham.) Standl. G 7667, 8558
Amphitecna breedlovei Gentry D 12983

A. latifolia (Miller) Gentry DEM 606; P 30251; Sp & St 2441
Anemopaegma chrysoleucum (H.B.K.) Sandw.
Arrabidea candicans (L. Rich.) DC
A. chica (H. & B.) Verl. D 13058; G 7604, 7766, 8060, 8227, 8457
A. corallina (Jacq.) Sandw. G 7686
A. floribunda (H.B.K.) Loes. D 10144 A; D & P 10103 A; L & D 1558
A. florida P. DC. D 12070; G 8608
A. inaequalis (DC. ex Splitg.) Schum. G 8184, 8465
A. patellifera (Schlecht.) Sandw. D & L 12222; G 7712, 7756, 8221, 8399
A. podopogon (DC.) Gentry C 24212, 24775; G 7752, 7819, 8056, 8416, 8488
A. pubescens (L.) Gentry G 7625, 8261, 8281, 8544; L & D 1589; Uck 17794; Wil 243
A. verrucosa (Standl.) Gentry D 12238; WH 1270
Callichlamys latifolia (L. Rich.) Schum. G 8184
Ceratophytum tetragonolobus (Jacq.) Sprague & Sandw. A 17733; G 8176, 8263
Clytostoma binatum (Thunb.) Sandw. D 12551; D & L 12225; Dieck 248; G 8478; L & D 1645
Crescentia cujete L. A & L 17023; C 23295; G 7850; Hus 0557; J & I 1122; U 143, 207 A, 212; Wil 207A
Cydista aequinoctialis (L.) Miers D 11051, 12562, 12816; G 7585, 7597
C. diversifolia (H.B.K.) Miers A 17739; G 8188, 8264, 8270
C. heterophylla Sieb. G 7620, 7851, 8150, 8192
C. potosina (Schum. & Loes.) Loes. D 10144, 12663, 12722; D & P 10144 A; DEM 461; G 7815, 8001, 8177, 8228, 8262; U 13
Godmania aesculifolia (H.B.K.) Standl. D & L 12357
Jacandra copaia (Aubl.) D. Don
J. copaia subsp. *spectabilis* (Mart. ex DC) Gentry P 35948
Lundia puberula Pittier
Macfadyena uncata (Andrews) Sprague & Sandw. D 10374, 12556 A, 12791, 13086; Dieck 195; G 7592, 8380
M. unguis cati (L.) Gentry
Martinella obovata (H.B.K.) Burm. & Schum. D 11699; G 7767, 7779, 7905, 8250, 8589; Sp 1910
Mussatia hyacinthina (Standl.) Sandw. G 7704, 7807, 8190
Pachyptera hymenaea (DC.) Gentry D & C 12927; G 8477
P. kerere (Aubl. emend. Splitg.) D 12327, 13030; G 7689, 7882, 8469; L & D 1436
Paragonia pyramidata (L. Rich.) Burm. D 12924, 12996, 13018, 13037; G 7795, 8070, 8080, 8223, 8247, 8259, 8432, 8462, 8491, 8547, 8579; U 75
Parmentiera aculeata (H.B.K.) Seem. DEM 291; G 7762; L & D 1443; P 30354; Sp 1872
P. acutifolia H.B.K.
Pithecoctenium crucigerum (L.) Gentry D & L 12332 A; D & P 10092; G 7666, 7725, 7855, 8189
Pseudocatalpa caudiculata (Standl.) Gentry G 7662, 8061, 8216, 8464
Schlegelia parviflora (Oerst.) Monach. D & L 12100; G 7945
Scobinaria japurensis (DC.) Sandw. G 7817, 7988, 8081, 8163, 8238, 8256
Spathodea campanulata Beauv. Dieck 191
Stizophyllum riparium (H.B.K.) Standl. C 24969; D 12513; D & Dieck 13060; G 7603, 7684, 7763, 7837, 7901, 8173, 8260, 8325, 8508, 8554; Wil 520
Tabebuia chrysantha (Jacq.) Nich. G 7716, 8486

T. guayacan (Seem.) Hemsl. G 7621, 8155, 8611

T. rosea (Bertol.) DC. A & L 17142; C 24379; G 7612, 8385, 8465, 8542, 8566

Tynnanthus guatemalensis Donn. Sm. C 32182, 23599, 23715; D 10814; D & P 10189; G 7661, 7689, 7730, 7755, 7768, 8014, 8119, 8222, 8489

Xylophragma seemannianum (Kuntze) Sandw.

BIXACEAE

Fieldiana 7 (1) : 65 67. 1961

Bixa orellana L. Uck 17788; V 656

BOMBACACEAE

Fieldiana 6: 386 403. 1949

Bernoullia flammea Oliver

Bombax ellipticum H.B.K.

Ceiba pentandra (L.) Gaertn. P 29810; Sp 1899

Ochroma lagopus Sw. DEM 499

O. lagopus var. *bicolor* (Rowl.) Standl. & Steyerm.

O. pyramidale (Cav. ex Lam.) Urban DEM 499

Pachira aquatica Aubl. A & L 17648, 17705; DEM 595, 609; J & L 1174; P 29520; Uck 17804; Wil 183, 492

Quararibea sp.

Q. funebris (Llave) Vischer D 9848 B; 11133

Q. guatemalensis (Donn. Sm.) Standl. & Steyerm.

Q. schippii Millsp. D 9947

Q. yunckeri Standl.

BORAGINACEAE

Fieldiana 9: 111 167. 1970

Bourreria huanita (Llave & Lex.) Hemsl.

B. mollis Standl. McD 14055

B. oxyphylla Standl. D 9124, 11375, 11381, 11538; D & C 12968; Sp 1855

Cordia alba (Jacq.) Roem. & Schult. D 12582

C. alliodora (R. & P.) Oken P 30157; Wil 129

C. bicolor DC.

C. collocca L. D 9913, 10833, 12582; Dieck 219; P 30328

C. curassavica (Jacq.) Roem. & Schult. C 24952; D 9108, 10998, 11358, 12470; Leino 7638, 76110; McD & D 14275; Wil 512

C. diversifolia Pavon ex DC C 24112; D 9912, 12683; G 7938, 7998, 8077; Uck 17811

C. dodecandra DC. A 17778; P 30255; Uck 17804

C. gerascanthus L.

C. hintoni Johnst. DSWV 814

C. nitida Vahl

C. prunifolia Johnst. D 12956

C. sebestina L. C 23555, 23727; Fos & Sach 53839, 53856; Hus 0696; J & I 1114; L 15, 22, 23, 56, 97, 103; Sp 1459; Sp & St 2452, 2483

C. spinescens L. DEM 122, 534; L & D 1581; McD 12881; Sp 1583; U 141

C. stellifera Johnst. C 23438, 23679; D 9913, 10833, 12515, 12534, 12575, 12582, 12657, 12749; Dieck 219; G 7586; P 30328; Wil 74

Ehretia tinifolia L. A & L 17026; C 24614; G 8289; Uck 17792

Heliotropium angiospermum Murr. C 24611, 24615; D & L 12159; G 8276, 8519; Lon 2353; Wil 548

H. campechianum H.B.K.

H. curassavicum L. McD & C 14369

H. filiforme Lehm. C 24214; D 12472; DSWV 356

H. fruticosum L.

H. indicum L. C 23447; D 11188, 12427; P 30318

H. inundatum Sw. D & P 10169

H. macrostachyum (DC.) Hemsl. DSWV 814

H. procumbens Miller D 12766; D & P 10169; P 30319

Rochefortia lundellii Camp

Tournefortia acutiflora Mart. & Gal. C 23438; G 7917, 7967, 8019; V 627; Wil 66

T. angustifolia R. & P. D 9839, 12709

T. belizensis Lundell C 23406, 24919; D 11242, 11645, 12634

T. bicolor Sw. D 10107; McD 13000, 14506

T. glabra L. C 14919; Sp 1829, 1998

T. gnaphalodes (L.) R. Br. ex Roem. & Schult. Fos & Sach 53908,53924; J & L 1095, 1189, 1206; Sp 1465; Sp & St 2255, 2266, 2296, 2535, 2544

T. hirstutissima L. C 23487, 23659, 23687; D 9949, 11189, 12479, 12524, 12661; D & Dieck 10439; DEM 205; DSWV 324; G 7681, 7793, 8153, 8275; P 29835, 30161, 30173; Sp 1786; V 626; WH 1141

T. maculata Jacq. C 23893; D 10944; G 7942, 8330

T. umbellata H.B.K.

T. volubilis L. C 23682, 24627; D 11587

BURSERACEAE

Fieldiana 5: 434 444. 1946

Bursera simaruba (L.) Sarg. C 23925; D 10444, 12463, 12751, 13081 A; Fos & Sach 53834; J & I 1140; K 482; P 29832; Sp 1873; Wil 533

Protium copal (Schlecht. & Cham.) Engl. A & L 17053; G 23923, 24435; D 10767, 11125, 11147, 11549, 11550, 11919; DEM 251, 253; G 7713, 7774, 8110; Leino 370

P. copal var. *glabrum* (Rose) Engl.

P. multiramiflorum Lundell P 29836

P. panamense (Rose) Johnst. C 23597

P. schippii Lundell D 11298, 11305, 11320, 11321, 12084; G 8466, 8604, 8609

Tetragastris panamensis (Engl.) Kuntze D 11019

BUXACEAE

Fieldiana 6: 172–174. 1949

Buxus bartlettii Standl. C 24597

CACTACEAE

Fieldiana 7 (2) : 187–234. 1962

Acanthocereus aff. *pentagonus* (L.) Britt. & Rose D 11399

Deamia testudo (Karw.) Britt. & Rose C 24799; G 7618

Discocactus ramulosus (Salm-Dyck) Kim P 36102

Epiphyllum crenatum (Lindl.) D. Don
E. strictum (Lem.) Britt. & Rose   A & L 17185
Rhipsalis baccifera (J. Miller) Stearn   D 12685; V 617
R. coriacea Polak
R. ramulosus (Salm-Dyck) Pfeiffer   WH 1281
Selenicereus sp.   C 23519
S. donkelarii (Salm-Dyck) Britt. & Rose   G 8561
Wilmattea minutiflora   Britt. & Rose

CAMPANULACEAE

Fieldiana 11: 396–431. 1976

Isotoma longiflora (L.) Presl.   DEM 260; K 486; Leino 316; P 29551; Sp 1841; WH 1135; Wil 58, 518

CAPPARIDACEAE

Fieldiana 4: 380–397. 1946

Capparis baducca L.   D 11057; G 8042
C. calciphila Standl. & Steyerm.
C. cynophallophora L.
C. flexuosa (L.) L.   G 8381
C. frondosa Jacq.   D 11057; G 8042
C. quiriguensis Standl.
C. verrucosa Jacq.   G 8344
Cleome lanceolatum (Mart. & Zucc.) Iltis   A & L 17201; D 11032; G 7646
C. serrata Jacq.   A 17911; Br 2216; C 23879; D & C 12970; P 29464
C. spinosa Jacq.   L & D 1537; P 30346; Wil 503
C. viscosa L.   C 24588; DEM 69; K 413; McD & C 14386; Sp 1793, 1838; U 25
Crataeva tapia L.   A & L 17639
C. tapia var. *glauca* (Lundell) Standl. & Steyerm.
Forchammeria trifoliata Radkl.

CARICACEAE

Fieldiana 7: 146. 1962

Carica mexicana (DC) L. O. Wms.
C. papaya L.   C 23859, 24906; G 7951; J & I 1196; K 536; L & D 1471; Sp 1706; WH 1128; Wil 515

CARYOPHYLLACEAE

Fieldiana 4: 217–239. 1946

Drymaria cordata (L.) Willd. ex Roem. & Schult.   DEM 96

CASUARINACEAE

Fieldiana 3: 227–228. 1952

Casuarina equisetifolia L.   J & I 1133; Sp & St 2199, 2224, 2384, 2472

CELASTRACEAE

Fieldiana 6: 202–218. 1949

Celastrus chiapensis Lundell
Crossopetalum eucymosus (Loes. & Pitt.) Lundell D 10876, 11120; L & D 1648; P 30114, 36123
C. parviflorum (Hemsl.) Lundell
Gyminda sp. C 24050, 24304, 24996; D 10714, 11393, 11562 A
Maytenus belizensis Standl.
M. guatemalensis Lundell
M. schippii Lundell D 10970
Rhacoma gaumeri (Loes.) Standl.
R. gentlei Lundell
R. lanceifolia Lundell
R. puberula (Lundell) Standl. & Steyerm.
Wimmeria bartlettii Lundell
W. concolor Schlecht. & Cham. D 11562
Zinowiewia costaricensis Lundell D 10354
Z. pallida Lundell Wil 315

CHENOPODIACEAE

Fieldiana 4: 137–143. 1946

Atriplex canescens (Pursh) Nutt.
Chenopodium ambrosioides L. C 24665
Salicornia bigelovii Torr. Sp & St 2221

CISTACEAE

Fieldiana 7 (1) : 61–64. 1961

Lechea torreyi Legg. Sp 1646
L. tripetala (Moc & Sesse) Britt.

CLETHRACEAE

Fieldiana 8 (2) : 74–80. 1966

Clethra hondurensis Britt. Hus 0614; Sp 1571; U 112, 123; Wil 286, 378, 398
C. macrophylla Mart. & Gal. D 10144; DEM 254; L 3243; P 29460; Ut 829
C. mexicana DC. Sor 7126
C. occidentalis (L.) Kuntze

COCHLOSPERMACEAE

Fieldiana 7: 67–70. 1961

Cochlospermum vitifolium Willd. ex Spreng. A & L 17306; DEM 346; D & L 12228; K 496; P 30307

COMBRETACEAE

Fieldiana 7 (2) : 268–281. 1962

Bucida bucera L. Cof. 123; D 10375; D & L 12181; Dieck 180; G 7595, 8480; J & I 1173; Leino 334; P 29609, 30254; Pul 7712
Combretum cacoucia Exell DEM 552
C. fruticosum (Loefl.) Stuntz DEM 284
C. laxum Jacq. A & L 17149; C 23269, 23428, 24591; D 11045, 12484, 12556, 12978, 13095; Dieck 240; Hus 0573; P 30314; WH 1234, 1257
Conocarpus erecta L. D & P 10031; Dieck 119; Fos & Sach 53803, 53890; Hus 0509; J & L 1091; Laz & Tyson 2127; P 29702; Sach & St 1632; Sor 7076, 7078; Sp 1464, 1956, 1959; Sp & St 2194, 2227, 2267, 2283, 2305, 2351, 2399, 2426, 2485, 2502, 2543, 2559; U 39, 40, 52; Wil 144
Laguncularia racemosa (L.) Gaertn. Dieck 115; Fos & St 53855; G 8371; Hus 0506; J & I 1090; Lin 60; Sach & St 1602; Sp 1961; Sp & St 2156, 2228, 2392, 2486, 2501, 2561; Wil 182
Terminalia amazonia (Gmel.) Exell P 29855, 35901
T. catappa L. Fos & Sach 53809; Hus 0695; Lin 94; Sach & St 1629; Sp & St 2204, 2259, 2301, 2334, 2359, 2394, 2421; Wil 505

COMPOSITAE

Fieldiana 12: 1–603. 1976

Ageratum conyzoides L. D 11849; Dieck 147; K 417
A. corymbosum var. *latifolium* (DC.) Robins.
A. corymbosum var. *salicifolium* (Hemsl.) Johns. Sp 1379
A. ellipticum Robins. A & L 17847
A. houstonianum Miller Sp 1416
A. littorale Gray forma *littorale* Hus 54; Lin 19, 185; Sp 1470; Sp & St. 2185; U 54
A. littorale forma *setigerum* Robins.
A. maritimum H.B.K. Lin 48, 131, 133
A. peckii Robins. D & L 12318
A. radicans Robins. C 23251, 24004; D 10090; DEM 45; G 7643; Hus 0535, 0554; Sor 7073; Sp 1519, 1656; Wil 108
A. rugosum Coult. D & L 12264
Ambrosia cumanensis H.B.K.
A. hispida Pursh Hus 0679; Lin 43; Sach & St 1608; Sp & St 2201
Artemisia mexicana Willd.
Aster bullatus Klatt
A. exilis Elliott
A. subulatus Michx. Sp 1785
Baccharis trinervis Pers. D 11116, 11528; D & Dieck 13024; DEM 314; G 8087; Hus 0638; P 29802; V 639; WH 1182
Bidens sp. DSWV 947; Sp & St 2443
B. pilosa L. A & L 17767; C 23795; Clev 7523; D 9953; K 448; Leino 7639; P 29639; Pul 7566, 7613; Sp 1791; Wil 54
B. reptans (L.) G. Don D & L 12026, 12224, 12243; L & D 1527
B. squarrosa H.B.K.
Borrichia arborescens (L.) DC L 25; Sp & St 2154, 2231; U 53

Calea fluviatilis Blake P 29673; Wil 252
C. longipedicellata Robins. & Greenm. Sor 7091, 7132; Sp 1510, 1638; U 120; Wil 249
C. peckii Robins. D 9084 A; D & L 12235; DEM 457; P 30192; Wil 11, 119
C. pittieri Robins. & Greenm. DEM 225
C. prunifolia H.B.K. Burch s.n., 1972
C. trichotoma Donn. Sm. P 29682; U 78
C. urticifolia (Miller) DC DEM 31, 335; Sor 7102
C. zacatecii Schlecht. D 12545
Calyptocarpus vialis
Chaptalia nutans (L.) Polak Hus 0646; K 661; Wil 422
Chromlaena glaberrima (DC.) King & Robins. Wil 386
C. odorata King & Robins. D 10445, 11998; D & L 12160, 12280; DEM 267; L & D 1551; Sp 1377, 1481
C. oerestedianum (Benth.) King & Robins. D & L 12260, 12278; Sp 1408
Cirsium horridulum Michx.
C. mexicanum DC. A & L 17267; C 23484, 23617; D 10005, 12314, 12721; K 501; P 29856
Clibadium arboreum Donn. Sm. C 24155, 24409; D 99030 A, 10969, 11415; D & Dieck 13050; DEM 514, 523; G 9436; McD 14482; Sor 7112; Sp 1914, 1916; Uck 17797; Wil 22
C. pittieri Greenm. C 24522; D 11198
C. polygonum Blake
Conyza bonariensis (L.) Cronq. A & L 17238; C 23877, 24299, 24366, 24911; K 623; Wil 487
C. canadensis var. *pusillus* (Nutt.) Cronq. C 24911; Sp 1746; Sp & St 2192, 2467; Wil 22
Cosmos caudatus H.B.K. D 11074; G 7083, 8160; L & D 1527 A, 1564; P 29512; Sp 1361; Uck 17781; Wil 53
Critonia bartlettii (Robins.) King & Robins. D 11567
C. bilbergiana (Hemsl.) King & Robins D 4714
C. daleoides DC. D 11843; Dieck 282
C. morifolia (Miller) King & Robins. D 23841; D 10500, 10963, 10966, 12543
Delilea biflora (L.) Kuntze DEM 277; Dieck 166; K 574; L & D 1478, 1585; P 29485
Eclipta alba (L.) Hassk. C 23270, 24020, 24850; D 12429, 12554; DEM 666; Dieck 137; L & D 2133; Pul 7629, 7647; Wil 78
E. prostrata (L.) L. P 29933; Sp 1455, 1609, 1868; Sp & St 2520; V 640;
Egletes liebmannii var. *yucatana* Shinners A & L 17245; C 23433; D & L 10771; Leino 323
Elephantopus angustifolius Sw. Wil 397
E. mollis H.B.K. C 23970; D 10809, 12678; Wil 233
Eleutheranthera ruderalis Sch.-Bip. C 23449; K 401; Sp 1773
Emilia fosbergii Nicolson DWSV 338
E. javanica (Burm.f.) Robins. C 24849; DEM 111; K 424; P 29475; WH 1115
E. sagittata (Vahl) DC. Sp 1779
E. sonchifolia (L.) DC. C 24904; D 9091, 11143; Dieck 173; Hus 0599
Erechtites hieracifolia (L.) Raf. D 11143; K 624; Wil 561
Eupatorium bartlettii Robins.

E. billbergianus Beurl.
E. blakei Robins. McD 14480
E. campechense Robins.
E. deltoides Hemsl.
E. hospitale Robins. P 19875
E. laevicaule Robins.
E. macrophyllum L. C 23864, 24235; G 7955; P 30166; Sp 1851
E. marifolium Miller P 30135, 30336
E. pittieri Klatt
E. sexangulare (Klatt) Robins.
Flaveria trinervia (Spreng.) Mohr Wil 583
Fleischmannia hymenophylla (Klatt) King & Robins. D 11934
F. pratensis (Klatt) King & Robins. Bradley 1; D & L 12141; Wil 57 A
F. pycnocephala (Less.) King & Robins. K 612; P 29681; Sp 1752, 1806; Wil 15
Garcilassa rivularis Poepp. & Endl. C 23449; Sp 1773
Gnaphalium leptophyllum DC. Sp 1441
Goldmannia sarmentosa Greenm.
Harleya oxylepis (Benth.) Blake D 10457; Pul 772
Hebeclinum macrophyllum (L.) DC A & L 17346; Wil 557
Heterotheca graminifolia Michx. D 11592; P 29742; Sp 1635; Wil 275, 345
Hitella americana L. G 7723
Koanophyllon albicaulis (Sch.-Bip. ex Klatt) King & Robins. A & L 17520; D 10184, 12517, 12590; 12762
K. solidaginoides (H.B.K.) King & Robins. D & L 12297
K. sorensenii King & Robins.
Lactuca sativa L.
Lagascea mollis Cav.
Liabum bourgeaui Hieron.
L. dimidium Blake DEM 237
Melampodium costaricense Steussy C 23799, 24487; DEM 378; D & P 10166; Sor 7122
M. divaricatum (Rich.) DC. C 24600 A; Dieck 118 A; Sp 1373, 1374, 1386
M. longicilium Robins. DSWV 197
Melanthera aspera (Jacq.) Small var. *aspera* C 23367, 23486, 23895, 24008, 24056, 24654, 24792, 24940, 24954; D 10874, 11247; D & P 10167; Dieck 136; DSWV 292, 362; J & L 1184; Long 3225; McD 14481; Sor 7110; Sp 1356, 1428, 1606, 1697, 1781
M. hastifolia Blake P 29654
M. nivea (L.) Small C 23310, 23364, 24282, 24479; Crank 6; Dieck 136; Fos & Sach 54351; G 8084; K 431; Sp 1468, 1575, 1729, 2021; Sor 7069; U 31, 68, 127; WH 1070; Wil 57, 410, 420
M. parviceps Blake
Mikania boliviensis Lingelsh
M. cordifolia (L.f.) Willd. K 549; L & D 1477, 1534; Sp 1409
M. houstoniana (L.) Robins.
M. leiostachya Benth. D & L 12112
M. micrantha H.B.K. D & Dieck 3025; D & L 12234; DEM 123; Sp 1896; WH 1101
M. olivacea Klatt

M. punctata Klatt
M. tysonii King & Robins. D 7378
M. vitifolia DC DEM 357
Milleria quinqueflora L.
Montanoa pauciflora Klatt D & L 12355; DEM 377; G 7761
Neomirandea araliaefolia (Less.) King & Robins.
Neurolaena lobata (Sw.) R. Br. C 23396, 24498; D 9894, 12604; DEM 31, 61; Dieck 148; K 565; P 30264; Pul 7614; Uck 17821
Notoptera scabridula Blake P 30193
Onoseris onoseroides (H.B.K.) Robins.
Orthopappus angustifolius (Sw.) Gleason
Parthenium hysterophorus L. A & L 17541; C 24590; D 10221, 11246; Hus 0644; P 29614; Uck 17822
Pectis bonplandiana H.B.K.
P. prostrata Cav.
P. schottii (Fern.) Millsp.
Perezia nudicaulis A. Gray
Perymenium gymnolomoides (Less.) DC. D 10493; P 29749; Wil 441
Piptocarpha chontalensis Baker C 24418
Pluchea carolinensis (Jacq.) G. Don A & L 17325; C 24414; D 10390, 11077, 12375
P. odorata (L.) Cass. Clev 758; D 9085; DEM 7, 17; L & D 1543; P 30285; Pul 767, 7554
P. rosea Godfrey C 23817; Sor 7072
P. purpurascens (Sw.) DC.
Podochaenium eminens (Lag.) Sch.-Bip. D 10898; DEM 206
Polymnia maculata Cav. D 10832; D & P 10194; DEM 135
Porophyllum ruderale (Jacq.) Cass. DEM 239, 247
Pseudoelephantopus spicatus (Juss.) Baker D 12678; K 396; Leino 7684
Salmea scandens (L.) DC. D 11225; K 688
Schistocarpha eupatorioides (Franzl.) Kuntze A 17923; C 23902, 24341, 24410; G 8151, 8337; Sor 7118; Sp 1749, 1800, 1868; Uck 17796; WH 1277; Wil 55
S. paniculata Klatt
Senecio chenopodioides H.B.K. A & L 17649
S. cobanensis Coulter
Sonchus oleracea L. A 17765; D 10475
Spilanthes alba L'Her DEM 480
S. americana (Mutis) Hieron. C23304, 23341; DEM 105; Sp 1865; Uck 17783
S. americana var. *parviflora* (Benth.) Moore C 23385, 23415
S. americana var. *ramosa* (Hemsl.) Moore Sp 1520
S. baccabunga DC. K 439
S. oppositifolia (Lam.) D'Arcy D 10165; Pul 7556, 7559, 7615; Wil 55
S. poliolepidica Moore D & L 12189; U 149
Spiracantha cornifolia H.B.K. A 17925
Struchium sparganophorum (L.) Kuntze A & L 17611; DEM 143
S. vaillantii Crantz.
Syndrella nodiflora (L.) Gaertn. A 17836; D & L 12161; DEM 101, 265; Leino 7698; Lin 52; P 19488; Sp 1469, 1474
Taegetes erecta L. Uck 17787, 17789

Tithonia diversifolia (Hemsl.) Gray
T. pittieri (Greenm.) Blake Sp 1412
T. rotundifolia (Miller) Blake
Trichospira menthoides H.B.K.
Tridax procumbens L. A 17887; P 29470, 29789; Sp 1492
Verbesina lanata Robins. & Greenm. J & I 1221
V. myriocephala Sch.-Bip.
V. turbacensis H.B.K. P 19628; Wil 387
Vernonia argyropappa Buek. C 24207; P 30051
V. aschenborniana Schauer P 30255
V. canescens H.B.K.
V. cinerea (L.) Less. A & L 17257, 17353, 17754; C 23279, 23999, 24087, 24884; D 9091 A; DEM 14; H & L 1102; K 485; Pul 7369, 7683; Sp 1445, 1727; WH 1145; Wil 78, 79
V. lanata Robins. & Greenm. J & I 1221; P 29462
V. leiocarpa DC.
V. patens H.B.K.
V. remotifolia Rich. P 30231
V. schiedeana Less. C 23562; D 11510; DEM 181
V. tortuosa (L.) Blake P 30191; Wil 459
Viguiera dentata var. *helianthoides* (H.B.K.) Blake Uck 17829
V. cordata (Hook. & Arn.) D'Arcy Sp 1372
Wedelia acapulcensis H.B.K.
W. calycina L.C. Rich. A & L 17750, 17774; C 24600 A
W. hispida var. *ramossisima* (Greenm.) K. Beck A & L 17347, 17610
W. inconstans D'Arcy C 24944; D 11377; D & L 12260; DEM 397; Dieck 247
W. parviceps Blake C 23271, 24190; D & P 10077; DEM 331; Dieck 157; Hus 0561; P 29536; Sp 1506, 1543; Wil 400 F
W. trilobata (L.) Hitch. A & L 17311; C 23663, 23676, 24088, 24120, 24944 A; D 9085; Fos & Sach 53821, 53903; J & I 1106, 1145; Pul 7533, 7557; Sach & S 1617; Sor 7066, 7100; Sp 1471, 1532, 1610, 1723, 2020; Sp & St 2466, 2490, 2545, 2563; U 3; Ut 810; V 574; WH 1185; Wil 60, 230
Ximensia americana L. DEM 624
X. scandens Hemsl. DEM 612
Zexemenia frutescens (Millsp.) Blake K 566; Leino 7636; P 29956
Z. serrata Llave
Zinnia elegans Jacq. DEM 292

CONNARACEAE

Fieldiana 4: 484 488. 1946

Cnestidium rufescens Planch. P 30103; Wil 493 A
Connarus lambertii (DC.) Sagot D 12377, 12414, 12444, 12468; P 30300; Pul 771
Rourea adenophora Blake
R. glabra H.B.K. C 24233; D 11287, 12921, 13084; G 8578; Sousa 4145
R. Schippii Standl.

CONVOLVULACEAE

Fieldiana 7: (1) : 67–70. 1961

Aniseia cernua Moric.
A. martinicensis (Jacq.) Choisy C 23968
Bonamia brevipedicellata Myint & Ward
Claonyction clavatum G. Don
Convolvulus nodiflora Desr.
Cuscuta campestris Yunck.
C. indecora Choisy
Evolvulus alsinoides L. P 29912
E. filipes Mart.
E. nummularius L. P 29624
E. sericeus Sw. A & L 17138; D 10368 A, 12748, 12812; Hus 0545; Pul 771; Sp 1539; Wil 400 H
Ipomea acuminata (Vahl) Roem. & Schult. C 24048; DEM 70, 677; Dieck 134; G 8512; Sp 1802
I. alba L. D 11042; D & L 12258; DEM 172
I. anisomeris Robins. & Bartl. G 8517
I. asarifolia (Desr.) Roem. & Schult.
I. batatas (L.) Poir. K 462; Sp & St 2249
I. callida House
I. carnea Jacq. DEM 16
I. carnea subsp. *fistulosa* (Mart. ex Choisy) Austin D 10389; DEM 16
I. cathartica Poir.
I. coccinea L.
I. crinicalyx Moore
I. demerariana Choisy
I. digitata L.
I. hederifolia L. DEM 219
I. heterodoxa Standl. & Steyerm.
I. indica (Burm.) Merill
I. lindenii Mart. & Gal. C24979
I. macrantha Roem. & Schult. Sp & St 2273, 2293, 2482, 2549
I. meyeri (Spreng.) G. Don
I. microsticta Hall. f.
I. morelii Duch. & Walp.
I. nil (L.) Roth A & L 17248; Wil 574
I. perplexa L. Wms.
I. pes-caprae (L.) Sweet DEM 625; J & I 1200; Sp & St 2187, 2269, 2294, 2507, 2532, 2541, 2555; U 43
I. phellomega (Vell.) House C 24889; DEM 568; G 8475
I. quamclit L.
I. reptans (L.) Poir.
I. sagittata Lam. C 23819; D 10983
I. sepacuitensis Donn. Sm. D 10456
I. setifera Poir. DEM 647
I. setosa Ker. C 23442; D 10458 A; DEM 182; G 7789; L & D 1584

I. setosa var. *campanulata* (Hall) House
I. squamosa Choisy DEM 580
I. stolonifera (Cyril.) Gmel. var. *stolonifera* DEM 625; Lin 177; Sp & St 2174, 2524, 2528
I. tiliacea (Willd.) Choisy DEM 628, 648; Dieck 139
I. trifida (H.B.K.) G. Don Clev 7518, 7528; Pul 7562
I. triloba L. P 30076
I. tuxtlensis House D 12597
I. umbraticola House D & L 12132
I. wallii (Morren) Hemsl.
Itazaea sericea (Standl.) Standl. & Steyerm. Lundell 4889
Jacquemontia apiculata House
J. azurea (Desr.) Choisy
J. havanensis (Jacq.) Urb.
J. hirtiflora (Mart. & Gal.) O'Donn.
J. houseana Standl.
J. pentantha (Jacq.) D. Don D & L 12140; DEM 44; K 487
J. simulans House P 29660
J. sphaerostigma (Cav.) Rusby Dieck 136; G 7718
J. tamnifolia (L.) Griseb.
J. verticillata (L.) Urban Leino 7641
Maripa nicaraguensis Hemsl. C 24367, 24554, 24835; D 10864, 11126, 11443; G 8131, 8606, 8217; WH 1223
Merremia aegyptica (L.) Urban DEM 430; K 446
M. aturensis (H.B.K.) Hall. f. DEM 318; G 7632; P 29911; WH 1340; Wil 268
M. cissoides (Griseb.) Hall. f. D 10458; DEM 39, 343
M. quinquefolia (L.) Hall. f. DEM 98
M. umbellata (L.) Hall. f. D & L 12142, 12151, 12178; DEM 67, 68, 157, 428, 636; Leino 7662; P 29515
Turbina corymbosa (L.) Raf.

CRASSULACEAE

Fieldiana 4: 404–415. 1946

Bryophyllum pinnatum (Lam.) Kurz D & L 12027
Kalanchoe sp. Sp & St 2460

CRUCIFERAE

Fieldiana 4: 354–380. 1946

Brassica integrifolia (Willd.) Rupr.
B. oleracea L.
B. rapa L.
Cakile lanceolata (Willd.) Schulz DEM 614, 668; Sp & St 2200, 2261, 2448, 2473, 2536
C. edulentula var. *alacranensis* (Millsp.) Schulz
Lepidium virginicum L. DEM 249
Sisymbrium auriculatum Gray A & S 17533

CUCURBITACEAE

Fieldiana 11: 306 395. 1976

Anguria angustifolia Cogn.
A. warscewiczii Hook. V 659
Cayaponia alata Cogn.
C. attenuata (Hook. & Arn.) Cogn. Sp 1354
C. racemosa (Sw.) Cogn.
Cionosicus macranthus (Pittier) Jeffrey
Citrullus vulgaris Schrad.
Cucumis anguria L.
C. sativa L.
Cucurbita pepo L. P 30232; Sp & St 2447, 2527
C. radicans Naud.
Echinocystis coulteri (Gray) Cogn.
Echinopepon pubescens Cogn. K 429
Elaterium gracile (Hook. & Arn.) Cogn.
Gurania makoyana (Lam.) Cogn.
Lagenaria siceraria (Molina) Standl.
Melothria guadalupensis (Spreng.) Cogn. K456; P 30036
M. pendula L. D 10951; Sp & N 1835, 2016
M. scabra Naud.
M. trilobata Cogn.
Momordica charantia L. A & L 17320; C 24848; K 443; Leino 201, 766; Sp 1740, 1864; Sp & N 1745; V 625; Wil 503
Sechium edule Sw.
Sicydium sp. D 10100
S. schiedeanum Schlecht.
S. tamnifolium (H.B.K.) Cogn.
S. tuerckheimii D. Sm. DSWV 297

CYRILLACEAE

Fieldiana 6: 195-196. 1949

Cyrilla racemiflora L. D 11678, 12909; McD 14303, 14424; P 29441; Wil 251, 259
Purdiaea belizensis (Smith & Standl.) Thomas D 12915; Wil 259

DILLENIACEAE

Fieldiana 7 (1) : 2-10. 1961

Curatella americana L. A & I s.n.; C 23946; D & Dieck 10442; J & I 1120; McD 12993; P 35705; Ut 818
Davilla kunthii St. Hil. C 23507, 24145, 24470; D & L 12180; DEM 196, 559; G 8067, 8207; V 581; Wilb & W 11452; Wil 380, 432, 545
Doliocarpus dentatus (Aubl.) Standl. P 35975
D. multiflorus Standl. C 24826
Tetracera belizensis Lundell
T. hydrophila Tr. & Pl. G 7940, 8428; L & D 1489
T. mollis Standl. Sp & N 1856
T. volubilis L. P 35853

DROSERACEAE

Fieldiana 4: 399–400. 1946

Drosera capillaris Poir. D 11656; DEM 28; Hus 0662
D. intermedia Hayne

EBENACEAE

Fieldiana 8: 244–251. 1967

Diospyros albens Presl Sp 1798
D. bumelioides Standl.
D. cuneata Standl.
D. digyna Jacq.
D. nicaraguensis Standl. D 12747; D & L 12250; P 35991, 36205, 36206, 36207
D. schippii Standl.
D. yucatanensis Lundell D 12747
D. verae-crucis Standl.

ELAEOCARPACEAE

Fieldiana 6: 303–324. 1949

Muntingia calabura L. D 9097, 10350; DEM 120; Dieck 144, 149
Sloanea guapilensis Standl. C 24328; D 9944, 11130; G 8093
S. medusula Schum. & Pit. D 8356 A
S. meianthera Donn. Sm.
S. schippii Standl.
S. tuerckheimii Donn. Sm. C 24892; D 11409; D & L 12069; G 7963, 8234, 8470; P 35966

ERICACEAE

Fieldiana 8 (1) : 88–127. 1966

Befaria discolor Benth. D 10139, 11690; Sp 1569
B. mexicana Benth. Sor. 7134
Cavendishia bracteata (R. & P.) Hoerold
Thibaudia meiantha D. Sm. B & S 5102

ERYTHROXYLONACEAE

Fieldiana 5: 390–393. 1946

Erythroxylon areolatum L. C 23528, 23949; 24484; D 10995, 11064, 11289, 11357, 11650, 12465, 12563, 12761, 12772, 12794, 12903; DEM 594; Dieck 320; G 7630, 8213, 8398; McD 14366
E. belizense Lundell
E. obovatum Macfad. D 14515
E. rotundifolium Lunan C 24013, 24685, 24782, 24945; D 10704, 11221; G 7656; J & I 1119; P 19819
E. tabascense Britt.

EUPHORBIACEAE

Fieldiana 6 (1) : 25–170. 1949

Acalypha sp. DSWV 45, 488, 992, 1028, 1054, 1150
A. alopecuroides Jacq. C 24610; Clev 7514; DEM 99; Pul 7561, 7625, 7635; Sp 1760
A. arvensis Poepp. & Endl. C 23600, 24323; D 9995; DEM 390; DSWV 270; G 8079; K 659; P 30034; Wil 76
A. chlorocardia Standl.
A. costaricensis (Ktze) Knobl.
A. diversifolia Jacq. C 23887, 24323; D 10962, 11093, 11136, 12487; D & Dieck 13002; DSWV 198; G 8095; P 30134; Sp 1733
A. gummifera Lundell
A. hispida Burm.
A. lancetillae Standl. P 35895
A. leptopoda Muell.-Arg. WH 1073
A. macrostachya Jacq. DEM 186, 467; DSWV 171
A. macrostachya var. *hirsutissima* (Willd.) Muell.-Arg.
A. mortoniana Lundell D 23323; D 10849, 11547; G 7800
A. polystachya Jacq. Pul 7632
A. aff. *schlechtendaliana* Muell.-Arg. C 23907
A. schiedeana Schlecht. DSV 491
A. setosa A. Rich. C 24610 A; P 29618
A. unibracteata Muell.-Arg. C 23355; D 10872; G 7842, 7715; P 29618; Sp 2033
A. villosa Jacq. C 23881, 23910; D 12490; L & D 1465
Adelia barbinervis Schlecht. & Cham. D 12048; DEM 287
Alchornea latifolia Sw. D & L 12954; G 7769
A. oblongifolia Standl. DSWV 387; G 7702
Amanoa grandiflora Muell.-Arg. D 12599
A. potomophila Croiz. D & C 12953
Astrocasia phyllanthoides Robins. & Millsp. Leino 364
Bernardia aurantiaca Lundell DEM 365
B. interrupta (Schlecht.) Muell. Arg. G 7841
Breynia disticha Forst. Dieck 202
Caperonia castaneifolia (L.) St. Hil. C 23951; D 10468; L & D 1652; Wil 127
C. paludosa Klotzsch D 12619
C. palustris (L.) St. Hil.
Cnidosculus souzae McVaugh Wil 577
Croton billbergianus Muell. Arg. D 9908, 9118, 12505; G 8439; Wil 7, 577
C. glandulosissima L. D 12644; WH 1103
C. guatemalensis Lotsy C 24957
C. hirtus L'Her Sp 1794
C. lobatus L.
C. nitens Sw. P 35836, 36173
C. niveus Jacq. A & L 17298
C. pyramidalis Donn. Sm. C 23350, 23621, 24445, 24483; D 10188, 10801, 11073, 11439, 12504; DEM 344; G 7840; V 622; WH 1139
C. reflexifolius H.B.K. C 24956, 24957; D 10484 A, 12478; McD 13068
C. repens Schlecht D 11508; DEM 322; Hus 0605; Sp 1655

C. schiedeanus Schlecht. C 23742, 24505, 24873; D 12478; D & Dieck 13024; G 8251; McD 12996
C. trinitatis Millsp.
C. xalapensis H.B.K. D 11556; DEM 344
Dalechampia scandens L. C 23362; DEM 282; Dieck 152; Long 3236; Sp 1567
D. schippii Standl. D 11646; DEM 204; Dieck 283; L & D 1593; Long 32; Sp 1650; WH 1291; Wil 313, 412
D. spathulata (Scheidw.) Baill.
D. tiliifolia Lam.
Drypetes brownii Standl. C 23813; D 10891; G 7843
D. laterifolia (Sw.) Krug. & Urb. A & L 17642
Euphorbia ammannioides H.B.K. Sp 1498 A
E. armourii Millsp. D 1216
E. blodgettii Engelm ex Hitchc. P 35785, 36203; Sp & St 2178, 2243, 2320, 2411, 2431, 2515, 2518
E. brasiliensis Lam.
E. cyathophora Murr. DEM 272 A; G 8407; Sp 1757; Wil 383 A
E. graminea Jacq. D 11565; P 29913; Sp 1759, 1812
E. heterophylla L. A & L 17263; C 23482, 23544, 24138, 24931; D 9994 A; DEM 66, 108, 272, 610; G 8120; Hus 0513; Sp 1700, 1758; V 628; Wil 61
E. hirta L. A & L 17264; C 24780; DEM 103, 107; Long 3251, 3255; McD 13118; Sp 1393, 1579, 1728, 1755, 1759
E. hypericifolia L. C 23560, 23696, 23853, 24369, 24781, 24928, 24994; D 9984, 10759, 10770, 12728; DEM 611; G 7929, 8048, 8493; K 409, 641; Leino 324, 7689; Pul 7618, 7619; Sp 1446, 1502, 1563, 1578, 1698, 1727, 1728, 1756
E. hyssopifolia L. A & L 17257, 17515; C 24101; D 13071; D & Dieck 10331; Long 3248, 3252; McD 12866; U 2; WH 1152
E. lancifolia Schlecht.
E. lasiocarpa Klotzsch C 23462; DEM 191, 229; DSWV 323; G 8573; McD 14351; Sp 1521, 1557, 1562, 1699, 1726
E. leucantha Klotzsch & Gke DEM 240
E. maculata L. K 641
E. marginata Pursh DSWV 141
E. mesembrianthemifolia Jacq. D 11297 A; DEM 670, 677; Lin 16; Sp & St 2180, 2229, 2236, 2245, 2287, 2344, 2395, 2424, 2500, 2514, 2517, 2533, 2546, 2550
E. ocymoidea L. U 39
E. cf. *prostrata* Ait. Sp & St 2519
E. scabrella Boiss. L & D 1566
E. thymifolia L. D 9094, 12430; P 35740
Gymnanthes lucida Sw.
Hieronyma alchorneoides Allen D 11444
H. gentlei Lundell
H. oblonga (Tul.) Muell. Arg.
H. ovalifolia Lundell
Hippomane mancinella L.
Jatropha curcas L. C 24425
J. gaumeri Greenm.
J. hastata Jacq. Wil 175
Julocroton argenteus (L.) Didr. DSWV 748

Mabea occidentalis Benth.
Manihot esculenta Crantz
Margaritaria nobilis L.f. A & L 17608; Leino 305, 7668; P 30334; Sp 1823
Pedilanthus tithymaloides (L.) Poir. DEM 199, 371; L & D 1454
Pera arborea Mutis Leino 76135
P. barbellata Standl.
Phyllanthus acidus (L.) Skeels
P. acuminatus Vahl L & D 1529; P 30272; Sp 1801
P. amarus Schum. & Thonn. C 24035; D 11450; K 407; Sp & St 2190, 2522
P. antillanus (A. Juss.) Muell.-Arg.
P. bartlettii Standl. P 30239, 30300
P. brasiliensis (Aubl.) Poir. L & D 1529; McD 14333; P 30272; Sp 1801
P. carolinensis Walt.
P. compressus H.B.K.
P. diffusus Klotzsch
P. eliasii Webster
P. excelsus Standl. & Wms. C 24263
P. ferax Standl. C 23365, 23548; DEM 258, 366; K 573; P 29494
P. glaucescens H.B.K.
P. liebmannianus Muell. Arg. D 12394, 12807; Sp 1586 A
P. longipes Steyerm.
P. niruri L.
P. nobilis (L.f.) Muell.-Arg. P 30334
P. nobilis var. *hypomalacus* Standl.
P. stipulatus (Raf.) Webster C 23948; D & L 12232; L & D 1659, 1669
P. urinaria L.
Plukenetia penninervia Muell. Arg. G 8180
Ricinus communis L. C 23359; U 125
Sapium macrocarpus Muell.-Arg. Wil 447
S. mammosum Lundell P 30211
S. nitidum (Monach.) Lundell
S. schippii Croiz.
Sebastiana adenophora Pax & Hoffm.
S. confusa Lundell P 30253
S. longicuspis Standl. C 23469, 24428; D 10788, 12659; G 7678, 7693, 8130; P 29806, 30180
S. pavoniana Standl. D 12402, 12572
Stillingia zelayensis (H.B.K.) Muell. Arg.
Tragia sp. D & L 12015
T. mexicana Muell.-Arg.
T. volubilis L. K 541; P 30333
T. yucatanensis Millsp.

FAGACEAE

Fieldiana 3: 369-396. 1952

Quercus sp. U 45
Q. anglohondurensis Muell.
Q. acatenangensis Trel.
Q. insignis Mart. & Gal.

Q. lavrina Humb. & Bonpl. A & L 17091
Q. oleoides Schlecht. & Cham. A 17840; P 29420, 29526, 29743, 30302; Sp 1529, 1643
S. peduncularis var. *sublanosa* (Trel.) Mull. Brunt 2267; P 29632
Q. purulhana Trel.
Q. sapotaefolia Liebm.

FLACOURTIACEAE

Fieldiana 7 (1) : 82 109. 1961

Bartholomaea sessiliflora (Standl.) Standl. & Steyerm. Uck 17785
Casearia aculeata Jacq. K 693; Leino 7668
C. arborea (L. Rich.) Urb. K 655
C. arguta H.B.K.
C. belizensis Standl.
C. commersoniana Camb. D 12449; G 8152
C. corymbosa H.B.K. D 12569 A, 12586, 12607, 12713; P 35844
C. javitensis var. *myriantha* (Turcz.) L. Wms. G 8152, 8614
C. nitida (L.) Jacq. C 24290, 24596, 24600, 24960; D 10482, 10774, 10879, 10894, 11142, 12119; D & L 12199; DEM 596; G 7808, 8124; P 29937, 30170
C. spiralis Johnst.
C. sylvestris Sw. D 10396; L & D 1945
C. tremula Griseb.
Hasseltia dioica (Benth.) Sleum. DEM 556
H. floribunda H.B.K.
Homalium racemosum Jacq.
Laetia thamnia L. C 23346, 23702; D 10798, 11261; G 7691, 8391; P 30226; Sp 1997
Lindackeria laurina Presl. P 35840
Pleuranthodendron mexicana (Gray) L. Wms. P 30086, 30176
Prockia crucis L. C 23872, 24596; D 10764, 10943, 10947, 12651, 12783; DSWV 462; G 8271; P 30326
Xylosma anisophylla Standl. D & L 12195
X. celastrinum (H.B.K.) Standl. & Steyerm.
X. flexuosum(H.B.K.) Hemsl.
X. hemsleyana Standl.
X. velutinum (Yul.) Triana & Karst. ex Karst. P 29634, 29693
Zuelania guidonia (Sw.) Britt. & Millsp. G 8409; P 30260, 36128

GENTIANACEAE

Fieldiana 8: 302 334. 1969

Centaurium pringleanum (Wittr.) Robins.
C. setaceum (Benth.) Robins.
Chelonanthus alatus (Aubl.) Pulle D 12913
Coutoubea spicata Aubl. A & L 17843; C 24062; D 10439 A; DEM 34, 441; DSWV 367; Hus 0525; Wil 101
Curtia tenella (Mart.) Cham.
Eustoma exaltatum (L.) Salisb. A & L 17854; D 10352 A; G 8516; Leino 326, 7644; WH 1333
Leiphaimos parasitica Schlecht. & Cham.

L. simplex (Griseb.) Standl.
Lisianthus auratus Standl.
L. axillaris (Hemsl.) Klotzsch C 23249, 23850, 23979; DEM 211, 660; Dieck 150 A; Leino 257; P 29489; Sp 1560, 1978; U 8
L. brevidentatus (Hemsl.) Klotzsch
L. saponarioides Schecht. & Cham P 29820
Nymphoides humboldtianum (H.B.K.) Klotzsch
N. indica (L.) Klotzsch
Schultesia sp. L & D 1410 A
S. brachyptera Cham.
S. guianensis (Aubl.) Malme L & D 1410; P 29500, 36536
S. heterophylla Miq.
S. lisianthoides (Griseb.) Benth. & Hook ex Hemsl. D 12442 A; DEM 585; D & L 12118
S. peckiana Robins.
Voyria alba (Standl.) L. Wms.
V. thalesioides (Standl.) L. Wms.
V. umbaticola L. Wms.

GESNERIACEAE

Fieldiana 10 (3) : 240 313. 1974

Achimenes erecta (Lam.) Fuchs
Besleria laxiflora Benth.
Codonanthe crassifolia (Foche) Morton B & S 5173; P 30274
C. macradenia Donn. Sm.
Columnea purpurata Hanst.
C. sulfurea Donn. Sm.
Drymonia macrophylla (Oerst.) Moore C 23849
D. ochroleuca Standl.
D. serrulata (Jacq.) Mart. ex DC.
Phinaea parviflora (Brong. & Bouche) Benth. ex Soler.

GUTTIFERAE

Fieldiana 7 (1) : 36-61. 1961

Calophyllum brasiliense var. *rekoi* Standl. A & L 17012
Clusia belizensis Standl.
C. chanekiana Lundell
C. flava Jacq.
C. gentlei Lundell
C. lundellii Standl. P 29869
C. massoniana Lundell P 29751, 29819
C. minor L.
C. quadrangulata Bartl. D & C 12951
C. rosea Jacq.
C. salvinii Donn. Sm. D 12908; P 35989; Wil 438
C. suborbicularis Lundell
Hypericum aphyllum Lundell

H. fasciculatum Lam. Crank 2; D 10019; D & P 10121; Hunt 63; Hus 0602; McD 14426; Sor 7140; Sp 1624; Wil & W 11480; Wil 250
H. pratense Schlecht. & Cham.
H. styphelioides A. Rich. D & P 10143; DEM 306, 336; Dieck 321; DSWV 355; Hus 0590, 0596; McD & C 14306; P 29408; Sor 7137; U 105; Wil & W 11480; Wil 260 A, 269
H. uliginosum H.B.K. P 29527, 30306
Mammea americana L.
Marila verapazensis Donn. Sm. P 36225
Rheedia edulis Triana & Planch.
R. intermedia Pitt.
Symphonia globulifera L.F. D 12855, 12870; WH 1287; Wil 448
Tovomita nicaraguensis (Oerst.) L. Wms.
Vismia angustata Miq. C 24546; D 12899, 13026; D & L 12127; P 29571; U 65; Wil 36
V. baccifera (L.) Triana & Planch. D 12477; Hus 0655
V. camparaguey Sprague & Riley C 23508, 24209, 24504; D 9907; 12859, 12881; G 8235, 8235 A; McD 13039, 14354; WH 1142; Wil 425
V. ferruginea H.B.K. V 666
V. latifolia Choisy
V. mexicana Schlecht.

HIPPOCRATEACEAE

Fieldiana 6: 218 222. 1949

Cheiloclinium belizense (Standl.) A.C. Sm. Contreras 6933
Elachyptera floribunda (Benth.) A.C. Sm. D 12888; Wil 151
Hemiangium excelsum (H.B.K.) A. C. Sm. D 12530; Leino 200, 329; WH 1329
Hippocratea celastroides H.B.K.
H. volubilis L. D 12627; G 7590; P 30359
Salacia belizensis Standl.

HYDROPHYLLACEAE

Fieldiana 9: 99 111. 1970

Hydrolea spinosa L. A & L 17913; D 10430 A, 10433, 10449 A; DEM 43, 492; Dieck 155; L & D 1654; Leino 7632; P 30323, 36215; Wilb & W 11566
Nama jamaicense L. K 530; P 29405

ICACINACEAE

Fieldiana 6: 225 229. 1949

Calatola laevigata Standl.

LABIATAE

Fieldiana 9 (3) : 237 317. 1973

Catopheria capitata Benth. ex Hemsl.
Coleus blumei Benth.
Hyptis americana (Aubl.) Urb.
H. atrorubens Poit.

H. brevipes Poit.
H. capitata Jacq. D 10418; DEM 377; Hus 0565
H. conferta Pohl ex Benth. Hunt 168
H. lantanaefolia Poit. P 29683; Sp 1437
H. obtusifolia Presl P 24411
H. pectinata (L.) Poit. K 630; Lazor et al 1759
H. recurvata Poit.
H. savannarum Britt. DEM 25, 49, 615
H. suaveolens (L.) Poit.
H. urticoides H.B.K. C 23379, 24832
H. verticillata Jacq. C 24114, 24832; D 11177, 12558; G 8384; J & L 1195; P 30345; U 91; Uck 17802; V 660 A; Wil 486
Leonurus sibiricus L. Leino 76
Marsypianthes chamaedrys (Vahl) Ktze C 23278, 24027, 24055; Crank 11; D 10936, 11525; Dieck 102, 287, 300; G 7873; Hus 0536; L & D 1428; P 29416; Sp 1518, 1654, 1782; Wil 197, 348
Ocimum micranthum Willd. A & L 17319, 17519; C 23632, 23695; DEM 392; K 561; Leino 314; P 29612; Sp 1782; V 660 B; Wil 52
Salvia coccinea Juss. ex Murr. D 10236; DEM 256
S. guarinae Standl. D & L 12309 A; DEM 362
S. hyptoides Mart. & Gal.
S. lundellii Epling P 30130
S. micrantha Vahl
S. miniata Fern. S & C 5033
S. obscura Benth.
S. urica Epling
Scutellaria chalicophila Loes.
S. inflata Epling
S. lundelii Epling
S. occidentalis Sw. D & Dieck 12204; K 428
S. orichalcea Donn. Sm. G 7920; P 29597, 29921
Teucrium inflatum Sw. Leino 317; P 30048
T. proctori L. Wms. P 25498
T. vesicarium Miller C 23327, 23494; Clev 7521; D 10778; G 7775, 8504, 8524; P 30048; Pul 7537; Sor 7065

LACISTEMACEAE

Fieldiana 3: 340 342. 1952

Lacistema aggregatum (Berg.) Rusby D & L 12360; DEM 524, 533; G 8202, 8397; P 30361, 36024

LAURACEAE

Fieldiana 4: 302 344. 1946

Beilschmiedea hondurensis Kosterm.
Cassytha filiformis L. A & L 17535; D 10092, 11021, 13076; DEM 33; G 8532; Hus 0551; J & I 1211; L & D 1451; Sp 1544; WH 1326
Licaria campechiana (Standl.) Kosterm.

L. capitata (Cham. & Schlecht.) Kosterm.
L. caudata (Lundell) Kosterm.
L. coriacea (Lundell) Kosterm.
L. peckii (Johnst.) Kosterm. P 30143, 36127
Nectandra albiflora Lundell
N. coriacea (Sw.) Griseb. D 11058, 12610
N. glabrescens Benth.
N. globosa (Aubl.) Mez.
N. lundellii Allen P 30092
N. membranacea (Sw.) Griseb.
N. mopanensis Lundell
N. salicifolia (Kunth) Nees P 29815, 30154; Sp 1804
N. sanguinea Rottb. McD 13067
Ocotea cernua (Nees) Mez
O. eucuneata Lundell
O. mayana (Lundell) Lundell
O. lenticellata Lundell G 8811
Persea americana Miller D 12739
P. longipes (Schlecht.) Meissn.
P. schiedeana Nees
Phoeba areolata Lundell
P. gentlei (Lundell) Standl. & Steyerm.
P. helicterifolia (Meissn.) Mez
P. longicaudata Lundell
P. mexicana Meissn
P. mollis Mez
P. trinervis Lundell

LECYTHIDACEAE
Fieldiana 7 (2) : 261-263. 1962

Grias gentlei Lundell
G. integrifolia (Standl.) Kunth

LEGUMINOSAE — CAESALPINOIDEAE
Fieldiana 5: 88-151. 1946

Bauhinia dipetala Hemsl.
B. divaricata L. A 17768; C 23413, 23703, 23914; D 19730, 11243, 12456; DEM 53; Dieck 143, 225; G 8482; K 528; Leino 256, 7676; P 30320, 30329; Sp1875; Uck 17824; Wil 519
B. glabra Jacq. Sp 1926
B. gentlei Lundell
B. herrerae (Britt. & Rose) Standl. & Steyerm. A 17782; C 24142; D 10353, 10355 A, 10715; Dieck 231; G 8525; P 29505; U 72; Uck 17782; Wil 495
B. rubelcruziana D. Sm.
B. sericella Standl.
B. ungulata L. C 23941; D 10992; D & L 12244, 12285
Caesalpinia bonduc (L.) Roxb. Sp & St 2262

C. bonducella Roxb.
C. crista L. D 11280
C. exostemma DC DEM 54
C. hispidula Vahl D 10080
C. pulcherrima (L.) Sw. D 11958; Uck 17790, 17791; Wil 590
C. recordii Britt. & Rose
C. violacea (Miller) Standl.
Cassia alata L. P 36601
C. bacillaris L.
C. bartlettii Standl. D 11069; DEM 295
C. bicapsularis L. DEM 36
C. biflora L. Leino 7626
C. diphylla L. C 24073; Dieck 249, 290; G 7642; Hunt 67; P 29413; Wil 283
C. emarginata L. C 23347; D 10153; DEM 57; G 7619; Sp 1874; Wil 254
C. fistula L. Dieck 252
C. flexuosa L. C 24010; Crank 14; DEM 79, 329, 330; G 7654; P 29409; Uck 17795
C. fruticosa Miller DEM 519
C. grandis L. A & L 17014; P 29506; Pul 685
C. hayesiana (Britt. & Rose) Standl. D 10398; D & Dieck 10451; D & L 12339; Dieck 279; L & D 1496, 1518 A, 1618; Uck 17814
C. hispidula Vahl D 10080; D & L 12153; Hunt 119; L & D 1639; Sp 1410; Wil 306 A
C. killippi Rose C 23382; DEM 305; P 29745
C. laevigata Willd. Sp 1772
C. lieophylla Vaq. C 23382; D & L 12124
C. leptocarpa Benth. DEM 374
C. moschata H.B.K.
C. nictitans L.
C. occidentalis L. DSWV 341; K 531; Leino 765; P 30347; Uck 17818
C. oxyphylla Kunth C 24604; K 613; P 29469
C. peralteana H.B.K.
C. petensis (Britt. & Rose) Standl. Burch 5886; P 29695, 30110
C. reticulata Willd. D 11956; DEM 501; Leino 7647
C. rotundifolia Pers.
C. serpens L. DEM 324
C. spectabilis DC A 17770
C. stenocarpa Vaq. C 24128; D & L 12148; L & D 1526; P 29472; Sp 1388
C. tagera L. A 17773; A & L 17202; Crank 8; D 10364, 10461; D & L 12152; L & D 1413; P 29412; Sp 1388; Wil 202
C. tetraphylla var. *aurivilla* Sowen. DEM 36, 295; Sp 1406; Wil 383 A
C. tora L. K 470; Sousa 4144
C. undulata Benth. C 23975, 24221, 24493, 24937; D 11008, 11087, 11203; DEM 19, 494, 519, 633; Wil 532
C. uniflora Miller A & L 17878; C 23312, 23480, 23724; G 7743; Sp 1777, 1788, 1811; Uck 17815
C. wilsonii (Britt. & Rose) Standl.
Cynometra retusa Britt & Rose G 8157; V 619
Delonix regia (Bojer) Raf. U 155
Dialium divaricatum Vahl

D. guianense (Aubl.) Steud. C 24567; D 10941; Leino 307; P 30084; Sp 1943
Haematoxylon brasiletto Karst. A & L 17036, 17197; D 12000; Leino 307
H. campechianum L. D 10373
Hymenaea courbaril L. D 11538, 11957; G 8058; P 36169
Poeppigia procera Presl Leino 355
Schizolobium parahybum (Vell.) Blake
Swartzia cubensis (Britt. & Rose) Standl. A & L 17064; Dieck 242
Tamarindus indica L. D 11401 A, 12611; Wil 500
Zollernia tango Standl.

LEGUMINOSAE — MIMOSOIDEAE

Fieldiana 5: 1 88. 1946

Acacia sp. DSWV 742, 754, 1090, 1202; C.O. Johnson 158–68
A. angustissima (Miller) Kuntze A 17921
A. collinsii Safford A & L 17001, 17530; C 23298; D 11973, 12781; D & P 10032 A; DSWV 315
A. cookii Safford P 30237
A. cornigera (L.) Willd. D 11025; DSWV 315; G 7577; Sp 1744, 1747, 1937
A. costaricensis Schenck. C 23198; D 11401; Sp 1937
A. dolichostachya Blake
A. farnesiana (L.) Willd. DSWV 854
A. flexicaulis Benth. DSWV 21
A. gentlei Standl. C 23546; D 10729, 12544; G 8072; P 30151; WH 1123; Wil 457
A. glomerosa Benth.
A. hindsii Benth.
A. spadicigera Schlecht. & Cham. P 30213, 30335
A. villosa Willd. DSWV 758, 801 A
Adenopodia polystachya (L.) Dixon
Albizzia adinocephala (Donn. Sm.) Britt. & Rose G 8219
A. idiopoda (Blake) Britt. & Rose DEM 91; L & D 1573
A. lebbeck (L.) Benth.
A. tomentosa (Michx.) Standl.
Calliandra belizensis (Britt. & Rose) Standl. D & L 12249; P 29734; Sousa 4159 A
C. caeciliae Harms DSWV 456
C. confusa Sprague & Riley D 11630; D & L 12091, 12282, 12304; DSWV 461
C. cookii (Britt. & Rose) Standl.
C. deamii (Britt. & Rose) Standl.
C. emarginata (Humb. & Bonpl.) Benth D 11333; D & L 12269; DSWV 469; G 8429; WH 1258; Wil 399
C. grandiflora Benth. Wil 11
C. houstoniana (Miller) Standl. A & L 17849; C 23255, 23545, 24488; D 11520; G 8200; K 665; L & D 1412, 1594; McD 14356; P 29421; U 81
C. lucens (Britt.) Standl. D 10386; DEM 30
C. mexicana Brandeg. C 23531; D & L 12323; DEM 353; Sp 1383; Wil 390, 391, 408
C. molinae Standl.
C. portoricensis (Jacq.) Benth. DSWV 1119
C. rhodocephala Donn. Sm. Sousa 4174

C. tetragona (Willd.) Benth. D 10893, 11873; Wil 247
C. yucatanensis (Britt. & Rose) Standl.
Desmanthus virgatus (L.) Willd. A & L 17333
D. depressus Humb. & Bonpl. D 10381; DEM 147
Entada gigas (L.) Fawc. & Rend. D 12919
E. monostachya DC. D 12919
E. polystachya (L.) DC.
Enterolobium cyclocarpum (Jacq.) Griseb. Hus s.n.
Inga belizensis Standl.
I. edulis Mart.
I. leptoloba Schlecht
I. lindeniana Benth.
I. oerstediana Benth. D & C 12973
I. pinetorum Pitt. D 11649; Hunt 431, 432; Wil 429
I. punctata Willd. C 24422; D 10805, 12506; L & D 1487
I. quaternata Poepp. C 7895
I. recordii Britt. & Rose D & L 12107
I. rodrigueziana Pitt.
I. sapindoides Willd. G 8078; Sp 1677, 1922, 1953
I. schippii Standl.
I. spuria (Willd.) Leon D 10111, 10894, 11336; L & D 1650; Pul 683; Sp 1845, 2024; WH 1155
I. stevensonii Standl.
I. thibaudiana DC.
Leucaena glauca (L.) Benth. D 12557; Leino 210
L. guatemalensis Britt. & Rose A & L 17163
Lysiloma bahamense Benth. C 23705, 23974; D 12674; DSWV 258; G 8557; L & D 1450; Sp 1995, 2011
L. desmostachys Benth. A & L 17040
Mimosa albida Humb. & Bonpl. D & L 12241; DEM 301; Hunt 229; L & D 1576
M. angustissima (Miller) Ktze. A & L 17921
M. hemiendyta Rose & Robins. A & L 17921; C 24061, 24947; D 11394 A, 11623, 12013, 13068, 14514; D & L 12220; Hus 0562; Leino 351, 7674; L & D 1570; Wil 234
M. hondurana Britt. D 10981, 12785; DEM 128; L & D 1515
M. pigra L. C 23303, 24095, 24499; D & L 12322; Hus 0571; Leino 7686; Sp 1808, 1871; U 94; WH 1180; Wil 85, 142, 501
M. pinetorum Standl.
M. pudica L. A & L 17219; D & L 12319; Leino 7686
M. quadrivalvis L. Dieck 110; Sp 1549
M. recordii Britt. & Rose C 23518; D & L 12107, 12131; DEM 336; Dieck 304
M. scalpens Standl.
M. somnians Humb. & Bonpl. C 24002; D & L 12296, 12321, 13080; Wil 126, 419
Pithecellobium albicans (Kunth) Benth.
P. arboreum (L.) Urban
P. brownii Standl. D 13090; D & L 12049; DEM 511
P. calostachys Standl. Sousa 4161

P. donnell smithii (Britt. & Rose) Standl. C 24065; D 10480, 11089, 11122, 11329, 11490, 12854; D & L 12068, 12939; G 7741, 8103, 8442, 8580; P 36180; V 584; WH 1221, 1274; Wil 576

P. dulce (Roxb.) Benth. J & I 1162

P. emarginatum Benth. Wil 399

P. erythrocarpum Standl. D 10450; WH 1160

P. gigantifolium (Schery) Leon A & L 17622; D & C 12975

P. graciliflorum Blake

P. halogenes Standl.

P. johanseni Standl.

P. keyense Britt. D 11460; D & P 10323, 10373; L & D 1535

P. lanceolatum (Humb. & Bonpl.) Benth. A & L 17343; C 24037, 24037 A; D 10496 A, 11349, 11460, 12496, 12670; D & L 12196; G 7655; Leino 416; Wil 200, 210

P. leucocalyx (Britt. & Rose) Standl. Brunt 2242

P. ligustrinum (Jacq.) Benth. C 23427; D 11347

P. macrandrium Donn. Sm. C 23980; D 11344, 11570, 12535, 12601, 12628, 12854; Sp 1788

P. microstachyum Standl. Sp 1484

P. pachypus Pitt. C 23919; D & Dieck 13070; D & P 10216; DSWV 204; G 8418, 8510

P. peckii (Robins.) Standl.

P. pistaciifolium Standl.

P. recordii (Britt. & Rose) Standl. A & L 17106; C 24065; D 11047, 13090

P. tenellum (Britt. & Rose) Standl. D 10727; Sp 2019; Wil 349

P. unguis cati (L.) Benth.

Schrankia leptocarpa DC

LEGUMINOSAE —PAPILIONOIDEAE

Fieldiana 5: 152 368. 1946

Abrus precatorius L. D 10400, 10957, 12811; DEM 646; G 7584; Wil 10

Aeschynomene americana var. *glandulosa* (Poir.) Rudd D & L 12117, 12150, 12242; DEM 396; Hunt 319; K 437; L & D 1503, 1599

A. brasiliana (Poir.) DC P 29914

A. deamii Robins. & Bart.

A. elegans Schlecht. & Cham. Wil 364

A. hystrix var. *incana* (Vaq.) Rudd.

A. laevis Mart. & Gal.

A. paniculata Willd. ex Vog. P 29534

A. rudis Benth.

A. sensitiva Sw.

A. tenerrima Robins.

Andira inermis H.B.K. A & L 17108; C 24471, 24861; D 11031, 11030 A, 11419; G 8041, 8111, 8231; P 29608, 30248

Arachis hypogaea L.

Ateleia cubensis Griseb.

A. gummifera (DC.) D. Dietr.

A. pterocarpa Moc. & Sesse ex A. Dietr. Sousa 4175

Barbieria pinnata (Pers.) Baill.

Cajanus cajan (L.) Millsp. D 10422, 11268; D & L 12371
Calopogonium brachycarpum Benth.
C. caeruleum Benth. D & L 12174; DEM 71; L & D 1601
C. galactoides Benth. DEM 156
Canavalia bicarinata Standl. D 11971
C. brasiliensis Mart. ex Benth. D 11003; DEM 145
C. maritima (Aubl.) Thouars C 14110; DEM 426, 630; J & L 1207; Sp & St 2184, 2433, 2552
C. mexicana Piper P 29736
C. oxyphylla Standl. & Wms. DEM 551
C. villosa Benth. D 11917, 12311; DEM 172, 317
Centrosema angustifolium (H.B.K.) Benth. WH 1344
C. plumierii Turp. D 10449; D & L 12163; DEM 118; Leino 7643
C. pubescens Benth. D 10953, 11957; D & L 12016; L & D 1479
C. sagittatum (Humb. & Bonpl.) Brandeg.
C. virginianum (L.) Benth. D & L 12123; DSWV 88; Sp 1790
Chaetocalyx belizensis Standl.
Clitoria angustifolia Kunth
C. guianensis (Aubl.) Benth. D & P 10084; Hus 0609; Wil 307, 369
C. rubiginosa Juss.
C. ternatea L. A & L 17592; DSWV 340
Cracca caribaea (Jacq.) Benth. K 60
C. greenmanii Millsp. DEM 257
Crotalaria adscendens (Sw.) DC C 24864
C. angulata Miller DSWV 1100
C. belizensis Lundell
C. incana L.
C. maypurensis H.B.K.
C. mucronata Desv. C 24102
C. nitens H.B.K. P 29744
C. pumila Ortega D 10927; DSWV 873; L & D 1433, 1592; P 29565
C. repens Schlecht. P 29430
C. reticulata L. Dieck 264
C. retusa L. C 23261; DEM 12, 427, 601; G 8369; J & I 1103; Sp & St 2164; U 73
C. sagittalis L. P 29735
C. sagittalis var. *fruticosa* (Miller) Fawc. & Rend.
C. verrucosa L. D 11455
C. vitellina Ker. D 11968; DEM 137
C. vitellina var. *schippii* Senn K 664; P 30149, 30150
Dalbergia brownei (Jacq.) Urban D 11048, 11409 A, 12378, 12512, 12729; D & L 12154
D. cubilquitensis (Donn. Sm.) Pitt.
D. ecastophyllum (L.) Taub. C 23287; D 11459, 12654, 12892; G 8376; J & I 1152, 1170; L & D 1444; Wil 180, 506
D. glabra (Miller) Standl. A 17702; C 24966; D 10207, 14486; Dieck 218; DSWV 294, 349; G 7594; Hus 0503, 0688; J & I 1183, 1185; K 663; P 30263; Pul 7734; Sousa 4165; U 103; Wil 110

D. laevigata Standl.
Desmodium adscendens (Sw.) DC. C 24864; D 10423; Sp 1818
D. axillare (Sw.) DC. A 17759; C 24416; D 9923; WH 1106, 1238
D. axillare var. *acutifolium* (Ktze) Urb. Sp 1592, 1665, 1933
D. barbatum (L.) Benth. & Oerst. C 24076; D 10046; L & D 1421
D. barclayi Benth. D 11969
D. canum (Gmel.) Schinz & Thell. C 24072, 24761; D 11164, 11342; DEM 42, 266, 542; K 476; Leino 7682; Wil 375, 411
D. frutescens (Jacq.) Schindl.
D. intotum (Mill.) Urb. D 12315; DSWV 889
D. macrodesmum (Blake) Standl. & Steyerm. P 36126
D. molliculum (H.B.K.) Kuntze Crank s.n.
D. obtusum (Muhl.) DC
D. purpureum (Mill.) Fawc. & Rendle
D. scorpiurus (Sw.) Desv. DSWV 195
D. tortuosum (Sw.) DC A & L 17879; D 11292; Leino 7677
D. triflorum (L.) DC Dieck 121
Dioclea guianensis Benth. DEM 640
D. virgata (A. Rich.) Amshoff
D. wilsonii Standl. D 9890; Laz & Tyson 1760
Diphysa carthaginensis Jacq. D 10463, 10938, 12198, 12415,12559; D & L 12001; G 7636, 7638; Sousa 4149; Uck 17820
D. macrophylla Lundell
D. robinoides L. Dieck 151; Leino 409
Dolichos lablab L.
Drepanocarpus lunatus (L.f.) Meyer
Eriosema crinitum (H.B.K.) G. Don var. *crinitum* D 11548; Sp 1522, 1550; Wil 310, 373, 384
E. diffusum (H.B.K.) G. Don
E. pinetorum Standl.
E. pulchellum (H.B.K.) G. Don
E. violaceum (Aubl.) G. Don Hunt 25
Erythrina berteroana Urb. D 11148
E. caribaea Kruk. & Barn. D 12714
E. crista galli L. DEM 2
E. folkersii Kruk. & Mold. D 12507, 12714; D & L 12121; DEM 88; WH 1144
E. fusca Lour. D 10741; Dieck 1970
E. glauca Willd.
E. rubrinervia H.B.K.
E. standleyana Kruk. C 23854; D & C 12943; G 8016
E. variegata L. Dieck 189
Galactia anomala Lundell
G. belizensis Standl.
G. nitida Standl.
G. striata (Jacq.) Urb.
Gliricidia sepium (Jacq.) Steud. A & L 17162; D 10934; Hus 0564; L & D 1546
Indigofera mucronata Spreng. A & L 17870
I. suffruticosa Mill. A & L 17605; C 22462; D & L 12166; L & D 1492; Wil 56 A

I. tinctoria L.
Lennea melanocarpa (Schlecht.) Vat. ex Harms Sp 2025
L. robinoides Klotzsch
Lonchocarpus amarus Standl.
L. castilloi Standl. D 11618, 11619; G 8536; L & D 1567; Sousa 4148, 4158 A; Sp 1738
L. guatemalensis Benth. A & L 17112; Sousa 4147
L. hondurensis Benth. L & D 1643; Sousa 4169
L. latifolius (Willd.) H.B.K.
L. miniflorus Donn. Sm. P 36177
L. pentaphyllus (Poir.) DC. A & L 17560, 17651; C 12420, 24874; D 10720, 11335, 12862; D & L 12412; G 7583, 7609, 8613; Leino 238, 244, 342; WH 1075; Wil 136, 244
L. rugosus Benth. C 24757; D & L 12145, 12237; L & D 1456; Sousa 4171; Uck 17806
L. xuul Lundell C 23432, 24199; D 11046, 12399, 13082; D & C 12960
Machaerium cirrhiferum Pitt. C 24198
M. falciforma Rudd D 12922
M. habroneurum Standl.
M. merrillii Standl.
M. pachyphyllum Pitt. C 24319; Sp 1921
M. roscescens Standl.
M. seemannii Benth. D 12843; Sp 1971
M. setosum Standl.
M. setulosum Pitt.
Melilotus alba Descr. DSWV 930
Mucuna andreana Micheli DEM 639; D 9832
M. holtonii (Ktze) Mold. D 11169, 12122
M. pruriens (L.) DC. A 17736
M. rostrata Benth.
M. sloanei Fawc. & Rend.
Muellera frutescens (Aubl.) Standl.
Myroxylon balsamum var. *pereirae* (Royle) Harms
Ormosia coarctata Jackson
O. isthmensis Standl.
O. macrocalyx Ducke
O. schippi Pierce
O. velutina Rudd
Pachyrhizus erosus (L.) Urb.
P. palmatilobus (Moc. & Sesse) Benth. D 10408; Leino 219, 76112
P. vernalis Clausen D & L 12028, 12236, 12240, 12245
Phaseolus aborigineus Burkh.
P. adenanthus Meyer D 12173, 12215; J & I 1189
P. atropurpureus DC C 24068; D & L 12277; Dieck 135; DSWV 482; L & D 1627 A
P. elegans Piper
P. gracilis Poepp.
P. heterophyllus Humb. & Bonpl. DSWV 877
P. hirsutus L.
P. lathyroides L. D 11293, 11448; D & L 12109
P. linearis H.B.K. D 10125, 11516; Wil 371, 400, 400 A, 460 A

P. lunatus L. A & L 17268; DEM 94
P. peduncularis H.B.K. L & D 1544
P. spectabilis Standl. vel sp. aff. D & L 12276
Piscidia piscipula (L.) Sarg. D 12383; G 8294, 8562
Playmiscium yucatanum Standl.
Pterocarpus belizensis Standl.
P. hayesii Hemsl.
P. officinalis Jacq. D 12912, 12923; D & C 12957; Sp 1834; U 92; Wil 484
P. reticulatum Standl.
Pueraria phaseoloides Benth. DEM 466
Rhynchosia discolor Mart. & Gal
R. edulis Griseb. DSWV 511
R. longeracemosa Mart. & Gal.
R. minima (L.) DC A & L 17507; D 10836, 11165; Leino 7628, 7675
R. pyramidalis (Lam.) Urb. D 9875; Sp 1974; V 622
Sesbania emerus (Aubl.) Leino 237
S. emerus var. *exasperata* (H.B.K.) Schery A & L 17834
S. sericea (Willd.) Link
Sophora tomentosa L. J & I 1138
Stylosanthes guianensis (Aubl.) Sw. A 17857; D 11555; Wil 296
S. humilis Sw. D 10753
S. viscosa Sw. DEM 309; Sp 1384
Sweetia panamensis Benth. McD & C 14328; WH 1181
Tephrosia belizensis Lundell
T. cathartica (Sesse & Moc.) Urb.
T. littoralis (L.) Pers.
T. multifolia Rose
T. nitens Benth. L & D 1608; Wil 284
T. rhodantha Brandeg.
T. senna H.B.K.
T. sinapou Buch.
Vigna luteola Benth. Pul 7541; U 44; Wil 80
V. vexillata (L.) Rich. C 24113; DSWV 424, 640
Zornia reticulata J.E. Sm. D 10086, 11512; Sp 1540; Wil 279, 301

LENTIBULARIACEAE

Fieldiana 10 (4) : 315–328. 1974

Genlisea filiformis St. Hil.
G. luteoviridis C. Wr.
Utricularia adenantha Standl. Pul 7735
U. adpressa St. Hil.
U. areola Blake
U. cornuta Michx.
U. erectiflora Standl. P 35732
U. fimbriata H.B.K.
U. foliosa L.
U. guianensis DC
U. hispida Lam. D & P 11658

U. hydrocarpa Vahl
U. juncea Vahl D 11065; D & L 12338
U. juncea forma *minima* Blake
U. macerrima Blake DEM 664; Sp 1620
U. mixta Barnh.
U. obtusa Sw.
U. peckii Blake
U. pinetorum Standl.
U. purpurea Walt.
U. pusilla Vahl
U. resupinata Greene D 10392, 10394
U. simulans Pilg. D & L 12366
U. subulata L. D 10393; D & L 12239

LOASACEAE

Fieldiana 7 (1) : 152 157. 1961

Mentzelia aspera L.

LOBELIACEAE

Lobelia cardinalis L. D 10808; G 7226
L. cliffortiana L. P 29946, 30094
L. splendens Willd.
L. xalapensis H.B.K. D & L 12332; DEM 388
Sphenoclea zeylanica Gaertn.

LOGANIACEAE

Fieldiana 8: 276 301.

Buddleia americana L. Dem 142; K 666; P 30044
Cynoctonum mitreola (L.) Britt. P 29713
Spigelia anthelmia L. C 23262, 23452, 24801, 24916, 19917; Clev 7567; Crank 3; D 11341; DEM 394, 570; K 682; P 29586; Sp 1576, 1679, 1763, 1989, 2014; U 28; WH 1112, 1171; Wil 109, 567
S. humboldtiana Cham. & Schlecht. D 10881; G 7291; 8135; L & D 1623
S. polystachya Klotzsch
Strychnos brachistantha Standl. C 23595, 24961; G 7717, 7767, 8114
S. panamenis Seem. A & L 17062
S. panamensis var. *hirtiflora* Standl.
S. peckii Robins. C 24206; G 8456
S. tabascana Sprague & Sandw. A & L 17062

LORANTHACEAE

Fieldiana 4: 62 86. 1946

Arceuthobium globosum Hawks. & Wiens. Etheridge BFDS 26; Hunt 286
A. marginatum (H.B.K.) Eichler P 30198
Oryctanthus cordifolius (Presl.) Urb. C 24485; D 11033; D & C 12940; D & L 12294
Phoradendron belizense Trel.
P. cayanum Trel.

P. ceibanum Trel.
P. cheirocarpum Trel. D 11144
P. cocquericetum Trel.
P. commutatum Trel.
P. flavens (Sw.) Griseb. D 11673
P. gentlei Trel.
P. manatense Trel.
P. millspaughii Trel.
P. piperoides (H.B.K.) Trel. D 11124; G 8246, 8471; P 30277
P. quadrangulare (Kunth) Krug & Urb. P 29924, 36020
P. robustissimum Eichler
P. supravenulosum Trel. P 29767
Phthirusa phaneroloma Standl.
P. pyrifolia (H.B.K.) Eichler D 11040; L & D 1439; P 29950, 30270
Psittacanthus aff. *allenii* Woods. & Schery D & P 10147
P. calyculatus (DC.) Don A 17703; Pul 779; Wil 92
P. chrismarii Urb. P 29437
P. schiedeanus (Cham. & Schlecht.) Blume DEM 528; Dieck 325
Struthanthus cassythoides Millsp. D 10874 A, 10974, 11152, 11153, 11383, 12533; Dieck 181; G 8538; McD & D 14319; P 30303; Sor 7080
S. orbicularis (H.B.K.) Blume D 11015; L & D 1640; Leino 310; Pul 7710

LYTHRACEAE

Fieldiana 7: 240 260. 1962

Ammania coccinea Rottb. Leino 76102
Cuphea appendiculata Benth. D 10819
C. axilliflora Koehne
C. calophylla Cham. & Schlecht. C 23375, 23536 A, 23937, 24076 A, 24443, 24871, 24936; D 10750 A, 10896; DEM 202, 459; G 8019; Hus 0576; Long 3224; P 29935; Sor 7054; Sp 1637, 1712; WH 1157; Wil 4, 374
C. carthaginensis (Jacq.) Macbr. C 23498, 23631; WH 1109, 1273
C. hyssopifolia H.B.K. C 24353; D 12074; D & L 12338; McD 12899
C. infundiblum Koehne D 10819; G 7680
C. mimuloides Cham. & Schlecht. P 29712
C. utriculosa Koehne C 23536; D 10758 A; DEM 341; P 29885
C. wrightii Gray
Lawsonia inermis L. Wil 504
Rotala ramosior (L.) Koehne P 29943

MALPIGHIACEAE

Fieldiana 5: 468 500. 1946

Banisteriopsis pubipetala (Juss.) Cuatr.
Brachyptera ovata (Cav.) Small
Bunchosia cornifolia H.B.K.
B. glandulosa (Cav.) DC.
B. lanceolata Turcz. G 7778; V 655
B. nitida (Jacq.) DC.

B. swartziana Griseb. var. *yucatanensis* Ndzu.
Brysonima bucidifolia Standl. McD 13066
B. crassifolia (L.) DC. A & L 17010; C 23517; Crank. s.n.; DEM 1291; Dieck 250; D 10723, 12911; McD 10723; P 30261
B. lanceolata Turcz. D 12483
Heteropteris beechyana Juss. DEM 293; Dieck 25; D 11647, 12219; D & L 12327; L & D 156; P 29540, 29656, 29671, 29673
H. brachyptera Standl.
H. heterocarpa (Standl.) Standl. McD & C 14358; DSWV 357
H. laurifolia (L.) Juss. C 23520, 24974; D 10748, 12458; Sor 7063; Sp 1545
H. macrostachya Juss. D 9904; G 8394
Hiraea macrostachya Juss. D 9904; G 8394
H. borealis Ndzu.
H. fagifolia (DC.) Juss.
H. obovata (H.B.K.) Ndzu. A & L 17072
H. quapara (Aubl.) Sprague G 7812
H. smilacina Standl.
Malpighia glabra L. P 30128
M. lundellii Morton
M. punicifolia L.
Mascagnia macrocarpa (Moc. & Sesse) Ndzu. G 8545
M. nicaraguensis (Griseb.) Ndzu. D 11364, 12836
M. polycarpa Brand. G 7576, 8545
M. vacciniifolia Ndzu.
Stigmatophyllon ciliatum (Lam.) A. Juss. P 36604
S. ellipticum (H.B.K.) Juss. A & L 17548
S. humboldtianum (DC.) A. Juss. A & L 17920; DEM 575; U 87; Wil 489
S. lindenianum Juss. D 12655; D & L 12259; DEM 491; G 7676, 7927
S. lindenianum var. *yucatanum* Ndzu.
S. puberum Juss. D & C 12985
S. sericans (Ndzu.) Small
Tetrapteris acapulcensis var. *macrocarpa* Ndzu. DEM 367
T. arcana Morton C 24490; D 10452, 12609; DEM 56, 310, 311; G 8211; Hunt 376; L & D 1453, 1569
T. discolor (Meyer) DC. D & L 12086
T. glabrifolia (Griseb.) Small
T. schiedeana Schlecht. & Cham. D 10452 A; DEM 20; L & D 1572; P 29800, 29889
T. seleriana Ndzu. McD 13069

MALVACEAE

Fieldiana 6: 324 386. 1949

Abelmoschus moschatus Medic. K 40
Abutilon sp. Wil 175, 482, 508
A. crispus (L.) Medic. DEM 227
A. hirsutum (Lam.) Sweet. Uck 17825
A. permolle (Willd.) Sw. D 11173
Anoda cristata (L.) Schlecht.

Gayoides crispum (L.) Small
Gossypium hirsutum L. A & L 17275, 17890; C 23363
G. mexicanum Todaro
Hampea euryphylla Standl. D 11578; DEM 358; P 29798
H. stipitata S. Wats. D 10786, 11553, 12317
H. trilobata Standl. C 24655, 24763, 24970; D 10831, 11014, 11361, 11390, 14491; G 8389, 8550; K 484; McD & C 14267; P 29841; Sp 1979; Wil 236, 378
Hibiscus abelomoschus L.
H. bifurcatus Cav.
H. cannabinus L.
H. costatus A. Rich. C 23627, 24776; D 9104, 10787, 11218, 12799; D & Dieck 13054; DEM 47; G 8390; Hus 0607; McD & C 14280; Wil 427
H. diversifolius Jacq. P 30054
H. esculentus L. Leino 7640
H. "sectio" *furcaria* Dieck 200
H. furcellatus Desr. P 29719
H. rosa-sinensis L. A & L 17140; Sp & St 2158
H. sabdariffa L.
H. sororius L.f.
H. tiliaceus L. D 11284, 12481 A; Leino 7681; P 29516; Sp & St 2309, 2429; Wil 146, 483
Malachra alceifolia Jacq. var. *alceifolia* A & L 17256; C 23868, 24336; D 10967; DEM 364, 487; Leino 7681; Wil 68
M. capitata L. P 30284
M. fasciata Jacq. K 603; P 30075
M. radiata L. Pul 7625
Malvastrum coromandelianum (L.) Garcke Pul 7638, 7641
Malvaviscus arboreus Cav. var. *arboreus* P 29504; U 132; WH 1275; Wil 130
M. arboreus var. *brihondus* Schery
M. arboreus var. *mexicanus* Schlecht. C 23704; Leino 235
M. brevibracteatus Baker
M. grandiflorus H.B.K.
Pavonia fruticosa (Mill.) Fawc. D 9942
P. malacophylla (Link & Otto) Garcke Wilb. & W 11528
P. paniculata Cav. D & L 12308; DEM 170; Sp 1432
P. rosea Schlecht. A 17706; C 24281; D 11161; G 7930; Sp 1590
P. spicata Cav. C 23288
Sida acuta Burm. A & L 17262, 17304, 17310; C 24091; DEM 391; K 515; L & D 1520; Sp 1538; U 73; WH 1183; Wil 551
S. aggregata Presl.
S. ciliaris L. A & L 17844
S. cordifolia L.
S. glabra Mill. DEM 379, 382
S. glomerata Cav. C 23381
S. linifolia Juss. A & L 17866; D 11015 A, 11594; Hunt 193; L & D 1419; U 134; W 51, 455 A
S. pyramidata Desv. DEM 132; K 647; P 30167

S. rhombifolia L. A & L 17876; C 24370; D 11453, 12696; DEM 100; P 30349; Sp 1660, 1724; Wil 51, 71, 177, 477, 488
S. urens L.
Thespesia populnea (L.) Soland. D 11394; J & I 1134
Urena lobata L.
U. aff. *sinuata* L. P 30350
Wissadula excelsior (Cav.) Presl. DEM 380, 485
W. periplocifolia var. *guatemalensis* (Baker) Hochr. Leino 7631

MARCGRAVIACEAE
Fieldiana 7: 16 23. 1961

Marcgravia nepenthoides Seem.
M. schippi Standl.
Souroubea guianensis Aubl.
S. loczyi (A. Richt.) Roon.
S. sympetala Gilg.

MARTYNIACEAE
Fieldiana 10 (3) : 233 238. 1974

Martynia accua L.

MELASTOMACEAE
Fieldiana 7 (4) : 407 525. 1963

Aciotis paludosa Triana
A. levyana Cogn. DEM 476
A. rostellata (Naud.) Triana C 24215
Acisanthera bivalvis (Aubl.) Cogn. D & L 12190; G 7659; P 36222
A. crassipes (Naud.) Wurdack
A. limnobios (DC.) Triana
A. quadrata Pers. A & L 17869; D 10731; DEM 27, 490; P 29790, 36219
Adelobotrys adscendens (Sw.) Triana
Arthrostema ciliatum Ruiz & Pavon C 23343; DEM 424; G 7770, 8447; P 30175; WH 1093
A. parvifolium Cogn. D 10859
Bellucia costaricensis Cogn. D 11210, 11213; DEM 417
B. grossularioides (L.) Triana WH 1177
Blakea cuneata Standl.
Clidemia capitellata (Bonpl.) Don C 24071; D 11204, 11318, 11482, 12896; D & L 12261; DEM 419; WH 1178; Wil 18
C. crenulata Gleason
C. densiflora (Standl.) Gleason
C. dentata Don C 24071, 24364, 24513, 24575, 24805, 24891; D 11179, 11199, 11209, 11355, 11487; G 7902; Wil 18 A
C. hirta (L.) Don A & L 17570; C 24181, 24794; Hus 0579; WH 1084
C. involucrata DC. D & L 12143
C. laxiflora (Schlecht.) Walp.

C. octona (Bonpl.) L. Wms. D 11204 A, 11255, 11566; D & L 12073; G 8174, 8237; L & D 1590; P 29575, 29801; Wil 1

C. petiolaris (Schlecht. & Cham.) Schl. ex Triana C 23316, 23542, 24154, 24439; D 9922, 10804 A, 11179, 11355, 11413, 11485, 13000; K 657; P 29814; Sp 1593, 1672, 1946; Wil 5

C. plumosa L. Wms. D & Dieck 13029

C. pustulata DC. DEM 444

C. sericea Don DEM 213, 438; Hus 0527; L & D 1610; Long 4244; Sp 1524; U 109; Wil 205, 256, 261 A

C. septiplinervia Cogn.

C. strigillosa (Sw.) DC. C 24182, 24194; D 10420, 11061, 11082, 11492, 12434, 12467, 12813, 12873, 12879; G 8069, 8209; Hus 0518, 0608; Sp 1508; U 153

C. urceolata DC. D 11682; D & L 12273; L & D 1689; Wil 257

Conostegia caelestis Standl.

C. icosandra (Sw.) Urb. C 24148, 24837; D 11212, 11500, 11675; D & Dieck 13005, 13047, 13051; Sp 1573; Wil 26, 260, 274 A, 334

C. puberula Cogn. D 10528

C. xalapensis (Bonpl.) Don C 23510, 23986, 24532; D 10987, 11208, 12825; D & L 12265; DEM 200, 527; G 8458; Hunt 56; Hus 0636; L & D 1614; Long 3281; P 29419; Wil 16

Graffenrieda gentlei Lundell

Henrietta succosa (Aubl.) DC. C 24197; D 11085, 12900; G 8452; Hus 0650; Long 3228; Wil 400

H. fascicularis (Sw.) Triana D 11196

Heterocentron subtriplinervum (L. & O.) A. Br. & Bouche D 11691; P 29451; Sp 1570, 1632

Leandra costaricensis Cogn.

L. dichotoma (Don) Cogn.

L. mexicana Cogn. D 11187, 11480; DEM 468; P 29576

Miconia aeruginosa Naud.

M. affinis DC. C 23333, 23606, 23635, 23721; D 10785, 11576; D & Dieck 13049; D & L 12288; DEM 368; G 7701, 7970; L & D 1580, 1591

M. albicans Triana C 23515; D 12447; DEM 214; G 8065; Long 3227; Sp 1657; U 122; V 813

M. ampla Triana

M. amplexicans (Creug.) Triana G 7969

M. angustispicata Blake

M. argentea (Sw.) DC. D 12527; P 32236, 36181

M. astroplocama Donn. Sm. C 24838; D & L 12077

M. belizensis Standl.

M. centrodesma Naud.

M. chamissonia Naud.

M. chrysophylla Urb.

M. ciliata (Rich.) DC. D 10411, 12916; DEM 434; G 8066; L & D 1688; U 154

M. clavescens DC.

M. desmantha Benth. C 23389, 23541, 23610, 23671; D 10780 A; G 7757

M. disparilis (Standl.) R. Wms.

M. dodecandra (Desr.) Cogn. D 11671; DEM 327

M. dorsiloba Gleason
M. fulvostellata L. Wms.
M. glaberrima (Schl.) Naud.
M. holosericea (L.) DC. C 24219; C 11078, 11503; P 29444; WH 1116
M. hondurensis Donn. Sm. C 24186; P 36224
M. hyperprasina Aubl. C 23333, 23569, 23606, 23635, 23721, 24503, 24820; D 10875, 10885; D & L 12288; L & D 1580, 1591; G 7701
M. ibaguensis (Bonpl.) Triana C 23339; D 11654; DEM 333
M. impetiolaris (Sw.) D. Don C 23572; DEM 359, 462; P 36140
M. involucrata Donn. Sm. D & L 12143
M. lacera (H. & B.) Naud. C 24181, 24819; D 11319, 11483; D & L 12076; DEM 474; L & D 1606, 1611
M. lateriflora Cogn. C 24526
M. lundelliana L. Wms. P 36021
M. microcarpa DC. C 24895; D 11210, 11576; G 7970
M. nervosa (Sw.) Triana D & L 12094; P 35832, 35973
M. oinochrophylla Donn. Sm. D 12875; D & L 12094; Long 3272
M. petiolaris (Sw.) D. Don Sp 1945
M. prasina (Sw.) DC. C 23514, 24196, 24824, 24840; D 11080, 11300, 11501, 12806; D & Dieck 13045; D & L 12263; G 7904, 8455, 8584; Long 3278
M. pteropoda Benth. DEM 297
M. schlimii Triana
M. stenostachys DC. C 23520; D 12448; U 820
M. tomentosa (L. Rich.) Don G 24583, 24841; D 11324; G 7969
M. triplinervis R. & P. C 24234, 24457
Mouriria cyphocarpa Standl.
M. exilis Gleason A & L 17841; P 35848; WH 1285
M. gleasoniana Standl.
M. myrtilloides subsp. *parvifolia* (Benth.) Morley A & L 7086; D 9839; D & L 12254; P 30310, 36152
Nespera aquatica (Aubl.) Naud.
Ossaea robusta (Triana) Cogn. D 11906
Pterolepis pumila (Bonpl.) Cogn. D 10370
P. stenophylla Gleason D 10370; DEM 50; Dieck 108
P. trichotoma (Rottb.) Cogn.
Tibouchina aspera Aubl.
T. longifolia (Vahl) Bail. DEM 521
T. longisepala Cogn. DSWV 1130
T. oerestedii (Triana) Cogn. D 7838
Tococa guianensis Aubl. C 24218; D 11674, 12869, 12893; P 29764
Topobea calycularis Naud. D 10547
T. aff. *urophylla* Standl. D 11860

MELIACEAE

Fieldiana 5: 444 468. 1946

Carapa guianensis Aubl.
Cedrela mexicana Roem.

Guarea chichon C. DC.
G. cook-greggsii C. DC.
G. glabra Vahl. A & L 17033, 17090; D 9836, 10914; G 7703, 8021, 8592; P 35843, 36079
G. grandifolia DC. C 24565; D 11427; G 8007, 8249
G. excelsa H.B.K.
G. guara (Jacq.) P. Wilson
G. tuerckheimii C. DC.
Melia azedarach L. D 11471
Spondias radlkoferi Donn. Sm. D 12599; G 7783
Swietenia macrophylla King
Trichilia breviflora Blake & Steyerm C 24172
T. cuneata Radkl.
T. erythrocarpa Lundell C 23611, 23791; D 10726, 10913, 11559; G 7728, 7777, 8334
T. glabra L. D 12510
T. havanensis Jacq. A & L 17067; C 23328; D 10870, 10872 A, 11701; D & L 12217, 12307; G 7834, 7939; L & D 1438, 1523
T. japurensis C. DC. 8592
T. minutiflora Standl. C 23814; D 10920; DEM 398; P 30099
T. martiana C. DC.
T. montana H.B.K. D & C 12935
T. moschata Sw. D & P 10204; D 11244
T. pallida Sw. C 24326; D 11561; G 8167
T. verrucosa C. DC.

MENISPERMACEAE

Fieldiana 4: 258 266. 1946

Abuta panamensis (Standl.) Kruk. & Barn. D 12920; D & C 12937, 12986
Cissampelos pareira L. D 9882 A, 10510, 10692, 10830, 11118, 11171, 12576; D & Dieck 13039; D & L 12020; DEM 60, 198, 285, 547; K 614; P 29561; Sp 1813; U 32
C. tropaeofolia DC.
Disciphania calocarpa Standl. G 8164
D. coriacea Standl.
Hyperbaena hondurensis Standl.
H. nectandrifolia Standl.
H. winzerlingii Standl.

MENYANTHACEAE

Limnanthemum humboldtianum (H.B.K.) Griseb.
Nymphoides humboldtianum (Kunth) Ktze. P 30325

MONIMIACEAE

Fieldiana 4: 299 302. 1946

Mollinedia costaricensis Donn. Sm. G 8474, 8616
M. guatemalensis Perkins WH 1216

Siparuna nicaraguensis Hemsl. C 24396, 24540; D 11195, 11138; D & Dieck 13009 A; G 7719; P 30141; WH 1217
S. riparia (Tul.) A. DC.

MORACEAE

Fieldiana 4 (1) : 10–58. 1946

Artocarpus communis Forst.
Brosimum alicastrum Sw. G 8162; Leino 369, 402; P 29602
B. belizense Lundell
B. gentlei Lundell
B. terrabanum Pitt.
Castilla elastica Cerv. A & L 17015; D 12612; P 30181, 36179
Cecropia asperrima Pitt.
C. mexicana Hemsl.
C. obtusa Trecul.
C. obtusifolia Bertol. C 24563, 24887
C. peltata L. C 23990, 24965; D 11017; K 441; P 30146; Sp 1938; Wil 572
Chlorophora tinctoria (L.) Guad. A & L 17018, 17757
Coussapoa oligocephala Donn. Sm. G 7727; P 30273
Dorstenia contrajerva L. A 17714; Hus 0618; K 521; P 29404, 30205; Uck 17804; V 593; Wil 551
D. lindeniana Bureau B & S 5063
Ficus bonplandiana Miq. DEM 528; G 7607
F. citrifolia P. Mill. G 8374
F. colubrinae Standl.
F. costaricana (Liebm.) Miq. D & C 12974 A
F. donnell smithii Standl.
F. gentlei Lundell
F. glabrata H.B.K. P 29949
F. goldmanii Standl.
F. guajavoides Lundell P 36145
F. hartwegii (Miq.) Miq. DEM 673; Sp & St 2307, 2308, 2397, 2434; Wil 179, 481
F. aff. *hemsleyana* Standl. Lin 11
F. insipida Willd. D 10734, 11049, 11334; DEM 500; G 8031
F. involuta (Liebm.) Miq.
F. kellermanii Standl.
F. laevigata Vahl P 30348
F. lapathifolia (Liebm.) Miq.
F. lundellii Standl.
F. maxima Mill. P 29657
F. obtusifolia H.B.K. DEM 528
F. oerestediana Miq. D 13893
F. ovalis (Liebm.) Miq. Sp & St 2338
F. padifolia H.B.K.
F. panamensis Standl.
F. paraensis (Miq.) Miguel G 7990

F. perforata L. D 12623
F. pertusa L.f. C 24507; D 11075, 11175; P 29809
F. popenoei Standl. P 30309
F. radula Willd. D 12766
F. schippii Standl. G 7994
F. segoviae Miq. D 11049
F. tuerckheimii Standl.
F. velutina Willd.
F. williamsii Standl.
Piratinera panamensis Pitt.
Poulsenia armata (Miq.) Standl. P 35958
Pourouma sp. D 10799
P. aspera Trecul. D 9885
P. guianensis Aubl. C 24831
Pseudolmedia oxyphyllaria Donn. Sm.
P. spuria (Sw.) Griseb. D 10174
Sebastiana pavoniana Standl. D 12402
Trophis chorizantha Standl. P 36165
T. mexicana (Liebm.) Bureau
T. racemosa (L.) Urb. A & L 17756; K 490; P 30269; U 129
T. racemosa subsp. *ramon* (Schlecht. & Cham.) Burger

MORINGACEAE

Fieldiana 4: 398 399. 1946

Moringa oleifera Lam.

MYRICACEAE

Fieldiana 3: 348 352. 1952

Myrica cerifera L. (including *M. mexicana* Willd.) A & L 17125; D 11689; D & L 12290; D & P 10146; DEM 194; P 29502

MYRISTICACEAE

Fieldiana 4: 294 299. 1946

Campsoneura sprucei (A. DC.) Warb. C 24376; D 11303; P 35961
Dialyanthera multiflora Standl.
Virola brachycarpa Standl.
V. koschneyi Warb. C 24562; G 8472
V. multiflora (Standl.) A.C. Sm.

MYRSINACEAE

Fieldiana 8 (2) : 135 210. 1966

Ardisia amplifolia Standl.
A. belizensis Lundell D & L 12066
A. compressa H.B.K. D 12531, 12750; Dieck 224 A; DSWV 353; P 29879, 29907; Pul 7654; U 10; Wil 19, 232, 416
A. densiflora Krug & Urb. D & C 12959

A. donnell-smithii Mez
A. erythrocarpa Lundell
A. escallonioides Schlecht. & Cham.
A. gentlei Lundell
A. hirtella Lundell
A. mitchellae Johnst.
A. nigrescens Oerst.
A. nigropunctata Oerst.
A. paschalis Donn. Sm. D 11241; P 30102
A. pellucida Oerst.
A. pulverulenta Mez
A. revoluta H.B.K. D 12460; DEM 217
A. schippii Standl.
Myrsine coriacea (Sw.) R. Br. P 29746
Parathesis aeruginosa Standl.
P. belizensis Lundell C 23052, 24373; D 11418, 12066
P. cubana (A. DC.) Mol. & Gomez C 24783; D 11359, 11382, 11418, 13087; D & L 12023; L & D 1602
P. guatemalensis Lundell G 7848
P. membranacea Lundell D 10909 A; P 30136
P. obovata Standl.
P. platyphylla Lundell
P. rufa Lundell C 24307; D 9988, 10909; WH 1200
P. sessilifolia Donn. Sm. G 8108
Rapanea guianensis Aubl. D 11006
Stylogyne guatemalensis Blake
S. perpunctata Lundell
Yunckeria amplifolia (Standl.) Lundell

MYRTACEAE

Fieldiana 7 (3) : 285 405. 1963

Callistemon lanceolatum DC. D 13096; Dieck 190
Calyptranthes bartlettii Standl. D 10170; D & L 12337; DEM 298; G 7614; Hus 0613; P 29669; WH 1293
C. belizensis (Standl.) Lundell
C. calderoni Standl. P 29939; Sp 2023
C. chytraculia (L.) Sw. A & L 17514, 17633; Sor 7846
C. chytraculia var. *americana* McVaugh A & L 17312
C. contrerasii Lundell D 11552
C. cuneifolia Lundell
C. fluviatilis Lundell
C. hondurensis Standl.
C. karlingii Standl. D 12837, 12890; P 35997
C. lindeniana Berg. D 10901; P 30145
C. megistophylla Standl. P 36063
C. millspaughii Urb.
C. schiedeana Berg. A & L 17013

Eugenia acapulcensis Steud. C 23575; Crank. s.n.; D 11026, 11037, 11295, 12565, 13089; G 8378; Leino 350
E. aeruginea DC. McD & C 14362
E. anglohondurensis Lundell
E. ardisioides Lundell
E. axillaris (Sw.) Willd. P 29863; Sp 1934
E. belizensis Standl.
E. biflora DC D 10708, 10939; G 8377; WH 1286
E. bumelioides Standl.
E. buxifolia (Sw.) Willd.
E. capuli (Schlecht. & Cham.) Berg. C 23525, 23673; D 9978, 11655, 12303, 12495, 12621, 12839; L & D 1553; P 36132; WH 1214
E. chinajensis Standl. & Steyerm. P 36611
E. coloradensis Berg. C 24070; D 11053
E. cumini (L.) Druce Sor 7068
E. domingensis Berg. D 13092
E. farameoides A. Rich.
E. flavoviridis Lundell
E. fragrans (Sw.) Willd.
E. ibarrae Lundell McD & C 14367
E. laevis Berg. C 24978
E. mouririoides Lundell
E. oblancifolia Lundell
E. octopleura Krug & Urb. D 10746 A
E. origanoides Berg.
E. percivalii Lundell
E. rufidula Lundell
E. aff. *savannarum* Standl. & Steyerm. D 11617
E. schippii Standl.
E. toledinensis Lundell
E. vacana Lundell D 12405; C 8603
E. aff. *venezuelensis* Berg. C 23628, 24032, 24790
E. winzerlingii Standl. C 23248; D & L 12206; DEM 655; G 7648; L & D 1406, 1452, 1680; P 29501
E. xalapensis (H.B.K.) DC. A & L 17080
E. yucatanensis Standl.
Myrcia belizensis Lundell
M. leptoclada DC.
M. splendens (Sw.) DC. C 24377; D 11154, 11563, 12897; DSWV 358; G 8057
Myrciaria floribunda (Willd.) Berg. G 7707; Long 3272; P 29599, 30185
Pimenta dioica (L.) Merrill A & L 17048; D 10199; D & C 12938; Leino 271
Plinia peroblata (Lundell) Lundell
Psidium anglohondurense (Lundell) McVaugh D 12829
P. chrysobalanoides Standl.
P. chrysobalanoides var. *macrophylla* Standl.
P. gentlei Lundell
P. guajava L. Sp & St 2161; WH 1071, 1195

P. guineense Sw.
P. hypoglaucum Standl.
P. oerestedianum Berg.
P. popenoei Standl. A & L 17129
P. rotundifolium Standl.
P. salutare H.B.K.
P. sartorianum (Berg.) Ndzu.
P. sartorium var. *yucatanense* (Lundell) McVaugh
P. schippii Standl.
Syszgium cumini (L.) Skeets C 23300; D 11393, 12388
S. malaccensis (L.) Merrill & Perry D & C 12967

NYCTAGINACEAE

Fieldiana 4: 174-192. 1946

Boerhaavia caribaea Jacq.
B. coccinea Mill.
B. diffusa L. A & L 17934; C 24103; D 11452
B. erecta L.
Bougainvillea glabra Choisy
B. spectabilis Willd.
Mirabilis jalapa L. Uck 17816, 17831
M. violacea (L.) Heimerl.
Neea acuminatissima Standl. D 9959
N. belizensis Lundell
N. choriophylla Standl. C 23281, 23942, 24213; D 10749, 11388; D & L 12034; G 8183; Leino 269; Lin 88; Sp 1546
N. guatemalensis Lundell
N. parviflora Lundell
N. psychotrioides Donn. Sm. A & L 17686; G 8272, 8376; Sp 1716; Wil 115, 206 A
Pisonia aculeata L. G 8026; K 618
P. macranthocarpa Donn. Sm. Dieck s.n.
Rivinia humilis L. K 464; Lin 189; Sp 1950; Sp & St 2270, 2387, 2494
Torrubia linearibracteata (Heimerl.) Standl.

NYMPHAEACEAE

Fieldiana 4: 239-242. 1946

Brasenia purpurea (Michx.) Casp.
Cabomba aquatica Aubl.
C. palaeformis Fass. D 10877 A
C. piauhyensis Gardner P 29706
Nymphaea ampla (Salisb.) DC. D 10409; P 29707
N. ampla var. *speciosa* (Mart. & Zucc.) Carp. D 12170
N. ampla forma *intensa* Fass.
N. blanda forma *jamesoniana* (Planch.) Fass.

OCHNACEAE

Fieldiana 7 (1) : 10–16. 1961

Ouratea insulae Riley
O. guatemalensis Engler C 24139; D 10440, 10762; D & L 12298
O. lucens (H.B.K.) Engler DEM 304, 384; K 575
O. nitida (Sw.) Engler A & L 17349; D 12457, 12550; P 29720, 30098
O. peckii Riley
O. pyramidalis Riley P 30112
O. stenobotrys Riley
Sauvagesia erecta L. A & L 17858; Crank 9; D 10369, 11028, 11605, 12488; DEM 26, 40, 337, 649; DSWV 282; G 7626, 7932, 8052; Hus 0532; P 30289; Pul 7723; Sor 7053, 7087; Sp 1622; WH 1342; Wil 342
S. tenella Lam.

OLACACEAE

Fieldiana 4: 88–92. 1946

Heisteria chippiana Standl. G 8145 (= H. media Blake)
H. media Blake P 30100
Schoepfia schreberi Gmel. D 12840, 12840 A
Ximenia americana L.

OLEACEAE

Fieldiana 8: 264–275. 1969

Forestiera rhamnifolia Griseb.
Jasimum fluminense Vell. Dieck 260
Linociera domingensis (Lam.) Krug & Urb.
L. oblanceolata Robins.

ONAGRACEAE

Fieldiana 7 (4) : 525–568. 1963

Jussiaea affinis DC. DEM 382 A
J. erecta L.
J. natans H.B.K.
J. nervosa Poir. DEM 342; P 29678
J. peruviana L.
J. pubescens var. *ligustrifolia* (H.B.K.) Hara C 23529, 24870; D & L 12093; G 7962; McD & D 12860, 14299
J. repens L.
J. suffruticosa L. DEM 495
J. suffruticosa var. *ligustrifolia* (H.B.K.) Griseb. Sp 1866
Ludwigia nervosa (Poir.) Hara DEM 342; P 29678
L. octovalvis (Jacq.) Raven C 23354, 23608, 24023, 24116, 24253, 24515, 24860; Clev 7515, 7529; D & Dieck 13013; D & L 12336; DEM 383 A; G 7647, 7810, 7922, 8438, 8499; Hunt 60; L & D 1497, 1506; Leino 767; Pul 7515, 7529, 7551; U 74; WH1149; Wil 14, 59, 77, 88, 147, 502, 591
Oocarpon torulosum (Arn.) Urb.

OXALIDACEAE

Fieldiana 5: 374–384. 1946

Biophyton dendroides (H.B.K.) DC. DEM 339; McD & D 12860; P 29665, 29940; Sp 1619, 2018; WH 1134

Oxalis frutescens subsp. *angustifolia* (H.B.K.) Lourt. A 17771, 17864; C 23824, 24014 A; D 12418; D & P 10168; DEM 52, 303, 440; G 7644; Sor 7095; Wil 128, 196

O. neaei DC. P 29623; Sp 1537, 1551

O. yucatanensis (Rose) Standl. McD 13014; P 29747

PAPAVERACEAE

Fieldiana 3: 347–354. 1946

Bocconia frutescens L. C 23792

PASSIFLORACEAE

Fieldiana 7 (1) : 115–146. 1961

Passiflora adenopoda DC.

P. ambigua Hemsl. DEM 653

P. biflora Lam. C 23418; DEM 541; C 8046 A

P. brevipes Killip C 23843

P. brighami Wats.

P. capsularis L.

P. choconiana Wats. D 11558; WH 1261

P. ciliata Ait.

P. cobanensis Killip

P. coriacea Juss. D 11002, 11063; D & L 12214; DEM 73; K 571; L & D 1531; P 29617; Wil 135, 494

P. foetida L. var. *foetida* D 10271, 12428; Leino 303; Pul 7633; U 80; Wil 87

P. foetida var. *hastata* (Bert.) Masters DEM 328; Dieck 128, 139 A

P. foetida var. *languinosa* Killip P 30043

P. foetida var. *mayarum* Killip Laz. & Tyson 2128

P. foetida var. *nicaraguensis* Killip

P. foetida var. *subintegra* Killip

P. guatemalensis Wats.

P. hahnii Fourn. C 23712

P. laurifolia L.

P. obovata Killip Sp 1900

P. oerestedii Masters

P. rovirosae Killip

P. sericea L.

P. serratifolia L. C 23889; D 10024; DEM 150

P. suberosa L. Dieck 263; Lin 53, 83, 145; Sp & St 2142, 2271, 2322, 2337, 2366, 2404, 2436

PEDALIACEAE

Fieldiana 10 (3) : 232–233. 1974

Sesamum orientale L. A & L 17929

PHYTOLACCACEAE

Fieldiana 4: 192 202. 1946

Microtea debilis Sw. D 11700; G 8425
Petiveria alliacea L. A & L 17601
Phytolacca icosandra L. K 602
P. rivinoides Kunth & Bouche A & L 17244; C 24879; D 9983, 11327; G 8012, 8433; Leino 76103; WH 1292
Rivina humilis L. A & L 17121, 17246, 17513; P 29616; WH 1079; Wil 123, 550
Suriana maritima L. Lin 26, 54

PIPERACEAE

Fieldiana 3: 228 337. 1952

Peperomia alata R. & P. D 10506; G 7832
P. chucanebana Trel.
P. crassiuscula Millsp.
P. deppeana Schlecht. & Cham. C 23748 A
P. glutinosa Millsp.
P. gollii Trel.
P. granulosa Trel.
P. hoffmannii C. DC. V 614
P. lenticularis Dahlst. P 30337
P. lundellii Trel.
P. macrostachya (Vahl) A. Dietr. C 23326, 24571; G 7953
P. obtusifolia (L.) A. Dietr. C 24331, 24397; D 10508; DEM 391; G 8126, 8534; Sp 1982
P. pellucida (L.) H.B.K.
P. petenensis Trel.
P. pololensis Trel.
P. praetenuis Trel.
P. rotundifolia (L.) H.B.K. D 9935; V 592
P. serpens (Sw.) Loud. C 24454; D 9932
P. tetraphylla (Forst.) Hook. & Arn. C 23748
Piper aduncum L. C 23485, 24265, 24436; DEM 356, 487; Sp 1737, 1751
P. aeruginosibaccum Trel. P 30244
P. amalgo L. A & L 17049; C 23352, 23650, 24293; D 10435, 10438, 10802, 11020, 11241 A, 11267, 12218, 12521, 12681; DSWV 383; G 8277; Leino 347, 7665; McD & C 14336; P 30339; Sp 1715, 1767, 1959; U 15
P. arboreum Aubl. G 8257
P. atlandidanum Trel. P 30338
P. atlandidanum var. *sibunense* Trel.
P. atrichopus Trel.
P. auritum H.B.K. A & L 17927; C 23373, 24270; Crank 31; D 10154, 10213, 10802, 10825, 10865, 11467, 12498, 12681, 12715; D & L 12114; DEM 228; G 7746, 7797, 8004; P 29553; Sp 1709, 1884; U 26; WH 1127, 1194
P. berlandieri C. DC. C 23988
P. carrilloanum C. DC. C 24467
P. cayoense Trel.

P. chanekii Trel.
P. cocquericotense Trel.
P. discolor Trel.
P. donnell-smithii C. DC.
P. eldoradense Trel.
P. elongatum Vahl C 23652
P. glabrescens (Miq.) C. DC. DEM 275
P. gracillimum Trel.
P. hispidum Sw. K 649
P. jacquemontianum Kunth A & L 17209; C 23463, 23557, 23612, 23799, 23870, 24606; D 10437, 10862, 11072, 11271, 11331, 12039, 12519, 12520; D & L 12039, 12040, 12208; G 7598, 7737, 4808; Hus 0583; J & I 1192, 1193; L & D 1562; Leino 265; Long 3231; Sp 1565, 1717, 1741, 1916, 1954, 1975; U 67; WH 1089, 1099, 1147, 1148; Wil 30, 31, 444
P. kantetulense var. *gentlei* Trel.
P. lundellii Trel.
P. marginatum Jacq. L & D 1476; Sp 1968
P. multinervium Trel.
P. nitidulifolium Trel. D 10737; K 534
P. patulum Bertol.
P. pseudo asperifolium (Trel.) Lundell C 24265; D 11149
P. pseudo-fulgineum C. DC. C 23330, 23471, 23888, 24275; D 10443, 11488, 12498, 12701 A; D & L 12310; DSWV 348; G 7789, 8086; L & D 1482; Sp 1607, 1742, 1828, 1923
P. psilorhachis C. DC. C 23574, 24162, 24290, 24315, 24442; D 10886, 10952, 11119, 11586, 12499, 12740, 12742; G 7665, 8137; P 30063, 30224
P. schippianum Trel.
P. sempervirens (Trel.) Lundell C 23440, 24680; D 10766, 10940, 11240, 12480, 12482
P. sibunense Trel.
P. stevensonii Trel.
P. subcitrifolium C. DC. Crank 23; Sp 1597, 1905
P. tuberculatum Jacq. D 12529, 12701; P 29945, 30340
P. tuerckheimii C. DC.
P. uvitanum C. DC.
P. variabile C. DC. ex D. Sm.
P. yucatanense C. DC. C 23337, 23629, 23793, 24174; D 10906 A, 11572, 12037; G 7830; P 30064
Pothomorphe peltata (L.) Miq. C 24258; D 11572; G 8024, 8140; L & D 1470; Sp 1797

PODOSTEMONACEAE

Fieldiana 4: 401 403. 1946

Marathrum foeniculaceum Humb. & Bonpl.
M. minutiflorum forma *indifferens* (v. Royen) v. Royen
M. modestum (Wedd.) Nadh. P 30183
M. oxycarpum Tul.

M. schiedianum (Cham.) Tul. D & L 12287; G 8581
Tristica trifaria (Willd.) Spreng.

POLEMONIACEAE
Fieldiana 9: 85–96. 1970

Loeselia glandulosa (Cav.) D. Don.

POLYGALACEAE
Fieldiana 6: 5–25. 1949

Bredemeyra lucida (Benn.) Benth.
Polygala adenophora DC. Crank 30; D 11071; Hus 0610; L & D 1793; McD & D 14313; Sp 1572, 1619, 1651; Wil 272
P. aparinoides Hook. & Arn. Wil 238, 396
P. asperuloides H.B.K. McD 14456
P. aff. *glochidata* H.B.K. Sp 1618
P. hondurana Chod. D & L 12301; K 552
P. hygrophila H.B.K. D 10722; L & D 1694; Wil 273
P. incarnata L. McD 14421
P. jamaicensis Chod.
P. leptocaulis Torr. & Gray D 10930, 12616; G 7634; McD & C 14272
P. longicaulis H.B.K. Crank 7, 24; C 24000; D 9089, 10722 A; DEM 313, 448, 618; G 7875; Hus 0521; McD 14279; WH 1330; Wil 199
P. paludosa St. Hil.
P. paniculata L. C 23506, 23507, 23603, 24806, 24939; DEM 187; G 7688, 7801, 8446; Hus 0642; K 684; McD 14492; P 29655; Sp 1381; WH 1271; Wil 303, 391, 491
P. timoutoides Chod.
P. timoutou Aubl.
P. variabilis H.B.K. Crank 17; D 11404, 11520 A; G 7633, 7635, 7874; McD 11409, 12951, 13051, 14296; P 29407; Sp 1542; WH 1346
P. variabilis forma *leucantha* Blake
Securidaca diversifolia (L.) Blake
S. sylvestris Schlecht.

POLYGONACEAE
Fieldiana 4: 104–137. 1946

Beta vulgaris L.
Coccoloba acapulcensis Standl. G 7821
C. barbaradensis Jacq. D 12553
C. belizensis Standl. A & L 17020; D 11356, 11627; G 8205, 8420; Hus 0589; L & D 1565; Leino 414; McD 14474; P 29594; Sp 1720; WH 1143; Wil 433, 434
C. coraxalensis Lundell
C. cozumelensis Hemsl. C 23757, 24957; D 11009, 12572, 12575; Leino 309; P 30233
C. gentryi Howard D 10241
C. hirtella Lundell
C. hondurensis Lundell D 11044, 12782; P 30283
C. laurifolia Jacq.
C. lundellii Standl.

C. reflexiflora Standl. D 12949; G 8541
C. schiedeana Lindaus P 35950
C. schippii Lundell
C. suborbicularis Lundell
C. tuerckheimii Donn. Sm. P 35950
C. uvifera (L.) Jacq. D 10401; DEM 513, 674; J & I 1118, 1209; Lin 55; Sp & St 2242, 2265, 2290, 2306, 2358, 2390, 2448, 2479, 2495, 2543
Gymnopodium floribundum Rolfe A & L 17165; G 23251, 24626; D 10091, 10446, 10447; D & L 12203, 12397; DEM 663; Hus 0566; P 30230; WH 192
Neomillspaughia paniculata (Donn. Sm.) Blake Leino 331
Polygonum acuminatum H.B.K.
P. persicarioides H.B.K.
P. punctatum Ell. A & L 17326; Leino 319; P 30343; Pul 7549

PORTULACACEAE
Fieldiana 4: 207 214. 1946

Portulaca grandiflora Hook. A & L 17508
P. oleracea L. C 24026; DEM 315; K 520; Lin 178; Sp & St 2166, 2246, 2276, 2281, 2388, 2442, 2540, 2554

PRIMULACEAE
Fieldiana 8 (2) : 200–207. 1966

Anagallis pumila Sw. D & L 12330
Samolus ebracteatus H.B.K. Leino 325

PROTEACEAE
Fieldiana 4: 58 62. 1946

Roupala borealis Hemsl.
R. montana Aubl. C 24200; D & L 12268; L & D 1687; Wil 219

PUNICACEAE
Fieldiana 7 (2) : 260–261. 1962

Punicum granatum L.

QUIINACEAE
Fieldiana 7 (1) : 23–24. 1961

Quiina schippii Standl.

RAFFLESIACEAE
Fieldiana 4: 101 104. 1946

Apodanthes caseariae Poit.

RANUNCULACEAE
Fieldiana 4: 243 256. 1956

Clematis dioica L. D 12014

RHAMNACEAE
Fieldiana 6: 277 293. 1949

Gouania lupuloides (L.) Urb.
G. polygama (Jacq.) Urb. A & L 17886, 17918; DEM 106, 464; Leino 7611, 7666; P 29473
Krugiodendron ferreum (Vahl) Urb.
Sageretia elegans (H.B.K.) Brogn.
Zizyphus jujuba Lam.
Z. mauritiana Lam. D 11035; D & L 12017; Hus 0510, 0515; U 98; Wil 261, 523

RHIZOPHORACEAE
Fieldiana 7 (2) : 263 268. 1962

Cassipourea belizensis Lundell
C. elliptica (Sw.) Poir. D 9864, 10066, 11214; G 8388; Wil 261
C. guianensis Aubl. P 29674
C. podantha Standl.
Rhizophora mangle L. J & I 1109; Lin 143; P 29701; Sp & St 2226; U 34; Wil 152

ROSACEAE
Fieldiana 4: 432 484. 1946

Chrysobalanus icaco L. C 24187, 24211, 24492, 24977; Cof 132; D 10986; DEM 511 A, 592; Hus 0526; J & I 1121; Lin 106; P 30305, 36221; Sp 1553; Sp & St 2308, 2329, 2412, 2456; Wil 104, 511
Couepia polyandra (Kunth) Rose
Hirtella americana L. C 24289; G 7723; Hunt 473; P 30200, 30172
H. guatemalensis Standl.
H. paniculata Sw. A & L 17047
H. racemosa Lam. A & L 17035; Burch 5823, 5886; D 13042; D & L 12252; DEM 207, 536; Dieck 296; Hus 0649; P 30200; Sp 1524
H. triandra Sw.
Licania hypoleuca Benth. C 24195; Dieck 318; G 7605; P 29666; Sp 1588; Wil 2, 64
L. platypus (Hemsl.) Fritsch C 24291; Sp 2027
L. sparsipilis Blake
Photina microcarpa Standl.
Rubus amplior Rydb.

RUBIACEAE
Fieldiana 11 (1) : 1-274. 1975

Alibertia edulis (L. Rich.) A. Rich. C 2410; D 11076, 11653 A, 12788, 12834, 13094; G 8226; WH 1131, 1222; Wil 24
A. garapatica (Karst.) Schum. D 12904, 12907
Alseis yucatanensis Standl.
Amaioua corymbosa H.B.K. D 10966, 11083, 11345, 12858, 12886, 14910; G 9392; Hus 0548; Wil 319, 439
Anisomeris protracta (Bartl.) Standl. D 10997; McD & C 14322; Uck 17776; Wil 215, 381

Appunia guatemalensis Donn. Sm. C 23512, 24144, 24810; D 10069, 10378, 11651, 12804; Wil 253, 258
Asemanthe pubescens Hook. f. A & L 17538
Bertiera guianensis Aubl. D 11207, 11424; G 7914, 8252; WH 1162, 1218
Borreria laevis (Lam.) Griseb. Sor 7062; Sp 1555
B. latifolia (Aubl.) Schum.
B. ocymoides (Burm.f.) DC. C 24521; G 7972
B. suaveolens Meyer D 10758, 11031, 11683 A, 11693, 13104; DSWV 322
B. aff. *tenella* (H.B.K.) Cham. & Schlecht. Sp 1515
B. verticillata (L.) Meyer A & L 17628, 17853; C 24929; D 10487; G 8045, 8494; Hus 0529; J & I 1217; P 35722; WH 1154; Wil 120, 276
Calycophyllum candidissimum (Vahl.) DC.
Cephaelis elata Sw. B 5882; P 35981; U 824; WH 1186, 1304
C. glomerulata Donn. Sm. D 14825
C. tomentosa (Aubl.) Vahl D 10863, 13046; G 7879, 8461; Hus 0575; Sp 1613, 1619; U 61; WH 1113, 1209, 1225; Wil 17
Cephalanthus occidentalis L.
Chiococca alba (L.) Hitch. D 10863, 10932, 11010, 11568, 12580, 12759, 12844, 12867; G 7720, 7759, 8410, 8454
C. pachyphylla Wernh. Sp 1616
Coccocypselum glabrum DC.
C. guianense (Aubl.) Schum. D 11591; U 108
C. herbaceum Lam. G 8617; WH 1272, 1308
C. hirsutum Bartl. J & I 1223
Coffea arabica L.
Coussarea impetiolaris Donn. Sm.
C. paniculata (Vahl) Standl.
Coutarea hexandra (Jacq.) Schum. D 10960; G 8282; Long 3258
Crusea brachyphylla Cham. & Schlecht.
C. calocephala DC. D 11636; D & L 12272; DEM 351
Declieuxia fruticosa var. *mexicana* (Willd.) Standl. D 11606; Sp 1626; Wil 245, 297 A
Diodia maritima Thonn.
D. rigida (Willd.) Cham. & Schlecht. A & L 17856; D & P 10079; Hus 0547; Sor 7084; Sp 1536; WH 1334; Wil 200 A, 202 A
D. sarmentosa Sw. D 10861; D & Dieck 13032; U 110; Wil 200 A, 255
D. teres Walt. D 10702, 12560; G 7649
Erithalis fruticosa L. DEM 678; Fos 53806, 53814, 53868, 53895; J & I 1117; P 36201; Sach & St 1607; Sp 1463; Sp & St 2160, 2238, 2316, 2463
Ernodia littoralis Sw. J & I 1115, 1205
Exostema mexicanum Gray
Faramea belizensis Standl.
F. brachysiphon Standl.
F. occidentalis (L.) A. Rich. D 11096 A, 11102; G 8170
F. stenura Standl.
Galium mexicanum H.B.K. DSWV 1012
Geophila repens (L.) Johnst. WH 1086, 1100
G. trichogyna (Muell.-Arg.) Standl.
Gonzalagunia panamensis (Cav.) Schum. A & L 17579; D 11298, 11420, 11951; Hus 0580; L & D 1474; WH 1088; Wil 29

Guettarda coombsii Urb. A & L 17078; D 11351, 11363, 11384, 11560, 11653, 12509, 12626, 12845; G 8535; Sp 1999; Wil 29, 435
G. deamii Standl. D 11642; Leino 378; Wil 378 A, 417
G. elliptica Sw. D 10997, 11023, 11105, 11106; G 8101, 1400
G. odorata Jacq. D 11366
G. gaumeri Standl.
G. macrosperma Donn. Sm.
G. seleriana (Loes.) Standl.
G. tikalana Lundell
Hamelia axillaris Sw. D 10179
H. calycosa Donn. Sm. C 23618, 23725; D 10099, 10776, 10793, 11036, 11543; Sor 7070
H. patens Jacq. var. *patens* C 24133, 24135, 24949; D 10948; G 8148, 8316, 8523; Hus 0574, 0592; Leino 7655; Sp 1690, 1739, 1792, 1844, 1983; U 11, 18; WH 1074, 1153, 1158, 1159; Wil 70, 525
H. rovirosae Wernh. Wil 16
Hemidiodia ocimifolia (Willd.) Schum. A 17758; C 23633, 24772, 24934; G 7811, 8449; WH 1104
Hillia tetrandra Sw. Crank 4; D 10797; Long 3237; Sp 1639
Hoffmannia bullata L. Wms. B & S 5146
H. ghiesbreghtii Hemsl. B & S 5127
H. lenticellata Hemsl.
H. refulgens (Hook.) Hemsl.
H. rhizantha Standl.
Ixora coccinea L. U 37
I. findlaysoniana Wall.
I. nicaraguensis Standl. D 9979
Lindenia rivalis Benth. D 11134; D & Dieck 13035; G 8102, 8582; Hus 0585; Sp 1658; WH 1220; Wil 305
Machaonia acuminata Humb. & Bonpl. D 11041, 12822, 13088; D & C 12954
Manettia reclinata L. WH 1087
Mitracarpus hirtus (Sw.) DC. WH 1105
M. rhadinophylla Meyer G 8533
Morinda asperula Standl.
M. panamensis Seem. D 10842, 12815, 12827; G 7711; Uck 17793; Wil 34
M. royoc L. A & L 17136; D 10812, 11640; DSWV 262; G 7571, 8293, 8549; U 140; Wil 458
Oldenlandia corymbosa L. D 11707
O. herbacea (L.) DC.
O. lancifolia (Schum.) DC.
Palicourea crocea (Sw.) Roem. & Schult. D 10856; Sp 1669, 1915, 1916
P. guianensis Aubl.
P. stevensonii Standl.
P. triphylla DC. D 11081, 12865, 14952; Hus 443; WH 1114; Wil 326, 443
Posoqueria latifolia (Rudge) Roem. & Schult. G 8618; WH 1321
Psychotria acuminata Benth.
P. axillaris Willd.
P. berteriana DC

P. capitata R & P. D 11079, 11308, 11494, 12876; DEM 530; G 7923
P. carthaginensis Jacq. A & L 17615; D 10860, 11096, 11187, 11201, 11428, 11575 A, 12589, 12787; D & P 10098; Sp 1714; WH 1259; Wil 5, 531
P. chagrensis Standl. D 11098, 12805; Hus 0620; Wil 213, 214
P. chiapensis Standl. C 23580, 23585, 23689; D & P 10098; D 9869, 10844, 10860, 11096, 11187, 11436, 11571, 12589; G 8138, 8349, 8468, 8591; Sp 1961; V 608; WH 1167
P. crebrinervia Standl. D 11201, 11215, 11428; G 7933
P. cuspidata Bredem. (= P. acuminata Benth.) D 11479; G 7933
P. deflexa DC. C 24549
P. emetica L.f.
P. erecta (Aubl.) Standl. & Steyerm. D 12914
P. flava Oerst. C 23570, 23585, 23694; D 10806, 10845, 11391, 11474, 11529, 12462, 12508, 12536, 12595; D & Dieck 10441; DEM 58, 84; Sp 1993
P. furcata DC. D 10304
P. grandis Sw. C 24429, 24478; Crank 1; D 9842, 9917, 11091; G 7710, 8076; Sp 1913; V 641 A
P. horizontalis Sw. A & L 17081; D 11152; Sp 1670; WH 1119; Wil 379
P. limonensis Krause C 23460, 23581; D 10769, 10846, 10917, 11577
P. lundellii Standl.
P. macrophylla Ruiz & Pavon
P. marginata Sw. C 24386; D 11095, 11151; Sp 1955
P. mombachensis Standl.
P. nervosa Sw. C 23774, 23830, 24811; D 9843, 10763, 11024, 11251 A, 11491, 12424, 12706; G 7849, 8298, 8406
P. oaxacana Standl. D 11150
P. oerestediana Standl. C 23465, 23745, 24311; D 12451, 12552, 12584, 12700
P. pendula (Jacq.) Urb.
P. pittieri Standl.
P. pleuropoda Donn. Sm. G 8172 A; V 637
P. pubescens Sw. C 23402, 23468, 23576, 23788, 23901, 24645, 24787; D 10224 A, 10725, 10797, 10942, 11244 A, 11256, 11272, 11353, 11374, 11526, 11557, 11575, 12523, 12719; DEM 192; Hus 0673; Leino 7671, 8326, 8485; Sp 1605, 1830, 1909, 2013; U 84; WH 1140; Wil 13, 524
P. schippii Standl. & Steyerm.
P. sessilifolia Mart. & Gal.
P. sulzneri Small
P. tenuifolia Sw.
P. trichotoma Mart. & Gal. D 10846, 10905, 12676
P. uliginosa Sw. C 23460
P. viridis R. & P.
Randia sp. A 17751; G 8123
R. aculeata L. D 12454; Leino 395, 7668; Wil 543
R. echinocarpa Schlecht. & Cham. Wil 451
R. gentlei Lundell
R. laetevirens Standl. Leino 240, 242, 243, 395
R. lundelliana Standl.
R. watsoni Robins.

Richardia scabra L. C 23499, 23958; G 8415; Wil 296, 366
Rondeletia amoena Planch. D 10852; Wil 296
R. belizensis Standl.
R. buddleoides Benth. DSWV 583
R. lundelliana Standl.
R. stachyoides Donn. Sm. C 11135, 11178, 24378; G 8116
Rudgea ceratopetala Donn. Sm. G 9860
Sabicea panamensis Wernh.
S. villosa Roem. & Schult. C 24821; D 11211, 11484; G 8463; WH 1233
S. villosa var. *adpressa* (Wernh.) Standl.
Simira salvadorensis (Standl.) Steyerm. Sp 1964
Spermacoce glabra Michx. Sp 1694, 1842, 2022
S. riparia Cham. & Schlecht.
S. subulata DC. ex Hemsl. Wil 248
S. tenuior L.
S. tetraquebra A. Rich.
Triodon angulatum Willd.
Uncaria tomentosa (Willd.) DC P 35842

RUTACEAE
Fieldiana 5: 398–425. 1946

Amyris elemifera L. C 24688; G 8287; Leino 368
A. rhomboidea Standl.
A. sylvatica Jacq.
Casimiroa sp. D 11056; Leino 361
C. tetrameria Millsp.
Citrus aurantifolia (Christ.) Swingle Sp & St 2327, 2440
C. aurantiacum L.
C. grandis (L.) Osbeck
C. medica L.
C. sinensis Osbeck
Esenbeckia pentaphylla (Macfad.) Griseb.
Murraya paniculata (L.) Jacq. A & L 17089; D 12603; Uck 1777
Triphasia trifolia (Burm.f.) Wils. G 8044
Zanthoxylum caribaeum Lam. D 10709, 12443, 12736
Z. crenulatum Standl.
Z. gentlei Lundell
Z. kellermanii Wilson
Z. mayanum Standl.
Z. microcarpum Griseb.
Z. nigropunctatum Lundell
Z. procerum Donn. Sm.

SAPINDACEAE
Fieldiana 6: 234–273. 1949

Alophyllus campostachya Blake McD 12917, 12919
A. cominia (L.) Sw. D & L 12018; K 558; L & D 1520, 1628
A. kinlockii Standl.

A. longeracemosus Standl.
A. occidentalis
Cardiospermum grandiflorum Sw. D & L 12281, 12300; K 498; L & D 1517
Cupania auriculata Standl.
C. belizensis Standl. D 10453; D & L 12058; L & D 1510, 1555; P 29658; Sp 1890
C. guatemalensis Radkl.
C. macrophylla A. Rich.
C. schippii Standl.
C. scrobiculata L. Rich. D 12918
C. spectabilis Radkl.
C. triqueta A. Rich. K 477
Dodonaea viscosa Jacq. D & L 12266
Exotheca diphylla (Standl.) Lundell
E. paniculata (Juss.) Radkl.
Hippobroma longiflora (L.) G. Don
Matayba oppositifolia (A. Rich.) Britt.
Paullinia clavigera Schlecht. D 11476 A, 12574, 12965, 12971, 14494, 14496; Wil 73
P. costaricensis Radkl. D & L 12106
P. cururu L.
P. fuscescens H.B.K. L & D 1642; McD 14455
P. pinnata L. C 11038; D 10837; D & L 12155; L & D 1536, 1559; P 29514; Sp 1664, 1705, 1912, 1972
P. scarlatina Radkl. P 29810
P. tomentosa Jacq. P 29526
Sapindus saponaria L. A & L 17055, 17552; Leino 308; Uck 17812
Serjania adiantoides Radkl.
S. atrolineata Sauv. & Wr.
S. cambessediana Schlecht. & Cham. L & D 1596
S. caracasana (Jacq.) Willd. D & L 12356; L & D 1587
S. grosii
S. lundellii Croat D 10494
S. mexicana (L.) Willd. A & L 17539; D 11088, 12516; P 30152, 30358
S. paniculata
S. pauciflora DC. DEM 521
S. pterarthra Standl.
S. scatens Radkl. D 10446; DEM 55, 221
S. yucatanensis Standl.
Talisia diphylla Standl.
T. oliviformis H.B.K. A & L 17065
Thinouia tomocarpa Standl.
T. paucidentata Radkl.
Urvillea ulmacea H.B.K. D & L 12305, 12352; L & D 1480, 1488

SAPOTACEAE
Fieldiana 8 (3) : 211 243. 1967

Achras staminodella Gilly G 7697
Bumelia celestrina H.B.K. C 24029; G 7641; Wil 201
B. mayana Standl.

B. megaphylla Blake
B. obtusifolia var. *buxifolia* (Roem. & Schult.) Miq. McD 13106
B. retusa Sw. McD 13079
Calocarpum mammosum (L.) Pierre
C. viride Pitt.
Chiclea guatemalensis Lundell P 30107
Chrysophyllum cainito L. D 11579; D & C 12981; Hus 0657; K 553; Leino 254
C. mexicanum var. *typicum* Cronq. C 24201; D 11579; D & L 12207, 12325; DSWV 361; McD 15403; Sp 1857
C. olivifore L. P 29680, 29879
Dipholis durifolia Standl. G 7820
D. salicifolia (L.) A. DC. A & L 17635
D. stevensonii Standl. G 7764
Dryetes lateriflora (Sw.) Krug & Urb. A & L 17642
Lucuma belizensis Standl.
L. campechiana H.B.K. Lin 41, 102; P 30190, 30227
Manilkara sp. D 11259
M. chicle (Pitt.) Gilly D & L 12179
M. zapota (L.) van Royen Leino 382; P 35954
Mastichodendron belizense (Standl.) Cronq. P 35990
M. foetidissimum subsp. *gaumeri* (Pitt.) Cronq. P 36109
Pouteria amygdalena (Standl.) Baehni
P. unilocularis (Donn. Sm.) Baehni P 30066
P. mammosa (L.) Cronq. P 29544, 29600; Sp 1589
P. viridis (Pitt.) Cronq. P 29850
Sideroxylon meyeri Standl. (= *Pouteria unilocularis* (Donn. Sm.) Baehni)
S. rufotomentosum Standl.

SCROPHULARIACEAE

Fieldiana 9: 319-416. 1973

Agalinis harperi Penn. Crank 28, 29; WH 1337
Alectra melampyroides (Rich.) Ktze.
Angelonia ciliaris Robins. A & L 17547, 17859; C 23954, 24055, 24933; D 11007, 12555; DSWV 283; G 8047; L & D 1425; P 29751
Anisantherina hispidula (Mart.) Penn. P 30197
Bacopa bacopoides (Benth.) Pulle
B. lacertosa Standl. D 10973; P 36008
B. monnieri (L.) Penn. Dieck 118
B. naias Standl. P 36565
Benjamina reflexa (Benth.) D'Arcy
Buchnera pusilla H.B.K. Arnason 17852; A & L 17204; C 24075; DEM 222, 304; D & P 10074; D 10413, 10419, 10424, 11356, 11680, 12778; Sp 1541, 1652; Wil 365
B. weberbaueri Diels
Capraria biflora L. Dieck 132; DEM 243; D & L 12177; Fos & Sach 53877; Lin 135
Dermatocalyx parviflorus Oerst.
Escobedia laevis C. & S. Wil 343
Gerardia harperi Penn. Sp 1621

G. hispidula Mart. A & L 17862
G. maritima Raf. var. *grandiflora* Benth. Sor 7089
Limourouxia viscosa H.B.K.
Lindernia crustacea (L.) Muell. A & L 17772; K 410; P 29932
L. diffusa (L.) Wett. D 11599
L. rotundifolia (L.) Standl. & Wms.
Mecardonia montevidensis (Spreng.) Penn.
M. procumbens (Mill.) Small C 23505; P 29625
Russelia campechiana Standl. C 24924; D 11385; L & D 1582; Sp 1362
R. equisetiformis S & C Sp & St 1468
R. polyedra Zucc.
R. sarmentosa Jacq. Burch 6266; C 23620, 23844; DEM 76; G 8274; L & D 1516; Sor 7061; Sp 1363; Sp & N 1762, 2012; Wil 106
R. soronensis Carlson G 7617
Scoparia dulcis L. C 24412; Wil 278
Stemodia durantifolia (L.) Sw. C 23327 A; DEM 278; P 29480, 29930; Sp & N 1837
S. macrantha Rob. A & L 17342; Leino 7673
S. maritima L.
S. parviflora Ait.
S. pusilla Benth.
S. verticillata (Mill.) Hemsl. L & D 1499
Torenia crustacea (L.) C & S.

SIMARUBACEAE

Fieldiana 4: 425 434. 1946

Alvaradoa amorphoides Liebm.
A. amorphoides ssp. *typica* Cronq.
Picramnia andicola Tuls. D 10489
P. antidesma Sw.
Quassia amara L. P 29824
Simaruba amara Aubl. var. *opaca* Engler
S. glauca DC. var. *latifolia* Cronq. D 10492
Suriana maritima L. DEM 665; Fos & Sach 53775, 53893; Sach & St 1623; Sp 1447, 1462; Sp & St 2233, 2315, 2530, 2551, 2566

SOLANACEAE

Fieldiana 7 : 1–151. 1974

Capsicum annuum L. C 23892; D 9948; DEM 546
C. escuintlense (Coult.) Standl.
C. frutescens L. C 23495
C. frutescens var. *baccatum* (L.) Irish
Cestrum macrophyllum Vent.
C. nocturnum L. DEM 560; D 12606; D & L 13034; WH 1276
C. nocturnum var. *mexicanum* Schulz.
C. racemosum R. & P. G 8253; P 36132
C. racemosum var. *panamense* Francey D 9120

Cyphomandra mollicella Standl.
Datura stramonium L.
Lycianthes escuintlensis (Coult.) D'Arcy G 7975
L. guianensis (Dun.) Bitter D 11505
L. hypoleuca Standl. C 23324, 23552, 23624; D 10780 A, 10790, 11265; G 1668
L. lenta (Cav.) Bitter
L. nitida Bitter
L. sericea Standl.
L. sideroxyloides (Schlecht.) Bitter
L. synanthera (Sendtn.) Bitter D 11170; G 8022, 8434; WH 1236
L. variifolia Standl.
L. vulpina Standl.
Lycopersicon esculentum Mill. C 24599
Markea neurantha Hemsl. G 8100
Melananthus guatemalensis (Benth.) Solr. D 12775
Merinthopodium neuranthus (Hemsl.) Donn. Sm.
Nicotiana tabacum L. G 7782
Physalis affinis Morton
P. angulata L. K 427; P 29476, 29615; Wil 58 A
P. ixocarpa Brot.
P. lagascae Roem. & Schult.
P. pubescens L. A & L 17529
Schwenkia americana L. D 10044, 10465, 11519, 11681; D & L 12216, 12262; D & P 10053, 10083; L & D 1687 A
Solanum acerosum Sendt. C 23376, 26586
S. accrescens Standl. & Morton C 23348, 23477, 23553 A, 23576, 23677; D 10149, 10875, 11584; D & P 10183; Hus 0641
S. aculeatissimum Jacq.
S. americanum Mill. A & L 17542, 17626; C 23380, 24129, 24287, 24430, 24609, 24710, 24848; D 9997, 10432, 11059, 11145; D & Dieck 13061; Dieck 177; G 8445; K 466; Laz 2136; Sp 1861; WH 1335
S. antillarum Schulz C 23397, 23551, 23903, 24830, 24950; D 10782, 10872, 11278; Sp 1766, 1879, 1976; WH 1126, 1196
S. bicolor Willd.
S. campechianum L. P 30296, 30344
S. ciliatum Lam. P 30159
S. cordavense Sesse & Moc. C 23351, 23566; D 10783, 10867 A; D & P 10158; P 30050; WH 1305
S. cornutum Lam.
S. cuspidatum Morton
S. aff. *diphyllum* (L.) Standl. 9117; Sp 1580, 1667, 1707; V 799
S. donianum Walp. Dieck 170; St 412, 433
S. donnell smithii Coult.
S. erianthum D. Don C 23650, 24690; D 11264; D & L 12162; G 8483; K 474; P 30281; Sp 1710, 1418, 1747, 1935, 1958
S. erythrotrichum Fernald G 7799
S. extensum Bitter
S. flavescens Dunal D & P 10113; Pul 7535, 7564; Sp 2017

S. hirtum Vahl. D 10113; P 30317
S. hypoleucum (Standl.) Morton
S. jamaicense Mill. C 24829; D 11414, 11493; DEM 487; G 8453; P 30316
S. lanceifolium Jacq. C 24619; G 8023; P 29468; Sp 1894, 1947
S. lentum Cav.
S. lepidotum Himb. & Bonpl. ex Dunal
S. limitaneum Standl.
S. madrense Fernald
S. mammosum L. A & L 17925
S. mayanum Lundell
S. molestum Brandly DEM 415
S. nigrescens Mart. & Gal. Dieck 172
S. nigrum L. Clev 7526; DEM 561; Hus 0634
S. nodiflorum Jacq.
S. nudum H.B.K. C 23533, 24129, 24224, 24430, 24609, 24710; D 11059, 11185, 11266, 12725; G 7679, 7805, 8335; Leino 222; Long 3235; P 30282; Uck 17813
S. ochraceo-ferrugineum (Dunal) Fern. A & L 17214; C 23372, 23885, 24115, 24404, 24842, 24910; DEM 138; D & L 11594, 12033; G 7785, 8435; Sp 1678, 1748, 1825, 1936
S. rugosum Dunal C 24888; D 11434
S. schippii Standl.
S. schlechtendalianum Walp. C 24119, 24572; 7906
S. torvum Sw. Brunt 2235
S. umbellatum Mill. C 24480, 24500; D 10724
S. witheringia L'Her DEM 493; G 7804
Witheringia nelsonii (Fern.) Hunziger WH 1191
W. solanacea L'Her DEM 493; G 7804

STERCULIACEAE

Fieldiana 6: 403-428. 1949

Byttneria aculeata Jacq. A 17889; A & L 17001; DEM 155; Leino 30; P 29463
B. catalpifolia Jacq. G 7960
Guazuma tomentosa H.B.K.
G. ulmifolia Lam. D 10224, 12675; DEM 125; G 7594, 7792; K 674; Leino 221, 301; P 29595; Sp 1743, 1789, 1820; Wil 477, 521, 556
Helicteres baruensis Jacq. DEM 210; P 29653
H. guazumifolia H.B.K. C 12437, 23958; Dieck 246, 319; G 7613; Hus 0530; K 658; P 29569, 29661; Wil 376, 521
H. mexicana Kunth WH 1275
M. lupulina Sw. DEM 133; K 452; Sp 1417
M. melissifolia Benth. C 24022; DEM 51; D & P 10072; DSWV 285; Sor 7099; Wil 478, 581
M. nodiflora Sw. Leino 7629; Sp 1535
M. pyramidata L. A & L 17873, 17875; C 23918, 24042, 24983; D 11456, 12019; K 453; Sp 1770
M. tomentosa L. DEM 226
M. villosa (Mill.) Fawc. & Rend. C 23967; G 8049; McD & C 14323, 14334
Pentapetes phoenicea L.

Sterculia mexicana Humb. & Bonpl.
Theobroma bicolor Humb. & Bonpl.
T. cacao L. G 8191; V 638; WH 1083
T. leiocarpum Bern. P 36134
Waltheria glomerata Presl. D & L 12292
W. indica L. C 24607; D 11596; DEM 1, 522; L & D 1431; Sp 1453, 1503

SYMPLOCACEAE
Fieldiana 8 (3) : 251 257. 1967

Symplocos martinicensis Jacq.

THEACEAE
Fieldiana 7 (1) : 24 61. 1961

Freziera grisebachii Krug & Urban
Marila macrophylla Benth.
Symplocarpon lucidum Lundell
Ternstroemia tepezapote Schlecht. & Cham. A & L 17637; D 10818, 11000; D & C 12693; McD 14395; Uck 17799; Wil 317

THEOPHRASTACEAE
Fieldiana 8 (2) : 127 134. 1966

Deherainia smaragdina (Planch.) Decne. C 23764; D & L 12358; P 36139
Jacquinia aurantiaca Ait. A & L 17362; C 23435, 24602; D 10700, 11515; K 669; L & D 1547; Leino 333; P 30387
J. paludicola Standl. P 29837
J. schippii Standl.

TILIACEAE
Fieldiana 6: 302 324. 1949

Carpodiptera cubensis Griseb.
Christiania africana DC.
Corchorus aestuans L. A & L 17874
C. siliquosus L. A & L 17205, 17208; C 23669; Dieck 163, 165; Laz & Tyson 1745; Leino 7267, 7661
Hampea euryphylla Standl. D 11578
H. stipitata S. Wats. C 23684, 23845, 24047, 24763; D 9906, 10728, 10786, 10831, 11014, 11361, 11390, 11553, 12317; G 8389, 8550
Heliocarpus donnell-smithii Rose
H. mexicanus (Turcz.) Sprague D 12306; P 29892
H. nodiflorus (Donn. Sm.) Donn. Sm. & Rose DEM 153
Luhea seemanii Triana & Planch.
L. speciosa Willd. D 12625; D & L 12247; DEM 432; L & D 1575; Sp 1970
Trichospermum mexicanum (DC.) Baill. A & L 17598, 17634, 17885
Triumfetta bartramia L.
T. bogotensis DC. L & D 1442
T. lappula L. DEM 209; Sp & N 1819; V 578

T. semitriloba Jacq. Sp 1355

T. speciosa Seem. Burch 5834; D & L 22274

TRIGONIACEAE

Fieldiana 6: 1–2. 1949

Trigonia floribunda Oerst.

TURNERACEAE

Fieldiana 7 (1) : 109–115. 1961

Erblichia odorata Seem.

Piriqueta cistoides (L.) Meyer C 24793; P 30291

Turnera diffusa Willd. C 23252, 24016; D & P 10095; DEM 201, 319, 662; Dieck 113; McD 12851, 14305

T. odorata L. McD 12852

T. ulmifolia L. A 17848; A & L 17151; D 10757, 10991, 11219, 11521, 11629; DEM 320; G 7615, 8068; Hus 0560; McD 13012; P 29533; Sp 1533, 1426; Wil 579

ULMACEAE

Fieldiana 4: 1–10. 1946

Amplocera hottlei (Standl.) Standl.

Celtis iguanea (Jacq.) Sarg. C 24676; G 7674, 7786

C. schippii Standl.

Trema floridana Britt. K 550; P 29471

T. micrantha (L.) Blume C 24133, 24915; D 11369; G 7907, 8481; Sp 1533, 1561, 1735, 1831, 1887

T. strigillosa Lundell P 20148

UMBELLIFERAE

Fieldiana 8 (1) : 21–67. 1966

Centella asiatica (L.) Urban D 10471; L & D 1655; Pul 7539; Wil 94

Eryngium carlinae Delwar Wil 82

E. foetidum L. C 24365

Foeniculum vulgare Hill

Hydrocotyle umbellata L. D 11846

H. verticillata var. *triradiata* (Rich.) Fern. Pul 7649

Spananthe paniculata Jacq. K 436

URTICACEAE

Fieldiana 3: 396–430. 1952

Boehmeria ulmifolia Wedd. D 9882; P 29919

Fleurya aestuans (L.) Gaud.

Myriocarpa heterostachya Donn. Sm.

M. obovata Donn. Sm. Sp 1376

M. yzabalensis (Donn. Sm.) Killip C 23776; D & L 12103; DEM 553; G 8113

Phenax hirsutus (Sw.) Wedd.

Pilea chiapensis Killip

P. donnell-smithiana Killip D 7723
P. hyalina Fenzl. P 29948
P. imparifolia Wedd. L & D 1859
P. microphylla (L.) Liebm. C 23832, 24316, 24519; D & L 12099; Hus 0679; Long 3261; Sp 1359, 1659; Wil 552
P. microphylla var. *longifolia* Wedd. Sp. 1689
P. pubescens Liebm. G 7928, 7952
Pouzolzia obliqua Gaud. C 24159; G 8085
Rousselia humilis (Sw.) Urb.
Urera alcerifolia Gaud. C 23728, 24257, 24294; G 7897, 8427; V 605; WH 1081
U. baccifera (L.) Gaud.
U. elata (Sw.) Griseb. Wil 52 A, 55 A

VALERIANACEAE
Fieldiana 11: 296-306. 1976

Valeriana scandens L. D & L 12309; DEM 86, 385; G 7802
V. clematitis H.B.K. D 10853

VERBENACEAE
Fieldiana 7 : 167-236. 1970

Aegiphila elata Sw. C 24257, 24708; D 11111, 12003; D & Dieck 13003, 13040, 13053; DEM 279; G 7985; Sp 1885; Wil 3, 13 A
A. monstrosa Moldenke C 24708; D 9853; DEM 279; K 475; L & D 1632; Leino 7667; P 30214; Sp 1885
A. pauciflora Standl.
Bouchera prismatica (Jacq.) Ktze. G 8280
Callicarpa acuminata H.B.K. A & L 17763; C 23445, 23593, 23596, 23978, 24720; D 10182 A, 11004, 11018 A, 11569; G 7670, 7892; Wil 440
Citharexylum caudatum L. C 23535, 23978; D 9100, 12760; Dieck 308; DEM 598; DSWV 307; G 7608, 7631; L & D 1548; Sp 1490
C. donnell-smithii Greenm. D & C 12929
C. hexangulare Greenm.
C. hirtellum Standl.
Clerodendrum ligustrinum (Jacq.) R. Br. A & L 17522; D 10351, 11039 A; G 7591; L & D 1649, 1673
C. philippinum Schau.
Cornutia grandifolia (Schlecht. & Cham.) Schau. C 24815; D 11703; D & Dieck 13036; DSWV 317; G 7959; Sp 1833; WH 1124; Wil 430
C. pyramidata L. C 23980 A, 23982; D 10217, 11580
C. pyramidata var. *isthmia* Moldenke Sor 7067
Ghinia spicata (Aubl.) Moldenke P 29496, 29627; Sp 1517
Gmelina arborea Roxb. Sp 1601
Lantana camara L. A & L 17597; C 24917; D 9103; G 8497; Hus 0593; J & I 1220; K 560; Long 3230; P 29564; Sp 1365; Uck 17808; Wil 383 B
L. dulcis Trey
L. glandulosissima Hayek DEM 189; Dieck 334 A; L & D 1640; Sp 1807, 1850, 1867, 2004; Wil 572 A
L. hispida H.B.K. C 23960

L. involucrata L. DEM 675; Dieck 332; DSWV 273 A; P 36200

L. moritziana Otto & Dietr. C 24948

L. trifolia L. D 11114; DEM 543; G 7744

Petrea arborea H.B.K.

P. aspera Turcz. A & L 17046; D 12522

P. volubilis L. C 23410; D 11132; D & L 12022; DEM 208; G 7794; K 514; P 30113

Phyla nodiflora (L.) Greene G 8568; Wil 509

P. scaberrima (A. Juss.) Moldenke

P. stoechadifolia (L.) Small A & L 17395; C 24976; D 11392, 12567; D & L 12172; G 8518; Sp 1776, 1876

P. strigulosa var. *sericea* Moldenke D 12391; Sor 7116; WH 1175

Priva lappulacea (L.) Pers. C 23450, 23802, 23861; D 9974; G 8521; Sp 1774

Rehdera penninervia Standl. & Moldenke L & D 1568; P 29603

Stachytarpheta angustifolia (Mill.) Vahl

S. cayennensis (L. Rich.) Vahl C 23543, 24778; Crank. s.n.; D 10869; DEM 269; G 8005, 8220, 8503; K 622; L & D 1457; Leino 7687; Sp 1368, 1784; Ut 807

S. frantzii

S. guatemalensis Moldenke D 11445; Sp 1704; U 71; WH 1110

S. jamaicensis (L.) Vahl C 24109, 24973; DEM 37; Fos & Sach 53880; G 8564; Sach & St 1609; Sp 1467; Sp & St 2188, 2319, 2458

S. miniaceae Moldenke C 23292; D 10479; D & L 12010

Vitex guameri Greenm. A & L 17069, 17303; C 23540, 23865, 24595; D 10834, 12598, 12753; D & L 12196 A; G 8267, 8511; Hus 0665; Sp 1994

VIOLACEAE

Fieldiana 7 (1) : 70 82. 1961

Amphirrhox malpighiifolia (Standl.) Standl.

A. subsessilis (Standl.) Standl.

Corynostylis arborea (L.) Blake C 23994; D 11282; G 7588

Gloeospermum ferrugineostictum Robyns D 8590

Hybanthus attenuatus (H. & B.) Schul. Sp 1771

H. calceolaris (L.) Schul. D 10047; DSWV 369; P 29910, 30203

H. galeottii (Turcz.) Mart. DSWV 104

H. ipecacuanha (L.) Taub. D 10047; Sp 1523

H. oppositifolius (L.) Taub.

H. thiemei (Donn. Sm.) Mort.

Orthion malpighiifolium (Standl.) Standl. & Steyermark

Rinorea guatemalensis (Wats.) Bart. D 12518, 12638; Sp 1941, 2026

R. hummelii Sprague P 35822, 35849, 35880

VITACEAE

Fieldiana 6: 293 302. 1949

Cissus biformifolia Standl. P 30169; Wil 72

C. erosa L. Rich. P 30302

C. gossypifolia Standl. C 24964; D & L 12052; Leino 255; McD 14452; P 29559; Wil 449, 538

C. microcarpa Vahl D & L 12052, 12648; P 36050; Sp 1863, 1949, 538

C. rhombifolia Vahl C 23422, 24489, 24822; G 8204, 8537

C. sicyoides L. DEM 121, 463 A, 502; K 598; P 29474; Sp 1817, 1870

Vitis tiliifolia H. & B. C 23408, 23708; D 9963, 10173, 10804, 10880, 12178, 12511; G 7811 A, 7695; K 547; McD 14265; P 30171; Sp 1668, 1862, 2000; V 624

VOCHYSIACEAE

Fieldiana 6: 2–5. 1949

Vochysia hondurensis Sprague C 24147; Ut 806; WH 1283

ZYGOPHYLLACEAE

Fieldiana 5: 393–398. 1946

Kallstroemia maxima (L.) Hook. & Arn. K 442; P 29486

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THE POLLEN MORPHOLOGY OF THE NATIVE NEW ENGLAND SPECIES OF THE GENUS[1] ACER (ACERACEAE)

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AND A. LINN BOGLE

ABSTRACT

Detailed descriptions.

The pollen morphology of the seven species of maple (genus *Acer*, family Aceraceae) indigenous to New England is described. The species included are *Acer pensylvanicum* L., *A. rubrum* L., *A. spicatum* Lam., *A. negundo* L., *A. saccharinum* L., *A. nigrum* Michx. f., and *A. saccharum* Marsh. Detailed descriptions for the species are based on both scanning electron and light microscope observations. The morphological characteristics and classification of the pollen grains of the New England species are discussed in comparison with the observations of previous workers. Size ranges, Polar axis/Equatorial axis ratios (P/E), and Polar Area indices are summarized. Photomicrographs from both light and scanning electron microscopes are included for each species.

Key words: palynology, pollen morphology, Aceraceae, *Acer*, Maple, *Acer pensylvanicum*, *A. rubrum*, *A. spicatum*, *A. negundo*, *A. saccharinum*, *A. saccharum*, *A. nigrum*.

The purpose of this paper is to provide detailed descriptions, based on observations made with both the light microscope and the scanning electron microscope, that will aid in the identification of pollen of the seven species of the genus *Acer* (Aceraceae, Maple family) native to New England. The descriptions, light micrographs, and scanning electron micrographs presented here should be of value to workers in the various fields of palynology in New England and elsewhere.

Acer, a genus of nearly 150 woody species, is found chiefly in the temperate regions of the northern hemisphere (Brizicky, 1963). Of the 15 species native to the United States (Lawrence, 1951), seven are indigenous to the New England region: *Acer negundo* L. (Boxelder), *A. nigrum* Michx. f. (Black Maple), *A. pensylvanicum* L. (Striped Maple), *A. rubrum* L. (Red Maple), *A. saccharinum* L. (Silver Maple), *A. saccharum* Marsh. (Sugar Maple), and *A. spicatum* Lam. (Mountain Maple). Several of these species are significant

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components of the region's forests. Certain introduced species, such as *A. platanoides* L. (Norway Maple) and *A. pseudo-platanus* L. (Planetree or Sycamore Maple), are also occasionally found escaped from cultivation in this region.

The species examined in the present study, with the exception of *Acer negundo* which is anemophilous, are reported to be amphiphilous. That is, they are capable of effecting pollination through either anemophilous or entomophilous means (Wodehouse, 1935, 1945; Hesse, 1979). Field observations in New England indicate an apparent tendency toward anemophily in several species (*A. rubrum, A. saccharinum, A. saccharum*). This tendency is suggested by both a characteristic flowering period, which occurs well before the emergence of the leaves in the spring, and the exsertion of the anthers well beyond the perianth, exposing the dehiscing anthers to the wind. As a result of this tendency, these species contribute to the airborne pollen rain during their peak periods of flowering, and may be a contributing factor in the cause of early spring "hay fever." The anemophilous condition also explains why grains of several species of this genus are frequently encountered in the analysis of sediments (Davis, 1965). It is reported by Sangster and Dale (1964), however, that Acer grains are under-represented in sediments under experimental conditions, a phenomenon which they attribute to rapid decomposition.

Most of the previous studies of pollen morphology in the genus *Acer* have been based on light microscope observations. Wodehouse (1935), Erdtman (1952), Erdtman, Berglund and Praglowski (1961), and Praglowski (1962), each provide basic morphological information for a few species of the genus. A more thorough light microscope study was conducted by Helmich (1963), who provides a key to eighteen, and illustrations of nine, North American species, as an aid toward the identification of *Acer* pollen in Cenozoic sediments. Another study designed to aid in the analysis of fossil *Acer* pollen is that of Gogichaishvili (1964), who describes and illustrates eleven species of *Acer* native to the Caucasus of Russia.

Several recent studies have involved scanning electron microscopy as well as light microscope observations. Biesboer (1975) published a survey of the pollen morphology of 40 taxa in the genus *Acer* and one species of the related genus *Dipteronia*. He was able to recognize four distinct pollen types, based on the visible sculpturing patterns of the pollen grain surface. He designated these simply as Types I - striate, II -rugulose, III - granular, and IV - microreticulate. Clarke and Jones (1978) adopt Biesboer's Types for the grains which they describe and illustrate in their study of the pollen of five species of *Acer* which occur naturally in northwestern Europe. Hesse (1979), studying the same northwest European species, considers the ultrastructure of the pollen grain wall and the distribution of pollenkitt on the wall surfaces in relation to pollen stickiness and its relationship to wind- and insect-pollination.

Based on morphological characteristics of their pollen the seven species included in this study can be assigned to three of the four Types established by Biesboer (1975): Type I-striate, II-rugulose, and IV-microreticulate. Type III-granular is not represented among our species.

MATERIALS AND METHODS

Material for this study was obtained from specimens in the Gray Herbarium (GH); the New England Botanical Club Herbarium (NEBC); and the Hodgdon Herbarium (NHA). Voucher information is cited with the description of each species.

Material for light microscopy was acetolyzed (Faegri & Iversen, 1975), washed in two rinses of distilled water and transferred to glycerine jelly in small storage vials. Acetolyzed grains were also dehydrated in xylene, transferred to silicone oil (2000 centistokes viscosity) and kept in small storage vials. Microscope slides were later made from the stored material.

Glycerine jelly (g.j.) was chosen as a mounting medium for this study because it provides a simple yet relatively permanent mounting medium which is widely used in palynology. However, pollen grains are known to expand in this medium, affecting their shape and dimensions. In order to assess the effects of g.j. on grains of *Acer*, silicone oil (s.o.) was used as an alternative mounting medium. This was accomplished by mounting grains from one population of each species in s.o. as well as g.j. The separate measurements were then compared. It should be noted that, in each case, upon comparison of s.o. versus g.j. measurements, significant differences were always encountered regarding both the P/E ratios and polar area indices.

The principal measurements presented in the descriptions below were taken from grains embedded in glycerine jelly. Separate average polar and equatorial axes, (P/E ratios, see Erdtman, 1952) and polar area indices (P.A.I.) (See Figs. I and II) were calculated based on measurements of 30 grains from each population. In order to allow the grains to respond to the g.j. medium, measurements were taken approximately two weeks after embedding. Measurements were

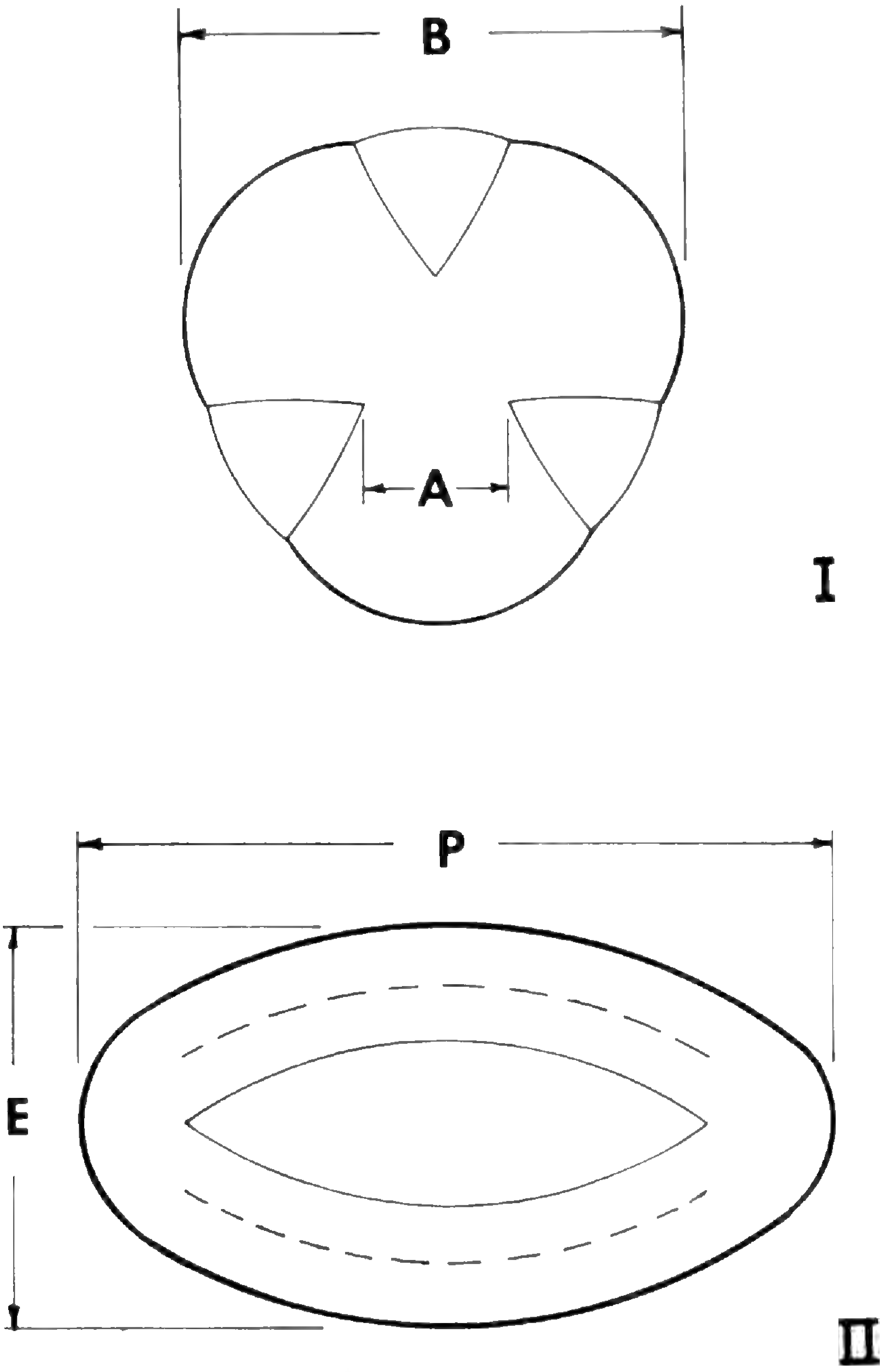


Figure I & II. I. Polar Area Index: Calculated as the ratio of the largest distance between the ends of two furrows (A) and the greatest diameter of the pollen grain (B). II. Polar axis/Equatorial axis ratio (P/E ratio); Calculated as the ratio between the polar axis length (P) and the equatorial axis length (E).

taken on an AO series 20 Microstar brightfield microscope, at 1000×. The measurements from silicone oil preparations are included in parentheses for each species.

For scanning electron microscopy, dried anthers were removed from specimens and acetolyzed (Faegri & Iversen, 1975). After the second distilled water wash, the material was washed in two successive 100% acetone washes, the first for ten minutes and the second for 30 minutes. The pollen material was then transferred to aluminum stubs, using a Pasteur pipette. The stubs had been previously coated with an acetone-tape adhesive (1mm of half-inch double-stick tape partially dissolved in 10 ml of 100% acetone). The stubs were then coated with palladium-gold on a TECHNICS 2 sputter coater and examined with an AMR 1000 Scanning Electron Microscope at the Museum of Comparative Zoology of Harvard University.

Unless otherwise noted the terminology of Erdtman (1952) is used in our descriptions. The species are grouped according to the types established by Biesboer (outlined above), based on patterns of sexine sculpturing.

GENERAL GRAIN DESCRIPTION

Grains tricolpate (tricolporate in *Acer spicatum*), radially symmetrical, isopolar, colpi long and narrow reaching nearly to the poles, margo absent, colpus membranes granular. Overall grain shape ranging from suboblate to prolate. Exine thickness (measured in Amb view) ca. 1.0 μm, thickest in center of mesocolpium thinning slightly toward colpi; bacula present; sexine tectate in two species and semitectate (Faegri & Iversen, 1975) in five species; sexine striate, rugulate (Faegri & Iversen, 1975), microreticulate or striato-reticulate.

TYPE I: STRIATE

Acer pensylvanicum: (Figures 3 & 7) lirae and striae appearing equal in width, or nearly so, fairly uniform in width throughout their length, variously arranged in relation to the polar axis, similar in mesocolpium and apocolpium;' sexine semitectate, exine thickness ca. 1.0 μm. Measurements: Ossippee, NH (*Philbrick 473*), P/E ratio, range 1.11 – 1.48, mean 1.30 ± 0.10; P.A.I., range 0.148 – 0.269, mean 0.209 ± 0.04. (s.o.: P/E ratio, range 0.96 – 1.39, mean 1.09 ± 0.08;

P.A.I., range 0.136 − 0.820, mean 0.243 ± 0.12). Cape Elizabeth, Me. (*Moulton s.n.*), P/E ratio, range 1.12 − 1.47, mean 1.22 ± 0.08; P.A.I., range 0.102 − 0.233, mean 0.163 ± 0.04. Southington, Conn. (*Bissell s.n.*), P/E ratio, range 0.88 − 1.66, mean 1.19 ± 0.13; P.A.I.; range 0.080 − 0.235, mean 0.143 ± 0.05. Rutland, VT (*Eggleston s.n.*), P/E ratio, range 1.07 − 1.45, mean 1.29 ± 0.22; P.A.I., range 0.121 − 0.241, mean 0.176 ± 0.03.

Voucher material: *Philbrick 473,* 21 May 1978, (NHA); *Moulton s.n.,* 27 May 1905 (NHA); *Kennedy s.n.,* 15 May 1901 (GH); *Bissell s.n.,* 18 May 1898 (GH); *Eggleston s.n.,* 16 May 1897 (GH).

Acer rubrum: (Figures 3 & 8) lirae and striae variable in width, not uniform throughout their length, variously arranged in relation to polar axis, lirae usually wider than striae; sculpturing similar in mesocolpium and apocolpium; lirae appearing interconnected, thus forming a more or less continuous striate network throughout the grain length, sexine semitectate, exine thickness ca. 1.0 μm. Measurements: Durham, NH (*Philbrick 377*), P/E ratio, range 0.89 − 1.40, mean 1.42 ± 0.12; P.A.I., range 0.119 − 0.256, mean 0.163 ± 0.04. (s.o.: P/E ratio, range 0.77 − 1.04, mean 0.92 ± 0.07; P.A.I., range 0.103 − 0.233, mean 0.181 ± .03). Gray County, Me. (*Fellows 1416*), P/E ratio, range 1.10 − 1.52, mean 1.33 ± 0.12; P.A.I., range 0.092 − 0.166, mean 0.126 ± 0.02. Sunderland, Ma. (*Floyd s.n.*), P/E ratio, range 1.21 − 1.63, mean 1.47 ± 0.10; P.A.I., range 0.055 − 0.122, mean 0.102 ± 0.02.

Voucher material; *Philbrick 377,* 23 April 1978 (NHA); *Fellows 1416,* 22 April 1900 (NHA); *Floyd s.n.,* 17 April 1915 (NEBC).

Acer spicatum: (Figures 4, 9, & 10) grains tricolporate, the pores made up of an inner and outer rim; mean pore size 4.2 μm (measured along the polar axis in the equatorial view); lirae and striae on most grains visible only in the peripheral regions at mid focus; when visible the lirae are wider than the striae. As a result of this semitransparent nature of the sexine the bacula become visible, causing the surface of the grain to appear granular; sexine tectate, exine thickness ca. 1.0 μm. Measurements: Isle au Haut, Me. (*Wise 38*), P/E ratio, range 1.04 − 1.44, mean 1.26 ± 0.11; P.A.I., range 0.120 − 0.263, mean 0.216 ± 0.04. Pownal, VT (*Kennedy s.n.*), P/E ratio, range 1.09 − 1.41, mean 1.24 ± 0.09; P.A.I., range 0.150 − 0.285, mean 0.209 ± 0.03. Berkshire Co., MA. (*Walters s.n.*), P/E ratio, range 1.05 − 1.47, mean 1.27 ± 0.10;

P.A.I., range 0.125 – 0.273, mean 0.183 ± 0.03. Southington, Conn. (*Bissell s.n.*), P/E ratio, range 1.14 – 1.50, mean 1.27 ± 0.08; P.A.I., range 0.136 – 0.286, mean 0.190 ± 0.04. Wolfeboro, NH (*Sargent s.n.*), P/E ratio, range 0.81 – 1.42, mean 1.28 ± 0.11; P.A.I., range 0.125 – 0.231, mean 0.175 ±0.03. (s.o.: P/E ratio, range 1.11 – 1.43, mean 1.22 ± 0.09; P.A.I.; range 0.111 – 0.235, mean 0.173 ± 0.04).

Voucher material: *Wise 38*, 5 July 1968 (NHA); *Walters s.n.*, 8 June 1913 (NHA); *Sargent s.n.*, 6 June 1918 (NHA); *Kennedy s.n.*, 17 June 1901 (GH): *Bissell s.n.*, 30 May 1901 (GH).

TYPE II: RUGULOSE (=rugulate)

Acer negundo: (Figures 4, 5, & 11) sexine rugulate, rugulae irregularly arranged, up to 4 μm in length, similar in mesocolpium and apocolpium; sexine appears "patchy" at low focus, these patchy areas are up to 3 μm in width; sexine tectate, exine thickness ca. 1.0 μm. Measurements: Durham, NH (*Philbrick 401*), P/E ratio, range 0.93 – 1.63, mean 1.24 ± 0.17; P.A.I., 0.250 – 0.414, mean 0.334 ± 0.05. (s.o.: P/E ratio, range 0.88 – 1.12, mean 1.02 ± 0.06; P.A.I., range 0.269 – 0.435, mean 0.361 ± 0.04). Burlington, VT (*Pringle s.n.*), P/E ratio, range 1.18 – 1.46, mean 1.32 ± 0.08, P.A.I.; range 0.094 – 0.258, mean 0.185 ± 0.04. New Milford, Conn. (*Averill s.n.*), P/E ratio, range 1.00 – 1.43, mean 1.25 ± 0.10; P.A.I., range 0.138 – 0.276, mean 0.215 ± 0.04. Dorchester, MA (*Jenks s.n.*), P/E ratio, range 1.19 – 1.62, mean 1.38 ± 0.13; P.A.I., range 0.125 – 0.233, mean 0.174 ± 0.02.

Voucher material; *Philbrick 401*, 1 May 1978 (NHA); *Pringle s.n.*, 13 May 1879 (GH); *Jenks s.n.*, 1883 (NEBC); *Averill s.n.*, 19 April 1897 (NEBC).

Acer saccharinum: (Figures 5 & 12) sexine rugulate, rugulae irregularly arranged, less than 2 μm in length, much finer in appearance than those of *A. negundo;* rugulae slightly smaller in apocolpium versus mesocolpium; at low focus "patchy" dark areas, if present, less than 1 μm in width; sexine tectate; exine thickness ca. 1.0 μm. Measurements: Durham, NH (*Philbrick 350*), P/E ratio, range 1.19 – 1.48, mean 1.31 ± 0.08; P.A.I., range 0.108 – 0.243, mean 0.174 ± 0.03. (s.o.: P/E ratio, range 0.860 – 1.28, mean 1.04 ± 0.09; P.A.I., range 0.140 – 0.280, mean 0.195 ± 0.03). Rutland, VT (*Eggleston s.n.*), P/E ratio, range 1.00 – 1.55, mean 1.35 ± 0.14; P.A.I., range 0.102 – 0.294, mean 0.185 ± 0.04. Providence, RI (*Hope 483*), P/E ratio, range 1.05 – 1.40, mean 1.24 ± 0.08; P.A.I., range 0.097 – 0.179, mean 0.136 ± 0.02.

Voucher material: *Philbrick 350,* 29 March 1978 (NHA), *Eggleston s.n.,* 20 April 1895 (GH); *Hope 483,* 13 March 1910 (NEBC).

TYPE IV: MICRORETICULATE

Biesboer places both *Acer saccharum* and *A. nigrum* in his Type IV grouping, which is characterized as having a microreticulate sexine. Our material of *A. saccharum* does not seem to fall very neatly into this group, since its sexine appears to be more striato-reticulate, an intermediate condition between striate and reticulate. The reticulate pattern appears at a lower level, with the striae situated above the reticulum. Therefore, two separate networks are formed, an upper striate network and a lower microreticulate network. However, we retain *A. saccharum* in the Type IV group because Biesboer expands this group to include *A. saccharum* ssp. *grandidentatum,* which he reports may occasionally be striato-reticulate. *Acer nigrum* also exhibits this striato-reticulate character, but to a much more limited extent.

Acer saccharum: (Figures 5 & 13) sexine striato-reticulate in mesocolpium; striate sculpturing occurring above the microreticulate sculpturing; sexine tending toward microreticulate in apocolpium; sexine semitectate; exine thickness ca. 1.0 μm. Measurements: Durham, NH (*Philbrick 425*), P/E ratio, range 0.97 – 1.33, mean 1.16 ± 0.09; P.A.I., range 0.025 – 0.457, mean 0.184 ± 0.07. (S.O.: P/E ratio, range 0.890 – 1.43, mean 1.12 ± 0.12; P.A.I., range 0.172 – 0.250, mean 0.194 ± 0.03.). Franklin, Conn. (*Woodward s.n.*), P/E ratio, range 1.05 – 1.56, mean 1.30 ± 0.12; P.A.I., none available. South Chesterville, ME (*Eaton s.n.*), P/E ratio, range 1.19 – 1.64, mean 1.40 ± 0.11; P.A.I., range 0.096 – 0.258, mean 0.167 ± 0.04. Amherst, MA (*Rogers s.n.*), P/E ratio, range 1.22 – 1.55, mean 1.35 ± 0.08; P.A.I., range 0.086 – 0.194, mean 0.135 ± 0.02.

Voucher material: *Philbrick 425,* 10 May 1978 (NHA); *Rogers s.n.,* 22 May 1950 (NHA); *Eaton s.n.,* May 1897 (NHA); *Woodward s.n.,* 2, 4 May 1905 (NEBC).

Acer nigrum: (Figures 6 & 14) sexine microreticulate, frequently tending toward striato-reticulate (the striato-reticulate nature is less pronounced in this species than in *A. saccharum*); sexine semitectate; exine thickness ca. 1.0 μm. Measurements: western VT (*Pringle s.n.*), P/E ratio, range 1.17 – 1.61, mean 1.41 ± 0.10; P.A.I., range 0.128 – 0.244, mean 0.182 ± 0.03. (s.o.: P/E ratio, range 0.91 – 1.41, mean 1.15 ± 0.15; P.A.I., range 0.125 – 0.300, mean 0.191 ± 0.04.).

Voucher material: *Pringle s.n.,* 27 May 1879 (NEBC).

DISCUSSION

Grains from the seven New England species included in this study fall into three of the four morphological types, based on sexine sculpturing, established by Biesboer (1975). *Acer pensylvanicum, A. rubrum,* and *A. spicatum* conform to Biesboer's Type I, striate group. All three species have a sculptured sexine differentiated into lirae and striae, with no significant difference in the sculpturing between the mesocolpium and apocolpium regions of the grain.

When viewed under the light microscope (Figure 3, A-D), at 1000×, the lirae of *Acer pensylvanicum* are observed to be fairly uniform in width though discontinuous, that is, they occur as segments of various lengths. The scanning electron micrographs of this species (Figure 7) illustrate both these characters clearly, showing the uniformity in width and the abrupt terminations of the lirae. The other two species of the striate group, *A. rubrum* and *A. spicatum,* do not exhibit this discontinuous pattern.

The mean P/E ratios for all the populations of *A. pensylvanicum* fall within the subprolate category of Erdtman (1952). However, with the exception of the *Bissell s.n.* population, the P/E ratios for all the populations of this species ranged from prolate-spheroidal to prolate. The *Bissell* population ranged from oblate-spheroidal to prolate.

The second species in the striate group, *Acer rubrum* (Figure 3 E-H, & 8), is characterized by having lirae which are notably wider than are the striae. This species also exhibits lirae and striae which vary in their width in relation to one another throughout the grain surface. Therefore, the uniformity of width noted in *A. pensylvanicum* is lacking in *A. rubrum.* The lirae of *A. rubrum* appear interconnected, thus forming a continuous network of lirae throughout the length of the grain. This network is also apparent in our scanning electron micrographs of *A. spicatum* (Figures 9 & 10), but not apparent in the light micrographs of this species. *Acer pensylvanicum* (Figure 7) does not show this continuous network.

Two of the three *A. rubrum* populations (*Philbrick 377, Floyd s.n.*) are characterized by mean P/E ratios which fall into Erdtman's prolate grouping, the remaining population (*Fellows 1416*) proved to be marginal between subprolate and prolate. The P/E ratios for all three populations of this species ranged over several of Erdtman's shape categories: oblate-spheroidal to prolate (*Philbrick 372*); prolate-spheroidal to prolate (*Fellows s.n.*); subprolate to prolate (*Floyd s.n.*).

When observed with the light microscope the lirae and striae of the third striate species, *Acer spicatum* (Figure 4 A–D), are much less obvious than those of the previous two species. They are observable only in th peripheral regions of the grain where the sexine is in oblique view. As a result of this apparent semitransparent quality of the *A. spicatum* sexine, the bacula subtending the tectum give a pseudo-granular appearance to the surface of the grain. The striate nature is apparent, however, in the scanning electron micrographs of the species (Figures 9 & 10).

All the populations of *A. spicatum* yielded mean P/E ratios within Erdtman's subprolate group. This species was unique in the sense that the ratios from the separate populations displayed no significant differences when compared statistically. The other species of this study shared little, if any, similarity between populations in regard to statistical analysis of P/E ratios.

In terms of tectal structure, two species of the striate group, *Acer pensylvanicum* (Figures 3 A–D, 7) and *A. rubrum* (Figures 3 E–F, 8), show a semitectate condition which is most obvious in the scanning electron micrographs of these species. The other species, *A. spicatum* (Figures 9 & 10), tends more toward a tectate condition, although some areas of the grain do lack a full tectum. The semitectate condition (in the sense of Faegri & Iversen, 1975) observed in these species differs from that described in the comprehensive pollen description of Biesboer (1975), who characterized all three species as having a full tectum.

Pollen grains conforming to Biesboer's rugulose group, Type II, are found in *Acer negundo* and *A. saccharinum.*As a result of its wider use in palynological texts (Faegri & Iversen, 1975, Moore & Webb, 1978), we choose to use the term "rugulate" in place of the less frequently used term "rugulose". Both terms describe the same wrinkled condition. The most prominent feature distinguishing *A. negundo* from *A. saccharinum* is the size and orientation of the individual rugulae. *Acer negundo* (Figures 4, 5, & 11) possesses rugulae which are much more elongate, up to 4 μm in length, and more variable in shape than those of *A. saccharinum* (Figures 5 & 12), with rugulae which are more uniform in shape and less than 2 μm in length. Another character which separates the two species is the presence or absence of dark "patchy" areas, apparent while focusing down through the rugulae. *Acer negundo* (see arrow, Figure 5A) exhibits these dark areas, which are up to 4 μm in width, while in *A. saccharinum* the areas are less than 1 μm in width if they are present at all. Both rugulate species exhibit larger rugulae in the mesocolpium region than in the apocolpium region.

Two populations of *A. saccharinum* (*Philbrick 350, Hope 483*) have mean P/E ratios which fall within Erdtman's subprolate category, with the remaining population (*Eggleston s.n.*) in the prolate group. As is commonly found among the species covered, the range of P/E ratios for this species extends through several of Erdtman's categories, *Philbrick 350* extended from subprolate through prolate, with both the *Eggleston s.n.* and *Hope 483* populations ranging from prolate-spheroidal to prolate.

Three populations of *A. negundo* (*Philbrick 401, Pringle s.n., Averill s.n.*) possess mean P/E ratios which are included in the subprolate group. The remaining population (*Jenks s.n.*) falls within the prolate category. In this species P/E ratios range from subprolate to prolate in *Jenks s.n.* and *Pringle s.n.*, oblate-spheroidal to prolate in *Philbrick 401* and prolate-spheroidal to prolate in the *Averill s.n.* material.

Two of our species, *Acer nigrum* and *A. saccharum*, exhibit pollen grains that can be attributed to Biesboer's microreticulate group, Type IV. However, we observed a striato-reticulate sexine, a condition intermediate between striate and reticulate, to be prominent in *A. saccharum* and common in *A. nigrum*.In *A. saccharum* (Figures 5 G–J & 13) both the striate and microreticulate sculpturings appear to be present, but at different levels in the sexine of the mesocolpium, with a more reticulate condition in the apocolpium. The striate condition is located at an upper level with the microreticulate condition situated beneath the lirae. The latter condition, as seen in the scanning electron micrographs for *A. saccharum* (Figure 13) and *A. nigrum* (Figure 14), is formed by various sized tectal ridges connecting the lirae across the striae.

The mean P/E ratios of the *Philbrick 425* and *Woodward s.n.* populations of *A. saccharum* fall within the subprolate group and the *Eaton s.n.* and *Rogers s.n.* into the prolate category of Erdtman. The upper range of all four populations lies in the prolate group, while the lower ranges of *Eaton s.n.* and *Rogers s.n.* are subprolate, with the *Philbrick 425* being oblate-spheroidal and *Woodward s.n.* being prolate-spheroidal.

Acer nigrum exhibits a sexine which corresponds more closely with Biesboer's description. With the light microscope (Figure 6 A D) the sexine of this species appears predominantly microreticulate in both the mesocolpium and apocolpium regions, though there are areas on most of the grains which do show a striato-reticulate condition. The one population of *A. nigrum* (*Pringle s.n.*) displayed a mean P/E value falling within Erdtman's prolate grouping, while extremes ranged from the subprolate to prolate categories.

We place *Acer saccharum* in Biesboer's Type IV group inasmuch as Biesboer includes there *A. saccharum* ssp. *grandidentatum,* which he reports to be occasionally striato-reticulate.

None of the seven species studied fall within Biesboer's granular group, Type III. This condition appears to be uncommon in the genus, as illustrated by the fact that only one (*Acer carpinifolium*) of the 41 taxa studied by Biesboer has a granular sexine. However, it should be kept in mind that, as of this writing, data on the pollen morphology of fewer than half the known species of the genus *Acer* can be found in the literature, and detailed descriptions of individual species are even less numerous. Biesboer (1975) provides descriptions of the four general types which he identified among the 41 taxa he examined, rather than descriptions of the individual species. Similarly, Helmich (1963) lists the names of 45 species which she examined, but provides detailed descriptions and a key for only 15 North American species, of which she considers only 13 to be "definite species". The studies of Gogichaishvili (1964), Clarke and Jones (1978), and Hesse (1979) add information for about 12 European or Asian species. Thus, new pollen "types", or additional species with granular exines, may be identified as additional studies appear in the literature.

Although the use of the polar area index is of important diagnostic value in many cases, it proves of little use in distinguishing the different *Acer* species covered here. Regarding this index, in almost every case there are no correlations between species or even similarities between separate populations within the same species.

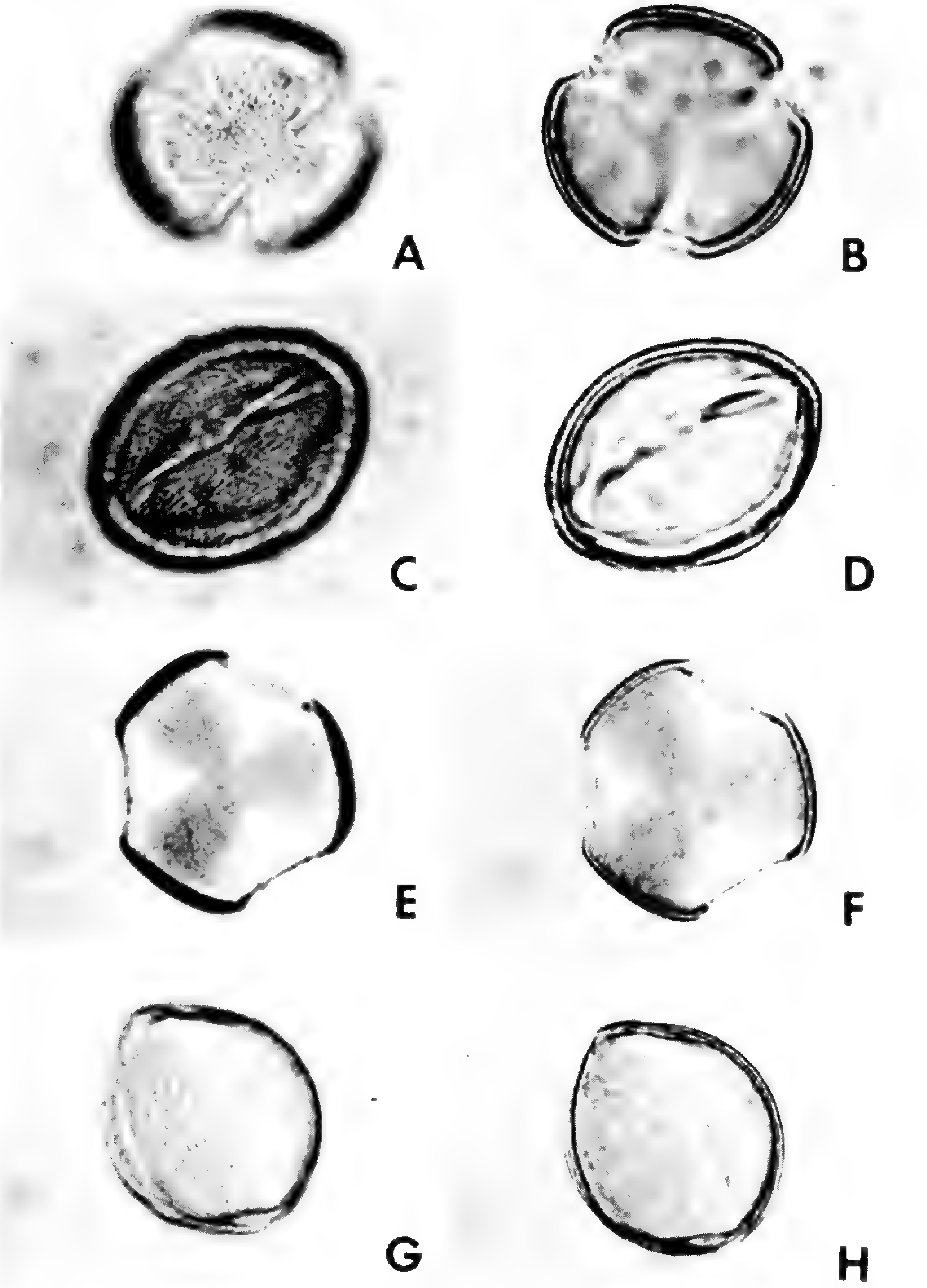


Figure 3. Light micrographs: A–D; *Acer pensylvanicum:* **A;** Polar view, High focus, 3165×. **B;** Polar view, Mid focus, 3230×. **C;** Equatorial view, High focus, 3487×. **D;** Equatorial view, Mid focus, 3487×. E–H; *A. rubrum:* **E;** Polar view, High focus, 1343×. **E;** Polar view, mid focus, 1343×. **G;** Equatorial view, High focus, 1273×. **H;** Equatorial view, Mid focus, 1273×.

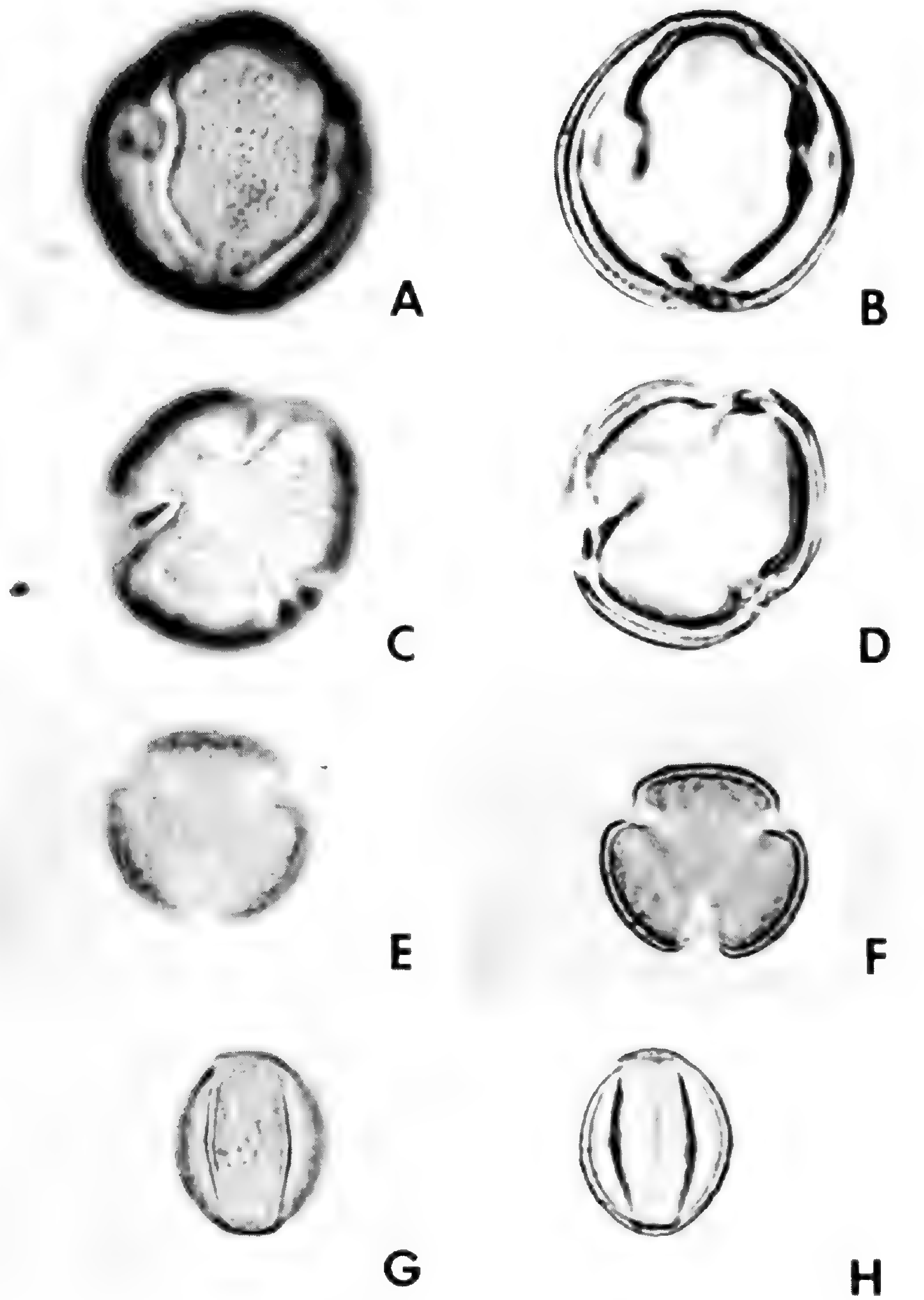


Figure 4. Light micrographs: A–D; *A. spicatum:* **A;** Equatorial view, High focus, 3429×. **B;** Equatorial view, Mid focus, 3429×. **C;** Polar view, High focus, 3230×. **D;** Polar view, Mid focus, 3230×. E–H; *A. negundo:* **E;** Polar view, High focus, 1311×. **F;** Polar view, Mid focus, 1311×. **G;** Equatorial view, High focus, 1380×; **H;** Equatorial view, Mid focus, 1380×.

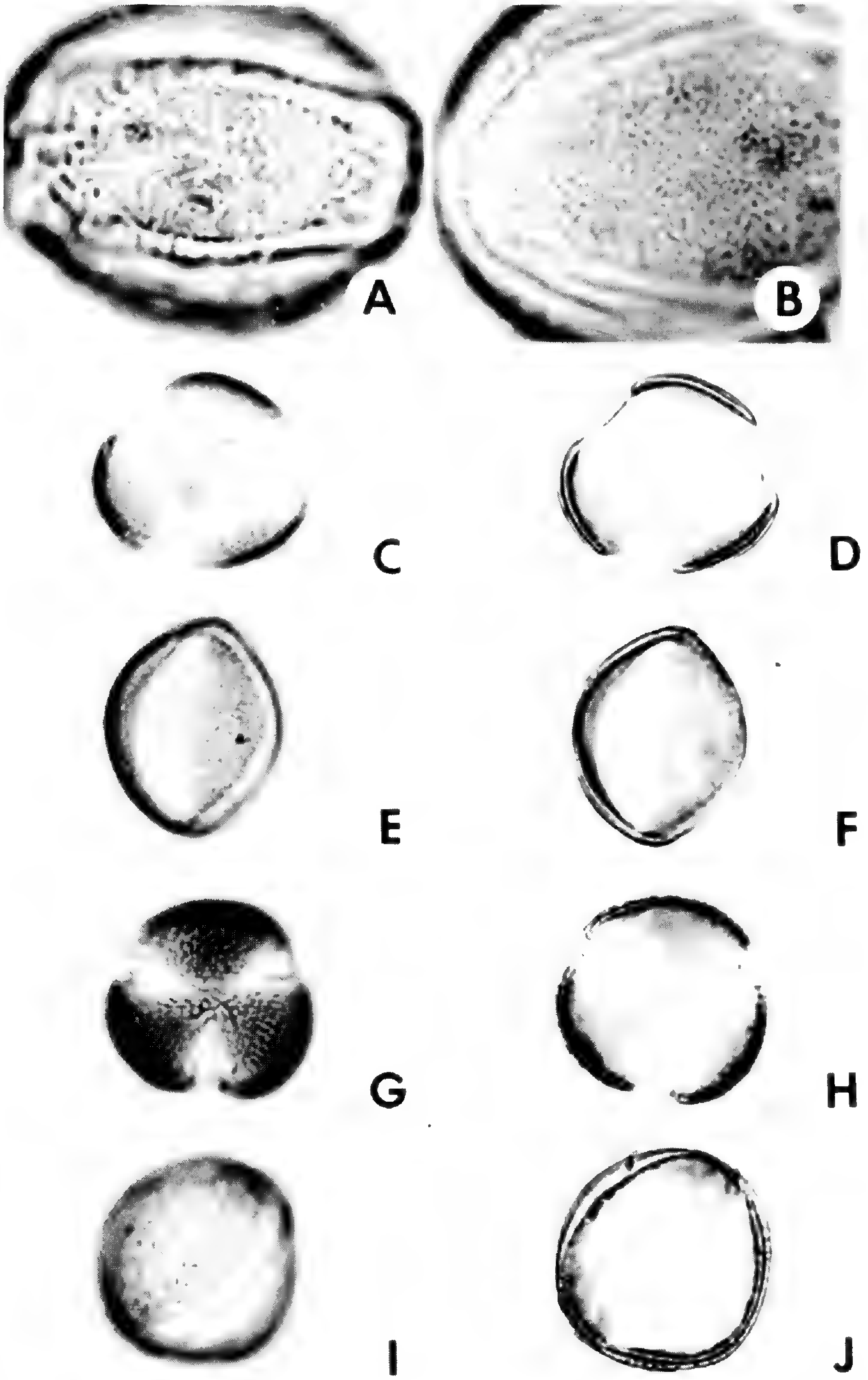


Figure 5. Light micrographs: **A;** *Acer negundo;* Equatorial view, Low focus, showing "patchy" dark areas separating the rugulae, 3128×. B–F; *A. saccharinum;* **B;** Equatorial view, showing smaller and more uniform rugulae than in *A. negundo,* also smaller "patchy" dark areas, 3214×. **C;** Polar view, High focus, 1200×. **D;** Polar view, Mid focus, 1200×. **E;** Equatorial view, High focus, 1257×. **F;** Equatorial view, Mid focus, 1257×. G–J; *A. saccharum:* **G;** Polar view, High focus, 1328×. **H;** Polar view, Mid focus, 1328×. **I;** Equatorial view, High focus, 1267×. **J;** Equatorial view, Mid focus, 1267×.

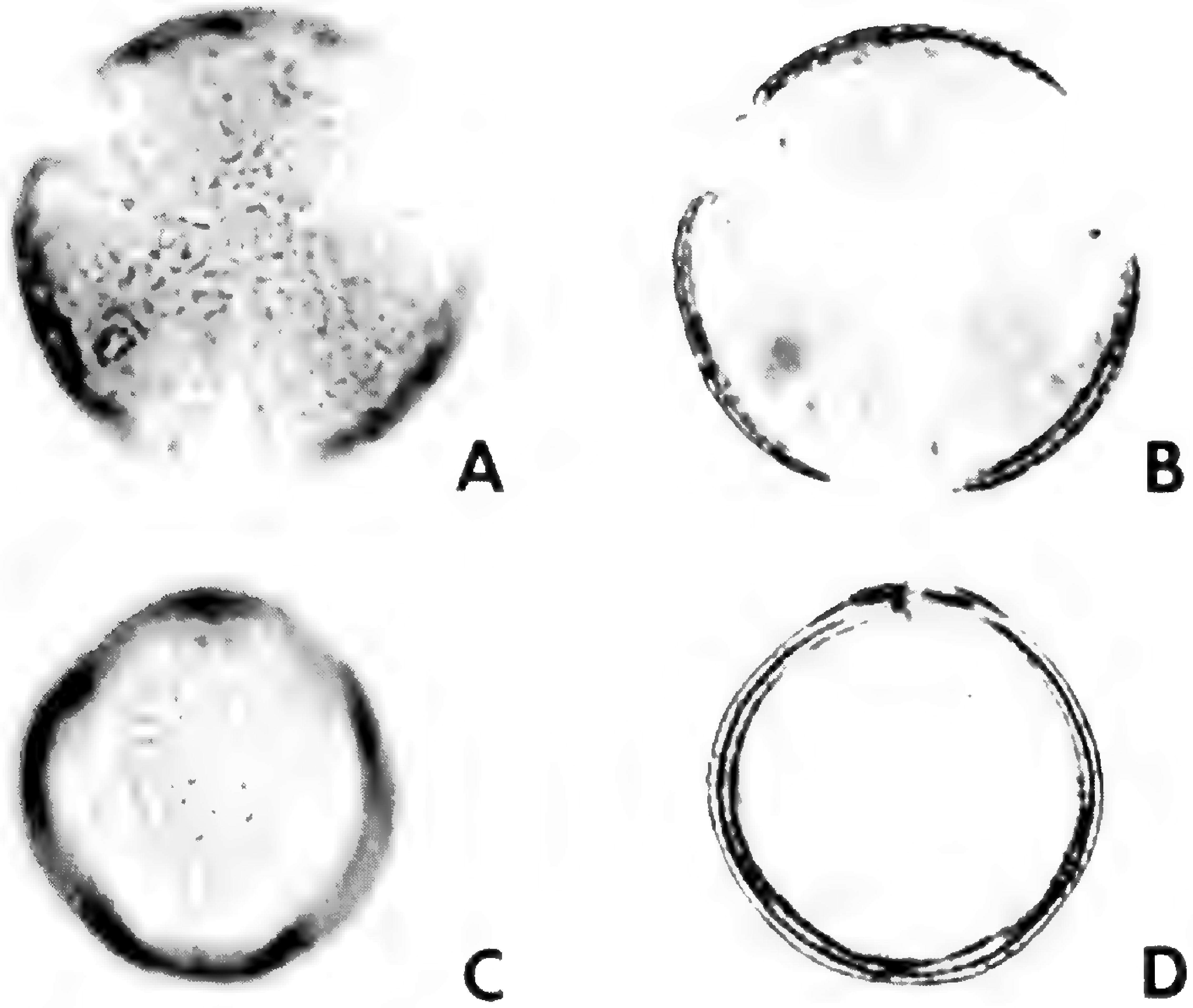
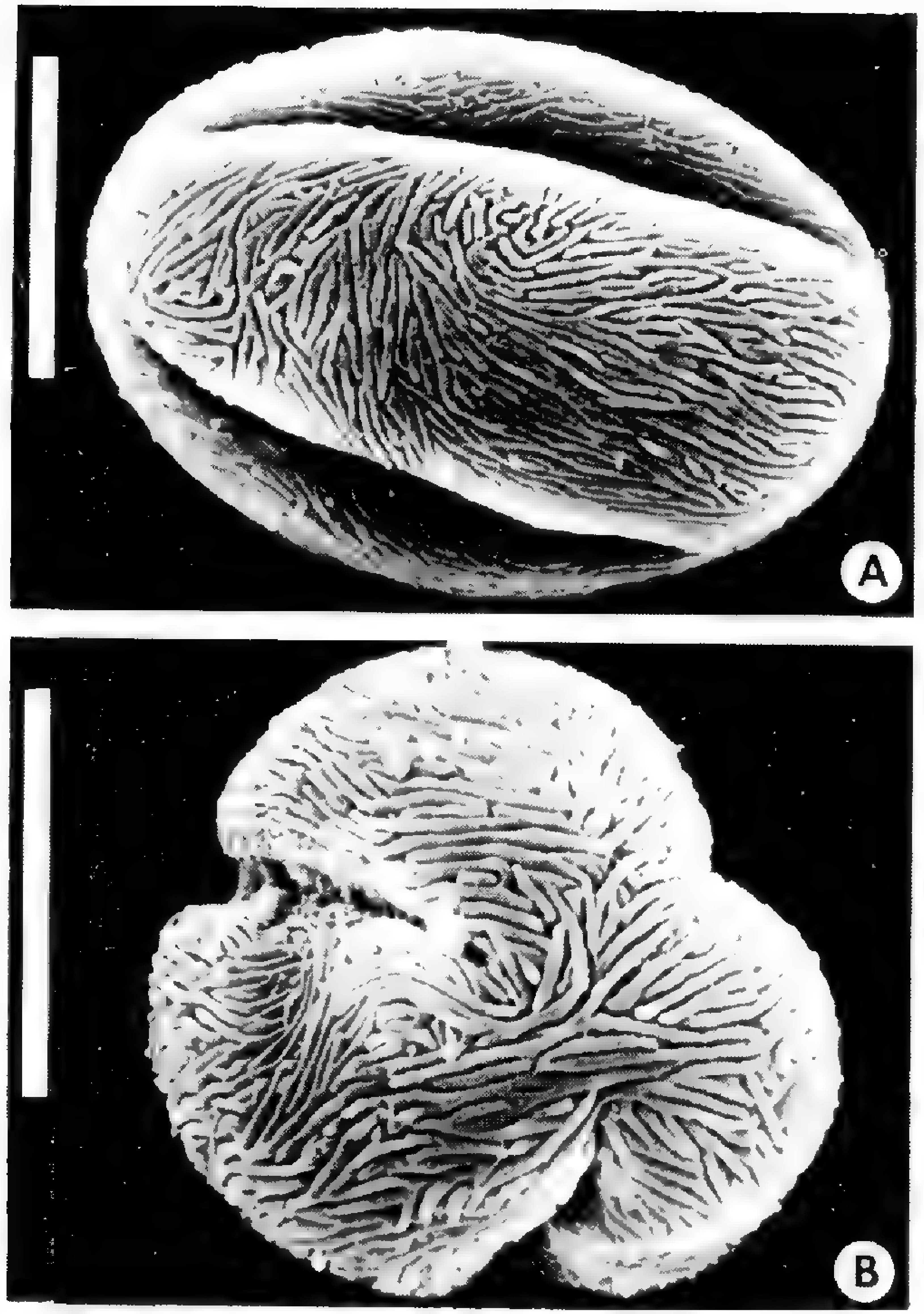
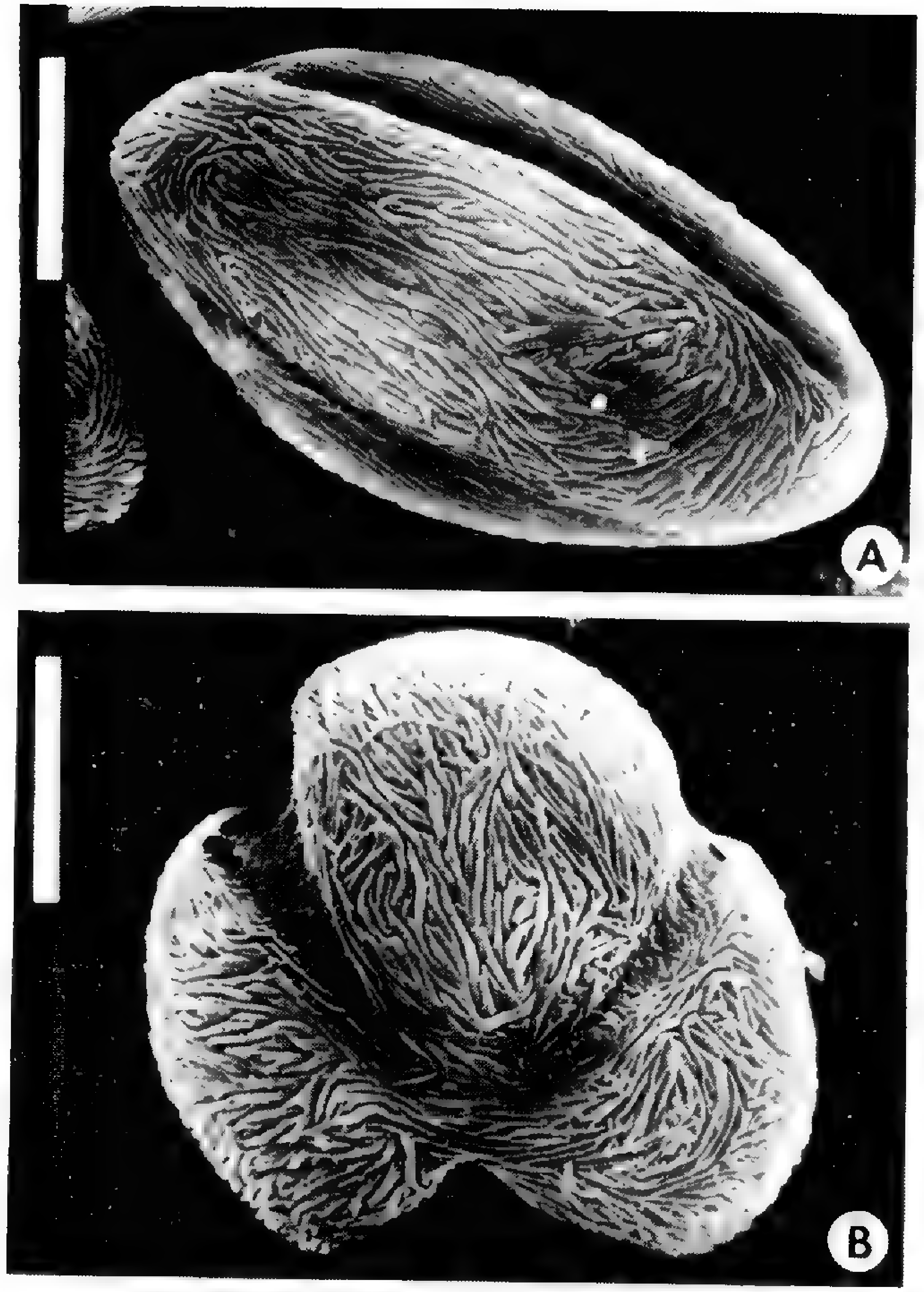
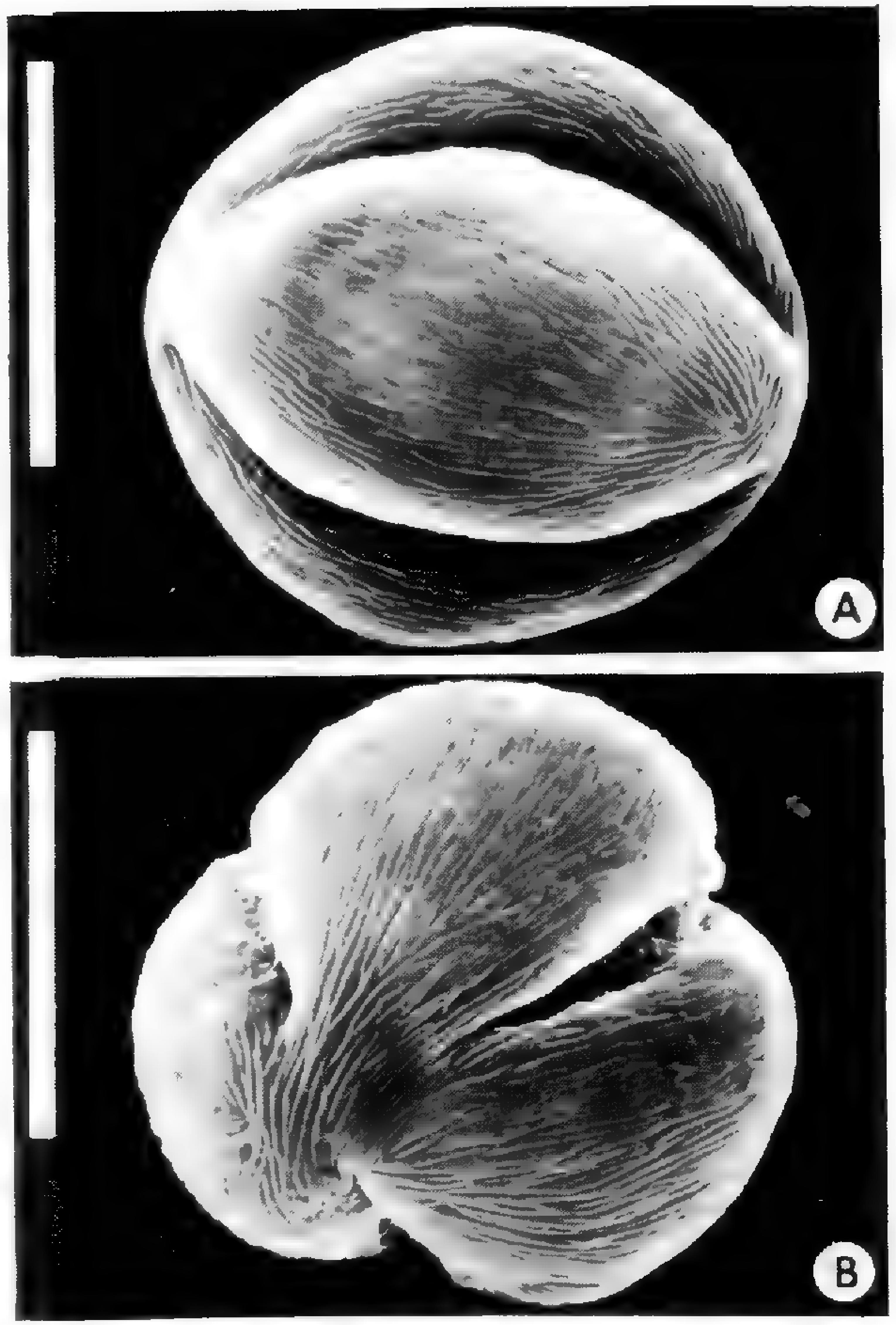


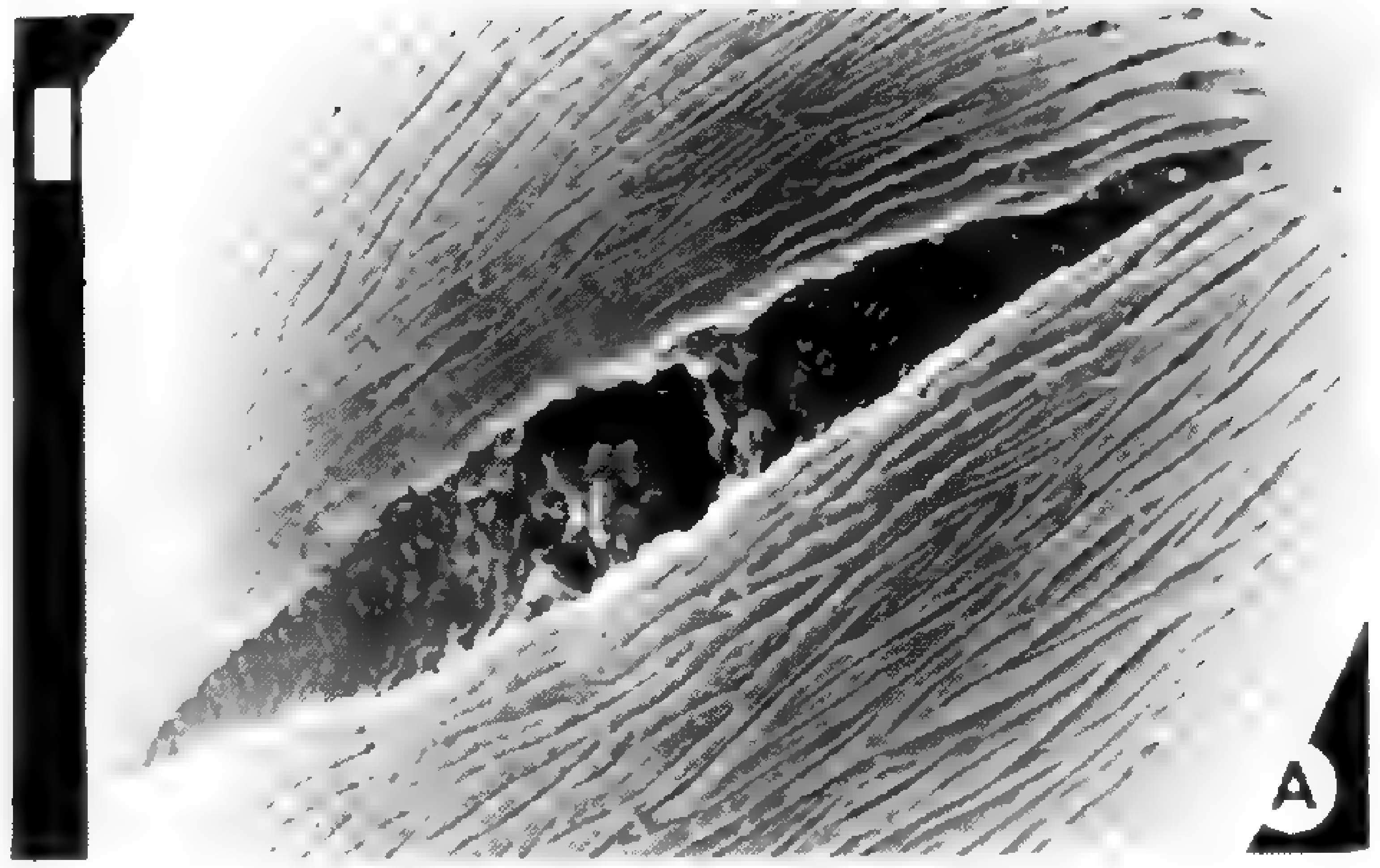
Figure 6. Light micrographs: A–D; *Acer nigrum:* **A;** Polar view, High focus, 1138×. **B;** Polar view, Mid focus, 1138×. **C;** Equatorial view, High focus, 1312×. **D;** Equatorial view, Mid focus, 1312×.



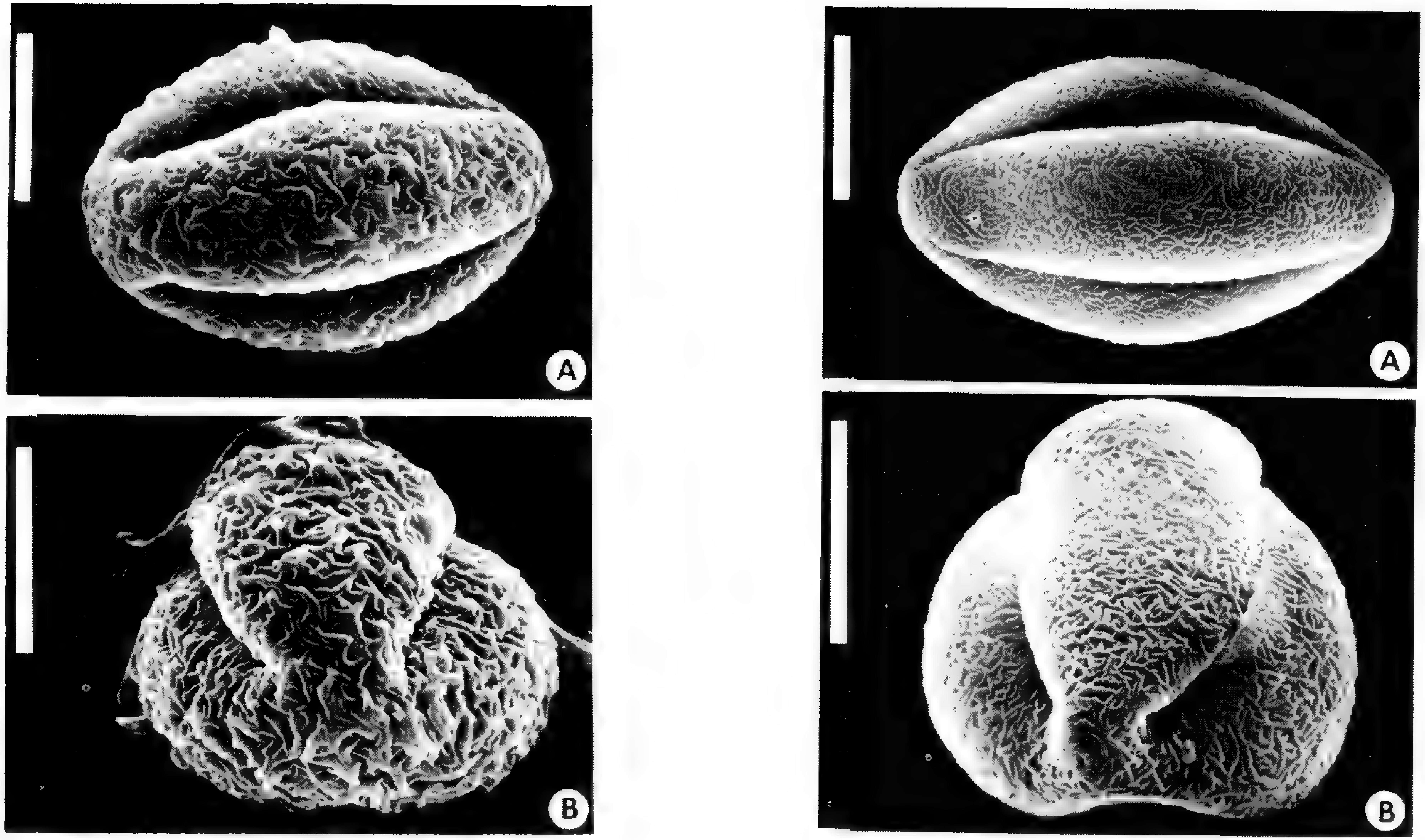


Figures 7 & 8. 7 (left). Scanning electron micrographs (Scale = 10 μm): A–B; *Acer pensylvanicum:* **A;** Equatorial view, showing fairly uniform width of lirae and striae. **B;** Slightly oblique polar view. 8 (right). Scanning electron micrographs (Scale = 10 μm): A–B; *Acer rubrum:* **A;** Equatorial view, showing lirae wider than striae and the ± continuous, interconnected striate nature. **B;** Slightly oblique polar view.

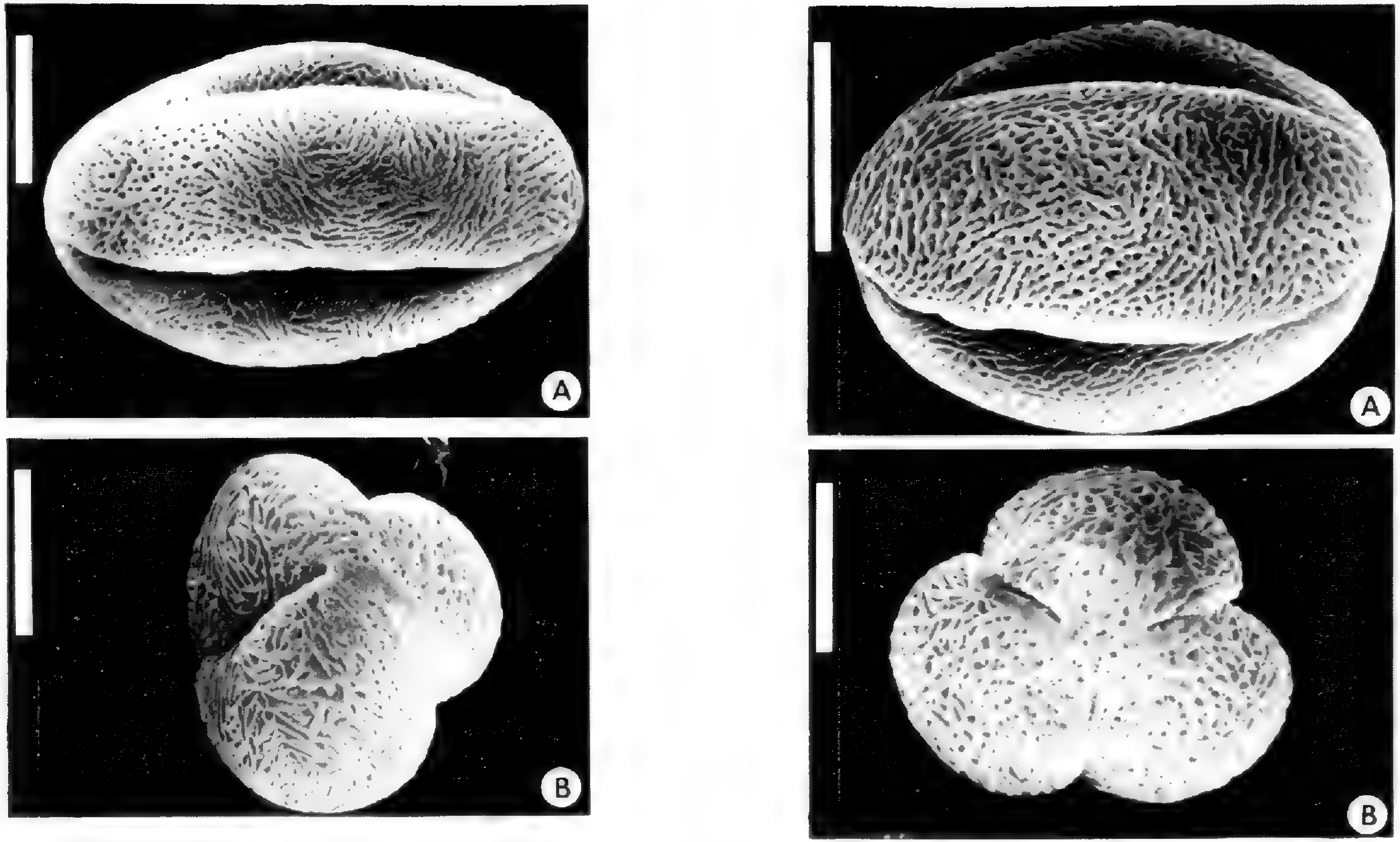




Figures 9 & 10. 9 (left). Scanning electron micrographs (Scale = 10 μm): A B; *Acer spicatum:* **A;** Equatorial view, showing "tight" orientation of the lirae. **B;** Slightly oblique polar view. 10 (right). Scanning electron micrograph (Scale = 1 μm): A; *Acer spicatum:* Close-up of the equatorial region showing a colporate aperture.



Figures 11 & 12. 11 (left). Scanning electron micrographs (Scale = 10 μm): A–B; *Acer negundo:* **A;** Equatorial view, showing rugulate sexine. **B;** Slightly oblique polar view, showing rugulate sexine. 12 (right). Scanning electron micrographs (Scale = 10 μm): A–B; *Acer saccharinum:* **A;** Equatorial view, showing rugulate sexine. **B;** Slightly oblique polar view, showing rugulate sexine.



Figures 13 & 14. 13 (left). Scanning electron micrographs (Scale = 10 μm): A–B; *Acer saccharum:* **A**; Equatorial view, showing striato-reticulate sexine. **B**; Slightly oblique polar view, showing striato-reticulate sexine. 14 (right). Scanning electron micrographs (Scale 10 μm): A–B; *Acer nigrum:* **A**; Equatorial view, showing striato-reticulate sexine. **B**; Polar view, showing striato-reticulate sexine.

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RARE AND ENDANGERED VASCULAR PLANT SPECIES IN NEW ENGLAND[1]

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This regional list represents an outgrowth of a project of the New England Botanical Club's Endangered Species Committee, chaired by William D. Countryman and Garrett E. Crow (vice-chairman). In the fall of 1978 the committee members published individual state reports of rare and endangered vascular plants: Maine (Eastman, 1978), New Hampshire (Storks & Crow, 1978), Vermont (Countryman, 1978), Massachusetts (Coddington & Field, 1978), Rhode Island (Church & Champlin, 1978), and Connecticut (Mehrhoff, 1978). It was then the desire of the committee to consolidate this information in an effort to produce a listing pertaining to the entire New England region, including only taxa significant to all of New England.

An interest in documenting the rare elements of New England's flora has existed for some time. In 1971 the Natural Areas Criteria Committee of the New England Botanical Club was formed to prepare a set of criteria for the identification and evaluation of natural areas (Countryman, 1972). The Endangered Species Committee has applied these criteria in the development of this regional list, as well as individual state lists. Additionally, for the regional list, a basic "rule of thumb" for listing taxa as E/T ("endangered"/"threatened") was documentation of each taxon by fewer than 10 towns and R ("rare") status was assigned to taxa represented by populations in 10-20 towns within New England. Special consideration was given to plants whose present known populations appear to be on the decline with respect to the number of documented localities, to disjuncts, and to plants of specialized or vulnerable habitats. Further attention was given to plants which are likely to be exploited because of particularly appealing features, such as the orchids and ferns. Certain plants which are less conspicuous, such as some grasses and sedges, may not have been included in the list even though documented records may have been few.

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[1] Scientific contribution 1074 from the New Hampshire Agricultural Experiment Station.

The New England regional list contains 479 taxa. Two New England taxa *(Pedicularis furbishiae* and *Potentilla robbinsiana)* have been listed by the Office of Endangered Species, U. S. Fish and Wildlife Service, as "endangered." Two additional taxa have been formally proposed *(Isotria medeoloides,* as "endangered," and *Paronychia argyrocoma* var. *albimontana,* as "threatened"). The federal status assigned each of these taxa is so adopted here in the regional list. However, the committee felt it desirable, at present, to use the compound status E/T rather than attempt to distinguish between those which might be "endangered" or might be "threatened" with extinction. The list is based, in large part, on historical records documented by specimens in herbaria. Although a great deal of field work has been conducted in conjunction with this project, information regarding the present-day status of populations of a large number of taxa on the list remains incomplete. 337 taxa are listed as E/T. Those taxa which are designated R, 133 taxa, merit watching in the future, but presently do not appear to be endangered or threatened in the New England region.

The committee has recognized 95 taxa as being of national significance (designated by an asterisk). This group includes numerous species whose occurrence within the United States is extremely limited, but which may, for instance, be more frequent in arctic regions of North America, and thus may not be eligible for consideration under the Endangered Species Act of 1973.

A total of 23 taxa which occcur in New England are under review by the Office of Endangered Species for possible listing under the Endangered Species Act of 1973, and 16 taxa previously under review have been dropped from consideration, as presented in Table 1. In 1975 the Office of Endangered Species published in the Federal Register (FR, 1 July 1975, Vol. 40, no. 127) a list of taxa under review for federal listing. This list was followed by a formal proposal of endangered taxa (FR, 16 June 1976, Vol. 41, no. 117). In 1978 the Smithsonian Institution (Ayensu & DeFilipps, 1978) published a revision of their 1975 report to Congress (which served as the basis of the 1975 notice of review). Subsequent to the Endangered Species Act Amendments of 1978, which placed a 2-year limit for proposed rulemaking, all proposed plant species were mandatorily withdrawn in November 1979. In an effort to bring the past notice of review, proposal, and Smithsonian reports up-to-date, the Office of Endangered Species has published a revised notice of review (FR, 15 December 1980, Vol. 45, no. 242).

Table 1. Threatened and Endangered Plant Species Considered for Federal Listing which occur in New England.

Taxon	States	Notice of Review FR 1975	Proposed taxa FR 1976	Smithsonian Report—1978	Notice of Review FR 1980
Pedicularis furbishiae	ME	PrEx	E	E	E*
Potentilla robbinsiana	NH	E	E	E	E*
Isotria medeoloides	ME, NH, VT MA, RI, CT	E	E	E	E*
Paronychia argyrocoma var. *albimontana*	ME, NH, MA	T		T	T*
Eupatorium leucolepis var. *novae-angliae*	MA, RI	T		T	1
Platanthera leucophaea *(=Habenaria leucophaea)*	ME	T		T	1
Prunus maritima var. *gravesii* *(=P. gravesii)*	CT	E	E	E	1
Trollius laxus ssp. *laxus*	CT	E	E	E	1

Table 1. Threatened and Endangered Plant Species Considered for Federal Listing which occur in New England.

Taxon	States	Notice of Review FR 1975	Proposed taxa FR 1976	Smithsonian Report— 1978	Notice of Review FR 1980
Agalinus acuta	MA, RI, CT	T		T	2
Minuartia marcescens (=*Arenaria marcescens*)	VT				2
Astragalus robbinsii var. *jesupi*	NH, VT	E	E	E	2
Braya humilis var. *leiocarpa*	VT				2
Cardamine longii	ME	T		T	2
Carex oronensis	ME	T		T	2
Helianthemum dumosum	MA, RI, CT	T			2
Isoetes eatonii	NH, MA, CT	T			2
Listera auriculata	ME, NH, VT	T		T	2
Mimulus ringens var. *colpophilus*	ME	E	E	E	2

Oxytropis campestris var. *johannensis*	ME				2
Potamogeton hillii	VT, MA, CT	T		T	2
Potamogeton lateralis	NH, VT, MA, CT				2
Prenanthes boottii	ME, NH, VT	T		T	2
Schwalbea americana	MA, CT			T	2
Scirpus ancistrochaetus	VT, MA	E	E	E	2
Scirpus longii	ME, MA, CT	T			2
Valeriana uliginosa	ME, VT				2
Viola novae-angliae	ME				2
Asplenium ebenoides	MA, CT	T			3B
Astragalus robbinsii var. *robbinsii*	VT	Ex	E	E	3A
Calamagrostis inexpansa var. *novae-angliae*	ME, NH, VT	E	E	E	3B
Calamagrostis nubila	NH	Ex, Tax?			3B

Table 1. Threatened and Endangered Plant Species Considered for Federal Listing which occur in New England.

Taxon	States	Notice of Review FR 1975	Proposed taxa FR 1976	Smithsonian Report 1978	Notice of Review FR 1980
Carex elachycarpa	ME	E	E	E	3B
Carex josselynii	ME			T	3B
Cypripedium arietinum	ME, NH, VT MA, CT	T		T	3C
Geum peckii	NH	E	E	E	3C
Hydrastis canadensis	VT, MA, CT			T	3C
Isoetes foveolata	NH, MA, CT	T		T	3B
Juncus pervetuus	MA	Ex,Cult	E	Ex	3A
Panax quinquefolius	ME, NH, VT, MA, RI, CT	E/T[1]		T	3C*
Platanthera flava (=*Habenaria flava*)	ME, NH, VT, MA, RI			T	3C
Primula mistassinica	ME, VT	E/T[2]			3C

Prunus alleghaniensis	CT	T	T	3C
Steironema laevigatum *(=Lysimachia hybrida)*	ME, NH, VT MA, RI, CT			3C

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[1] *Panax quinquefolius*–FR 11 August 1977, Vol. 42, No. 155.

[2] *Primula mistassinica* FR 21 April 1975, Vol. 40, No. 77.

E = endangered
T = threatened
Ex = recently extinct or extinct in wild
PrEx = probably extinct
Tax? = taxonomic status in doubt
Cult = may be extinct in nature, but the plants are in cultivation or have been transplanted
1 = good candidates for listing
2 = potential candidates for listing, need further study
3A = delete, taxon extinct
3B = delete, taxonomic status clarified (synonym)
3C = delete, more abundant than warrants listing

* *Pedicularis furbishiae*—final rulemaking, "endangered" status, Federal Register, 26 April 1978, Vol. **43**, no. 81.

* *Potentilla robbinsiana*—final rulemaking, "endangered" status, Federal Register, 17 September 1980, Vol. **45**, no. 182.

* *Isotria medeoloides*—proposed, “endangered” status, Federal Register, 11 September 1980, Vol. **45**, no. 178.
* *Paronychia argyrocoma* var. *albimontana*—proposed “threatened” status, Federal Register, 27 October 1980, Vol. **45**, no. 209.
* *Panax quinquefolius*—final rulemaking, trade regulated by international treaty; prohibits export from states such that it would be detrimental to the survival of the species, Federal Register, 15 August 1979, Vol. **44**, No. 159.

NEW ENGLAND REGIONAL LIST OF RARE AND ENDANGERED VASCULAR PLANTS

Families are ordered according to Gray's Manual 8th. Ed. Species are ordered alphabetically within each family.

KEY TO THE SYMBOLS USED IN THIS LIST

Status:

*	Taxon is of national significance
E/T	Taxon is Threatened or Endangered in New England
R	Taxon is Rare in New England but not Threatened nor Endangered
?	Taxonomic problem, the taxon needs taxonomic clarification

Occurrence within individual states:

(blank)	Does not occur within the state
×	Is on the state list of rare and endangered vascular plant species
×?	Is on the state list but perhaps shouldn't be
"×"	Occurs in the state, is not on the state list but perhaps should be
O	Occurs in the state
1S	One station has been reported for the state
1S?	Unconfirmed report of one station for the state
1R	One report exists for the state
1H	One historical record exists for the state
?	Questionable record(s) exists for the state

Status	Taxon	ME	NH	VT	MA	RI	CT
LYCOPODIACEAE							
E/T	*Lycopodium alopecuroides*				×	×	
E/T	*Lycopodium carolinianum*				×		
R	*Lycopodium sabinaefolium*	0	0	0			
R	*Lycopodium selago*	"×"	×	×	×		×
R	*Lycopodium sitchense*	0	0	0			
SELAGINELLACEAE							
* E/T	*Selaginella selaginoides*	×					
ISOETACEAE							
* E/T	*Isoetes eatoni*		×		×		×
R	*Isoetes engelmanni*		×	×	0	×	0
OPHIOGLOSSACEAE							
* E/T	*Botrychium lunaria*	×	×	×			
SCHIZAEACEAE							
* E/T	*Lygodium palmatum*		×	×	×	×	×

POLYPODIACEAE								
	E/T	*Adiantum pedatum* var. *aleuticum*	×		×			
	E/T	*Asplenium montanum*				×	×	×
	R	*Asplenium ruta-muraria*			“×”	×		×
*	E/T	*Asplenium viride*	×		×			
	E/T	*Cheilanthes lanosa* *(=C. vestita)*						×
	R	*Cryptogramma stelleri*	×	×	0	×		×
*	E/T	*Dryopteris filix-mas*	×		×			
	R	*Dryopteris fragrans*	×	×	×			
	E/T	*Pellaea glabella*			×			
*	E/T	*Woodsia alpina*	×		×			
*	E/T	*Woodsia glabella*	×	×	×			
PINACEAE								
	R	*Juniperus horizontalis*	0	×	×			
ZOSTERACEAE								
	R	*Potamogeton diversifolius* var. *diversifolius*				“×”		“×”
	R	*Potamogeton filiformis* var. *alpinus*	“×”	×	×			
	E/T	*Potamogeton filiformis* var. *occidentalis*	“×”					
	R	*Potamogeton friesii*	“×”		×	×		×

Status	Taxon	ME	NH	VT	MA	RI	CT
R	*Potamogeton hillii*			×	×		"×"
* E/T	*Potamogeton lateralis*		×	×	×		×
R	*Potamogeton strictifolius*	"×"		O	×		×
ALISMATACEAE							
* E/T	*Echinodorus tenellus*				×		
R	*Sagittaria montevidensis* ssp. *spongiosus* *(=Lophotocarpus spongiosus)*	"×"	×		×		×
* E/T	*Sagittaria teres*				×	"×"	
GRAMINEAE							
R	*Agrostis borealis* var. *borealis*	"×"	×	×			
?	*Ammophila champlainensis*			×			
R	*Aristida purpurascens*				×	O	O
E/T	*Aristida tuberculosa*		×		×		×
E/T	*Bouteloua curtipendula*						×
E/T	*Calamagrostis fernaldii*	"×"		×			
E/T	*Calamagrostis inexpansa* var. *brevior*			×			
* E/T	*Calamagrostis inexpansa* var. *novae-angliae*	×	×	×			
* E/T	*Calamagrostis lacustris*	×	×				
E/T	*Calamagrostis neglecta*	×	×	×			
E/T	*Calamagrostis pickeringii*	"×"	×		×		

	E/T	*Danthonia spicata* var. *pinetorum*	“×”	“×”	“×”			
*	E/T	*Deschampsia atropurpurea*	“×”	×	×			
	E/T	*Deschampsia caespitosa* var. *caespitosa*	0	×	0			0
	R	*Elymus arenarius* var. *villosus* *(=E. mollis)*	0	×		×		
	E/T	*Festuca ovina* var. *saximontana* *(=F. saximontana)*			×			
*	E/T	*Festuca prolifera*	“×”	×				
	E/T	*Hierochloe alpina*	“×”	×	×			
	E/T	*Muhlenbergia capillaris*				×		0
	E/T	*Oryzopsis canadensis*	0	×				
	E/T	*Panicum amarum*						×
	E/T	*Panicum auburne*				×		
	E/T	*Panicum boscii* var. *boscii*				×		0
	E/T	*Panicum boscii* var *molle*						“×”
	R	*Panicum commonsianum*				×		×
	E/T	*Panicum flexile*			×	0		×
	E/T	*Panicum gattingeri*				×		×
	R	*Panicum longifolium*		×		×	0	0
	E/T	*Panicum lucidum*				0		×
	E/T	*Panicum polyanthes*				×		×
	E/T	*Panicum roanokense*					“×”	×
	E/T	*Panicum scoparium*				×	0	
	E/T	*Panicum stipitatum*					0	×

Status	Taxon	ME	NH	VT	MA	RI	CT
R	*Panicum verrucosum*				0	0	×
E/T	*Panicum wrightianum*				×		
E/T	*Phleum alpinum*	×	×	1S?			
* E/T	*Poa alpigena*	"×"	×				
E/T	*Poa fernaldiana*	"×"	×	×			
R	*Poa glauca*	0	×	0			
R	*Puccinellia paupercula* var. *alaskana*	0	×		×	"×"	×
R	*Setaria geniculata*				×	"×"	0
R	*Spartina caespitosa*	"×"	×		0	"×"	
R	*Spartina cynosuroides*				×		0
E/T	*Sporobolus clandestinus*						×
E/T	*Sporobolus heterolepsis*				×		×
R	*Tripsacum dactyloides*				×	"×"	0
R	*Trisetum melicoides*	0	×	0			
* E/T	*Trisetum spicatum* var. *pilosiglume*	"×"	×	×			
CYPERACEAE							
E/T	*Carex adusta*	0	×				
R	*Carex alopecoidea*	×		0	×		×
* E/T	*Carex atratiformis*	"×"	×	×			
E/T	*Carex barrattii*						×
R	*Carex bigelowii*	"×"	×	×			

	E/T	*Carex bushii*	"X"		X	X		()
	E/T	*Carex capillaris* var. *capillaris*	"X"	X				
	E/T	*Carex capillaris* var. *major*	X					
*	E/T	*Carex capitata*		X				
	E/T	*Carex collinsii*			X		"X"	X
	E/T	*Carex crawei*	X					X
	E/T	*Carex davisii*			X	X		X
	R	*Carex flaccosperma* var. *glaucodea*		X		X		()
*	E/T	*Carex flava* var. *gaspensis*	"X"		X			
	R	*Carex formosa*			()	X		X
	E/T	*Carex garberi* var. *bifaria*	"X"	X				
	R	*Carex gracilescens*		X	X	()		()
	R	*Carex grayii*			()	X		()
	R	*Carex hitchcockiana*			()	X		()
*	E/T	*Carex katahdinensis*	X					
*	E/T	*Carex lenticularis* var. *albimontana*		X				
	E/T	*Carex livida* var. *grayana*	"X"		X	X		
	R	*Carex lupuliformis*			()			X
	E/T	*Carex media*	X					
	E/T	*Carex molesta*				X		X
	E/T	*Carex nigromarginata*						X
	R	*Carex oligocarpa*			X	X		X
*	E/T	*Carex oronensis*	X					
	E/T	*Carex polymorpha*	()	X		X	"X"	X

Status	Taxon	ME	NH	VT	MA	RI	CT
E/T	*Carex praticola*	×					
E/T	*Carex rariflora*	×					
* E/T	*Carex richardsonii*			×			
E/T	*Carex salina* var. *kattegatensis*	O			×		
E/T	*Carex saxatilis* var. *militaris*	×					
E/T	*Carex saxatilis* var. *rhomalea*	×					
E/T	*Carex schweinitzii*			O	×		×
R	*Carex scirpoidea*	O	×	O			
E/T	*Carex sterilis* (including *C. elachycarpa*)	"×"		×	×		×
E/T	*Carex striatula*				×		O
E/T	*Carex styloflexa*			×			O
E/T	*Carex tenuiflora*	O		×			
E/T	*Carex tetanica*				×		×
R	*Carex trichocarpa*			×	×		O
E/T	*Carex vaginata*	O		×			
E/T	*Carex walteriana* var. *brevis*				×		
R	*Carex weigandii*	O	×	×			
E/T	*Carex willdenowii*			×	×		×
E/T	*Carex woodii*		×		×		×
E/T	*Cyperus engelmanni*			×	×		
E/T	*Cyperus ferruginescens*			×	×		O

	R	*Cyperus houghtonii*	×	×	×	O		
	E/T	*Eleocharis ambigens*				×		
	R	*Eleocharis diandra*	O	×	×			×
	E/T	*Eleocharis equisetoides*				×	“×”	×
	R	*Eleocharis melanocarpa*				×	O	
	E/T	*Eleocharis microcarpa* var. *filiculmis*						×
	E/T	*Eleocharis nitida*		×	×			
	E/T	*Eleocharis ovata* var. *heuseri*	O	×				
	R	*Eleocharis pauciflora* var. *fernaldii*	O	×	×			
	E/T	*Eleocharis quadrangulata* var. *crassior*				×		×
	E/T	*Eleocharis tricostata*				×	“×”	
	R	*Fuirena pumila*				×	“×”	×
	R	*Hemicarpha micrantha*	×	×		O	O	×
	E/T	*Psilocarya nitens*				×		
	E/T	*Psilocarya scirpoides*				×	“×”	
	R	*Rhynchospora capillacea*	O	×	×			×
*	E/T	*Rhynchospora inundata*				×	“×”	
	E/T	*Rhynchospora torreyana*				×	“×”	
	E/T	*Scirpus ancistrochaetus*			×	×		
*	E/T	*Scirpus hallii*				×		
*	E/T	*Scirpus longii*	×			×		×
	R	*Scirpus pendulus* (=*S. lineatus*)	×	×	×	×		×
	E/T	*Scleria pauciflora*						×

Status	Taxon	ME	NH	VT	MA	RI	CT
R	*Scleria reticularis*				×	"×"	×
R	*Scleria triglomerata*				×		O
E/T	*Scleria verticillata*						×
ARACEAE							
R	*Arisaema dracontium*		?	×	×		×
E/T	*Orontium aquaticum*				×	×	×
LEMNACEAE							
R	*Wolffiella floridana*				"×"		
ERIOCAULACEAE							
R	*Eriocaulon parkeri*	×			×		×
PONTEDERIACEAE							
E/T	*Heteranthera reniformis*						×
JUNCACEAE							
E/T	*Juncus alpinus* var. *alpinus*	"×"					
E/T	*Juncus alpinus* var. *fuscescens*			×			
R	*Juncus alpinus* var. *rariflorus*	×		×			
E/T	*Juncus biflorus*				×		

E/T	*Juncus debilis*					"×"	×
E/T	*Juncus oronensis*	×					
* E/T	*Juncus stygius* var. *americanus*	×					
* E/T	*Luzula confusa*	×	×				
E/T	*Luzula pallescens*		×	×			
E/T	*Luzula spicata*	×	×	×			
LILIACEAE							
E/T	*Chamaelirium luteum*				×		()
E/T	*Melanthium hybridum*						×
E/T	*Smilax bona-nox*				×		
E/T	*Smilax tamnoides* var. *hispida*						×
E/T	*Streptopus* × *oreopolus* *(S. amplexifolius* var. *oreopolus)*	"×"	"×"				
E/T	*Zigadenus glaucus*			×			
HAEMODORACEAE							
R	*Lachnanthes caroliana* *(=L. tinctoria)*				×	×	×
IRIDACEAE							
E/T	*Iris hookeri*	×					
E/T	*Sisyrinchium arenicola*				×		

Status	Taxon	ME	NH	VT	MA	RI	CT
ORCHIDACEAE							
E/T	*Aplectrum hyemale*			×	×		×
R	*Arethusa bulbosa*	×	×	×	×	0	×
* E/T	*Calypso bulbosa*	×	×	×			
R	*Corallorhiza odontorhiza*	×		×	0	0	×
* E/T	*Cypripedium arietinum*	×	×	×	×		×
R	*Cypripedium calceolus* var. *parviflorum*	0	×	×	0	×	0
R	*Cypripedium calceolus* var. *pubescens*	0	×	×	0	×	0
R	*Cypripedium reginae*	0	×	×	×		×
E/T	*Goodyera oblongifolia*	×					
* E	*Isotria medeoloides*	×	×	×	×	×	×
E/T	*Isotria verticillata*	×	×	×	×	×	0
* E/T	*Listera auriculata*	×	×	×			
* E/T	*Listera australis*			×			
R	*Malaxis brachypoda* (=*M. monophyllos* var. *brachypoda)*	×	×	"×"	×		×
* E/T	*Orchis rotundifolia*	×		×			
R	*Orchis spectabilis*	×	×	×	0	0	0
E/T	*Platanthera ciliaris* (=*Habenaria ciliaris)*		×		×	×	×
E/T	*Platanthera cristata* (=*Habernaria cristata)*				×		

	R	*Platanthera flava* var. *herbiola* (=*Habenaria flava* var. *herbiola)*	×	×	×	×	×	0
*	E/T	*Platanthera leucophaea* (=*Habenaria leucophaea)*	×					
	E/T	*Spiranthes tuberosa* var. *grayii*				"×"	"×"	"×"
	E/T	*Spiranthes vernalis*		×		×	0	0
	E/T	*Tipularia discolor*				×		
	R	*Triphora trianthophora*	×	×	×	×		×
	SAURURACEAE							
	E/T	*Saururus cernuus*					×	"×"
	SALICACEAE							
	E/T	*Populus heterophylla*						×
*	E/T	*Salix* × *peasei*		×				
*	E/T	*Salix arctophila*	×					
*	E/T	*Salix argyrocarpa*	×	×				
	E/T	*Salix cordata* var. *abrasa*	0	×				
	E/T	*Salix cordata* var. *cordata*	"×"			"×"		
	E/T	*Salix glaucophylloides*	×					
*	E/T	*Salix herbacea*	"×"	×				
*	E/T	*Salix interior* var. *exterior*	×					
	E/T	*Salix planifolia*	"×"	×	"×"			

Status	Taxon	ME	NH	VT	MA	RI	CT
R	*Salix serissima*			"×"	×		×
R	*Salix uva-ursi*	×	×	×			
BETULACEAE							
R	*Betula caerulea-grandis*	×		×			
* E/T	*Betula glandulosa*	×	×	×			
* E/T	*Betula minor*	"×"	×				
R	*Betula pumila*	O			×		×
FAGACEAE							
R	*Quercus muehlenbergii*			×	×		O
ULMACEAE							
E/T	*Ulmus thomasi*			×			
URTICACEAE							
E/T	*Parietaria floridana*		×				
SANTALACEAE							
E/T	*Comandra richardsiana*			×			
R	*Geocaulon lividum*	×	×	×			

ARISTOLOCHIACEAE								
	R	*Aristolochia serpentaria*						×
POLYGONACEAE								
	E/T	*Oxyria digyna*		×				
	R	*Polygonum douglasii*	×	×	()			
	R	*Polygonum glaucum*				×	"×"	1R
	E/T	*Polygonum setaceum* var. *interjectum*				×	"×"	
*	E/T	*Polygonum viviparum*	×	×	×			
	E/T	*Rumex fenestratus*	()		×	()		
CHENOPODIACEAE								
	E/T	*Suaeda americana*	()			×		
	R	*Suaeda richii*	()			×		
AMARANTHACEAE								
	E/T	*Amaranthus pumilis*				"×"	"×"	
PORTULACACEAE								
	E/T	*Montia lamprosperma*	×					
CARYOPHYLLACEAE								
	E/T	*Minuartia caroliniana* (=*Arenaria caroliniana)*					×	

Status	Taxon	ME	NH	VT	MA	RI	CT
R	*Minuartia glabra* *(=Arenaria glabra)*	“×”	“×”			“×”	×
R	*Minuartia groenlandica* *(=Arenaria groenlandica)*	“×”	×	×			
* E/T	*Minuartia marcescens* *(=Arenaria marcescens)*			×			
* E/T	*Minuartia rubella* *(=Arenaria rubella)*	“×”		×			
E/T	*Moehringia macrophylla* *(=Arenaria macrophylla)*			×	×		×
* T	*Paronychia argyrocoma* var. *albimontana*	×	×		×		
R	*Sagina decumbens*			×	O		O
E/T	*Sagina nodosa* ssp. *borealis*	“×”					
E/T	*Silene acaulis* var. *exscapa*	“×”	×				
NYMPHAEACEAE							
* E/T	*Nymphaea tetragona*	×					
RANUNCULACEAE							
E/T	*Anemone multifida*	×		×			
* E/T	*Hydrastis canadensis*			×	“×”		×
E/T	*Ranunculus gmelini* var. *hookeri*	×					

*	E/T	*Ranunculus lapponicus*	×					
	E/T	*Ranunculus subrigidus*		×	0	×		×
	E/T	*Thalictrum confine*	×		0			
*	E/T	*Trollius laxus* ssp. *laxus*						×
MAGNOLIACEAE								
	E/T	*Magnolia virginiana*				×		
PAPAVERACEAE								
	R	*Corydalis aurea*		×	"×"			
	E/T	*Corydalis flavula*						×
CRUCIFERAE								
	E/T	*Armoracia aquatica*			×			
	E/T	*Barbarea orthoceras*	"×"	×				
*	E/T	*Braya humilis* var. *leiocarpa*			×			
*	E/T	*Cardamine bellidifolia*	×	×				
	E/T	*Cardamine douglassii*				×		×
	E/T	*Cardamine longii*	×					
	E/T	*Descurainia pinnata* var. *brachycarpa*		×	×	0		
	E/T	*Descurainia richardsonii*	×					
	R	*Draba arabisans*	×		0			
*	E/T	*Draba glabella* var. *glabella*			×			
*	E/T	*Draba glabella* var. *orthocarpa*			×			

Status	Taxon	ME	NH	VT	MA	RI	CT
* E/T	*Draba lanceolata*	×	×	×			
R	*Subularia aquatica* ssp. *americana*	×	0	×			
DROSERACEAE							
* E/T	*Drosera anglica*	“×”					
R	*Drosera filiformis*				×	×	×
* E/T	*Drosera linearis*	×					
PODOSTEMACEAE							
R	*Podostemum ceratophyllum*	×	“×”	×	×	×	×
CRASSULACEAE							
R	*Sedum rosea*	×		×			
R	*Tillaea aquatica*	“×”	×	×	0		×
SAXIFRAGACEAE							
R	*Ribes rotundifolium*				?		×
* E/T	*Saxifraga aizoides*			×			
* E/T	*Saxigraga aizoon* var. *neogaea*	×	×	×			
* E/T	*Saxifraga cernua*		×				
* E/T	*Saxifraga oppositifolia*			×			

*	E/T	*Saxifraga rivularis*		×				
*	E/T	*Saxifraga stellaris* var. *comosa*	×					
		HAMAMELIDACEAE						
	E/T	*Liquidambar styraciflua*						×
		ROSACEAE						
	E/T	*Agrimonia parviflora*						×
	E/T	*Amelanchier gaspensis*	×					
	R	*Amelanchier humilis*	×		O			
*	E/T	*Amelanchier nantucketensis*				×		
	R	*Amelanchier wiegandii* *(=A. interior)*	×					
*	E/T	*Geum peckii*		×				
*	E	*Potentilla robbinsiana*		×	1H			
*	E/T	*Prunus alleghaniensis*						×
*	E/T	*Prunus maritima* var. *gravesii* *(=P. gravesii)*						×
	R	*Rosa johannensis*	"×"		×			
	R	*Rubus chamaemorus*	×	×				
	E/T	*Rubus cuneifolius*		×				O
	E/T	*Sibbaldia procumbens*		×				
	R	*Spiraea latifolia* var. *septentrionalis*	"×"	×				

Status	Taxon	ME	NH	VT	MA	RI	CT
LEGUMINOSAE							
R	*Astragalus alpinus* var. *brunetianus*	×	×	×			
E/T	*Astragalus eucosmus*	×					
* E/T	*Astragalus robbinsii* var. *jesupi* (=*A. jesupi*)		×	×			
E/T	*Astragalus robbinsii* var. *minor* (=*A. blakei*)	×		×			
E/T	*Astragalus robbinsii* var. *robbinsii*			×			
E/T	*Cercis canadensis*						×
E/T	*Desmodium glabellum*						×
E/T	*Desmodium humifusum*						×
R	*Desmodium sessilifolium*				×	O	×
* E/T	*Hedysarum alpinum* var. *americanum*	×		×			
E/T	*Lespedeza repens*						×
* E/T	*Oxytropis campestris* var. *johannensis*	×					
E/T	*Phaseolus polystachios* var. *aquilonius*						×
LINACEAE							
E/T	*Linum intercursum*				×	"×"	×
E/T	*Linum sulcatum*			×	×		O

POLYGALACEAE							
R	*Polygala senega*	×		0	×		×
EUPHORBIACEAE							
E/T	*Crotonopsis elliptica*						×
CALLITRICHACEAE							
R	*Callitriche anceps*	0	×	×	0		
E/T	*Callitriche hermaphroditica*			×			
E/T	*Callitriche terrestris* (=*C. deflexa* var. *austini*)				×		0
LIMNANTHACEAE							
E/T	*Floerkea proserpinacoides*			×	×		×
ANACARDIACEAE							
R	*Rhus aromatica*			×			0
AQUIFOLIACEAE							
E/T	*Ilex montana* var. *mollis*				×		
ACERACEAE							
R	*Acer nigrum*		×	0	0		"×"

Status	Taxon	ME	NH	VT	MA	RI	CT
RHAMNACEAE							
E/T	*Ceanothus herbaceous* *(=C. ovatus)*			×	“×”		
GUTTIFERAE							
E/T	*Ascyrum hypericoides* var. *multicaule*				×		
R	*Hypericum adpressum*		×		×	×	×
CISTACEAE							
* E/T	*Helianthemum dumosum*				×	×	×
R	*Helianthemum propinquum*				0	“×”	×
VIOLACEAE							
* E/T	*Hybanthus concolor*						×
?	*Viola adunca* var. *minor*	×	0	0	×		
R	*Viola brittoniana*	×			0		×
E/T	*Viola hirsutula*						×
* E/T	*Viola labradorica*		×				
* E/T	*Viola novae-angliae*	“×”					
E/T	*Viola palustris*	“×”	×				
E/T	*Viola striata*		“×”				×

CACTACEAE							
R	*Opuntia compressa*				×		()
ELAEAGNACEAE							
E/T	*Shepherdia canadensis*	×		×			
LYTHRACEAE							
E/T	*Cuphea petiolata*				×		()
E/T	*Lythrum lineare*						×
R	*Rotala ramosior*				×	()	×
MELASTOMATACEAE							
E/T	*Rhexia mariana*				×		
ONAGRACEAE							
E/T	*Epilobium alpinum*	×	×				
E/T	*Epilobium anagallidifolium*	×					
R	*Epilobium ciliatum*	()	×				"×"
E/T	*Epilobium hornemanni*	()	×				
E/T	*Ludwigia polycarpa*				×		×
E/T	*Ludwigia sphaerocarpa* var. *macrocarpa*				×	()	×
E/T	*Ludwigia sphaerocarpa* var. *sphaerocarpa*					()	()

Status	Taxon	ME	NH	VT	MA	RI	CT
HALORAGACEAE							
R	*Myriophyllum pinnatum*				×	0	×
ARALIACEAE							
E/T	*Panax quinquefolius*	×	×	×	×	1H	×
UMBELLIFERAE							
E/T	*Angelica venenosa*				×		0
E/T	*Hydrocotyle verticillata*				×		
R	*Lilaeopsis chinensis*	×	×		0		0
R	*Osmorhiza chilensis*	0	×	×			
E/T	*Osmorhiza obtusa*			×			
E/T	*Taenidia integerrima*			×		"×"	×
E/T	*Zizia aptera*						×
PYROLACEAE							
E/T	*Pterospora andromedea*		×	×	1H		
R	*Pyrola asarifolia* var. *purpurea*	"×"	×	0	×		
ERICACEAE							
* E/T	*Arctostaphylos alpina*	×	×				

*	E/T	*Cassiope hypnoides*	×	×				
*	E/T	*Loiseleuria procumbens*	×	×				
	E/T	*Lyonia mariana*						×
*	E/T	*Phyllodoce caerulea*	×	×				
*	E/T	*Rhododendron lapponicum*	×	×				
*	E/T	*Vaccinium boreale*	"×"	×	"×"			
DIAPENSIACEAE								
*	E/T	*Diapensia lapponica*	×	×	×			
PRIMULACEAE								
	E/T	*Primula laurentiana*	×					
	E/T	*Primula mistassinica*	×		×			
EBENACEAE								
	E/T	*Diospyros virginiana*				×		×
GENTIANACEAE								
	E/T	*Gentiana amarella*	×		×			
	R	*Gentiana andrewsii*		×	0	0		0
	E/T	*Gentiana rubricaulis*	×		×			
	E/T	*Lomatogonium rotatum*	×					
	E/T	*Sabatia campanulata*				×		
	E/T	*Sabatia dodecandra*						×

Status	Taxon	ME	NH	VT	MA	RI	CT
* E/T	*Sabatia kennedyana*				×	×	
R	*Sabatia stellaris*				×	×	0
ASCLEPIADACEAE							
E/T	*Asclepias variegata*						×
E/T	*Asclepias viridiflora*						×
CONVOLVULACEAE							
E/T	*Cuscuta coryli*						×
POLEMONIACEAE							
E/T	*Polemonium van-bruntiae*			×			
HYDROPHYLIACEAE							
E/T	*Hydrophyllum canadense*			×	×		
BORAGINACEAE							
E/T	*Cynoglossum virginianum*						×
E/T	*Hackelia americana*	×	×	×			
R	*Mertensia maritima*	0			×		
R	*Onosmodium virginianum*				×	0	0

LABIATAE

	E/T	*Agastache nepetoides*			×			×
	R	*Agastache scrophulariaefolia* var. *mollis*			0	×		0
	R	*Agastache scrophulariaefolia* var. *scrophulariaefolia*			0	×		0
	R	*Blephilia ciliata*			0	×		0
	E/T	*Blephilia hirsuta* var. *glabrata*			×			
	E/T	*Blephilia hirsuta* var. *hirsuta*			0	×		×
	E/T	*Collinsonia canadensis* var. *punctata*						×
	R	*Isanthus brachiatus*			0	×		"×"
	E/T	*Pycnanthemum clinopodioides*				×		×
	E/T	*Pycnanthemum torrei*		×				×
	E/T	*Scutellaria integrifolia*				×		"×"
	E/T	*Scutellaria parvula* var. *leonardi*	"×"					"×"
	E/T	*Scutellaria parvula* var. *parvula*	"×"		"×"			

SCROPHULARIACEAE

*	E/T	*Agalinis acuta* *(=Gerardia acuta)*				×	×	×
*	E/T	*Agalinis neoscotia* *(=Gerardia neoscotia)*	"×"					
	E/T	*Aureolaria pedicularia* var. *intercedens*		×		"×"		
	R	*Castilleja coccinea*		×		0	×	0

Status	Taxon	ME	NH	VT	MA	RI	CT
E/T	*Castilleja septentrionalis*	×	×	×			
E/T	*Collinsia parviflora*			×			
E/T	*Euphrasia disjuncta*	×					
* E/T	*Euphrasia oakesii*	×	×				
R	*Mimulus alatus*				×		0
?	*Mimulus ringens* var. *colpophilus*	×		×			
* E	*Pedicularis furbishiae*	×					
R	*Pedicularis lanceolata*				×		0
* E/T	*Schwalbea americana*				×		×
E/T	*Veronica alpina* var. *unalaschcensis*	×	×				
E/T	*Veronica comosa*			0	×		
LENTIBULARIACEAE							
E/T	*Pinguicula vulgaris*		×	×			
R	*Utricularia biflora*				×	0	×
E/T	*Utricularia fibrosa*				×		×
E/T	*Utricularia subulata*				"×"		
ACANTHACEAE							
E/T	*Justicia americana*			×			
PLANTAGINACEAE							
E/T	*Littorella americana*	"×"		×			

RUBIACEAE								
	R	*Galium labradoricum*	()	×	×	×		×
*	E/T	*Houstonia caerulea* var. *faxonorum*		×				
	E/T	*Houstonia lanceolata*	×			×		
CAPRIFOLIACEAE								
	E/T	*Lonicera hirsuta*			×	×		
	E/T	*Triosteum angustifolium* var. *angustifolium*						"×"
	E/T	*Triosteum angustifolium* var. *eamesii*						×
	R	*Viburnum edule*	×	×	×			
	E/T	*Viburnum nudum*						×
	E/T	*Viburnum prunifolium*						×
VALERIANACEAE								
*	E/T	*Valeriana uliginosa*	×	"×"	×			
	E/T	*Valerianella radiata* var. *fernaldiana*						×
CAMPANULACEAE								
	E/T	*Lobelia siphilitica*	×			()		()
	E/T	*Lobelia spicata* var. *campanulata*	"×"	×				
COMPOSITAE								
*	E/T	*Achillea borealis*	×	×				
	?	*Antennaria petaloidea*						×

Status	Taxon	ME	NH	VT	MA	RI	CT
?	*Antennaria rupicola*	×					
E/T	*Antennaria virginica*			×			
E/T	*Arnica mollis*	×	×	×			
E/T	*Artemisia canadensis*	×		“×”			
E/T	*Aster concolor*				×	0	
E/T	*Aster foliaceus* var. *arcuans*		×				
R	*Aster foliaceus* var. *foliaceus*	×	0	×			
R	*Aster glomeratus*		0	×	“×”		×
R	*Aster infirmus*				×		0
R	*Aster johannensis* var. *villicaulis*	“×”	“×”	×	“×”		
R	*Aster junciformis*	0		×			
E/T	*Aster patens* var. *phlogifolius*				“×”	“×”	“×”
E/T	*Aster prenanthoides*				×		×
R	*Aster ptarmicoides*		×	0	×		×
E/T	*Aster sagittifolius*			×			
R	*Bidens eatonii*	0			×		×
E/T	*Bidens heterodoxa*						×
R	*Bidens hyperborea*	0			×		
E/T	*Cacalia suaveolens*						×
E/T	*Chrysopsis mariana*					×	
R	*Erigeron hyssopifolius*	×		×			
* E/T	*Eupatorium leucolepis* var. *novae-angliae*				×	×	
E/T	*Eupatorium rotundifolium*				×		“×”

	R	*Gnaphalium purpureum*	“×”			×	0	0
*	E/T	*Gnaphalium supinum*	×	×				
	E/T	*Gnaphalium sylvaticum*	0	0	×			
	E/T	*Hieracium robinsonii*	0	×				
	E/T	*Hieracium umbellatum*		×				
	E/T	*Polymnia canadensis*			×			×
*	E/T	*Prenanthes boottii*	×	×	×			
	E/T	*Prenanthes racemosa*	×		×?			
	R	*Prenanthes trifoliolata* var. *nana*	0	×				
	R	*Rudbeckia triloba*			×	0		0
	E/T	*Sclerolepis uniflora*		×		×	×	
*	E/T	*Solidago calcicola*	“×”	×	×?			
	R	*Solidago cutleri*	×	×	×			
	E/T	*Solidago erecta*				×		0
	E/T	*Solidago macrophylla* var. *thyrsoidea*	×	0	“×”			
	R	*Solidago rigida*				×	0	0
*	E/T	*Tanacetum huronense* var. *johannense*	×					

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FURTHER ADDITIONS TO SOME NOTES ON THE FLORA OF THE SOUTHERN STATES, PARTICULARLY ALABAMA AND MIDDLE TENNESSEE

ROBERT KRAL

Several more new or otherwise interesting records of vascular plants have been found through continuing field work in Alabama, Tennessee, and other southern states since my last entries in Rhodora (1973, 1976). These are as follows (families arranged in Engler & Prantl order):

Phalaris arundinacea L.

TENNESSEE. Robertson Co.: sandy openings in Red River bottoms by Tenn. 52, 4 mi. E Orlinda, 26 Jun. 1975, *Kral 56059;* Grundy Co.: coldwater marsh meadow, SE side Tracy City, forming large stands, 13 Jun. 1975, *Kral 55960.*

Two more records, this time from middle Tennessee to add to my earlier (1976) report of it from west Tennessee (Obion Co.). Sharp et al. (1960) list it as an uncultivated introduction from the north or west, where it definitely is native.

Carex austro-caroliniana Bailey

ALABAMA. Cleburne Co.: 4.8 mi. W Heflin turnoff by I-20; acidic ravine bluffs of schistaceous-micaceous rock, in deep shade, 27 Apr. 1979, *Kral 63396.*

An additional report for this rather rare southern Appalachian sedge previously reported for Jackson county (1973), and perhaps a southern-most record for the species.

Carex baltzellii Chapm.

GEORGIA. Early Co.: Kolomoki Mounds State Park; sandy loam of ravine slope in beech-maple-magnolia, 16 Apr. 1979, *Kral 63311.*

Reported in Small (1933) as from Gadsden County, Florida and SW Georgia. Thorne (1954), in his fine floristic study of southwestern Georgia, did not mention this species, thus it is cited here simply to verify presence of the plant in Georgia. Dr. McDaniel has found it in several localities in southeastern Alabama.

Carex buxbaumii Wahl.

TENNESSEE. Cumberland Co.: scattered, with deepset rhizomes, in peaty open bog due north of Crossville by I-40, 5 Jun. 1975, *Kral 55912A*.

This species of sect. *Atratae* reaches further south than do the other two eastern North American species of the section, being reported as rare and local in Kentucky, North Carolina, and Arkansas. This is a first report for Tennessee.

Carex hirtifolia Mackenzie

TENNESSEE. Coffee Co.: calcareous moist rocky woods by headwaters of Crumpton's Creek, just N of Rutledge Falls, 28 Apr. 1974, *Kral 52516*.

A first report for Tennessee of this member of the sect. *Triquetrae* Carey, which occurs in rich woods and meadows across southern Canada to Ontario, in the US from New England west to Minnesota and south from Maryland west to Missouri. Probably an extension southward from Kentucky.

Carex interior Bailey

TENNESSEE. Dickson Co.: tufts on shaley creekbank by US 70, 2.8 mi. W White Bluff, 13 May 1975, *Kral 55397*. Lawrence Co.: creek bottoms in low woods by Natchez Trace, SW Napier and 4.2 mi. N turnoff to Laurel Hill Lake, 18 May 1975, *Kral 55474*. Lewis Co.: 3.1 mi. SW Hampshire; shaley shaded streambank, 1 May 1970, *Kral 38862*.

This member of the sect. *Stellulatae* is distinguished from its nearest relative, *Carex Howei*, by a combination of broader leaf and nervelessness of the upper perigyne surface. It is reported by Fernald (1950) and Gleason (1952) as being in their manual range essentially northern, ranging southward only into Ind., Ill., W. Va., and Pa.; in the western mountains it ranges southward into Mexico. Not previously recorded for Tennessee.

Carex meadii Dewey

ALABAMA. Dallas Co.: remnant of blackland prairie by US 80, 2 mi. E Marion Junction, 20 Mar. 1976, *Kral 57421*. Sumter Co.: 4.5 mi. S of Boyd, pine flatwoods, open low area, 28 Apr. 1968, *S. McDaniel 10532;* 4 mi. S Boyd by Ala. 17 in sandy-peaty clearing by railroad through pine flatwoods, 20 May 1975, *Kral 55604*.

A first report for Alabama for this plant of prairie swales and meadows from N.J. to Mich. and Sask., s. to N.C., Ga., Ark., and

Tex. Difficult to distinguish from *C. tetanica* Schk., perhaps distinguishable on quantitative characters only.

Carex latebracteata Waterfall

ARKANSAS. Howard Co.: shaley soil under oak-hickory and in powerline right of way, by Ark. 4, 10.3 mi. E Wickes, 9 May 1979, *Kral 63491;* river bluffs, shale, 9.6 mi. E Wickes, 9 May 1979, *Kral 63502.* Polk Co.: abundant tufts on dryish sandy loams over novaculite, under oaks, by Ark. 375, 4 mi. NW end of paved road at Cossetot Road jct., 28 Apr. 1977, *Kral 59857.*

A first report of this sedge of wooded ridges and ravines over shale or novaculite and formerly thought confined to eastern Oklahoma. A strongly tufted plant with very whitened, broadened, leafy bracts and large, pale perigynes, whose closest relatives in sect. *Phyllostachyae* are far to the north and west.

Carex pedunculata Muhl.

ALABAMA. Winston Co.: abundant on sandy loam under pine-hardwood, below sandstone bluffs along west bank of Sipsey River, Sipsey Rec. Area, Bankhead National Forest, 9 Apr. 1978, *Kral 61418.*

The second known station in Alabama for this *Carex* of eastern southern Canada and the middle western U.S., which appears to range southward into Virginia and West Virginia and is now known also to occur locally in the Cumberlands of Tennessee (Grundy & Marion counties), also in northeastern Alabama (Kral, 1976) with this Winston county locality perhaps being its southernmost extension.

Carex socialis Mohlenbrock & Schwegman

ALABAMA. Colbert Co.: forming large clones by rhizome, Town Creek bottoms by Ala. 157, NW Moulton, 6 May 1978, *Kral 61685.*

TENNESSEE. Humphries Co.: ca. 2 mi. E Buffalo by I-40; wooded gravelly bottoms, 17 Apr. 1977, *Kral 59779.*

The above collections represent morphologies identical to that of the newly described *Carex* of the sect. *Bracteosae* once though endemic to southern Illinois. The plants are as Mohlenbrock & Schwegman (1969) describe, namely similar to the complex of species including *C. rosea,* which it most closely resembles, save for the habit of elongate-creeping rhizomes connecting clumps of culms with the total mass of plants forming large, dense stands.

Cyperus brevifolioides Thieret & Delahoussaye

TENNESSEE. Davidson Co.: silty clay loam of bank of Richland Creek by Belle Meade Country Club golf course, just W of Belle Meade Blvd., 8 Oct. 1977, *Kral 61103*.

A first report for Tennessee of this member of sect. *Kyllingia*, formerly treated as either *Kyllingia brevifolia* (Rottb.) Hassk. var. *leiolepis* Franch. et Sav. or as *Cyperus brevifolius* (Rottb.) Hassk. var. *leiolepis* (Franch. et Sav.) Koyama. As Thieret and Delahoussaye (1967) point out, it should be a species distinct from *C. brevifolius* in that it has a smooth scale keel, more stamens/floret. In the Davidson county locality the plants are very abundant, quite weedy in cleared areas along the stream and promises to be a rapid spreader in moist lawns. The species in the U.S. was known to range from southern New England through eastern Virginia with an inland station reported from Mitchell county in western North Carolina.

Psilocarya scirpoides Torr.

ALABAMA. Chilton Co.: ca. 1 mi. S Maplesville in sunny seep bog in longleaf pine hills, 24 Aug. 1978, *Kral 62558*.

This Bald-rush superficially resembles the much more common *P. nitens*, but differs in its persistent style surmounting a tubercle approximately as long as the akene body (in *P. nitens* the style does not persist, the tubercle is much shorter than the akene body!). Small's often too-inclusive range statements are exemplified here in that his cited (1933) range for the species includes Alabama, but this new find appears to be the first actual record. Godfrey (1979) indicates the previously known range to extend in the Coastal Plain from Mass. to N.C. and the Florida panhandle, with outliers in the Great Lakes Lowland.

Rhynchospora chalarocephala Fern. & Gale

TENNESSEE. Coffee Co.: 2.2 mi. E of Manchester off US 41; sandy clay of low place in oak barrens, 9 Aug. 1973, *Kral 51053*.

An extension of known range for this beakrush which is commonest in the lower terraces of the Atlantic and Gulf Coastal Plain.

Schoenus nigricans Beauv. ex R. & S.

FLORIDA. Gadsden Co.: limerock outcrop ledges (Marianna Limestone) at S side Chattahoochee, 8 Jun. 1976, *Kral 58219*.

Reported here more for the unusual location, considerably inland from recently reported coastal stations in northern Florida. This densely caespitose, dark-bracted sedge is wide-ranging in the tropics, often in brackish marshy sites in arid regions.

Scirpus erismanae Schuyler

ALABAMA. Houston Co.: sandy peaty edges of Indigo Pond, a limesink pond, SE Cottonwood, 10 Oct. 1973, *Kral 52348;* same locality 12 Oct. 1978, *Kral 62923.*

Dr. Schuyler, monographer of *Scirpus,* does not indicate (1969) Alabama records for this little sedge which he described from the karst country of peninsular and northwestern Florida, southwest Ga., and eastern S.C. The plants appear abundantly every now and then on sands and sandy peats of shores of limesink ponds and lakes.

Scirpus purshianus Fernald (*S. debilis* Pursh)

ALABAMA. Russell Co.: peaty drying margins of large pond at Seale, 11 July 1978, *Kral 62293.*

Previously added to the Alabama flora (1973) but only from the very north; this new locality is from well inside the Coastal Plain of Alabama, thus is a considerable extension of known range southward.

Tradescantia rosea Vent. var. **rosea** (*Tripogandra rosea* (Vent.) Woods.; *Cuthbertia rosea* (Vent.) Small).

ALABAMA. Russell Co.: oak-pine woodland, sandy loam, in light to full shade, above Bluff Creek, S of Ft. Mitchell; petals pink, 19 Jun. 1978, *Kral 62068.*

This distinctive, pale-pink-petalled, spiderwort was previously believed to occur in upland and lowland pine-hardwood formations of Piedmont and Coastal Plain from the Carolinas southward into Florida; it is a novelty for Alabama. It and the other variety (var. *graminea* (Small) Anders. & Woods.) are distinguished from other southeastern spiderworts by bracts being shorter than, rather than longer than, the cyme.

Lilium catesbaei Walt.

ALABAMA. Chilton Co.: ca. 1 mi. S Maplesville in hillside seep in longleaf pine, 24 Aug. 1978, *Kral 52550.*

Certainly not a first report for Alabama, the species being locally very abundant in wet pineland savanna and bogs in the lowermost counties. However, this is a most unusual find for so far inland in the State, and an indication of the close floristic affinity that the bogs of Autauga, Chilton, and Elmore counties have with those of the lower Coastal Plain in Alabama. These inland sites present a floristic situation somewhat comparable to the Fall Line floras of eastern Virginia that intrigued M. L. Fernald.

Hexastylis heterophylla (Ashe) Small

ALABAMA. Cleburne Co.: sandy loam under *Kalmia* along stream, Pine Glen, Talladega Nat. Forest, 24 Apr. 1978, *Kral 61628;* under *Kalmia,* sandy loam, in ravine, Talladega Nat. Forest just E of Coleman Lake and SE Pine Glen, 24 Apr. 1978, *Kral 61636;* sandy loam of acid moist ravine ca. 1 mi. NE Heflin off US 78, 24 Apr. 1978, *Kral 61639.* Winston Co.: hemlock forested ravine 4 mi. W Addison, 16 Apr. 1978, *Kral 61530;* hemlock ravines ca. 2 mi. E Addison, 16 Apr. 1978, *Kral 61522;* ravine in sandstone just S of Houston in Bankhead Nat. Forest, 6 May 1978, *Kral 61660.*

In the last revision of *Hexastylis* (1957) Dr. Blomquist indicated a range for *H. heterophylla* as Appalachian from Va. and W. Va. southward through western N.C. and eastern Tenn. into western S.C. and northeastern Ga. For some reason unknown, he made no mention of Dr. Small's statement of range (1933) to wit: "Piedmont to Appalachian Plateau, Ga. to Ala., W. Va., and S. Va." The Alabama populations I have observed fit well the Blomquist description, though showing the great variation in flower size and sepal lobe length that one comes to expect on viewing a "spread" of this species.

Hexastylis minus (Ashe) Blomq. (*Asarum virginicum* Ashe; *A. minus* Ashe)

VIRGINIA. Montgomery Co.: 2 mi. E Ellett; dry shale bluff, fls. pale purple with definite carina below calyx lobes, 16 Apr. 1960, *Kral 9819;* shaley White pine-Hemlock woods just below Ellett by rd. to Christiansburg, 17 Apr. 1975, *Kral 55120.*

Reported by Blomquist (1957) and Radford et al. (1968) as from bluffs and streambanks through the Piedmont of North Carolina and South Carolina, also foothills of the mountains in both states; not previously reported for Virginia. Distinctive in its combination of small flower, prominent flange midway up calyx tube, and longer calyx lobes (relative to *H. virginica* (L.) Small).

Portulaca pilosa L.

TENNESSEE. Wilson Co.: limestone glade and adjacent gravelly shoulders of I-40, ca. 1 mi. W of jct. US 70 at Lebanon; petals deep rose-pink, 6 Sept. 1978, *Kral 62823.*

This is probably a disjunct population of the var. *mundula* (I. M. Johnst.) Legrand, which is found in limestone glade situations and calcareous outcrops from western Mo. southward and westward. A first report of this taxon for Tennessee.

Rorippa sylvestris (L.) Besser (*Radicula sylvestris* (L.) Druce)

TENNESSEE. Davidson Co.: grounds of Geddes-Douglass Nursery, by Hobbs and Estes, south side of Nashville; cor. deep yellow, 18 Jul. 1974, *Kral 53672;* wet open areas along Richland Creek, Belle Meade Country Club, S side Nashville, forming showy yellow patches, 15 Jun. 1979, *Kral 63856.*

This Yellowcress has been reported for far western Tennessee by Stuckey (1972); it ranges mostly through the northern U.S. with occasional extensions southward into Kentucky, Miss., and the Virginias. In our area it appears to be abundant locally along streams that flow over limestones and is the showiest of our *Rorippa.*

Psoralea lupinellus Michx. (*Rhitidomene lupinellus* (Michx.) Rydb.)

ALABAMA. Autauga Co.: longleaf pine sandhills by US 82, 17 mi. NW Prattville, 3 Oct. 1979, *Kral 64402.*

An extension of known range into Alabama from Coastal Plain sandhills to the east from N.C. south to peninsular Fla. Very distinctive in its digitate-filiform leaflets.

Psoralea onobrychis Nutt.

ALABAMA. Dekalb. Co.: edge of open limestone woods by I-59, ca. 14 mi. SSW Ft. Payne just S of jct. Ala. 68, 25 May 1974, *Kral 52842* (in flower); 21 Jun. 1974, *Kral 53171* (in fruit).

A first report for Alabama for this Scurf-pea, previously known to occur in woods, thickets, and clearings, Ohio to Ill., south to western Va., Tenn., eastern Mo. The most robust, tallest, broadest-leaved, of our eastern species. The Alabama site is quite calcareous.

Sesbania drummondii (Rydb.) Cory (*Daubentonia drummondii* Rydb.)

ALABAMA. Mobile Co.: sandy dock area by truck bypass US 98-90 across river from Mobile, 20 Sept. 1975, *Kral 56620;* shrub, fls. yellow, of sandy Mobile docks area just N of N boundary Air Force Base, 15 Aug. 1973, *Kral 51354.*

This, if also the same as *Daubentonia longifolia* (Cav.) DC., is reported by several authors, the most recent being Correll &

Johnston (1970), as continuous along the Gulf coast from Fla. into Tex. and Mexico. Alabama records appear to be scarce however, and so these localities are added.

Croton elliottii Chapm.

ALABAMA. Escambia Co.: sandy field by US 31, 0.5 mi. E Canoe, 7 Oct. 1968, *Kral 33889*. Houston Co.: sandy fields and upper sandy beaches of Indigo Pond, SW of Cottonwood, 21 Aug. 1977, *Kral 60847*.

Long ago collected from Mobile county by Dr. Mohr, but not reported since. Neither had it been reported in recent years from stations known for it in southwestern Georgia. The plants were however in great abundance around most of the karst lakes and ponds in southwest Georgia and northwestern Florida in summer of 1977, a disastrously dry season for farmers of the area but which, through drying of the ponds and lakes, appeared to have created suitable areas of drying sandy peat. The species belongs to that complex of entire-leaved *Croton* containing *C. capitatus* and *C. monanthogynus*, but is distinguished by a combination of erect pistillate flowers, with the unequal sepals strongly hooded, and lineal leaves. While *C. elliottii* is listed as an endangered species I have observed it in populations of countless thousands not only around the pond margins but also in cultivated fields adjacent. Such intermittent abundance must mean that the seeds often have to lie dormant, sometimes for many years, until a correct combination of factors arises.

Pirequeta caroliniana (Walt.) Urban

ALABAMA. Houston Co.: sandy live oak woods bordering Indigo Pond, SE Cottonwood, 21 Aug. 1977, *Kral 60848b*.

A first record for Alabama for this rather showy Turneraceous annual, so frequent around the limesink lakes and ponds of southwestern Ga. and northwestern and peninsular Fla.

Ludwigia arcuata Walt. (*Lugwigiantha arcuata* (Walt.) Small)

ALABAMA. Geneva Co.: sandy peaty bank of pond by Ala. 53, 7.3 mi. NE Geneva, forming mats, 25 Jun. 1974, *Kral 53498*.

First noted for Alabama by Dr. Rebecca Bray in her thesis (unpublished) on the Flora of Dauphin Island, this species is known to range from Va. southward into Fla. Reported here in order to enter it for the State flora and also to add another county. It is definitely a rare plant in Alabama.

Oenothera missouriensis Sims.

TENNESSEE. Rutherford Co.: locally abundant, the corollas pale but bright yellow, on broken limestone of open glade by Factory Rd., ca. 3-4 mi. E of Murphreesboro, 13 Jun. 1975, *Kral 55994.*

This and one other locality of limestone barrens east of Murphreesboro are the only known stations east of the Mississippi River for this spectacularly large-flowered Evening primrose which centers in the sandy or calcareous barrens of Missouri, Arkansas, Texas, and Kansas. The locality has long been known to Dr. Hal DeSelm of the University of Tennessee and to the Faculty of Botany at Middle Tennessee State University. The species grows readily from seed and is a fine addition to a sunny garden.

Ammoselinum butleri (Wats.) Coult. & Rose

TENNESSEE. Davidson Co.: abundant on low cleared area of main picnic grounds by tributary of Harpeth River, Edwin Warner Park, S side Nashville; petals white, 20 Apr. 1975, *Kral 55204;* weed on Vanderbilt University Campus, by Garland Hall, 10 Apr. 1979, *Kral 63254.*

This little plant, in our area found mixed with *Galium pedemontanum, Alchemilla microcarpa,* and various lawngrasses, is here reported as new to the Tennessee flora. The species is frequent in Texas, Oklahoma, and Arkansas, where it occurs in low prairies and open wooded bottoms in prairies. Its spread eastward must be rapid in that there are now records for it from the Carolinas and eastern Tennessee.

Ammoselinum popei T. & G.

TENNESSEE. Davidson Co.: cedar glades by the road from Smith Springs Rd. to the Couchville Pike, 31 May 1942, *J. M. Shaver 2538.* Rutherford Co.: gravelly bulldozed limestone glade by US 71S, 3.5 mi. E Murphreesboro, 20 May 1974, *Kral 52830.*

The Rutherford Co. record is entered here to confirm the continued presence in middle Tennessee of this adventive from the western U.S. first found in the state by Dr. Shaver.

Lycopus amplectens Raf.

ALABAMA. Barbour Co.: ca. 10 mi. N Eufaula in cypress-gum pond by US 431, 11 Oct. 1978, *Kral 62877.*

This record is included so as to help clear up a small distributional riddle broached by Dr. Norlan Henderson in his revision of *Lycopus* (1962), in which he indicates a distribution of the species including the

Great Lakes Lowland, the Coastal Plain from New England south to northeastern Fla. and westward to southwestern Ga., and western Carolina. Dr. Henderson mentions that Rafinesque indicated that the plant grew in Alabama, which is in fact the type locality, but that he had seen no authentic specimen from Alabama. The species actually is abundant locally in southwestern Georgia in boggy areas along cypress-gum branches or in bogs around cypress ponds, its common herbaceous associates being such species as *Eriocaulon compressum, E. decangulare, Xyris fimbriata, Ludwigia sphaerocarpa, L. pilosa, Polygala cymosa, Sabatia bartramii, Lobelia boykinii, Rhexia aristosa,* etc. Shrubby *Hypericum,* particularly *H. fasciculatum* abound.

Agalinis oligophylla Pennell. (*Gerardia microphylla* (Gray) Small)

ALABAMA. Sumter Co.: chalk prairie remnant near Geiger, corolla lavender-rose, 19 Sept. 1975, *Kral 56583;* chalk outcrop prairie 5.8 mi. W Greenville, corolla pink, 7 Oct. 1976, *Kral 59390.*

These are records for Alabama of a species previously known to range eastward only to the Florida parishes of La. Both stems and leaves are minutely scabrid, the leaves mostly under 1 cm long, sharp-tipped, the pinkish corollas ca. 2 cm long, the ripe fruit ca. 5 mm long, more than 1/2 its length covered by an obscurely reticulate calyx tube, the calyx lobes very short.

Utricularia floridana Nash.

ALABAMA. Covington Co.: shallows of Blue Pond, Blue Springs Game Mgmt. Area, Conecuh Nat. Forest, SW of Andalusia; corolla pale yellow, 26 Jun. 1974, *Kral 53515.*

A first report for Alabama for this rather bulky Bladderwort previously known only from Fla. and Ga.

Ruellia brittoniana Leonard.

ALABAMA. Mobile Co.: old homelot, downtown Old Mobile, in preserved area near Government Street, 20 Sept. 1975, *Kral 56595.*

Seemingly an escape from cultivation, this is a record for Alabama of a showy species which is native in Florida, scattered (introduced?) elsewhere in the Gulf Southeastern U.S.

Viburnum lentago L.

ALABAMA. Montgomery Co.: shrub of low blackland woods by city bypass, south side Montgomery, 23 Jun. 1974, *Kral 53369;* tall shrubs on sandy clay of oak-pine woods by I-85, 1 mi. E jct. Perry Hill Rd., Montgomery, 24 Aug. 1978, *Kral 62591.*

Small (1933) indicates that this essentially northern species ranges south into Ga., presumably through the Appalachians, but several reports of this taxon from southern localities turn out, when specimens are examined, to be extremes of *V. prunifolium* or *V. rufidulum.* However, this Alabama material agrees very well with that I have collected from around tamarack bogs in southern Michigan and northern Indiana, and may actually represent a considerable extension of known range.

Lobelia boykinii T. & G.

ALABAMA. Barbour Co.: forming large clones by pale rhizomes in shallow Tupelo-*Hypericum* pond, ca. 8.5 mi. N Eufaula by US 431; corolla blue, 19 Jun. 1978, *Kral 62053.*

A first Alabama report for this (apparently rather rare and local) species of acidic pineland ponds, hitherto believed to occur only in S.C., Ga., and Fla. Associated species are those it is found with in southwestern Ga., namely, *Polygala cymosa, Rhynchospora perplexa, R. tracyi, Eriocaulon compressum,* and *Rhexia aristosa.*

Sphenoclea zeylanica Gaertn.

ALABAMA. Mobile Co.: moist sands by river across from Mobile in dock area off truck bypass US 90-98, 20 Sept. 1975, *Kral 56609.*

This wetlands weed, common in the Gulf Coastal Plain from Miss. westward and reported by Radford et al. (1968) as an adventive in Jasper Co., S. C., has not been reported previously for Alabama. Dr. Robert Haynes of the University of Alabama, in his recent field work on the aquatic plants of that state, has found several more localities, proof that the species is now well established.

Ambrosia bidentata Michx.

GEORGIA. Catoosa Co.: cherty gravelly sandy clay of bank by I-75, 1 mi. N turnoff to Ft. Oglethorpe, 29 Sept. 1976, *Kral 59136.*

Evidently rapidly spreading eastward in Tenn., now also in Ga., and already reported for N.C. Appears to be moving with good speed along highways and railroads from its once much more western area.

Ambrosia psilostachya DC.

ALABAMA. Green Co.: 1 mi. N of Pleasant Ridge, common on open chalk prairie, black belt region, 30 Sept. 1967, *S. McDaniel 9859a.* Marengo Co.: rhizomatous, on shallow soil over chalk by US 43, 0.5 mi. S Demopolis just S of railroad and 2 mi. S jct. US 80, *Kral 59392.* Sumter Co.: dry chalk barrens just N of Epes, 16 Sept. 1954, *R. M. Harper 4312* (not identified to species by Harper!); blackland prairie patch by rd. between Gainesville and Ala. 17, 20 May 1975 (sterile), *Kral 55620;* prairie remnant near Geiger, 19 Sept. 1975, *Kral 56582;* chalk barren prairie between Gainesville and Geiger on Ala. 116, 19 Sept. 1975, *Kral 56579.*

This perennial, reported as long ago as 1901 by Dr. Mohr for Alabama (from the Prattville area), is entered here simply to verify its continued presence and spread as a weed. It appears to have become an abundant plant in some parts of the Black Belt. Outliers, as for example from the longleaf pine sandhills of Autagua Co. to the east, show tendencies toward another rhizomatous perennial, *A. rugelii* Rydb. Further study of these will be required before a true treatment of the genus for Alabama is ready.

Aster commixtus (Nees) Kuntze. (*A. mirabilis* T. & G.)

ALABAMA. Lee Co.: acid sandy loam of bouldery slopes and ravines along Hallawakee Creek ca. 6 mi. ENE Opelika in shade of oak-pine-*Kalmia;* rays pale blue, *Kral 62331, 62389, 62523* (last number at full anthesis, collected 20 Aug. 1978).

This squarrose-bracted member of the sect. *Macrophylli* has been reported by Small (1933) as from "dry woods, Appalachian provinces, Ga. and Ala." Subsequently combined with this taxon is *A. mirabilis* T. & G., a blunter-bracted entity from Piedmont areas of N.C., S.C., and Ga. The slender bract tips of the Lee County population relate it more to the type material, another indication of the very Appalachian character of the ravine flora of Piedmont Alabama. This species is of very rare occurrence in the state and probably should be considered endangered or threatened.

Aster phyllolepis T. & G.

ALABAMA. Sumter Co.: blackland prairie patch by hwy., 5.8 mi. W Greenville, 7 Oct. 1976, *Kral 59389;* chalk barren between Gainesville and Geiger by Ala. 116, 19 Sept. 1975, *Kral 56578.*

FLORIDA. Gadsden Co.: calcareous open rocky outcrop at south side Chattahoochee; rays deep purple-blue, 5 Oct. 1976, *Kral 59318.*

This spindly, tall *Aster* is in most ways similar to *A. sericius* Vent., differing mainly in its broader, less-hairy, more strongly ciliate phyllaries, its generally sparser but harsher pubescence. Previously, *A. phyllolepis* has been known from dryish open woods or from prairies west of the Mississippi River in Louisiana and Texas. In the Florida locality it is associated with *Schoenus nigricans,* a strange companion which in that state is normally found near the coast.

Cacalia suaveolens L. (*Synosma suaveolens* (L.) Britt.)

FLORIDA. Levy Co.: 1.9 mi. E Gulf Hammock and just E of Wekiva Run, by Fla. 326; low hammock with loblolly pine-*Sabal,* 16 Apr. 1979 (rosettes), *Kral 63300;* 5 Oct. 1979 (at anthesis), *Kral 64504.*

This find came as quite a suprise. In preparation of a manuscript on Florida *Cacalia* (1958) Dr. Godfrey and I borrowed all the Florida material on deposit at GH, NY, US, DUKE, FLAS, and FSU. In that *C. suaveolens* was indeed reported for western Florida by Chapman (1897) and subsequently for that state by Fernald (1950) and Cronquist (1952), we felt that some authentic material of it would show up. However, no specimens from Florida were located in those loans; we decided to omit the species from our synopsis with the reservation that something had to provide a basis for Chapman's comments and that suitable habitat could exist in "western" Florida. The plant is pretty local even in interior provinces in the southeast; there are no Georgia records at GA and none for it in Alabama herbaria. Thus perhaps the reader will share to some extent my amazement at seeing this plant of cool, alluvial woodlands in hundreds in the shade of *Sabal palmetto* in a peninsular Florida hammock.

Doellingeria reticulata (Pursh) Greene. (*Aster reticulatus* Pursh)

ALABAMA. Geneva Co.: ca. 5 mi. S Samson; edge of hillside bog in longleaf pine, 19 Jun. 1978, *Kral 62084.*

Here reported as new to Alabama, this species, common in low pinelands and savannas of the Coastal Plain from southern S.C. southward into southern Fla., becomes increasingly scarce in the Gulf Coastal Plain west of Apalachicola in Fla. Its strongly caespitose habit, broadish, entire, thickish leaves, and whitish to lavender liguled heads arranged on corymbs make it a striking and distinctive species. Unlike others of its genus, and unlike most *Aster,* this flowers in spring (with summer and fall flowering sometimes resulting from disturbance, particularly fire!).

Gnaphalium helleri Britt. (*G. obtusifolium* L. var. *helleri* (Britt.) Blake)

TENNESSEE. Polk Co.: sandy oak-hickory-pine woodland at north side of Benton, 3 Oct. 1978, *Kral 62800.*

Using the treatment of this species done by Dr. Mahler (1975), I come up with the var. *helleri.* His map shows the northeastern var.

micradenium (Weatherb.) Mahler as extending southward from eastern Ky. through eastern Tenn. into northern Ga., but indicates no localities for the var. *helleri* in that area. In the field this plant from a distance resembles *G. obtusifolium* but differs in its visibly glandular indumentum as well as in a very pungent, not altogether pleasant, odor. Var. *helleri* is locally abundant, primarily in the Coastal Plain, from N.J. south through Ga., west to La., Ark., and e. Tex.

Heterotheca trichophylla (Nutt.) Shinners. (*Chrysopsis trichophylla* Nutt.)

NORTH CAROLINA. Bladen Co.: Sandridge in pineland near Kelley, 19 Sept. 1977, *Kral 60988.*

This Golden-aster was known to range on sandy soils in the Coastal Plain from eastern S.C. into peninsular Fla. and west through the Gulf Coastal Plain into Miss. It was not reported for N.C. in Radford et al. (1968).

Rudbeckia triloba L. var. **pinnatiloba** (T. & G.) Beadle (*R. pinnatiloba* T. & G.)

ALABAMA. Bibb Co.: limestone woods and sunny calcareous roadbanks, just NE Pratt's Ferry, 18 Jul. 1979, *Kral 64002;* ca. 1 mi. NE Pratt's Ferry in rocky limestone woods, same date, *Kral 64008.*

This shaggy-stemmed, pinnate-leaved var. of *R. triloba* has been reported previously only from calcareous sites in northeastern Florida and western North Carolina.

Verbesina walteri Shinners. (*Ridan paniculata* (Walt.) Small)

NORTH CAROLINA. Polk Co.: moist areas, light shade of hardwoods, west face of Tryon Mountain, el. ca. 2000′, 22 Sept. 1977, *Kral 61079.*

This rather rare Crown-beard, scattered in the Atlantic and Gulf Coastal Plain from S.C. south to Fla., west into Ala. is not reported for N.C. by Radford et al. (1968).

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MORE ON PINUS BANKSIANA IN NEW YORK

EDWARD W. LITTLEFIELD

The recent article on the distribution of *Pinus Banksiana* (Baldwin, 1979) requires further comment with respect to artificial forestation with the species in New York. During the preparation of the article I collaborated with Dr. Baldwin in furnishing such information as I had in publications, notes, and personal recollections with respect to the distribution of Jack Pine in New York. I find that I failed to draw his attention adequately to information in my article "Jack Pine: poor relation or pioneer" (Littlefield, 1960) which included data on the program for planting Jack Pine. Since a knowledge of the planting of Jack Pine in New York is essential to an overview of its southeastern distribution, Dr. Baldwin has suggested that I present this *addendum* to his article.

From the early 1930's until 1957, when the production of the species was discontinued, substantial numbers of Jack Pine seedlings were shipped from the state nurseries for the planting of public and private lands within the state. A majority of these were destined to be planted on submarginal agricultural lands lying on the post-glacial sands along the northern and western fringes of the Adirondacks. The larger plantings were made on state and county lands acquired for reforestation, but numerous smaller plantings were made on farms, often to provide windbreaks and to stabilize blow-sand. Many of these must, by now, have become prominent features of the landscape and having exhibited the well-known proclivity of this species for regeneration — must present the appearance of natural stands. To locate all these will be a challenge to future investigators. In the meantime, it is well that those botanical explorers who penetrate the region should be forewarned that *Pinus Banksiana* may turn up at unexpected man-made locations, far removed from previously recorded stations. Otherwise they may fall into the same trap as did Harshberger on Nantucket Island!

Here, then, we have a striking illustration of how the "domestication" of a tree species near the limits of its range may, in time, inundate and confuse the pattern of its natural distribution. For this reason, alone, it is fortunate that Dr. Baldwin has published his article while the outlines of the original distribution of *Pinus Banksiana* in New York are still discernable.

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265 SUNRISE TERRACE
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NEW ENGLAND NOTES

SOME NOTES REGARDING POLLINATION IN A NEW HAMPSHIRE POPULATION OF *PODOSTEMUM CERATOPHYLLUM* MICHX. (PODOSTEMACEAE)

C. Thomas Philbrick

While working in the Hodgdon Herbarium, University of New Hampshire, I came across several specimens of *Podostemum ceratophyllum* Michx. (Riverweed or Threadfoot) which were collected in 1973 by the late Dr. Albion Hodgdon. Riverweed is a unique aquatic dicot found growing attached to rocks in rapidly moving water. In fact the entire family (Podostemaceae), primarily a tropical group, is ecologically restricted to rocks in the rapids of fast moving rivers and streams.

Noticing that these specimens had several flower buds but no open flowers I decided to visit the site at Packers Falls on the Lamprey River, Durham, New Hampshire, where Dr. Hodgdon had collected the plant, in hopes of finding flowering material. During my initial visit in early June I found the plants to be growing profusely, covering many rocks throughout the rapids. This first visit proved to be too early to obtain flowering material. Late in June I again visited the location and was delighted to find plants with small inconspicuous flowers in full bloom. Due to the lack of perianth parts the flowers are far from showy, but they proved to be very interesting with regard to their possible mode of pollination.

In tropical Podostemaceae, flowering occurs during the dry season after the water level in the river has dropped (Royen, 1951; Went, 1926; Accorsi, 1950; Willis, 1902). At this time the flowers open and are accessible for pollination. *Podostemum ceratophyllum* follows the trend of flowering when the water level subsides.

Anemophily and cleistogamy have both been reported for different species in this genus (Willis, 1902) and entomophily is common in the family (Went, 1926; Lawrence, 1951). The actual mode of pollination in *Podostemum ceratophyllum* is unclear, however. Hammond (1937) states that "since the flowers are not noticeably fragrant, and are somewhat inconspicuous, it seems likely that they are either anemophilous or autogamous". My observations during the summer of 1980 shed some doubt on both pollination mechanisms suggested by Hammond.

It seems unlikely that anemophily could be successful when, at the time of anthesis, the flowers are no more than several centimeters above the water's surface, therefore being continually splashed and frequently inundated. Also, if anemophily (or even hydrophily) were taking place a much greater supply of pollen would be required to account for the large amount of waste involved in such a random pollination mechanism. In *Podostemum ceratophyllum* there are only two or three (occasionally four) anthers per flower. Relatively few flowers are open at any one time during the flowering period, further limiting a timely pollen supply. The flowers are not extrorsely exserted and lack feathery stigmas, features usually associated with anemophily.

Due to the lack of perianth, and no apparent nectaries, insect pollination seems unlikely. However, the dense mats of Riverweed are often inhabited by many types of aquatic insect larvae. Though I have not seen any of these insects visiting the flowers, more detailed observations and field experiments are required before entomophily can be completely ruled out.

Another problem regarding reproduction in this plant arose after I had sectioned numerous fruits, of all developmental stages, in the hopes of finding embryos. During this sectioning I was surprised to discover a complete lack of embryos. I also noticed a complete lack of embryosac development. These observations make pollination appear insignificant in this population. Hammond (1936) noted that *Podostemum ceratophyllum* has a great capacity for regeneration of vegetative organs after fragmentation. This vegetative growth most likely accounts for the majority of reproduction in this population. I have also sectioned seeds from other New England populations and have found embryos. From this, it appears that sexual reproduction is being inhibited in the Durham, New Hampshire location. Whether or not this inhibition is common in this species will be investigated during continued field work.

These observations illustrate the lack of understanding which exists concerning the reproductive biology of this interesting plant. Additional field observations throughout the range of the species will hopefully help to clarify some of these problems.

Riverweed is often overlooked because of its inconspicuous nature and the often inaccessible habitat in which it grows. Through information from herbarium material I have become aware of several locations of this plant throughout New England and elsewhere. If anyone has any information regarding *Podostemum ceratophyllum*, or knows of any populations, I would be most pleased to hear of them.

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THE REDISCOVERY OF JUNCUS STYGIUS IN MAINE

C. BARRE HELLQUIST

Juncus stygius L. var. *americanus* Buchenau is a northern bog rush found throughout Canada and rarely into northern United States from Maine to Minnesota. This rush is on the rare and endangered lists of Maine (Eastman, 1978), New York (Mitchell et al. 1980) and Michigan (Wagner et al., 1977). A total of five locations have been reported for this species from Minnesota (Wheeler & Glaser, 1979). Three historical records are known from Maine: two from Fort Kent and one from Crystal Bog, Crystal. The Fort Kent populations were last reported in 1908. The Crystal Bog population was discovered in

1907 by M. L. Fernald. Tyler and Gawler (1980) indicated that this rush had not been found recently.

During August 1979, while doing field work with Harry Tyler, Jr. and Kathy Kehoe on the wetland areas in Aroostook County, Garrett Crow of the University of New Hampshire and I were taken to the bog. Accompanying us were Candy McKellar and Sally Rooney, of the Nature Conservancy's Crystal Bog Stewardship Committee, who have been conducting botanical investigations of the bog. They stated at that time that *Juncus stygius* was the only plant not rediscovered in the bog. Upon entering the bog I spotted several plants and then found it to be common. The site was the large open portion of the bog west of the *Thuja* stand. Here *J. stygius* was found growing with *Rhynchospora alba* (L.) Vahl., with which it might be confused. This species can easily be overlooked and may occur more frequently in other bogs of Aroostook County. Specimens have been deposited in the herbaria of Boston State College, The University of Maine, and the New England Botanical Club.

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FIELD TRIPS

Following the May meeting, which will be held at Yale University, there will be a Saturday trip held in conjunction with the Connecticut Botanical Club to see the flora and vegetation of the New Haven, Connecticut, area.

The NEBC is sponsoring a "major" field trip to the towns of Lewis, Averill, and Avery's Gore in northern Essex County, Vermont, on the second weekend in July. The area is virtually unknown and very much under-represented in most herbaria. We expect to be collecting from wetlands, dry cliffs, and a variety of habitats between these extremes in the effort to improve our knowledge of the flora and to increase herbarium representation. Local accomodations are being arranged. Please write or call Dr. David Barrington, Pringle Herbarium, University of Vermont, Burlington, Vermont 05405 (Area code 802) 656–3221.

On Wednesday, August 12, Dr. George Newman will lead a tour of the Alpine Gardens and Great Gulf areas of Mt. Washington, N.H. Please write or telephone well in advance to allow planning:

Dr. George Newman
60 Carriage Lane
Bedford, NH 03102
(603) 472–3416

RHODORA **April 1981** **Vol. 83, No. 834**

CONTENTS

A list of the Dictyledonae of Belize
John D. Dwyer and *David L. Spellman* 161

The pollen morphology of the native New England species of the genus Acer (Aceraceae)
C. Thomas Philbrick and *A. Linn Bogle* 237

Rare and endangered vascular plant species in New England
Garrett E. Crow, William D. Countryman, George L. Church, Leslie M. Eastman, C. Barre Hellquist, Leslie L. Mehrhoff, and *Irene M. Storks* 259

Further additions to some notes on the flora of the southern states, particularly Alabama and middle Tennessee
Robert Kral 301

More on Pinus Banksiana in New York
Edward W. Littlefield 317

NEW ENGLAND NOTES:

Some notes regarding pollination in a New Hampshire population of Podostemum ceratophyllum Michx. (Podostemaceae)
C. Thomas Philbrick 319

The rediscovery of Juncus stygius in Maine
C. Barre Hellquist 321

Field Trip Announcement . . . . Inside back cover

Rhodora

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Cover illustration

Caltha palustris L., known to Thoreau as "Cowslip" and commonly called Marsh Marigold, is a low perennial herb which provides a bright accent to wet woods and meadows, swamps, bogs, and other wet places across the northern United States and Canada and south along the Appalachians to the Carolinas and Tennessee.

Original artwork by Carol Ann Kearns

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A REVISION OF THE GOLDENASTER GENUS *CHRYSOPSIS* (NUTT.) ELL. NOM. CONS. (COMPOSITAE-ASTEREAE)

JOHN C. SEMPLE

The genus *Chrysopsis* (Nutt.) Ell. is a yellow rayed member of the Tribe Astereae of the Family Compositae with $x = 5$. It has never before been monographed with the limits recognized here. Excluded from the genus are all the grass-leaf goldenasters (*Pityopsis* Nutt.), the prairie goldenasters (*Heterotheca* Cass. sect. *Phyllotheca* (Nutt.) Harms), and the two species of sect. *Ammodia* (Nutt.) Harms of *Heterotheca,* all of which have been included in *Chrysopsis* by some authors. A list of all the taxa of the three goldenaster genera was given in Semple, Blok, and Heiman (1980). The affinities of the genus are with the lower chromosomal base number genera of the tribe. It is most closely related to *Bradburia*, less so to *Xanthisma* and *Croptilon,* and more distantly to *Macheranthera* sensu lato. This group of genera with $x = 5$ or $x = 4$ includes annuals, monocarpic perennials (usually biennials), and short-lived perennials. All have dentate-serrate to pinnatifid basal rosette leaves. All have one acrocentric satellite chromosome with the nucleolar organizer region that divides the short arm into subequal portions. In this group are included species with a double pappus whorl crowning the fruit and species with only one pappus whorl on the fruit. Most are endemic to the southeastern United States in the broad sense.

Chrysopsis as treated here consists of 10 species native to the southeastern United States, particularly Florida (Fig. 1). Only three derived species occur elsewhere in the United States; *C. pilosa* on the Ozark Plateau and surrounding areas; *C. mariana* on Long Island, N.Y., southward to Florida and westward to Ohio and

Texas; and members of the *C. gossypina* complex on the coastal plain from Virginia to Louisiana.

HISTORICAL REVIEW OF THE GENERIC NAME AND LIMITS

The name *Chrysopsis* first appeared in the literature in 1818 in T. Nuttall's *The Genera of North American Plants* as a sectional name under the genus *Inula* L. Elliott (1824) subsequently raised the name to generic status, *Chrysopsis* (Nutt.) Ell., which has been conserved over the earlier name *Diplogon* Raf. a *nomen rejeciendum* (International Code of Botanical Nomenclature, 1972). In more recent times the generic status was questioned by Shinners (1951), who merged *Chrysopsis* into *Heterotheca* Cass. Most recently Semple (1977) proposed that part of Elliott's genus be recognized at the generic level and part be transferred to *Heterotheca*. Thus considerable confusion has developed over the proper generic name to place in front of the type species of the *Chrysopsis* group of taxa. Linnaeus (1753) described the type species as *Inula mariana* L. The combination *Chrysopsis mariana* (L.) Ell. was proposed in 1824. The combination *Heterotheca mariana* (L). Shinners was made in 1951. Elliott's combination is considered proper and is used in this revision.

The concept of the genus or section *Chrysopsis* has varied greatly during the past century and a half. Nuttall (1818) included in his *Inula* sect. *Chrysopsis* the species native to North America having double pappus and naked anther bases. In this assemblage were: 1) species of *Chrysopsis* as defined here; 2) species of the grass-leaf goldenaster genus *Pityopsis* Nutt., e.g., *P. graminifolia* (Michx.) Nutt.; 3) species of *Heterotheca* sect. *Phyllotheca* (Nutt.) Harms, e.g. *H. villosa* (Pursh) Shinners; 4) a member of *Heterotheca* sect. *Heterotheca, H. subaxillaris* (Lam.) Britton & Rusby (listed as *Inula scabra* Pursh); and 5) several species of *Aster* without yellow ray florets, e.g., *A. linariifolius L.*

Elliott (1824) removed the species of Astereae from Nuttall's *Inula* of the Inuleae. He emphasized the yellow ray floret color in his genus *Chrysopsis* by excluding *A. linariifolius,* by retaining the heterocarpic *H. subaxillaris* as *Chrysopsis scabra* (Pursh) Ell., and by including *Croptilon divaricatum* (Nutt.) Raf as *Chrysopsis divaricata* (Nutt.) Ell. This last species is frequently treated as *Haplopappus* (sect. *Isopappus*) *divaricatus* (Nutt.) Gray. Otherwise Elliott included in *Chrysopsis* all that Nuttall had.

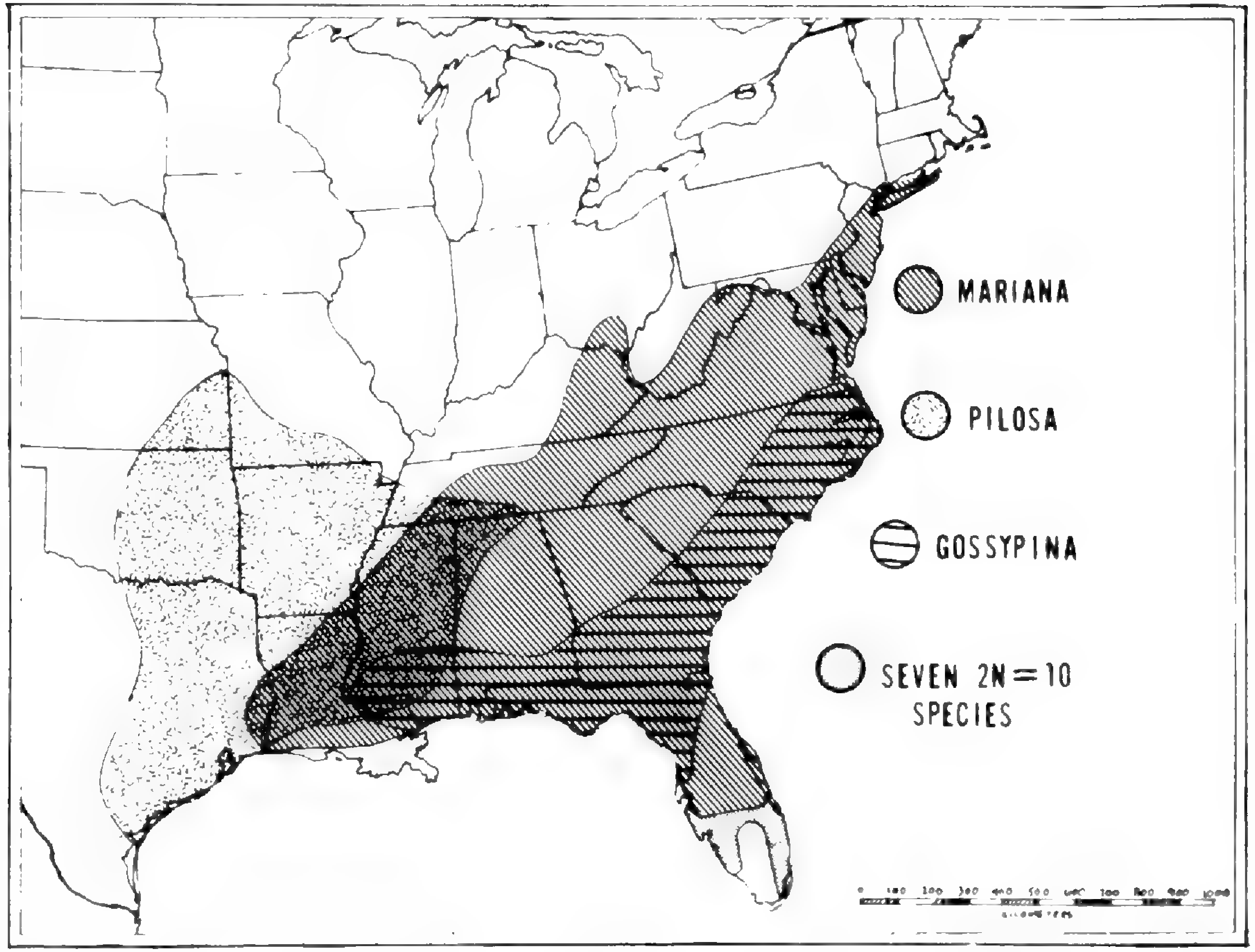

Figure 1. **The distribution of species groups in Chrysopsis.** Superimposed on a state outline map of the eastern United States are the ranges of the four groups of taxa. *Chrysopsis mariana* and *C. pilosa* are $x = 4$ taxa and have specialized morphologies. The *gossypina* complex is of allopolyploid origin and has $x = 9$. All the $x = 5$ diploid species are endemic to Florida.

Most botanists have accepted Elliott's concept of *Chrysopsis* with only a few alterations (Fig. 2). DeCandolle (1836) described several new taxa that properly belong in *Heterotheca* sect. *Phyllotheca,* but were included in *Chrysopsis.* Torrey and Gray (1842) described additional new taxa belonging to sect. *Phyllotheca* as well. Nuttall (1841) treated the grass-leaf taxa as a separate genus *Pityopsis,* thus reducing the limits of *Chrysopsis.* The number of species described and placed in *Chrysopsis,* but belonging in either *Heterotheca* or *Pityopsis* steadily increased through the latter half of the eighteen hundreds. By the turn of the century the number of species generally included in *Chrysopsis* was sufficiently large that it had become difficult for any one person to carefully examine all the species in detail.

The treatments of Bentham and Hooker (1876) and Gray (1884) have been followed by many tradition-minded botanists of the twentieth century, e.g. Cronquist (1977, 1980). A broadly delimited genus *Chrysopsis* was accepted by Keck (1960), Steyermark (1963), Barkley (1968), Seymour (1969), and Boivin (1972) in their floristic

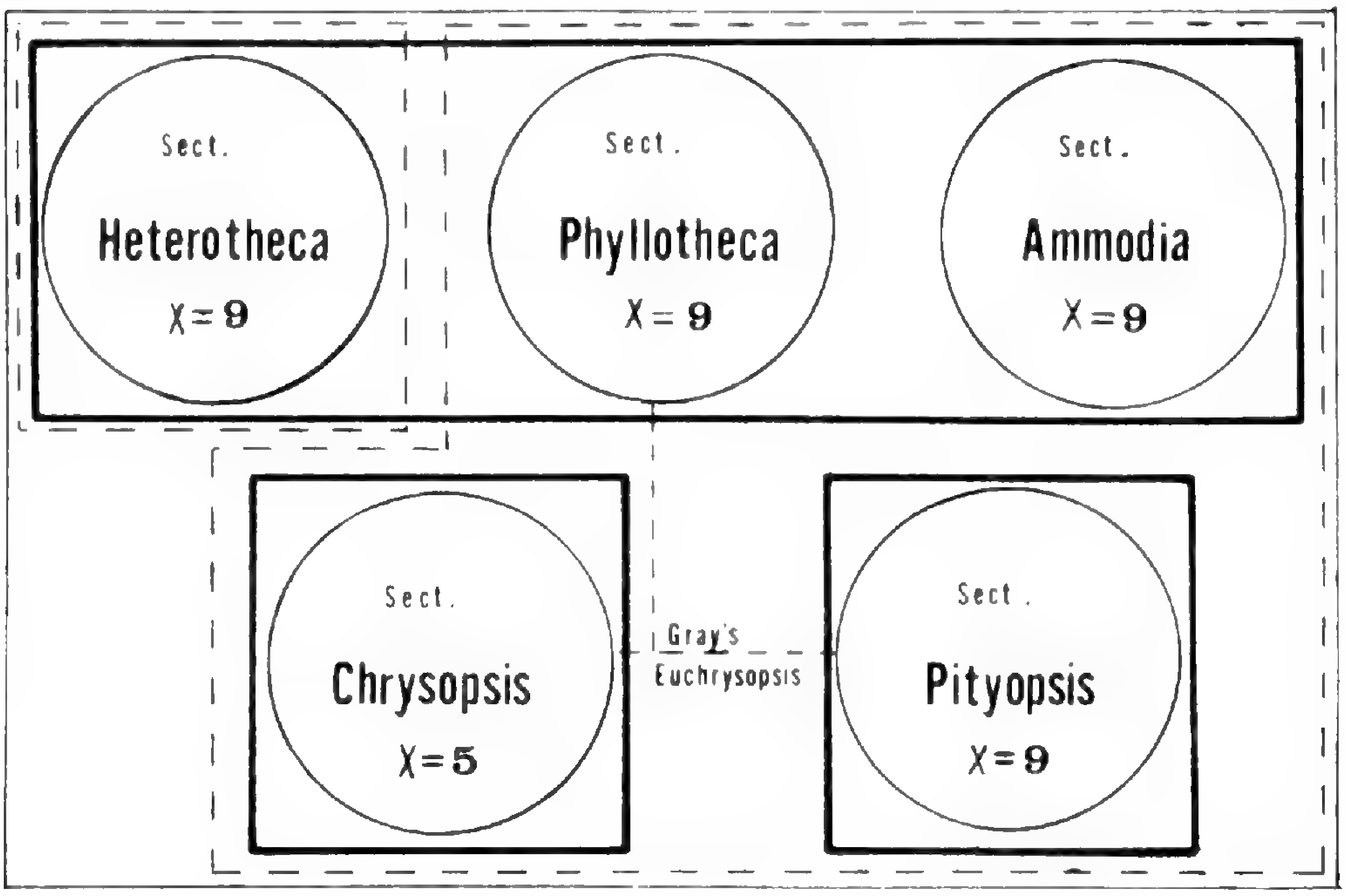

Figure 2. **Generic placement of the five sections of goldenasters.** Three genera were recognized by Semple, Blok, and Heiman (1980)—thick lines. Elliott (1824) and Gray (1884) and others recognized a large genus *Chrysopsis* and a small genus *Heterotheca*—broken thin lines. Gray included both sect. *Pityopsis* and sect. *Ammodia* in his large sect. *Euchrysopsis.* Shinners (1951), Harms (1974) and others placed all sections into one genus *Heterotheca*—thin line.

treatments of different regions of North America. Small had recognized *Pityopsis* at the generic level in 1903, but in 1933 he merged it with *Chrysopsis,* abandoning Nuttall for Gray.

Other twentieth century botanists have taken a different view of the status and limits of *Chrysopsis.* When Shinners (1951) merged *Chrysopsis* into *Heterotheca* he did so on morphological grounds. He noted that the lack of a pappus on the ray floret fruits of *Heterotheca* was not absolute in separating the two genera. Some individuals of the usually heterocarpic *H. chrysopsides* DC. occasionally produced ray floret fruit with a bristly pappus. The merger was substantiated on cytological evidence, or so it appeared, by Harms (1965). Shinner's concept of a single goldenaster genus *Heterotheca* was adopted in regional floras by Radford et al. (1968), Correll and Johnston (1970), and Long and Lakela (1971). Bowers (1972) treated *Pityopsis* as a section of *Heterotheca* in his revision of the grass-leaf goldenasters. Harms (1974) treated *Chrysopsis* along with *Pityopsis, Ammodia*, and *Phyllotheca* as sections of *Heterotheca* and included in his conspectus of the section *Chrysopsis* a key to the sections of the genus.

The concept of *Chrysopsis* followed in this revision was first presented in a paper on the cytotaxonomy of the goldenasters (Semple, 1977). Harms (1965) had based his support for *Heterotheca* sensu Shinners on an experimental hybrid between *H. latifolia* Buckley and what he referred to as *Chrysopsis berlandieri* Green, a member of the *villosa* complex of sect. *Phyllotheca.* Both taxa had $2n = 9_{II}$, as did the hybrid. Semple, Blok, and Heiman (1980) have noted the morphological similarities between the two parental species and the differences between these two and members of the genus *Chrysopsis* as delimited in this revision. They suggested that a "better' name for the "Chrysopsis" species Harms worked with is *Heterotheca canescens* (DC.) Shinners.

The fact that no intergeneric hybrid had been made other than nomenclaturally was noted previously by me (Semple, 1977) along with observations on karyotype differences between members of *Heterotheca* and members of *Chrysopsis*. Species of *Heterotheca* and *Pityopsis* have a base number of $x = 9$, chromosomes ranging from one to three nanometers (nm), while species of *Chrysopsis* have a base number of $x = 5$ or derived base numbers of $x = 4$ and $x = 9$. The chromosomes range in size from approximately two to seven nanometers. Semple and Chinnappa (1980a & b) have documented the allopolyploid origin of the $n = 9$ taxa in *Chrysopsis* and described in detail the karyotypes of all the species of the genus.

The similarity between flavonoid profiles of all the species of *Chrysopsis* was noted casually in Semple (1977). The patterns of ray floret, disc floret, and leaf extracts were examined in all species and compared with patterns obtained from extracts of similar tissues from species of *Heterotheca* and *Pityopsis*, which differed significantly from those of *Chrysopsis*.

There is no reason other than conservatism for treating *Chrysopsis* in any way but that done here. The cytological and morphological links thought to have existed between the groups of goldenasters do not exist. Whether or not *Pityopsis* and *Heterotheca* are congeneric is beyond the scope of this revision. The merger of *Pityopsis* into *Heterotheca*, however, was the result of *Pityopsis* being considered a part of *Chrysopsis* sensu lato. Thus the long history of the recognition of the goldenasters as a group of genera has been replete with assumptions about relationships which later have been shown to be only the products of nomenclature or overactive imaginations. Desire to maintain one or two large genera apparently has been the primary cause for such misconceptions.

TAXONOMIC UNITS, THE VALUE OF CYTOLOGICAL DATA, AND THE TRICHOPHYLLA PROBLEM

> One man's section may be another man's genus, and there is no criterion or set of criteria that can definitively determine who is right.
>
> A. Cronquist (1977), p. 218

The above statement is generally true about all similar taxonomic levels and particularly so about infraspecific taxonomic ranks. This is frequently also true when no new data have been gathered by one botanist revising another botanist's treatment of a group. In the case of *Chrysopsis* a great deal of new evidence has come to light very recently (Semple, 1977, 1978a and b; Semple, Blok, & Heiman, 1980; Semple & Chinnapa, 1980a & b). The new evidence indicates that the decision to treat *Chrysopsis* as a genus or a section of *Heterotheca* does not fall within the bounds of what Dr. Cronquist has noted as a major difficulty in taxonomy.

The number of genera that one divides the goldenasters into and the number of species that one recognizes within *Chrysopsis* here depends greatly upon the significance given to cytological data by the individual doing the splitting or lumping. How much cytological variability one is willing to tolerate within a taxon becomes critical, when cytological data are considered very important. A danger in being dogmatic arises because there are so many kinds of cytological variation which are not always carefully distinguished. The amount of variability in a taxon like *Claytonia virginica* L. (Lewis & Semple, 1977), which has 54 known cytotypes based on $x = 6$, 7, and 8, cannot be equated with the variation in chromosome numbers reported for species with B-type accessory chromosomes, e.g. *Xanthisma texanum* DC. (Semple, 1976), or with the variation in chromosome numbers reported for some genera, e.g. *Crepis* (Babcock, 1947). In short, even though considerable cytological variation is generally accepted to occur within one taxon, it is counterproductive to assume that considerable cytological variability is acceptable in every taxon. The nature of the variation and the nature of the taxon it occurs in must be evaluated in each situation.

In the tribe Astereae a wide range of cytological situations exists at the generic level. For example, the Australian genus *Brachycome* Cass. includes a full documented, aneuploid series from $n = 9$ to $n = 2$ all within a single morphological complex (Grau, 1977). The North American genus *Astranthium* Nutt. includes plants with $2n = 6$, 8, 10, 12, 16, 20, 24, and 36. The primary base number of the genus is $x = 5$, with $2n = 8$ and 16 based on $x = 4$, and $2n = 6$, 12, 24, and 36 being based on $x = 3$ (DeJong, 1965). From the sporophytic numbers alone base numbers of $x = 6$ and $x = 8$ might also be postulated to expand the range of the base numbers arbitrarily. This interpretation of the chromosome count data would make the genus appear to be cytyologically parallel to *Brachycome*, both having long aneuploid series. But, in using cytological data in systematic studies, it is not enough to know reported numbers. Knowledge of the ploidy level and karyotype morphologies is critical for meaningful interpretation. Such data have shown that there are no base numbers of $x = 6$ and $x = 8$ in *Astranthium* and thus it is not cytologically parallel to *Brachycome* at all.

In the case of *Chrysopsis*, Harms (1974) assumed the existence of an aneuploid series with $x = 9$ as primitive and $x = 8$, 7, 6, 5, and 4 as derived. Counts of $n = 4$, 5, 9 and 12 were known at the time. The $2n = 12_{II}$ count for *C. mariana* was assumed to be based on $x = 6$, the mitotic karyotype not having been studied. Only a third of the taxa had been counted in fact. By not making assumptions about the existence of certain base numbers necessary for a particular taxonomic interpretation, but rather by actually determining chromosome numbers from both meiosis and mitosis, the actual situation in *Chrysopsis* has been discovered (Semple, 1977; Semple and Chinnappa, 1980a and b). No evidence of a long aneuploid series has been found, and in fact $x = 5$, not $x = 9$ is basic for the genus. The presumed $x = 6$ species *C. mariana* has $x = 4$, and the $x = 9$ taxa are allopolyploid hybrids between the $x = 5$ and $x = 4$ phylogentic lines. In the absence of any cytological links *Chrysopsis* has to stand apart from the other goldenaster genera, unless many ad hoc assumptions about extinct intermediates are made. Such assumptions are easier to accept if cytological data are not viewed as critical. I find it unacceptable to have sections with radically different cytological characteristics placed in the same genus which is defined by only one or two shared morphological characteristics. Thus, the low base number group of goldenasters was recognized at the generic level and not as a section of an otherwise high base genus. Such botanists as Arthur Cronquist (pers. comm.) do not find it unacceptable to have sections with significantly different cytological characteristics in the same genus and therefore have grouped high base number sections with the low base number section into a single large genus *Chrysopsis*.

Within *Chrysopsis* as defined here no sections are recognized nomenclaturally, although several species complexes can be recognized on cytological grounds. The reticulate nature of evolution in the genus makes it impractical to name these groups formally (Fig. 3). If no allopolyploidy had occurred, thereby recombining characteristics of the separate diploid lines, then the genus would be practicably divisible into sections. However, the allopolyploid *gossypina* complex does exist and so it is only useful to discuss the groups informally. This is done in detail in the section on relationships within the genus.

A comparison between my treatment of *Lasallea* Greene amend. Semple and Brouillet, and my treatment of *Chrysopsis* is useful here. Both genera are small, each with fewer than a dozen species by and large native to the southeastern United States, and both have a base number of $x = 5$. In *Lasallea* there were no allopolyploids to blur the lines of evolution (Semple & Brouillet, 1980). Also the differences between species groups were more pronounced than in

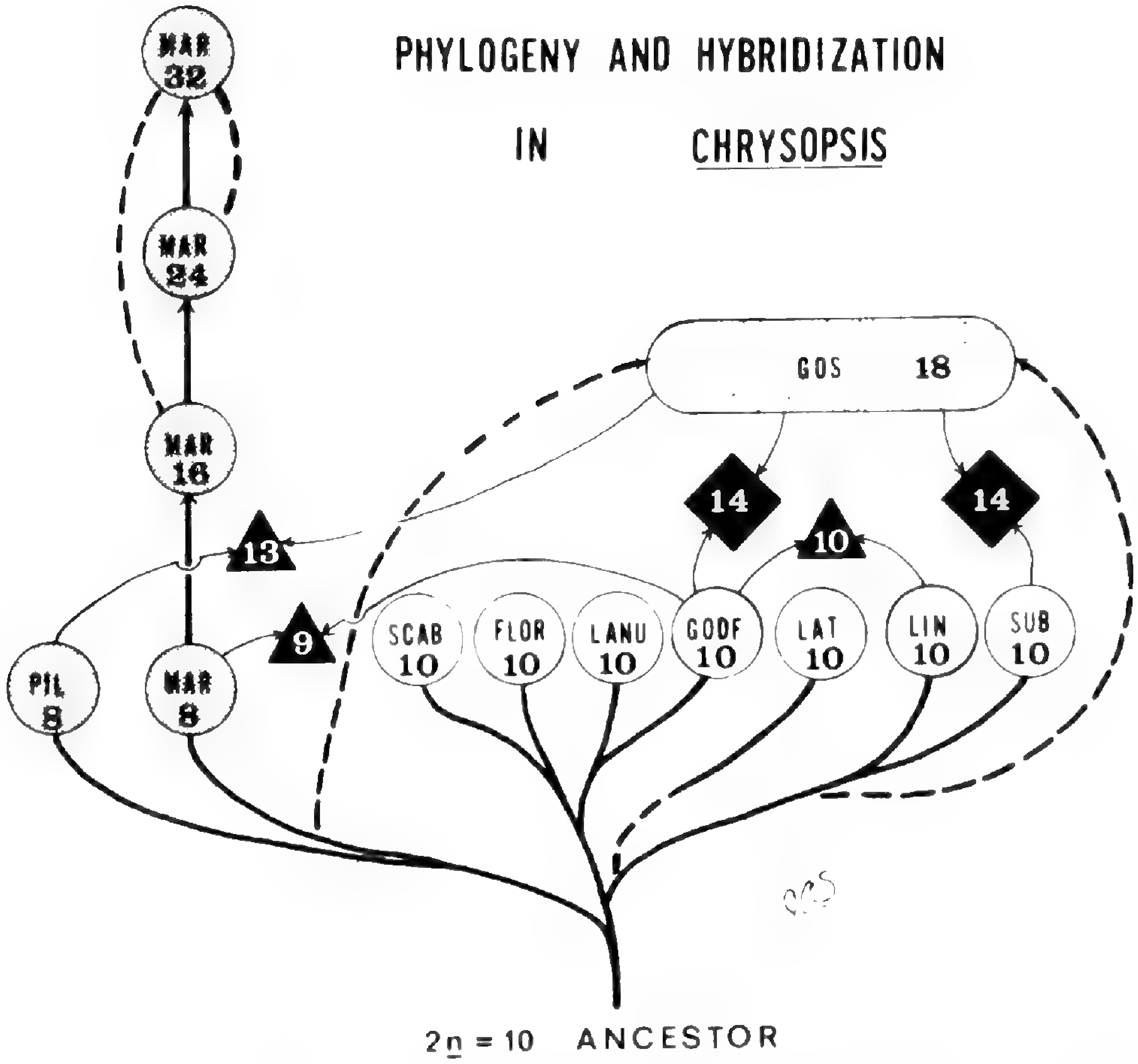

Figure 3. **A hypothetical phylogeny of the genus Chrysopsis.** The nine diploid species (circles) are thought to have evolved from a common ancestor as indicated by thick lines. The $x = 4$ line (shaded circles) includes one polyploid series with alternative derivations of higher ploidy levels indicated by broken lines. The allopolyploid *gossypina* complex (stippled) is thought to have arisen by hybridization between the two diploid lines indicated by thick broken lines. The number in each enclosure is the sporophytic number of the taxon or hybrid. Solid diamonds indicate interspecific hybrids found in nature. Solid triangles indicate experimentally produced interspecific hybrids. Parental species are joined to the hybrids by thin lines.

Chrysopsis, although again not so much so as to bar hybridization between morphologically very distinct taxa. In *Lasallea* sections were recognized, the names already having been proposed under *Aster* for the most part. In *Chrysopsis* no names have been previously proposed that can be usefully applied here. The names proposed by Small (1903) would only confuse matters more. There is little to be gained by proposing additional names.

The criteria used to delimit species vary from one taxonomist to another and from one group to another. This is certainly the situation in *Chrysopsis*. For example, Small (1903, 1933) recognized 13 species, while Harms (1974) recognized only seven. Ten species are recognized here. In each treatment the species have rather different limits and can only be compared with difficulty in some cases. Knowledge of chromosome numbers and interpretation of these data have made the treatment given below the most unusual. The somewhat unorthodox approach of beginning *de novo* was employed. Cronquist (1977) criticized L.H. Shinners for this method in connection with the goldenasters. The various keys available and the differences in species interpretation, however, made it necessary to start at the beginning with the plants themselves rather than with the literature.

The state of confusion generated by the contrasting opinions on the status of the taxa *Chrysopsis trichophylla, C. subulata,* and *C. lanuginosa* was particularly deep. Dress (1953), for example, completely ignored the last taxon, while Harms (1974) placed it into synonymy under *C. gossypina.* In another instance, the relationship between *C. floridana* and *C. mariana* postulated by Fernald (1937) and restated by Harms (1974) was very misleading, since undue emphasis was placed on the perennial habit of the two species. The actual form of the perenniality, the degree of pubescence, and the kind of hairs were not recognized as critical. In short, the level of understanding was such that more than "tidying up" an earlier published revision was necessary.

Species were defined on sets of charcteristics with chromosome number, glandularity, phyllary shape, and capitulescence type receiving the greatest weighting. All the diploid species (both $x = 5$ and $x = 4$) are well defined on morphological grounds alone; variation between these is generally discontinuous. The allopolyploid complex, however, is extremely varied morphologically and is only well defined by its $2n = 18$ chromosome number. The "pillar complex" nature of a portion of the genus is represented diagramatically in Fig. 3. Each "pillar" is well defined and given species status. The overtopping "roof" group is treated as a single species as well, since the morphotypes intergrade fully and can not even be distinguished cytologically. An alternative approach would have been to lump under a few names the following groups of species and have a few very broadly defined species: *Chrysopsis scabrella* ($n = 5$), including *C. floridana, C. godfreyi,* and *C. lanuginosa; C. mariana* ($n = 4, 8, 12, 16$); *C. pilosa* ($n = 4$); and *C. gossypina* ($n = 5$

& 9) including *C. linearifolia, C. hyssopifolia, C. subulata, C. trichophylla,* and *C. decumbens* with *godfreyi* and *decumbens* linking the first and last assemblages. In the past, authors have tended to separate one or two of the listed species on the basis of a single characteristic that often had no real value, e.g., Small (1903) used phyllary shape. While not a useful key character, chromosome number does have absolute value in separating the *gossypina* complex from the other species of the genus. Furthermore, any suspected hybrids between this complex and any other species would be easily identifiable as such by chromosome number alone.

Subspecies were recognized in two species. Both cases fall within the philosophical bounds of the problem referred to in the opening quote of this section of the paper. I followed the definition of subspecies given in my treatment of *Xanthisma* (Semple, 1974), in which distinct morphology and nearly allopatric distributions were emphasized. The subspecies of *C. linearifolia* were recently described (Semple, 1978b). In this case the morphological differences involved both leaf shape and the kind of capitulescence. The occurrence of a few individuals of the Florida peninsula morphotype, subsp. *dressii,* within the panhandle Florida distribution of the type subspecies made it unsound to recognize each morphotype at the species level, though someone else might wish to do so.

Included in *Chrysopsis gossypina* are three semi-allopatric subspecies. These integrate in the respective zones of symmpatry to such an extent that treating each as a species also would have to be done on an arbitrary basis. When only the investiture of the involucre is artificially considered to be of three kinds, then the *gossypina* complex can be split into three groups. Plants with densely woolly heads are similar to Michaux's type collection of the species and Fernald's type collection of *C. longii.* Plants with glabrous or glabrate heads are similar to the type collections of *C. trichophylla, C. hyssopifolia, C. gigantea, C. cruiseana,* and *C. mixta.* This last group was treated as *C. trichophylla* by Harms (1974) who included the distinct $x = 5$ diploid species *C. subulata* as well.

Members of the glabrous-headed subset of the *gossypina* complex, however, are heterogeneous for such traits as habit, degree of leaf pubescence, leaf shape, kind of capitulescence, involucre size, and the nature of the upper stem and peduncle indument. When these traits are considered along with head investiture (which really does not occur in three distinct kinds) then the glabrous-headed subset is seen to merge into the other two subsets to such an extent that it is not possible to subdivide the complex in this traditional manner.

The *gossypina* complex can be divided into subunits when sets of characteristics are compared. Two subunits can be separated out on the basis of morphology and distribution, and these have been given subspecies status. Subspecies *cruiseana* inhabits the Gulf coast barrier islands of western Florida and Alabama. Over much of the subspecies' range populations contain only individuals with the following characteristics: stems decumbent or spreading from a perennial base, stem leaves small and glabrous, stems glabrous and often red-tinted, capulescence subumbellate-cymose with a few heads, phyllaries glabrous and generally appressed. In populations that occur on parts of the barrier island system which are in contact with the mainland, individuals with a combination of these traits and those of subsp. *hyssopifolia* have been collected. Hybrids between subsp. *cruiseana* and subsp. *gossypina* also have been collected near Panama City Beach. Of the three subspecies in the complex, subsp. *cruiseana* is the most isolated and the most distinct morphologically.

The second relatively homogeneous group of populations given subspecies status occurs in western Florida, Alabama, Mississippi, and eastern Louisiana on the outer coastal plain. Plants of this group, subsp. *hyssopifolia,* have the following set of characteristics: stems erect and unbranched from perennial bases and from basal rosettes produced at the ends of short to long lateral rhizomes or roots, stem leaves small and with ciliate margins (sometimes very linear), stems glabrate and often red-tinted, capitulescence subumbellate-cymose with one to a few heads, phyllaries glabrous and often spreading to recurved at the very tips. Only populations of such individuals occur in the western part of the distribution, but are sympatric with populations differing in inflorescence and habit in the most eastern part of the subspecies' range. Plants that are difficult to categorize as either subsp. *hyssopifolia* or subsp. *gossypina* are frequent in the Panama City Beach to Tallahasee corridor. The existence of these populations makes recognition of *hyssopifolia* as a species unsound.

The third subspecies includes the nomenclatural type of the species and is the most morphologically varied of the three subspecies of *Chrysopsis gossypina*. As treated here subsp. *gossypina* includes individuals with glandular and non-glandular heads and individuals with woolly and glabrous heads. The reasons for treating some of these morphotypes at the formal level are discussed below.

Varieties were not recognized in any species of the genus in this revision. Varieties have been recognized in the genus in the past. Fernald (1937) treated *Chrysopsis floridana* as a variety of *C. mariana*. This was not found to be a reasonable classification, since the taxa differ in many morphological traits and even have different chromosome base numbers. Fernald also described a second variety of no significance in *C. mariana*, var. *macradenia*. Dress (1953) described a new variety in *C. scabrella*, but the name was never validly published. I have chosen not to give the morphotype Dress recognized any nomenclatural status. Dress also proposed that *C. gigantea* be treated as a variety of *C. hyssopifolia* (i.e. *C. linearifolia*), but this combination also was not published. Torrey and Gray (1842) treated *C. hyssopifolia* as a variety of *C. trichophylla*. Long (1970) treated *C. subulata* as a variety of *hyssopifolia* under the generic name *Heterotheca*. I have not accepted any of the relationships that these combinations imply and so none have been used in this revision.

Herbarium collections are not always helpful in assessing whether a morphotype should receive variety or form status. Generally, insufficient numbers of plants from a single population are collected to determine whether the population sampled consisted of only one morphotype or of several morphotypes. Following my usage of the terms "variety" and "form" this distinction is critical (Semple, 1974). For example, no population of *Chrysopsis godfreyi* studied in the field consisted of only the woolly-leaf form or the non-woolly, green leaf form (Semple, 1978a). Both morphotypes occurred in all populations and therefore were given the rank of form. Had both morphotypes existed in pure populations, they would have been given varietal status. The same distinction was found to be true of the densely glandular-headed individuals of *C. gossypina*. Godfrey (1949) treated these as f. *decumbens*. My field work supports Dr. Godrey's conclusion.

The level at which to recognize Nuttall's *trichophylla* was the most troublesome aspect of the revision for several reasons. The first reason is the fact that nearly all previous authors have treated the taxon as a species, but I quickly decided that it was not deserving of this rank. Second was the question of what rank it did deserve, if not species. Certainly the type specimen of *trichophylla* is different from the types of *hyssopifolia* and *gossypina* in leaf shape, pubescence, and capitulescence characteristics. Examination of many collections indicated that the type of *trichophylla* is part of a continuum of variation in leaf shape and pubescence. Phyllary shape also varies greatly and is not useful as a key characteristic. The type collection of *trichophylla* has a few large heads in a cymose capitulescence, acute erect to recurved phyllaries that are glabrous, leaves that are sparsely covered with long woolly hairs, peduncles that are glabrous, and an apparently erect habit. The collection was made in the "Carolinas" where plants with this combination of characteristics are rare. Such plants are more common in parts of Georgia and north-central and eastern Florida. Plants similar to this kind predominate in the Tallahassee to Panama City region of Florida, but these have coarse ciliate leaf margins, which is characteristic of subsp. *hyssopifolia.* The stem habit of all these *trichophylla*-like plants varies from erect and relatively unbranched to highly ramose and ascending to erect. In Georgia and South Carolina plants have been collected that are even more glabrous than the type of *trichophylla* and have very large heads with erect phyllaries. All these glabrous-headed plants could be assigned to a single species and have been by some authors (Small, 1903 & 1933; Harms, 1974; Radford et al., 1968). To do this, however, an arbitrary degree of pubescence has to be chosen to distinguish *C. trichophylla* from *C. gossypina.*

Each of the characteristic states that defines the *trichophylla* group is only one state in a continuum from one extreme condition to the opposite. Individuals have been collected that have one or more of the *trichophylla* traits in combination with *gossypina* traits. Plants having large heads with hairy and erect phyllaries have been collected in Florida and Georgia. Decumbent, but glabrous plants occur in the Carolinas. Peduncle pubescence varies greatly so that some plants have glabrous heads but woolly peduncles, while others have glabrous heads and glabrous peduncles. Still others have peduncles with a few hairs and are thus intermediate. The frequency of plants with a combination of some *trichophylla* characteristics and some *gossypina* or *hyssopifolia* characteristics is sufficiently high in the region where "pure" *trichophylla* plants have been collected that recognizing *trichophylla* as more than a form or variety is unjustifiable. No arbitrary decision about the degree of hairiness was necessary to separate any of the $2n = 10$ and $2n = 8$ species. It would be inconsistent to adopt such an arbitrary limit in order to recognize species in the $2n = 18$ complex.

Nuttall's *trichophylla* could have been treated as either a variety or a form of one of the subspecies of *Chrysopsis gossypina.* The inclusion of the *trichophylla* morphotypes in either subsp. *cruiseana* or subsp. *hyssopifolia* would expand these taxa to useless limits. Furthermore, *trichophylla* morphotypes occur within the range of subsp. *gossypina.* Therefore, *trichophylla* is treated as part of subsp. *gossypina,* which has traditionally included many morphotypes.

The nature of population dynamics in *Chrysopsis* makes the choice of either variety or form rank for *trichophylla* possible. A large colony of plants can develop over a few seasons from the progeny of one or a few plants. Such populations tend to be composed of genetically similar individuals. Thus, "pure" populations of *trichophylla* morphotypes potentially could be encountered in South Carolina, Georgia, and Florida. These *trichophylla* populations would be sympatric in the broad sense with populations of *gossypina* morphotypes. Such populations are short lived and could be replaced by ones consisting of another kind of plant or intermediate ones. This pattern of distribution is the kind that I have suggested warrants varietal level status (Semple, 1974). I have chosen to minimize the nomenclatural importance of this particular glabrous-headed variant of *C. gossypina* because the importance of the variant has been given in the past is excessive. Treating the variant as f. *trichophylla* retains the name, but indicates that it is not significant at this time.

RELATIONSHIPS WITHIN CHRYSOPSIS

Sufficient data on the similarities and differences between the ten species of *Chrysopsis* are available that a phylogenetic history of the genus can be suggested at this time. Although much of what is stated must be speculative, the history takes into consideration all the information available. The hypothesized phylogenetic history of *Chrysopsis* given below is pictorially summarized in Fig. 3.

The ancestor of the genus is believed to have been an $x = 5$ taxon native to southwestern North America, possibly in the Texas-Mexico region. The range of this taxon later expanded eastward to Florida along the coastal plain, when conditions permitted. The population complex became isolated in Florida, and the members evolved to a state recognisable as *Chrysopsis*. The fate of the more western populations is unknown. They may have given rise to other genera related to *Chrysopsis* such as *Xanthisma* and *Amphiachyris* or they may simply have gone extinct.

In Florida these early progenitors of the genus evolved the following set of characteristics: the $x = 5$ standard karyotype (Semple and Chinnappa, 1980a), a monocarpic to weakly perennial habit, woolly basal rosette leaves with flagelliform hairs (Semple, Blok, & Heiman, 1980), sessile and woolly stem leaves, a few-headed lax cymose capitulescence, densely stipitate glandular phyllaries and peduncles, and cypselas with a pappus of short outer bristles and long inner ones. The taxon retained the yellow ray color of its ancestor to the west. Also retained were the out-crossing breeding system and short taproot.

The ancestral populations were divided, perhaps by simple isolation, into two subgroups which were subjected to slightly different environmental conditions and which had different gene frequencies. In time different genes were fixed in each subgroup. New allelic forms of other genes evolved and were fixed in each set of populations, furthering divergence between the subgroups. Seed dispersal permitted exchange of some genes between populations within each subgroup, but not between subgroups. One subgroup is thought to have evolved the following set of characteristics: densely stipitate glandular peduncles and phyllaries, clasping stem leaves, and fruit without any distinct glandular ridges. From this first phylogenetic group with $x = 5$ evolved the $x = 4$ line following the processes described in Semple and Chinnappa (1980a & b). The second subgroup evolved the following different set of traits: glabrate peduncles and phyllaries, sessile and glabrous to sparsely woolly stem leaves, and fruit with one to many pronounced clavate, red-yellow translucent ridges. Once these two groups had evolved they again became sympatric in the northern Florida region.

Geographic isolation and subsequent adaptation to different habitats was apparently a recurrent pattern of evolution in the genus. This must have been particularly true in the case of *Chrysopsis pilosa*, the most divergent species in terms of morphology, chemistry, and cytology. The divergence is easily understood if the taxon had a long history of migration from the Florida region to the Ozark Plateau (Fig. 7E). If migration involved short steps by ephemeral populations of a few individuals for much of the time, but with the occasional generaton of large population size, such a situation would have favored genetic drift and would have lead to speciation according to the Carson Founder-Flush Speciation Theory experimentally tested by Powell (1978). The effect of such boom-bust fluctuations in population size would have been to maximize the rate of divergence. Once in the drier regions of the Ozark Plateau, drier climatic conditions would have favored the evolution of the annual habit, since more changes in morphology would have been required for the species to become a true perennial utilizing a long taproot to overcome dry soil conditions at the end of the summer. A shift in flowering time from fall to early summer would have advantages as well because of the dry late summer conditions. In addition the lower chromosome number and reduced amount of chromatin in the karyotype could have resulted in an increase in growth rate permitting the plant to achieve flowering size more quickly (Semple & Chinnappa, 1980a). During this long process of specialization that resulted in the evolution of *C. pilosa*, some populations apparently became isolated and diverged in different ways. These populations are thought to have ultimately evolved into *Bradburia hirtella*, with a very rare $n = 4$ race and the common $n = 3$ race (Semple & Chinnappa, unpublished).

Geographic isolation appears to have been critical for speciation in both $x = 5$ phylogenetic lines. The stipitate-glandular group of species can be divided into two subgroups of two species each. One pair occupies the Florida peninsula and consists of the widespread mainland species *Chrysopsis scabrella* (Fig. 8F) and the Tampa Bay endemic *C. floridana* (Fig. 9F). The second species is known from less than a half dozen locations. These populations occur on isolated sandhills with Sand Pine communities. The other pair of species is found in the Florida panhandle region where both species have limited distributions. *Chrysopsis lanuginosa* occurs to the north and east of Panama City, occupying disturbed sites (Fig. 9F). Its range appears to have greatly expanded only recently with the onset of clear-cut logging operations in the area (R. K. Godfrey, personal communication). The second panhandle species, *C. godfreyi*, is endemic to the Gulf coast barrier islands from Panama City west to Alabama (Fig. 10F). Both panhandle species have long woolly hairs on the basal rosette leaves, clasping stem leaves, and large heads which nod in bud. Both peninsular species have short woolly hairs on the basal rosette leaves and small heads erect in bud. The stem leaves of *C. floridana* are slightly clasping; those of *C. scabrella* are non-clasping.

Similarities in morphology between *Chrysopsis godfreyi* and *C. floridana* suggest that both evolved in response to similar environmental pressures. Individuals of both species are perennial. Both have a dense white woolly indument on the leaves and stems and both have a compact few-headed capitulescence. These traits may in some way be due to the barrier island habitat *C. godfreyi* now occupies and *C. floridana* may have originally occupied. The few populations of *C. floridana* may be relictual, the species having once been more common in the area when the sandhill habitats were the tops of barrier island sand dunes. In contrast both inland species (*C. lanuginosa* and *C. scabrella*) are usually biennial and have light green, densely stipitate-glandular stem leaves. Both have many-headed capitulescences that are very distinct from those of the other species of the region. The combination of capitulescence differences and leaf indument differences may facilitate distinction by foraging insects between the species in each regional pair. Floral color changes do not seem to have been available for this purpose, all the species of the genus being the same. Background and head positioning apparently were utilized in alternative.

The degree of difference is greater between *Chrysopsis floridana* and *C. scabrella* than between *C. godfreyi* and *C. lanuginosa*. The length of time each pair has existed may be responsible for this. The possible relictual distribution of *C. floridana* implies a long history for the species. Of course the greater difference between *C. floridana* and *C. scabrella* than between *C. godfreyi* and *C. lanuginosa* may also be due to simple chance and not reflect age at all.

In the second $x = 5$ line geographic isolation also apparently resulted in divergence and a move toward speciation. As in the stipitate-glandular group, the split in morphotypes is geographical and involves peninsular and panhandle populations. The two subspecies of *Chrysopsis linearifolia* differ in head size and capitulescence characteristics, as well as in leaf shape. When the two taxa were described (Semple, 1978b), the existence of plants of the subsp. *dressii* morphotype in the range of subsp. *linearifolia*, and vice versa was noted. Interestingly, these disparate individuals occur near the coast and generally in the region where the specialized species of the stipitate-glandular group occur. The history of these regions has apparently favored divergence in *Chrysopsis*.

Somewhere in northern Florida at some time in the past an individual with $n = 4$ and looking much like *Chrysopsis mariana* hybridized with an individual with $n = 5$ that looked similar to *C. linearifolia* subsp. *dressi* or *C. subulata,* but with nonsubulate phyllaries. From this hypothetical event evolved the $x = 9$ *gossypina* complex, which has been shown to be allopolyploid in nature (Semple & Chinnapa, 1980b). The hybrid origin of the complex indicates why so much morphological variation occurs within it. The distributions of these morphotypes have been mentioned briefly in the section on taxonomic units. The morphotypes have restricted and sometimes isolated distributions within the total range of *C. gossypina*.

Although not absolutely, *Chrysopsis gossypina* can be divided into a panhandle complex and a peninsular complex. Each complex extends outward on the coastal plain, westward and northeastward respectively. The panhandle complex is subdivided into semi-isolated groups of populations by several large rivers and estuary systems. Subsp. *cruiseana* occupies the barrier island region (Fig. 15C); typical subsp. *hyssopifolia* occupies the western mainland region; while the eastern region is occupied by individuals with characteristics of both subsp. *gossypina* and subsp. *hyssopifolia*. The ancestral hybridization event giving rise to the entire complex may have occurred in the eastern region surrounding Tallahassee. Both diploid *C. mariana* and *C. linearifolia* occur in this region.

Alternatively, the hybridization event yielding the $x = 9$ phylogenetic line could have taken place further east near Gainesville, Fla. In this region, diploid *Chrysopsis mariana* populations have been discovered. Also, in Alachua County there are populations of *C. subulata* that consist of plants with non-subulate phyllaries, but otherwise typical *subulata* morphology. *Chrysopsis gossypina* in this second area can be very similar to *C. subulata*, causing some difficulty in identification. When such a population of *C. subulata* was encountered during field work, plants were collected that appeared to be aberrant members of the species and this was later confirmed by the $2n = 10$ chromosome number obtained. At the site as well, a $2n = 14$ *C. subulata* × *gossypina* subsp. *gossypina* individual was also collected. The similarity in the two species at this location in their respective distributions may be interpreted as 1) environmentally induced convergence, 2) chance, or 3) relictual, both species having retained very primitive morphotypes in this area. If the last situation is correct then perhaps *C. gossypina* evolved in this region by hybridization between primitive morphotypes of *C. mariana* and *C. subulata*.

Within subsp. *gossypina* there occur several rather different morphotypes, which require some explanation about their origins. Since the species is of hybrid derivation, it includes genes from both the stipitate-glandular line and the translucent-ridged fruit line of evolution. It is postulated that depending upon the environmental conditions or simple chance, genes from only one parental line became fixed in some populations. In these populations the plants may even have backcrossed with one or the other of the parental taxa to further blur the distinctions. More likely, however, is the possibility that the morphological convergence toward one or the other parental line came about simply because essentially the same genes were present in the allopolyploid populations and the diploid populations in some cases. The subtle differences that occur between the diploid and mimicing allopolyploid morphotype are due possibly to the differences in chromosome number and the expression of some genes derived from the second parental line in the allopolyploid phenotype. In populations containing f. *decumbens* a single modifier gene could be determining whether an individual manifests the f. *gossypina* or the f. *decumbens* phenotype, as is perhaps the case with the forms of *Chrysopsis godfreyi*. The gene systems controlling the different morphologies could be quite complex, but their activation or suppression very simple. In the case of the *trichophylla* morphotype, the continuum between very glabrous and very woolly plants is such that a more complex genetic control system appears to be involved. Only rarely does a plant possess a full complement of genes that induces development of a pure *trichophylla* phenotype. That is, the *trichophylla* phenotype could be determined by a multi-allelic, multi-genic blended inheritance. Carefully controlled breeding studies need to be conducted to determine what genetic systems are involved in each of these cases.

The most difficult species to place phylogenetically is *Chrysopsis latisquamea*. It is the only species with luteolin in floral extracts in large enough quantities to be easily detected. This could be a relictual trait or one recently evolved. It has densely stipitate-glandular peduncles and phyllaries (characteristics of the *scabrella* group) and clavate translucent ridges on the fruit (characteristic of the *subulata* group). The origin of the species could thus be hybrid in nature. Or, it may represent an early offshoot of the $x = 5$ ridged-fruit phylogenetic line that differentiated before the line as a whole lost the ability to produce densely stipitate-glandular structures. It is clearly not a part of the *gossypina* complex as Harms (1974b) suggested. Its $2n = 10$ chromosome number precludes this relationship. No evidence for hybridization with *C. gossypina* was found. *Chrysopsis gossypina* can hybridize with species in both $x = 5$ lines and with at least *C. pilosa* in the $x = 4$ line. There is no real reason to assume that it could not ever hybridize with *C. latisquamea* as well. The phylogenetic position of *C. latisquamea* is thus uncertain. In Figure 3 it is indicated with broken lines as arising from near the point at which the two $x = 5$ lines diverge.

In summary, evolution in *Chrysopsis* has proceeded in two main ways. First, changes in the karyotype have accompanied or brought about significant changes in morphology and distribution. Second, geographic isolation and small population size have apparently favored repeated divergence leading to speciation. The relative times of various events are unknown as is the age of the genus itself.

SYSTEMATIC TREATMENT

The following systematic treatment is based on field work during 1974–1978 and extensive herbarium studies on general and type collections. Specimens from the following herbaria were examined and annotated; DUKE, F, FSU, GA, GH, MT, NCSC, NY, OAC, PH, TENN, TEX, TUFTS, UNCC, US, USF, and WAT. Discussions of the morphology and the phylogeny of the genus have been presented in part in Semple (1977, 1978 a & b) and Semple et al. (1980), in which are also given location and voucher data of collections made as part of this study.

Chrysopsis (Nutt.) Ell., Sketch Bot. S.C. and Ga. **2**: 333. 1824. *nomen conservandum.*

Inula section *Chrysopsis* Nutt., Gen. North Amer. Pl. **2**: 150, 1818. TYPE: *Inula mariana* L.

Diplopappus Cass., Soc. Phil. Bull. des Sc. **137**. 1817. nom. ill.

Diplogon Raf., Amer. Monthly Mag. **2**: 268. 1818. nom. rej.

Hefeldera Sch.-Bip. Flora **36**: 35. 1853.

Heterotheca sect. *Chrysopsis* (Nutt.) Harms, Wrightia **4**: 12. 1968. in part. sensu Harms, Castanea **39**: 155–165. in full.

Plants annual, biennial, or perennial, herbaceous or suffrutescent. *Stems* erect, ascending, or decumbent, woolly pubescent to glabrous, or stipitate glandular. *Basal rosette leaves* spathulate to oblanceolate, narrowing to petiole-like bases, sessile, entire or apically dentate-serrate, sparsely to densely wooly-pubescent, the hairs flagelliform, arachnoid-pubescent, or pilose. *Stem leaves* linear to ovate, elliptic, or lanceolate, sometimes clasping the stem, glabrous to densely short or long woolly-pubescent, or densely stipitate-glandular, pilose or arachnoid-pubescent, margins entire or obscurely dentate, sometimes coarsely ciliate. *Capitulescence* cymose, subumbellate-cymose, or cymose-paniculate; *heads* solitary in depaupered shoots to 100 or more in robust plants, showy, radiate, borne on nearly naked to leafy-bracted peduncles; *involucres* campanulate, 5–12 mm high; *phyllaries* in 3–5 unequal series, 1-nerved, linear-lanceolate to oblanceolate, glabrous or variously pubescent, sometimes stipitate-glandular or sessile-glandular. *Ray florets* pistillate, 9–36, straps 5–15 mm long, yellow. *Disc florets* 5–8 mm long, ampilate, the throat making up about half the length, the lobes 0.5–1 mm long, yellow. *Fruit* a cypsela, body compressed-obconic, smooth or with 1–10 weak ribs and sometimes 1–4 yellow to red-brown, clavate, translucent ridges per side, sparsely to densely strigose, 1.5–3 mm long; *pappus* double, the outer bristles short, ca. 0.5 mm long, thin and barbellate to scale-like, the inner bristles thin, barbellate, 4–7 mm long. Chromosome base number: $x = 5$; derived bases $x = 4$ and 9.

The genus is distinguished by the following set of characteristics: basal rosette leaves with flagelliform hairs, florets yellow, ray and disc fruit similar, pappus double, the outer whorl of short bristles, the inner whorl of long ones, base number of $x = 5$ and derived bases of $x = 4$ and 9.

The general distribution of species groups, habit variation, and floret and trichome morphology of the genus are illustrated in Figs. 1, 4, and 5 respectively. The leaf anatomy of the genus was described in Semple et al (1980). It was undistinctive and similar to the leaf anatomy of species of *Heterotheca*, *Solidago*, and some species of the lower base number segregate genera of the *Haplopappus* complex.

There is considerable habit variation in *Chrysopsis*. The basic habit appears to be that possessed by *C. gossypina* subsp. *gossypina*, *C. godfreyi*, and *C. latisquamea* in part (Fig. 6A). A basal rosette develops the first season; a single shoot with branches ending in few-flowered cymose capitulescences develops the second season. The plant may produce additional basal rosettes from its lowest stem

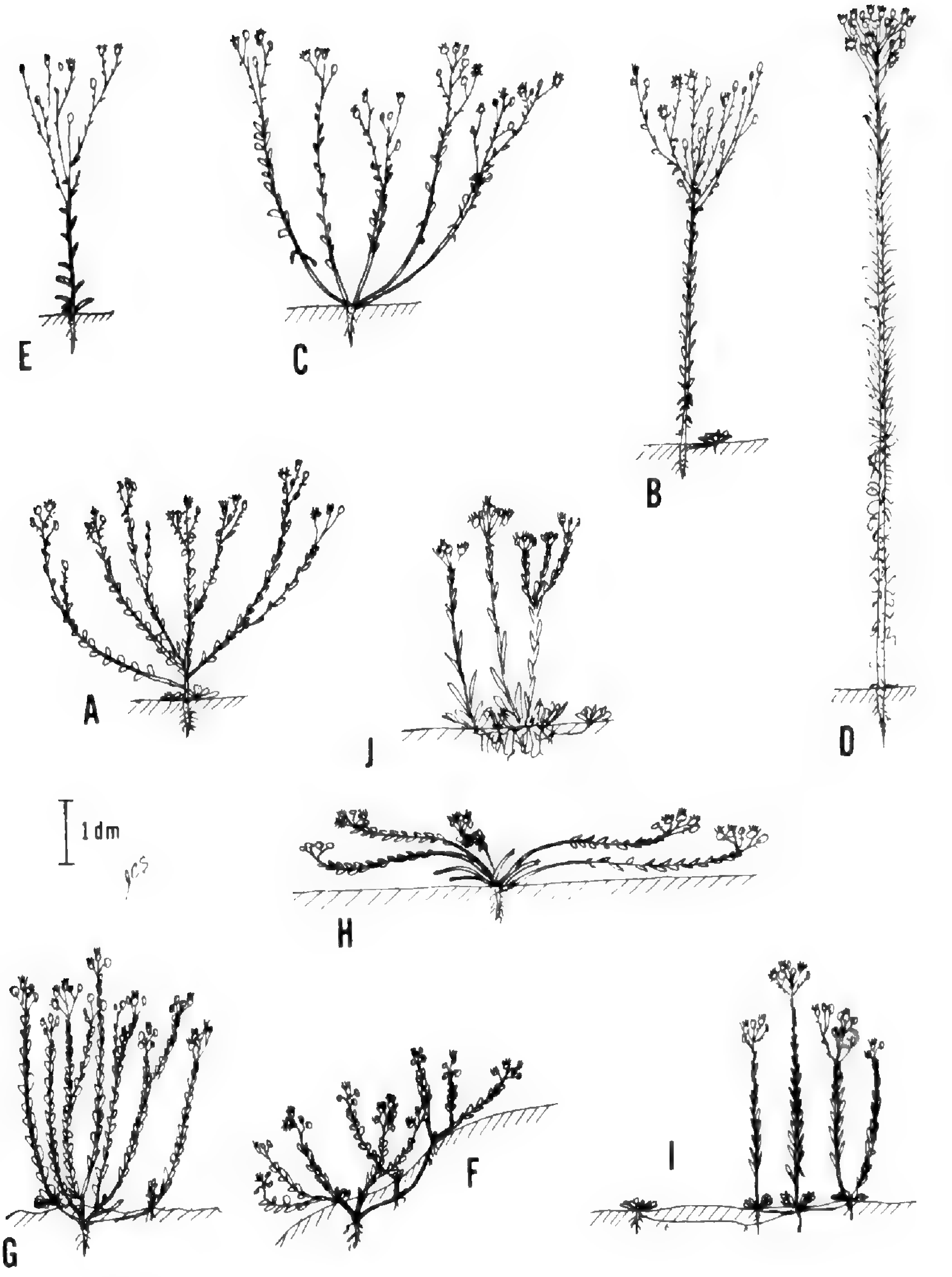

Figure 4. **Habit variation in Chrysopsis.** A full discussion is given in the text. All figures are at the same scale. **A.** *C. gossypina* subsp. *gossypina, C. godfreyi* and *C. latisquamea* (in part). **B.** *C. latisquamea* (in part) and *C. linearifolia* subsp. *dressii.* **C.** Appearance of damaged plants normally like (B) and plants blooming for the second time or more. **D.** *C. linearifolia* subsp. *linearifolia.* **E.** *C. pilosa.* **F.** *C. godfreyi* (in part). **G.** *C. floridana.* **H.** *C. gossypina* subsp. *cruiseana.* **I.** *C. gossypina* subsp. *hyssopifolia.* **J.** *C. mariana.*

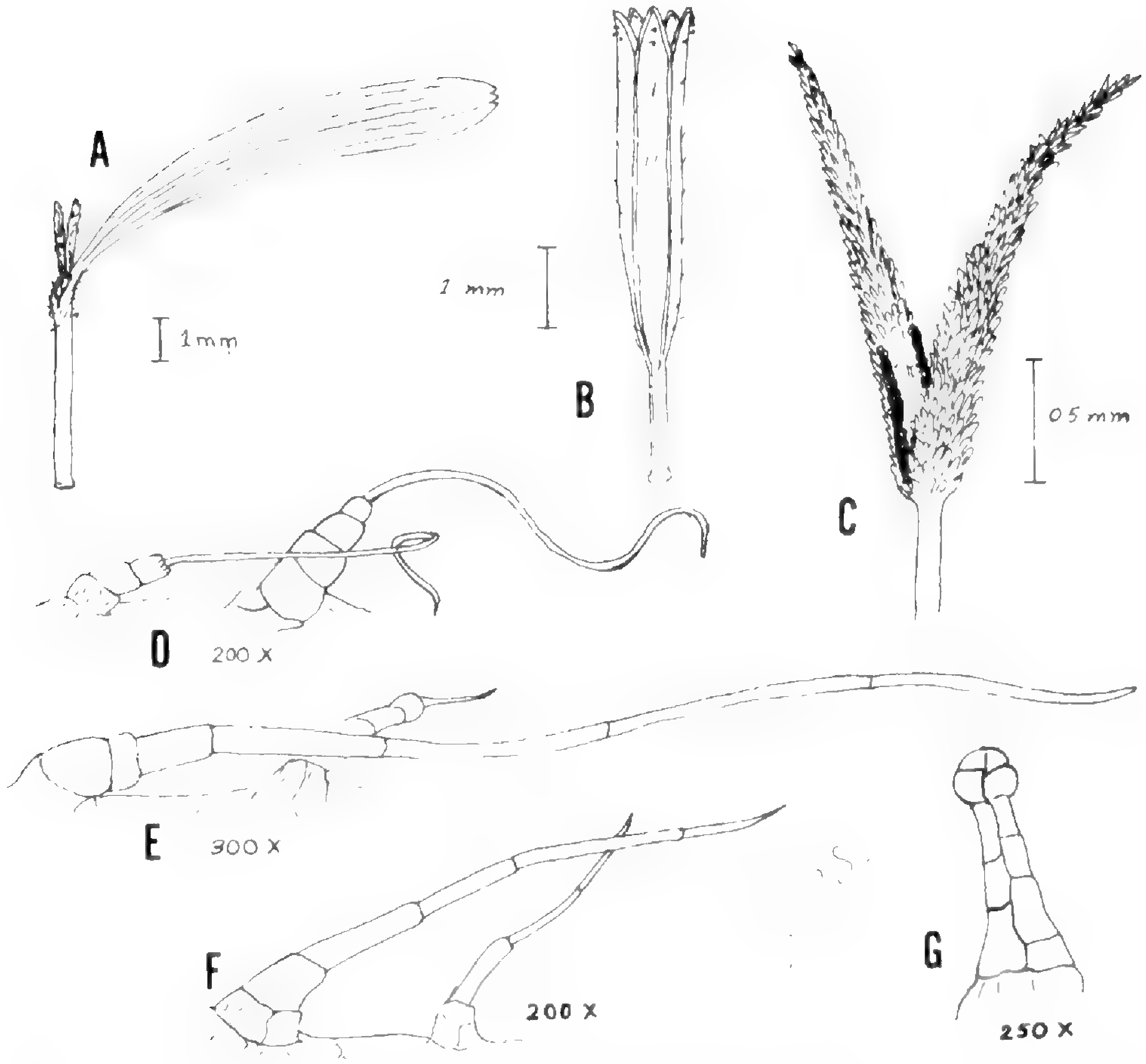

Figure 5. **Floral and trichome morphology in Chrysopsis. A.** Ray floret; hairs may be absent. **B.** Disc floret corolla; hairs and glands may be absent. **C.** Style branches of disc floret. **D.** Flagelliform hairs present in all species but two. **E.** Leaf hairs of *C. mariana*. **F.** Leaf hairs of *C. pilosa*. **G.** Stipitate glandular trichome. The size of the trichomes varies greatly even on the same tissue. A discussion of hair types and scanning electron micrographs of them were presented in Semple et al. (1980).

nodes or on short lateral rhizomes or roots. These permit the plant to survive another season. Greater apical dominance leads to growth forms with usually unbranched, erect stems (Fig. 6B) as found in *C. latisquamea* and *C. gossypina* subsp. *gossypina* in part, *C. scabrella*, and *C. linearifolia* subsp. *dressii*. Damaged plants and those perennating by production of additional secondary basal rosettes look like plants in Fig. 6C. Plants of *C. linearifolia* subsp. *linearifolia* can reach nearly two meters in height with up to 100 heads (Fig. 6D). Plants of *C. pilosa* are annual (Fig. 6E). Short and long lived perennial forms develop in several ways. Plants of *C. godfreyi* colonize dunes and can produce secondary basal rosettes at soil level, the lower portions of the older stems being buried in drifting sand (Fig. 6F). Plants of *C. floridana* are true perennials, new growth arising from the bases of old shoots and at the ends of lateral rhizomes or roots (Fig. 6G). The shoots of *C. gossypina* subsp. *cruiseana* are decumbent and arise from old stem bases (Fig. 6H). The shoots of *C. gossypina* subsp. *hyssopifolia* arise singly from basal rosettes formed at the base of old stems and at the ends of long lateral rhizomes (Fig. 6I). Plants of *C. mariana* are true perennials, basal rosettes developing from a fibrous root system (Fig. 6J).

ARTIFICIAL KEY TO THE TAXA OF *CHRYSOPSIS* (NUTT.) ELL.

1. Fruits lacking yellow-red translucent ridges (in some forms of *C. gossypina* the ribs are distinct but not translucent); peduncles and phyllaries usually stipitate-glandular. .... 2.
  2. Upper stem leaves stipitate-glandular, not woolly. ...... 3.
    3. Inflorescence open flat-topped corymbose; leaves linear-elliptic; phyllaries obtuse, short; stems erect; peninsular Florida; $n = 5$ .... (3) *C. scabrella*
    3. Inflorescence compact corymbose or paniculate, buds nodding, leaves clasping stem. .... 4.
      4. Inflorescence paniculate; phyllaries long attenuate, spreading to reflexed; leaves linear-lanceolate, stems erect often branching; central West Florida; $n = 5$ .... (5) *C. lanuginosa*
      4. Inflorescence corymbose; phyllaries acute to attenuate; leaves lanceolate, sessile; stems procumbent to ascending; barrier islands of West Florida; $n = 5$ .... (6b) *C. godfreyi* f. *viridis*
  2. Upper stem leaves glabrous to woolly, not densely stipitate-glandular. .... 5.
    5. Upper leaves not usualy greatly reduced, clasping auriculate; inflorescence subumbellate; stems ascending, perennial; Tampa Bay area only; $n = 5$ .... (4) *C. floridana*
    5. Upper stem leaves reduced, long woolly or pilose or arachnoid. .... 6.
      6. Upper leaves pilose or arachnoid (cobwebby hairs), not long woolly. .... 7.
        7. Upper leaves pilose; inflorescence long peduncled, corymbose; erect annuals; Ozark Plateau west to Kansas and Texas, rare and perhaps introduced in states of the SE U.S.; $n = 4$ .... (2) *C. pilosa*

7. Leaves and portions of stem arachnoid pubescent; inflorescence subumbellate; fibrous rooted perennial; N.Y. to Fla. west to southern Ohio and eastern Texas; $n = 4, 8, 12, 16$ .... (1) *C. mariana*

6. Upper leaves woolly .... 8.

8. Inflorescence corymbose, buds nodding; procumbent to ascending stems; barrier islands of West Florida; $n = 5$ .... (6a) *C. godfreyi* f. *godfreyi*

8. Inflorescence cymose-corymbose, buds not nodding; procumbent stems; N.C. to Florida; $n = 9$ ...... (10e) *C. gossypina* subsp. *gossypina* f. *decumbens*

1. Fruits with one or more translucent yellow-red ridges; peduncles and phyllaries not stipitate-glandular (except for *C. latisquamea*). .... 9.

9. Phyllaries stipitate-glandular, usually 1.5 mm wide or more; stems erect, branching; northern peninsular Florida; $n = 5$ .... (7) *C. latisquamea*

9. Phyllaries glabrous to woolly, not densely glandular, averaging 1 mm wide or less. .... 10.

10. Margins of upper stem leaves not pubescent; leaves linear-elliptic, linear-lanceolate, or linear, often glabrous. . 11.

11. Inflorescence subumbellate; leaves linear or linear elliptic. .... 12.

12. Leaves linear (more than 7 times long as wide); inflorescence usually many headed; stems erect, usually biennial; West Florida; $n = 5$ ....(8a) *C. linearifolia* subsp. *linearifolia*

12. Leaves linear-elliptic (less than 7 times long as wide); inflorescence few-headed; procumbent stems, perennial; barrier islands of West Florida; $n = 9$ ....(10a) *C. gossypina* subsp. *cruiseana*

11. Inflorescence open corymbose-cymose; leaves linear, linear-lanceolate to elliptic, often twisted; stems erect, usually biennial; central and southern peninsular Florida; $n = 5$ .... (8b) *C. linearifolia* subsp. *dressii*

10. Margins of stem leaves pubescent, surfaces glabrous to densely woolly; leaves elliptic, lanceolate, or linear. 13.

13. Phyllaries long subulate, often twisted, biennial to short lived perennials; central peninsular Florida; $n = 5$ .. .. (9) *C. subulata*

13. Phyllaries acute to attenuate, not long subulate .... (*C. gossypina*) .... 14.
    14. Inflorescence subumbellate; leaf margins distinctly serrate-pilose; stems erect; usually perennial; La. to central West Florida, and a few scattered locations further east; $n = 9$. .... (10b) *C. gossypina* subsp. *hyssopifolia*
    14. Inflorescence corymbose-cymose; leaf margins various (*C. gossypina* subsp. *gossypina*). .... 15.
        15. Upper stem leaves pilose to glabrous; margins pilose; phyllaries glabrous; stems erect; N.C. to central West Fla.; $n = 9$ .... (10d) *C. gossypina* subsp. *gossypina* f. *trichophylla*
        15. Upper stem leave glabrous to densely long-woolly; phyllaries glabrate to woolly; stems procumbent to erect, biennial or perennial; Va. to Florida on coastal plain; $n = 9$ .... (10c) *C. gossypina* subsp. *gossypina* f. *gossypina*

1. **Chrysopsis mariana** (L.) Ell., Sketch Bot. S.C. and Ga. **2**: 335. 1824.

Inula mariana L. Sp. Pl. 2nd ed. **2**:1240. 1763. TYPE: A specimen in the Linnean Herbarium labelled by Linnaeus as *Inula mariana* (not seen).

Inula glanulose Lam. Encycl. Meth. Bot. **3**: 259. 1789.

Diplopappus marianus (L.) Cass. ex Hook Compan. to Bot. Mag. **1**: 97. 1836.

Inula mariana L. var. Nutt. ex. DC. Prod. **5**: 327. 1836, in syn.

Diplogon mariana (L.) Raf. ex DC. Prod. **5**: 327. 1836, in syn.

Chrysopsis mariana (L.) Ell. var. *macradenia* Fern., Rhodora **39**: 455. 1937. TYPE: Virginia, 1 mil NW of Williamsburg, 19 Oct. 1920. *Fernald & Long 6885* (HOLOTYPE,GH!; ISOTYPES,PH!; US!).

Chrysopsis mariana (L.) Ell. f. *efulgens* Fern., Rhodora **48**: 60. 1946. TYPE: Virginia, NW of Newville, 13 Sept. 1945. *Fernald & Long 14,996* (HOLOTYPE,GH!; ISOTYPES,NY!,US!,GH!).

Heterotheca mariana (L.) Shinners, Field & Lab. **19**: 71. 1951.

Plants perennial, new stems arising from basal rosettes borne on the fibrous rootstock or at the ends of short lateral rhizomes or roots. *Stems* erect or ascending, usually unbranched, 2–9 dm high, with long silky hairs that twist together at the ends, often purple-tinged. *Basal rosette leaves* spathulate to oblanceolate with petiole-like bases, to 25 cm long and 4 cm wide, obscurely dentate apically or entire, acute or obtuse, with long silky hairs like the stems, becoming glabrate. *Stem leaves* reduced upward, sessile, lanceolate to elliptic oblong, 1–3 cm long, entire or obscurely dentate, acute, with hairs like the basal leaves or glabrate and ciliate marginally. *Capitulescence* usually crowded subumbellate-cymose with 1–50 or more heads depending upon the robustness of the plant; *peduncles* densely stipitate-glandular, the glandular tips yellow to brown, 1–5 cm long, sometimes with a few bracteoles, arising from the axes of the upper-most stem leaves or in the axes of peduncular bracteoles. *Involucres* campanulate, 7–10 mm high (ploidy-level-dependent, in part); *phyllaries in* 4–5 unequal series, erect, linear ± 1 mm wide, acute, densely stipitate-glandular on the outer surfaces. *Ray florets* 10–22, averaging 14 per head, the strap 8–11 mm long, 2–3 mm wide. *Disc florets* 5–7 mm long, lobes 0.5 mm long. *Cypselas* straw to purple in color, short strigose, surface shallowly ribbed or smooth, 2–3 mm long; *pappus* double, the outer bristles short, the inner bristles 4–6 mm long. *Chromosome numbers*: $n = 4, 8, 12, 16$.

The species is easily recognized by its capitulescence and leaf pubescence. The morpholoty and distribution are illustrated in Figs. 4J and 6A–E. The fruit is like that of *Chrysopsis floridana* illustrated in Fig. 9D. None of the variants described by other authors have been accepted as meaningful. Gland color was found to vary continuously from yellow to dark brown by Dress (1953). He placed Fernald's var. *macradenia*, distinguished by dark glands, in synonymy, as was done here for the same reasons. Dress (1953) also noted that the rayless condition of f. *efulgens* Fern. was due to insect damage and that even the type collection had some ray florets present, though partially eaten. Some differences in size can be attributed to ploidy level, while other times the differences are due to growth conditions.

The species inhabits open or partially shaded, disturbed sandy and clay soils of pine and oak woods, roadside embankments and natural rocky slopes. Diploid, tetraploid, and octaploid plants are confined to Florida. Hexaploid plants occur in Florida and extend the range to Long Island, New York, and Ohio in the north and extreme eastern Texas in the west.

Plants bloom on a north to south gradient from late August and September on Long Island to November and December in Florida. Occasionally plants may bloom in the late Spring in Florida.

REPRESENTATIVE SPECIMENS. **Alabama.** BALDWIN CO., Gateswood, *Tracy 8,575* (GH, NY, US); CULLMAN CO., Cullman, *Eggert s.n.* (NY, US); ESCAMBIA CO., Atmore, *Blanton*

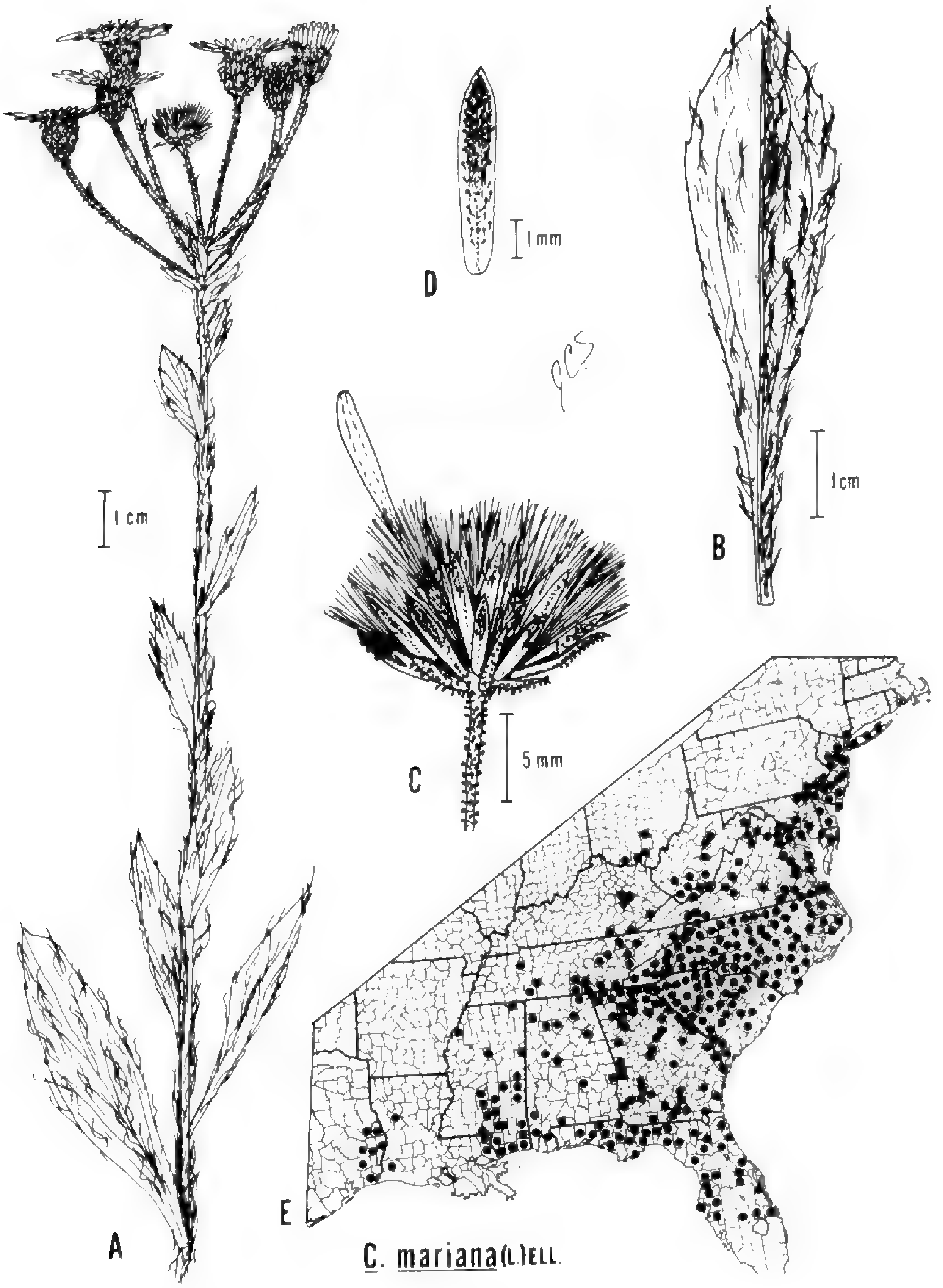

Figure 6. **The morphology and distribution of C. mariana. A.** Flowering shoot, the height and number of heads may be considerably greater than shown. **B.** Lower stem/ basal rosette leaf; the cobwebby hairs are only shown as dense on one side. **C.** A dried head with only one ray floret shown. **D.** Mid series phyllary. **E.** County dot map of the distribution based on all collections seen and literature reports.

7,082 (GH); JACKSON CO, Bryant *Porter s.n.* (GH), MARSHALL CO., Albertville, *Biltmore Herb. 165* (US); MONTGOMERY CO.; Montgomery, *Eggleston 5,139* (GH, NY). **Delaware.** KENT CO.; Milford, *Goodale 62,532* (GH); NEWCASTLE CO.; Wilmington, *Tatnall s.n.* (GH); SUSSEX CO.; Ellendale, *Tatnall 194* (GH). **Florida.** ALACHUA CO.; W. of Gainesville, *D'Arcy 2,219* (GH, NY). BRADFORD CO., Starke, *Gilbert s.n.* (GH); BREVARD CO., N. of Wilson's Corner, *Shuey s.n.* (USF); COLUMBIA CO., Lake City, *Straub 1* (GH); DUVAL CO., Jacksonville, *Curtiss 5,317* (NY,US); FRANKLIN CO., Apalachicola, *Chapman s.n.* (GH,US); *Jones 103* (US); HIGHLANDS CO., S of Lake Istokpoga, *Brass 15,716* (US); HILLSBOROUGH CO., N of Branchton, *Lakela 24,732* (GH,USF); MANATEE CO., Bradenton, *Tracy 7,141* (GH,NY,US); OKEECHOBEE CO., Ft. Bassinger to Okeechobee City, *Small & DeWinkler s.n.* (NY); ORANGE CO., Clarcona, *Meislahn 145* (US); PASCO CO., New Port Rickey, *Carpernter s.n.* (GH); PINELLAS CO., N.E. of Clearwater, *Genelle & Fleming 379* (USF); POLK CO., T. Meade, *Jennings s.n.* (USF); ST. JOHNS CO., W. of Hastings, *Ward 2,278* (GH,US,USF); ST. LUCIE CO., Vero, *Small & De Winkeler 9,738* (GH,NY,US); VOLUSIA CO., Merritt's Is. Nat'l Wildlife Refuge, *Poppleton 579* (USF); WAKULLA CO., N of Sopchoppy, *Godfrey 55,217* (USF).

Georgia. CHARLTON CO., Folkston, *Harper 670* (GH,NY); DAWSON CO., Amicalala Falls, *Duncan 4,246* (CH); EFFINGHAM CO., 4 mi. from Clyo, *Boole 1,037* (GH); ELBERT CO., SE of Elberton, *Duncan 10,573* (GH); GLYNNE CO., N of Brunswick, *Moldenke 5,200* (NY); HARRIS CO., F.D.R. State Park, *Jones 21,612* (GH); JACKSON CO., 11 Mi N of Athens, *Cronquist 4,737* (GH,NY,US); PUTNAM CO., S of Madison, *Cronquist 4,854* (GH,NY,US); RICHMOND CO., Augusta, *Cuthbert 314* (NY); SUMTER CO.; Leslie, *Harper 1,715* (GH,NY,US); UNION CO., N of Cooper Gap, *Duncan 2,924* (GH). WALKER CO.; N of Maddox Gap, *Cronquist 4,811* (GH,NY,US). **Kentucky.** BELL CO., Pine Mt. *Kearney 427* (NY); HARLAN CO., Pine Mt., *Kearney 266* (GH,US); LEE CO., near Beattyville, *Braun 2,148* (US); LETCHA CO., Pine Mt., *Braun 295* (US); MCCREARY CO., Starns Park, *Rogers 1,074* (US); POWELL CO., Natural Bridge, *McFarland 2,042* (GH); WOLFE CO., Sky Bridge, *Braun 2,065* (US). **Louisana.** CALCASIEU PARISH, W of Sulfur, *Brown et al. 8,623* (GH); NATCHITOCHES PARISH, Natichitoches, *Palmer 8,798* (NY,US); ST. TAMMANY PARISH, Covington, *Arsene 11,122* (US); WASHINGTON PARISH, W of Bogalusa, *Brown 6,742* (GH). **Maryland.** ANNE ARUNDEL CO., SE of Leon, *Shull 268* (GH,NY,US); CALVERT CO., Chesapeake Beach, *Hunnewell 5,552* (GH); CECIL CO., Old Neck, *Abbott 139* (US); HOWARD CO., W of Waterloo, *Wilkens 3,052* (UNCC); PRINCE GEORGES CO., Hyattsville, *House 197* (NY); WORCESTER CO., Snow Hill, *Moldenke 6,596* (NY).

Mississippi. CLARKE CO., Shubuta, *Schuchert s.n.* (US); COVINGTON CO., Ora, *Tracy 8,577* (GH,NY,US); HANCOCK CO., Kiln, *Demaree 36,298* (NY); HARRISON CO., Biloxi, *Tracy 4,773* (GH,NY,US). **New Jersey.** ATLANTIC CO., Hummonton, *Gershey 687* (GH); BURLINGTON CO., Atison, *Allen s.n.* (GH); CAMDEN CO., Parkdale, *Pennell 9,118* (NY); CAPE MAY CO., Clermont, *Moldenke 29,008* (US); GLOUCESTER CO., Newfield, *Tiedestrom 8,065* (GH); MONMOUTH CO., Bradley Beach, *Pennell 6,578* (NY); OCEAN CO., Lakewood, *Hunnewell 6,979* (GH). **New York.** BRONX CO.; near N Y Botanical Garden, *Gilly 193* (NY); BURLINGTON CO., New Egypt, *Taylor 2,675* (NY); RICHMOND CO., Staten Is., *Britton s.n.* (GH); SUFFOLK CO., Long Is., Naragansett, *Taylor 1,506* (NY). **North Carolina.** BENTIE CO., Windsor, *Godfrey 6,997* (GH); CASWELL CO., Yanceyville, *Godfrey 5,549* (GH); CRAVEN CO., Fort Barnwell, *Godfrey & White 6,834* (GH); FORSYTH CO., *Schallert s.n.* (NY). HAYWOOD CO., Waynesville, *Standley 5,752* (US); JOHNSTON CO., SE of Smithfield, *Godfrey & Fox 12,044* (GH); MACON CO., Highlands, *Magee s.n.* (GH); MCDOWELL CO., *Beaman 214* (NY); MECKLENBURG CO., Charlotte, *Gress s.n.* (US); ORANGE CO., Chapel Hill, *Godfrey 12,007* (GH); PAMLICO

CO., Grantsboro, *Godfrey & White 6,827* (GH); ROWAN CO., Salisbury, *Heller 83* (NY); RUTHERFORD CO., Chimney Rock, *Hunnewell 10,038* (GH); SWAIN CO., S of Lauada, *Radford 17,284* (US); TRANSYLVANIA CO., Frying Pan Gap, *Rydberg 9,508* (NY); WAKE CO., Raleigh, *Ashe 2,410* (NY).

Ohio. ADAMS CO., Shawnee State Forest, *Braun s.n.* (US); JACKSON CO., Liberty Twp., *Cronquist 4,023* (NY); SCIOTO CO., Camp Gordon, CCC, Shawnee Forest, *Demaree 11,130* (GH,NY). **Pennsylvania** CHESTER CO., Nottingham, *Pennell 8,892* (NY); DELAWARE CO., Lansdowne, *Redfield 2,979* (MO); LANCASTER CO., Pleasant Grove, *Small s.n.* (NY); PHILADELPHIA CO., Wissahickon Ravine, *Lang 586* (GH); YORK CO., E of Bryansville, *Wherry s.n.* (PH). **South Carolina.** AIKEN CO.; Aiken, *Ravenel s.n.* (US); BEAUFORT CO., Beaufort, *Millichamp 418* (US); CHARLESTON CO.; S of Charleston, *Moldenke 5,176* (NY); FAIRFIELD CO., NE of Winnsboro, *Bell 9,936* (GH); HORRY CO., near Burgess, *Weatherby 7,132* (GH,US); JASPER CO., Savannah National Wildlife Refuge, *Mellinger s.n.* (GH); LEXINGTON CO., Batesburg, *McGregor 73* (US); PICKENS CO., Clemson College, *House 2,884* (NY,US). WILLIAMSBURG CO., Benson, *McCullough 15* (US). **Tennessee.** CARTER CO., Roan Mt. Station, *Rydberg 8,228* (NY); CUMBERLAND CO., E of Crossville, *Svenson 4,187* (GH); FENTRESS CO., Allardt, *Shanks 3,093* (GH); HAMILTON CO., Lookout Mt., *Vasey s.n.* (NY); KNOX CO., Knoxville, *Ruth 3,784* (NY); MONROE CO., Cherokee National Forest, *Shanks s.n.* (TENN); SEVIER CO., Gatlinburg, *Miller 2,224* (US); WAYNE CO., Natchez Trace Parkway, *McDougall 1,099* (US).

Texas. JASPER CO., NW of Jasper, *Correll 26,724* (GH). **Virginia.** AUGUSTA CO., Augusta Springs, *Stelle s.n.* (US); BEDFORD CO., *Curtis s.n.* (GH); BRUNSWICK CO., W of Triplett, *Fernald & Lewis 14,509* (GH); CAROLINA CO., NE of Ruther Glen, *Iltis 2,341* (US); CARROLL CO., Galax, *Moldenke 19,267* (NY); DINWIDDIE CO., S of Petersburg, *Fernald et al. 15,371* (GH,NY,US); FAUQUIER col, Hopewell Gap, *Allard 932* (GH,NY); HANOVER CO., Ashland, *Chalmot s.n.* (US); HENRICO CO., Richmond, *Moorman 3,001* (GH); MONTGOMERY CO., W of Blacksburg, *Kral 11,435* (USF); NORFOLK CO., Norfolk, *Jensen s.n.* (GH,NY,US); PAGE CO., Luray, *Ball s.n.* (US); PRINCE EDWARD CO., Worsham, *Baldwin 5,395* (GH); PRINCESS ANNE CO., W of Kempsville, *Kral 14,357* (USF); SHENANDOAH CO., Massanutten, *Hunnewell 11,357* (GH); SUSSEX CO., NW of Waverly, *Fernald & Long 14,997* (GH); WARREN CO., Little Passage Cr., *Miller s.n.* (US). **West Virginia.** BARBOUR CO., Tygart Junction, *Greenman 321* (GH); FAYETTE CO., *Nuttall s.n.* (GH); GREENBRIAR CO., White Sulfur Springs, *Mackenzie 405* (NY); HAMPSHIRE CO., Capon Springs, *Core s.n.* (NY); MONROE CO., Sweet Springs, *Steele 312* (GH,NY,US); SUMMERS CO., Bargers Springs, *Fox 1,955* (GH); UPSHUR CO., *Dickey 155* (GH).

2. **Chrysopsis pilosa** Nutt., J. Acad. Sci. Phila. 7: 66–67. 1834. TYPE: The grassy plains of the Arkansas, *Nuttall s.n.* (HOLOTYPE, PH!; ISOTYPE,? GH).

Not *Chrysopsis pilosa* (Walt). Britt., Mem. Torrey Bot. Club **5**: 316. 1894.

Chrysopsis nuttallii Britt. Mem. Torr. Bot. Club 5:316. 1894.
Diplogon nuttallianum (Britt.) Kuntze, Rev. Gen. 1:334. 1891.
Heterotheca pilosa (Nutt.) Shinners, Field & Lab. 19:68. 1951.

Plants annual, usually only one stem arising from the basal rosette that develops during the Spring. *Stems* erect, sparsely to densely pilose, 1.5–8 dm tall. *Basal leaves* oblanceolate narrowing to petiole-like bases, 5–10 cm long, 1–2.5 cm wide, pilose on both surfaces, entire to apically dentate, acute. *Stem leaves* reduced upward to 1 cm long or less, linear-elliptic, sessile, pilose, obscurely dentate or entire. *Capitulescence* lax cymose, the heads borne on branches arising from the upper most stem leaf axes and from the axes of leaves on primary and secondary branches; *peduncles* 1.5–7 cm long, short pilose, sometimes stipitate-glandular near the heads. *Involucres* campanulate, 6–9 mm high; *phyllaries* in 3–4 unequal series, linear, scarious marginally, sparsely glandular, sparsely to densely short to long pilose. *Ray florets* 11–24, averaging 16 per head, strap 7–10 mm long, 1–2 mm wide. *Disc florets* 4.5–6 mm long, lobes 0.5 mm long. *Cypselas* straw to brown in color, short strigose, smooth or slightly ribbed; *pappus* double, the outer bristles scale-like and short, the inner bristles 5–6 mm long. *Chromosome number*: $n = 4$.

The morphology and distribution of *Chrysopsis pilosa* are illustrated in Figs. 4E and 7A–E. The fruit is like that of *C. floridana* illustrated in Fig. 9D, but less strigose and the outer pappus bristles are broad and scale-like. The size and number of heads borne by a plant depends upon growth conditions. In drier regions and seasons the plants are typically small, few headed, and most stem leaves drop off quickly. The lower stem leaves persist to late in the season only under very moist conditions.

The species inhabits open areas in oak woods in the eastern part of its range and disturbed roadside margins and lots throughout. In the west it inhabits grassy areas in oak savanahs and patches of prairie. Its distribution in Tennessee and Mississippi may be relictual from drier times or may be due to more recent chance introductions along roadsides. The collections from North Carolina are most likely from chance introductions. Efforts to locate populations in central North Carolina during September of 1977 were unsuccessful and they may now be extinct. Soils vary from coarse sand and gravel to fine silt and clay types.

Plants come into bloom in May and continue blooming in some areas until October. The peak blooming period is June.

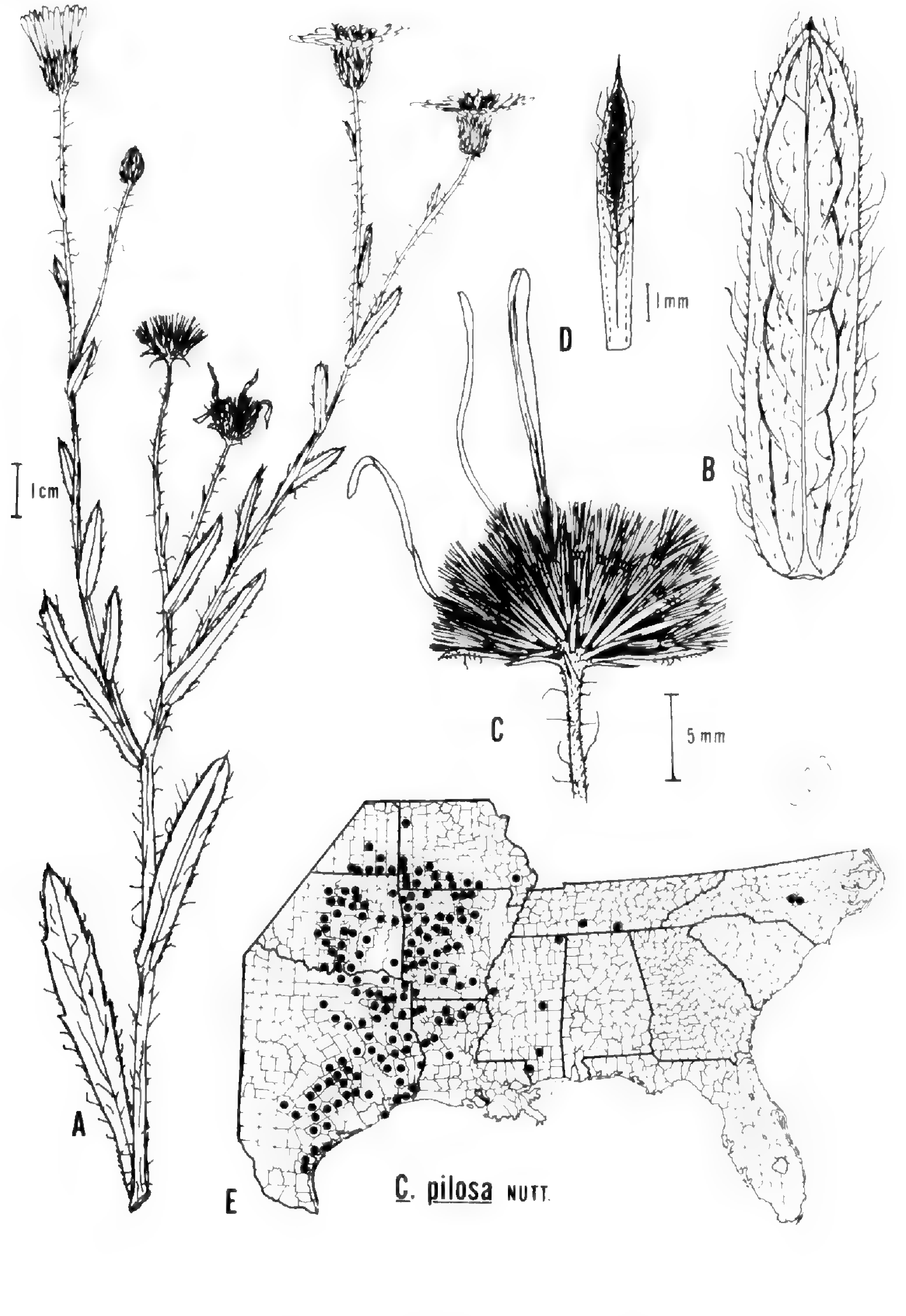

Figure 7. **The morphology and distribution of C. pilosa. A.** Upper portion of a flowering shoot with a few heads. Additional branches bearing heads can arise from lower stem leaves and from the axes of leaves of the inflorescence branches. **B.** Mid stem leaf; upper surface on the left, lower on the right, scale same as C. **C.** Dried head with a few ray florets drawn. **D.** Mid series phyllary. **E.** County dot map of the distribution based on all the collections seen.

REPRESENTATIVE SPECIMENS. **Arkansas.** BENTON CO., Siloam Springs, *Demaree 22,396* (NY); BOONE CO., Harrison, *Palmer 43,849* (NY); CAROLL CO., *Busch 6,034* (UNCC); CLARK CO., Gordon, *Demaree 40,492* (GH); CONWAY CO., Morrilton, Petit Jean State Park *Demaree 25,223* (GH); DREW CO., 9 mi N of Monticello, *Demaree 13,545* (US); FRANKLIN CO., 4 mi S of Ozark on Hwy 23, *Redfern 17,304* (UNCC); FULTON CO., Salem, *Demaree 26,321* (PH); GARLAND CO., Ouchita Mts. near Hot Springs, *Chase 9,913* (NY, UNCC); HOWARD CO., Mineral Springs, *Demaree 42,747* (GH); INDEPENDENCE CO., US Hwy 167 4 mi N of Beltsville, *Thomas 16,367* (UNCC); JOHNSON CO., 5.4 mi S of Ozone, *Smith 947* (UNCC); LOGAN CO., Booneville, *Demaree 8,105* (GH,US); MADISON CO., 2 mi E of Wesley, *Carter 18* (UNCC). MONTGOMERY CO., Hopper, *Tucker 5,284* (UNCC); MILLER CO., Texarkana, *Eggert s.n.* (NY,US); NEVADA CO., 4 mi SE of Prescott Woods, *Hollister 98* (US); OUACHITA CO., Beardon, *Demaree 37,631* (GH); PIKE CO., Lake Greeson, *Tucker 5,687* (UNCC); POLK CO., 6 mi E of Mena, *McWilliam 545* (GH); POPE CO, Dover, *Demaree 19,817* (NY); PULASKI CO., N of Little Rock, *Merrill 506* (GH); SALINE CO.; Bauxite, *Demaree 34,247* (GH, UNCC); SCOTT CO., Mansfield, *Demaree 18,173* (NY); SEVIER CO., 5 mi E of Lockesburg, *Tucker 5,661* (UNCC); STONE CO., Big Springs, *Demaree 59,378* (UNCC); VAN BUREN CO., 1 mi NE of Pee Dee, *Redfern 29,402* (UNCC); WASHINGTON CO.; Fayetteville, *Demaree 22,428* (GH,NY). **Kansas.** CHAUTAUQUA CO., 3 mi NE of Sedan, *McGregor 15,817* (GH); LABETTE CO., SW of Parsons, *McGregor 4,452* (GH); MONTGOMERY CO., Dearing, *Gates 21,632* (NY). NEOSHO CO., Chanute, *Boden 7,035* (NY); WOODSON CO., *Lathrop 1,558* (GH,NY). **Louisana.** BOSSIER PARISH; Barksdale AFB, *Balogh 152* (UNCC); CADDO PARISH, 2 mi NE of Mooringsgart, *Thieret 21,174* (UNCC), 5 mi NW of Shreveport, *Correll 10,100* (GH); LINCOLN PARISH, Douglas, *Moore 5,225* (GH); MOREHOUSE PARISH, 6.5 mi NW of Beckman, *Thieret 20,376* (UNCC); NATCHITOCHES PARISH, Chopin, *Palmer 8,826* (NY,US); OUCHITA PARISH, W of West Monroe, *Thomas 18,868* (UNCC); SABINE PARISH, Toledo Bend Lake, *Soarbrough s.n.* (UNCC); WEBSTER PARISH, Miden, *Brown 5,341* (GH). **Missouri.** GREENE CO., Malden, *Bush 166* (GH); HOWELL CO., 5 mi W of Plains, *Thomas 9,925* (TENN); JASPER CO., Smithfield, *Palmer 16,300* (GH); LAWRENCE CO., ¼ mi E of Spring River on Hwy 60, *Redfern 24,888* (UNCC). **Mississippi.** FOREST CO., Hattiesburg, *Rogers 6,841* (GH); TISHOMINGO CO., *Coleman 50,644* (TENN); WASHINGTON CO., Greenville, *Sargent s.n.* (NY). **North Carolina.** HARNETT CO., 3 mi SW of Kipling, *Godfrey & Fox 49,428* (GH,NY). **Oklahoma** ATOKA CO., 3.2 mi E of Waganoka, *Wiseman & Williams 4* (UNCC); CLEVELAND CO., E of Norman, *Massey 2,295* (UNCC); CREEK CO.; W of Sapulpa, *Pennell 5,394* (PH); HUGHES CO., Calvin, *Demaree 12,728* (NY); JOHNSTON CO., Reagen, *Robbins 2,623* (NY); LOVE CO., 2 mi SW of Bomar, *Goodman 5,706* (GH); MARSHALL CO., 2.8 mi SW of Willis, *William 469* (UNCC); MCCURTAIN CO., N of Tom, *Waterfall 8,469* (GH); MCFAIN CO., SW of Norman, *Massey & Hoisington 1,478* (UNCC); MURRAY CO., Platt Park *Merrill & Hagen 949* (US); OKLAHOMA CO., W of Oklahoma City, *Waterfall 768* (GH); OSAGE CO., Tulsa, *Ward 16* (US); PITTSBURG CO., McAlester, *Palmer 6,408* (US); PONTOTOC CO., Ada, *Robbins 2,226* (NY). **Tennessee.** LAWRENCE CO., SSW of Summerton, *Kral 48,412* (GH, US). **Texas.** ANGELINA CO., S of Lavalla, *Cory 49,751* (GH, NY); ARANSAS CO., Aransas Refuge, *Cory 45,763* (GH, NY, US); ATASCOSA CO., S of San Antonio, *Schulz 417* (US); BASTROP CO., Bastrop-Buescher State Park, *Lundell 8,979* (GH); COLORADO CO., Columbus, *Rushby s.n.* (NY); GALVESTON CO., Galveston Island, *Ridell s.n.* (US); GRAYSON CO., S of Gordonville, *Correll 33,627* (GH); GREGG CO., Kilgore, *Barkley 13,373* (NY); GRIMES CO., W of Roans Prarie, *Thomas & Brett 4,422*

(TENN); HARRIS CO., Houston, *Armon 7,365* (GH); LAVACA CO., SE of Yoakum, *Tharp et al. 49,175* (US); LEON CO., Centreville, *Corell 33,987* (GH); MONTGOMERY CO., E of Conroe, *Raven & Gregory 19,441* (US); MORRIS CO., SE of Daingerfield, *Cory 56,944* (US); NACOGDOCHES CO., Cushing, *Tharp & Braun 53-9* (UNCC); RUSK CO., NW of Tatum, *Cory 56,461* (US); SAN AUGUSTINE CO., San Augustine, *Palmer 10,615* (US); SELBY CO., Center, *Correll 15,357* (UNCC); SMITH CO., NE of Tyler-Camp, *Moore 519* (GH); TARRANT CO., S of Benton, *Whitehouse 16,422* (NY, US); TRINITY CO., SW of Trinity, *Cory 10,480* (GH); VICTORIA CO., E of Aloe, *Pennell 5,498* (NY); WALLER CO., Hempstead, *Haab s.n.* (US).

3. **Chrysopsis scabrella** T. & G., Fl. North Amer. **2**: 255. 1842. TYPE: Florida, in pine woods, *Leavenworth s.n.* (HOLOTYPE, NY!, Torrey Herbarium; ISOTYPE?, GH, fragmentary).

Diplogon scabrellum (T. & G.) Kuntze, Rev. Gen. 334. 1891.
Heterotheca scabrella (T. & G.) Harms, Castanea **39**: 162. 1974.

Plants biennial, rarely perennating a season or two more by production of one or more basal rosettes at the lower stem nodes, usually only one shoot arising from the basal rosette. *Stems* erect, or ascending if more than one, 4–10 dm tall, unbranched in the lower 2/3 or more, branches part of the inflorescence, woolly basally, stipitate-glandular above. *Basal rosette leaves* oblanceolate, sessile, apically dentate-serrate, 4–10 cm long, 1–2 cm wide, densely short-woolly on both surfaces, the hairs flagelliform. *Stem leaves* reduced upward, sessile, linear-elliptic, acute, densely stipitate-glandular on both surfaces, rarely the lower and mid stem leaves woolly. *Capitulescence* corymbose- cymose, 10–100 heads, usually congested and making up less than ¼ of the plant height; *peduncles* 2–10 cm long, stipitate-glandular, with a few linear, stipitate-glandular bracteoles. *Involucres* campanulate, 6–9 mm high; *phyllaries* in 4–5 unequal series, linear, densely stipitate- glandular, 1 mm wide. *Ray florets* 19–32, averaging 21 per head, the strap 6–8 mm long, 1.5–2.5 mm wide. *Disc florets* 5–7 mm long, lobes 0.5–1 mm long. *Cypselas* straw to brown in color, short-strigose, smooth to shallowly ribbed, 2–3 mm long; *pappus* double, the outer bristles short, the inner bristles 5–7 mm long. *Chromosome number:* $n = 5$.

The morphology and distribution of *Chrysopsis scabrella* are illustrated in Figs. 4B and C and 8A–F. The plants have a yellowish-green color in the field that is not always retained upon drying. The species is distinguished by its many-headed, corymbose capitulescence and its small stipitate-glandular stem leaves. Dress (1953)

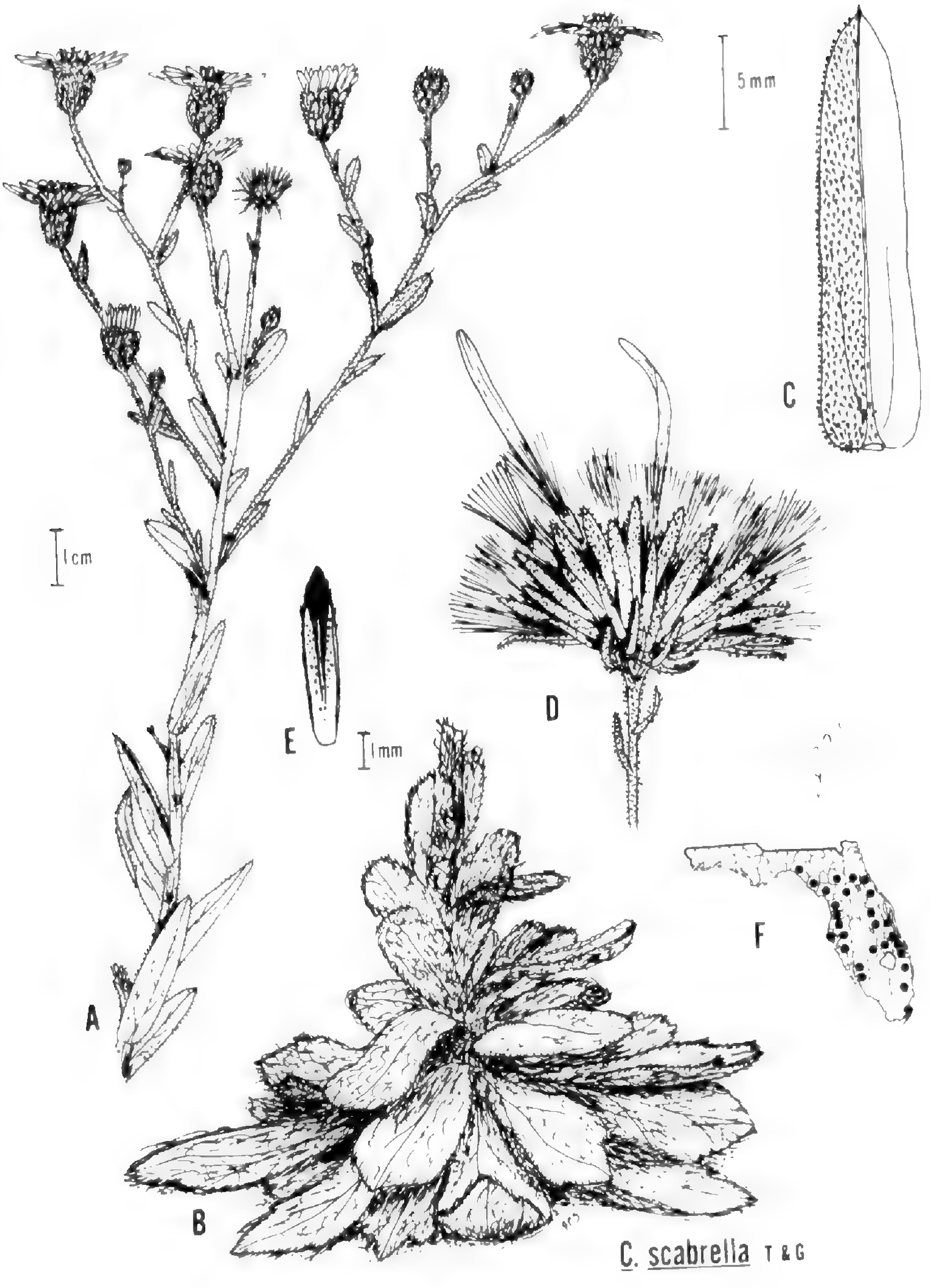

Figure 8. **The morphology and distribution of C. scabrella. A.** A moderate sized shoot with corymbose capitulescence. **B.** A bolting basal rosette with only the lower portion of the stem shown, scale same as A. The leaves are densely short-woolly pubescent. **C.** Mid stem leaf with glands only illustrated on one half. **D.** Dried head with only a few ray florets illustrated, scale same as C. **E.** Mid series phyllary. **F.** County dot map of the distribution based on all collections seen.

treated plants with woolly stem leaves as a variety, but the name was never published. I have found that the point at which leaf indument shifts from woolly pubescence to stipitate-glandularity varies from very low on the stem to more than ½ way up the stem. This continuum would make it necessary to set arbitrary limits to define the typical and woolly varieties. Therefore, the morphotype has not been recognized at any nomenclatural rank. These woolly plants could be mistaken for *C. floridana*, ignoring the inflorescence characteristics. They occur scattered through the range of the species.

The species inhabits open sandy soils, often disturbed, throughout much of the Florida peninsula. Its range extends to Miami on the east coast but it is absent from the Everglades-Lake Okeechobee region. A putative *Chrysopsis scabrella* × *linearifolia* collection was made in Bradenton (*Simpson s.n.*, F) with the odd flowering time of June. The plant has a mixture of traits between the two parents. At a site with *C. floridana* and *C. scabrella* fruit collected from the former species yielded plants of *C. floridana* and *C. floridana* × *scabrella*, when grown at the University of Waterloo. The hybrid did not survive to maturity but did begin developing a corymbose inflorescence and had woolly stem leaves. The plant may have died because of unfavorable greenhouse conditions rather than due to innate genetic factors.

The species blooms from August to December and rarely in the Spring. The peak flowering period is September through October.

REPRESENTATIVE SPECIMENS. **Florida.** ALACHUA CO., W of Archer, *Small et al. 10,043* (GH, NY, US); BREVARD CO., Indian River region, *Fredhom 5,583* (GH, MO); BROWARD CO., Ft. Lauderdale, *Small & Carter 1,036* (NY); CITRUS CO., Hwy 98, close to Hernando Co. line, *Lakela 24,780 & 27,701* (USF); DIXIE CO., 13.5 mi S of Old Town, *R. K. Godfrey 56,191* (GH, NY, FSU), E of Old Town, Suwannee River, *R. K. Godfrey 75,780* (FSU, MO, WAT); FLAGLER CO., N of Bunnell, *Godfrey 50,900* (FSU, NY); HERNANDO CO., Brooksville, *Jones s.n.* (US), 4 mi N of Brooksville, Chinesequt Wildlife Refuge, *Ray 9,507* (USF); HIGHLANDS CO., E of Sebring, *Small & DeWinkeler 9,786* (GH, NY, US); HILLSBOROUGH CO., Tampa, *Garber s.n.* (GH, MO, PH), Temple Terrace, *Godfrey 59,166* (FSU); LEVY CO., between Janney and Vista, *Godfrey et al. 64,787* (FSU); MANATEE CO., Manatee, *Simpson s.n.* (US); MARION CO., 3 mi S of Citra, *Murrill s.n.* (MO), W of Lake George, Small 8,962 (NY); MARTIN CO., Picture City, *Blake 12,100* (GH); MONROE CO., N of Key Largo, *Jennings 12,786* (USF); OSCEOLA CO., 5 mi NW of Loughman, *Ray et al. 10,434* (GH, USF); PASCO CO., Jassamine, *Barnhart 2,609* (NY); PINELLAS CO., Clear Water Harbor, *Chapman s.n.* (US); PUTNAM CO., 9 mi S of Melrose, *Godfrey 69,166* (FSU), San Mateo, *Butts s.n.* (GH), W of Palatka, *Godfrey & Morrill 52,630* (FSU, GH); ST. LUCIE CO., W of the Sabastian River, *Small & DeWinkeler 9,730* (NY); TAYLOR CO., S of Perry, *Godfrey 60,397* (FSU, GH); VOLUSIA CO., Orange City, *Hood s.n.* (MO).

4. **Chrysopsis floridana** Small, Fl. SE U.S., 1339. 1903. TYPE: Florida, Braidenton, 28 November 1901. *Tracy 7,344* (HOLOTYPE, NY!; ISOTYPES, CU, F!, GH!, MINN, MO!, US!).

Chrysopsis mariana (L.) Ell. var. *floridana* (Small) Fern., Rhodora **39**: 455. 1937.
Heterotheca mariana (L.) Shinners subsp. *floridana* (Small) Harms, Wrightia **4**: 13. 1968.
Heterotheca floridana (Small) Long, Rhodora **72**: 44. 1970.

Plants perennial, suffrutescent, the bases of old shoots giving rise to new growth, additional basal rosettes produced at the ends of short lateral rhizomes or roots. *Stems* erect or ascending, 3–7 dm tall, sometimes branching, densely short-woolly pubescent. *Basal rosette leaves* spathulate to oblanceolate, entire or apically dentate, 4 10 cm long, 1.5–2.5 cm wide, densely short-woolly, the hairs flagelliform. *Stem leaves* gradually reduced upward or hardly reduced to just below the capitulescence, obovate-elliptic, slightly auriculate-clasping, entire, sometimes undulate, mucronulate, densely short-woolly pubescent. *Capitulescence* subumbellate-cymose to more paniculate-cymose in branching shoots, 1 25 or more heads, lower branches sometimes flowering also; *peduncles* densely stipitate-glandular, 1–4 cm long with 0–4 linear glandular bracteoles. *Involucres* 5–8 mm high, campanulate; *phyllaries* in 3–4 unequal series, erect, linear, stipitate-glandular, 1 mm wide. *Ray florets* 15–20, strap 6–7 mm long, 1–2 mm wide. *Disc florets* 6–7 mm long, lobes 0.5 mm long. *Cypselas* straw colored, densely strigose, 2–2.5 mm long, smooth or faintly ribbed; *pappus* double, outer bristles short, inner bristles 5–6 mm long. *Chromosome number:* $n = 5$.

The morphology and distributionof *C. floridana* are illustrated in Figs. 4G and 9C–F. The species is easily recognised by its shrubby habit, short-woolly ovate to obovate stem leaves, and its subumbellate capitulescence. The species is very rare and found only on sandhills with Sand Pine in the Tampa Bay region. Only a half dozen populations are known, some of these very marginal for survival. The species will undoubtedly be placed on the rare and endangered species list for Florida and for the United States, a status it deserves. In full bloom it is the most striking of the species

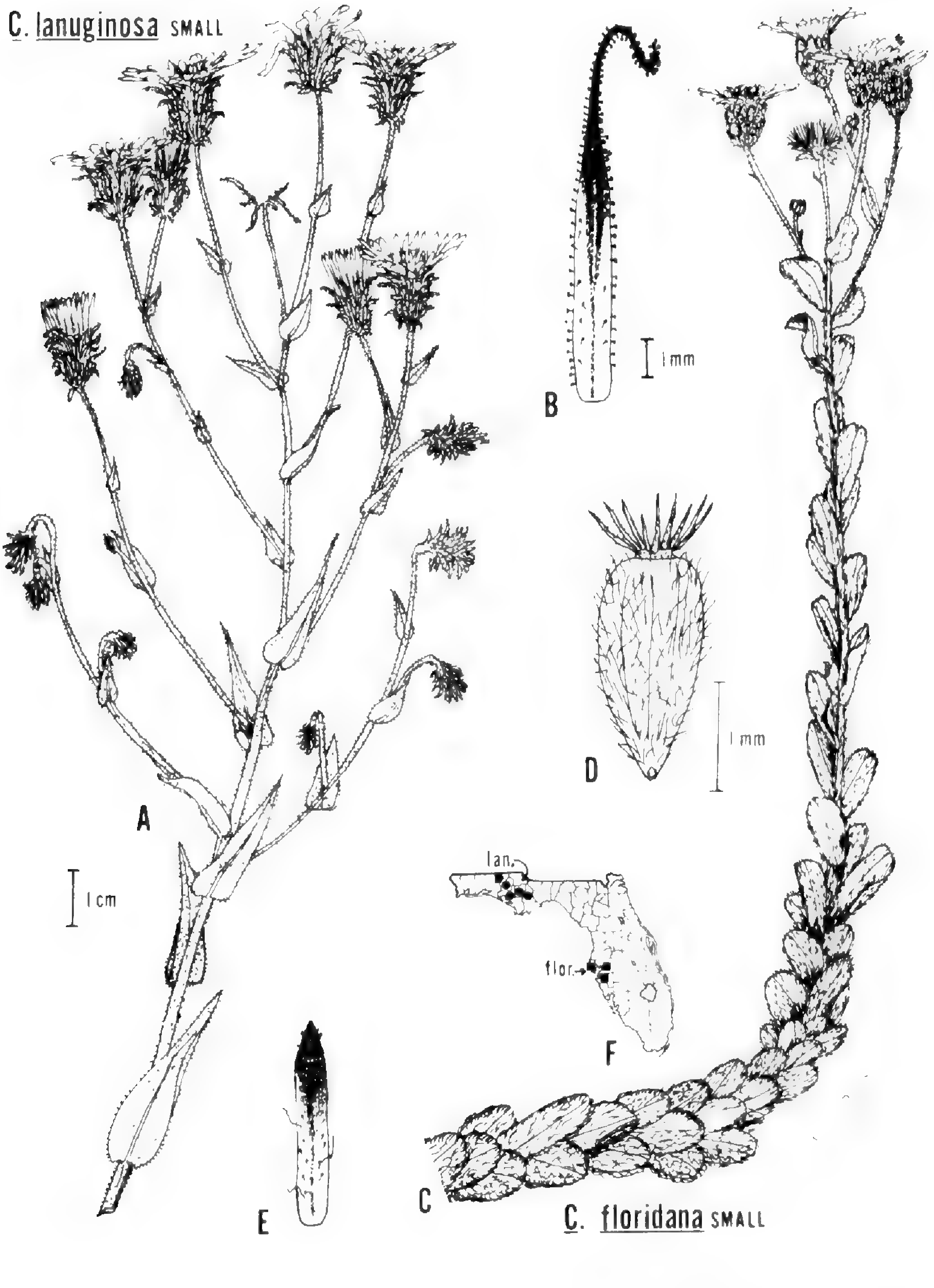

Figure 9. **The morphologies and distribution of C. lanuginosa and C. floridana. A. & B.** *C. lanuginosa.* **A.** Upper portion of stem with small capitulescence; robust plants may have up to 80 or more heads which nod in bud. **B.** Mid series phyllary. **C.–E.** *C. floridana.* **C.** Flowering shoot with a few-headed capitulescence; robust shoots may branch and have up to several dozen heads in a more paniculate arrangement; scale same as A. **D.** Disc floret cypsela; inner pappus bristles not illustrated. **E.** Mid series phyllary; same scale as B. **F.** County dot map of the distribution of *C. lanuginosa* (lan.) and *C. floridana* (flor.) based on all collections seen.

of this group of goldenasters. Its peak blooming period is December.

SPECIMENS EXAMINED. **Florida.** HILLSBOROUGH CO., scrub near Riverview, *Small s.n.* (NY), 5 mi E of Riverview, *Semple & Wunderlin 2,514* (MO, WAT), *Wunderlin 5,658* (MO, WAT, USF), S of Little Manatee River, Rustin, *Lakela 24,826* (FSU, USF) & *24,868* (USF), 0.7 mi S of Little Manatee River, Hwy. 11, *Semple & Wunderlin 2,502* (WAT); MANATEE CO.; between Braidenton and Braidenton Beach, *Godfrey 65,184* (FSU), Manatee, *Simpson s.n.* (US); PINELLAS CO., Long Key, dunes, *Small et al. 10,098* (NY, US).

5. **Chrysopsis lanuginosa** Small, Man. SE Fl. 1339. 1933. TYPE: Florida, near Lynn Haven, grassy places, *Van Cleve 11* (HOLOTYPE, NY!, aberrant specimen; ISOTYPE, US!).

Plants biennial, usually only one shoot arising from the basal rosette. *Stems* erect, 4–10 dm tall, densely stipitate-glandular, usually unbranched in the lower 2/3's. *Basal rosette leaves* oblanceolate, 3–8 cm long, densely long-woolly pubescent, the hairs flagelliform. *Stem leaves* sessile, clasping, linear-lanceolate to lanceolate, reduced upward, entire, densely stipitate-glandular on both surfaces. *Capitulescence* paniculate-cymose, (18–)30–80 heads nodding in bud; *peduncles* densely stipitate-glandular, 2–12 cm long, with 0–6 clasping glandular bracteoles. *Involucres* campanulate, 8–12 mm high; *phyllaries* in 3–4 unequal series, linear, the tips long-subulate, often twisted and reflexed, densely stipitate-glandular, 1 mm wide. *Ray florets* 12–31, averaging 19 per head, straps 8–11 mm long, 1.5–2.5 mm wide. *Disc florets* 5–6 mm long, lobes 0.5 mm long. *Cypselas* densely strigose, 2–2.5 mm long, straw colored; *pappus* double, the outer bristles short, the inner bristles 5–6 mm long. *Chromosome number:* $n = 5$.

The morphology and distribution of *Chrysopsis lanuginosa* are illustrated in Figs. 9A, B, and F. The species has a yellowish-green color in the field accented by the sometimes black-tipped glands. Small plants can be morphologically similar to robust individuals of *C. godfreyi* f. *viridis*, but are distinguished by their more paniculate capitulescence, their usually longer and more linear stem leaves and the linear, subulate phyllaries.

The species is endemic to a small region of western Florida to the north and east of the type locality in Bay County, Florida. The species has apparently very recently expanded its range by colonizing greatly disturbed Slash Pine plantations after clear-cut logging operations (R. K. Godfrey, pers. comm.). Populations persist at such sites for a few years before other species colonize and cover the barren sandy soil. The numbers of individuals at such sites can reach into the thousands. In Calhoun County a population was found which included very robust plants that had flowering branches arising from nodes along the entire stem. Hundreds of heads were in bloom at the same time on these plants. The species blooms from October to December and rarely in the Spring.

REPRESENTATIVE SPECIMENS. **Florida.** BAY CO., Lynn Haven, *Godfrey 59,119* (FSU), N of Lynn Haven, jct. of Fla. 77 and Rte 20, *Godfrey 75,774a* (FSU, MO, USF, WAT), approx. 7 mi N of Panama City, *Godfrey & Houk 61,555* (FSU), 10.5 m N of Southport, *Godfrey 61,639* (FSU); CALHOUN CO., 6 mi W of Clarksville, *Godfrey & Semple 76,120* (FSU); HOLMES CO., 5.5 mi E of Argyle, *Godfrey & Semple 76,210* (FSU); LIBERTY CO., 4.5 mi E of Bristol, *Godfrey 75,712* (FSU, WAT, MO), between Hosford and Quincy, 0.8 mi from county line, *Godfrey 76,070* (FSU), Torreya State Park, *Godfrey 72,274* (FSU), White Springs E of Bristol, *Godfrey 64,667* (FSU); WASHINGTON CO., S of Chipley, Crystal Lake, *Godfrey 61,637* (FSU), 3 mi S of Wausau, *Godfrey 73,939* (FSU).

6. **Chrysopsis godfreyi** Semple, Can. J. Bot. **56**: 2092. 1978.
TYPE: Florida, Okaloosa Co.; US 98 E of Destin, dunes N of Silver Beach Wayside Park, 5 November 1977, *Semple & Godfrey 3,148* (HOLOTYPE, WAT!; ISOTYPES, FSU!, GH!, MO!, NY!, US!, USF!).

Plants biennial or perennating by means of basal rosettes developing along the previous season's growth at soil level. *Stems* solitary and unbranched to branched in robust plants, decumbent or ascending to erect, 2–5 dm tall, woolly basally and either woolly apically or densely stipitate-glandular. *Basal rosette leaves* oblanceolate, obtuse, sparsely dentate-serrate apically, to 10 cm long, long-woolly on both surfaces, hairs flagelliform. *Stem leaves* ovate to linear-lanceolate, entire, sometimes strongly clasping, woolly or glabrous and densely stipitate-glandular, acute, either abruptly or gradually reduced below the inflorescence. *Capitulescence* corymbose-cymose to corymbose-paniculate in robust plants, 5–15 (25) heads nodding in bud; *peduncles* densely stipitate-glandular, bracteoles either glabrous-glandular or densely woolly. *Involucres* campanulate, 9–12 mm high; *phyllaries* 4–5 unequal series, attenuate to subulate, tips spreading to recurved, densely stipitate-glandular. *Ray florets* 16–36, averaging 25 per head, straps 10–15 mm long. *Disc florets* 6–7 mm long, lobes 0.5–1 mm long. *Cypselas* straw colored 2–2.5 mm long, densely strigose, shallowly ribbed; *pappus* double, outer bristles short, inner bristles 6–7 mm long. *Chromosome number:* $n = 5$.

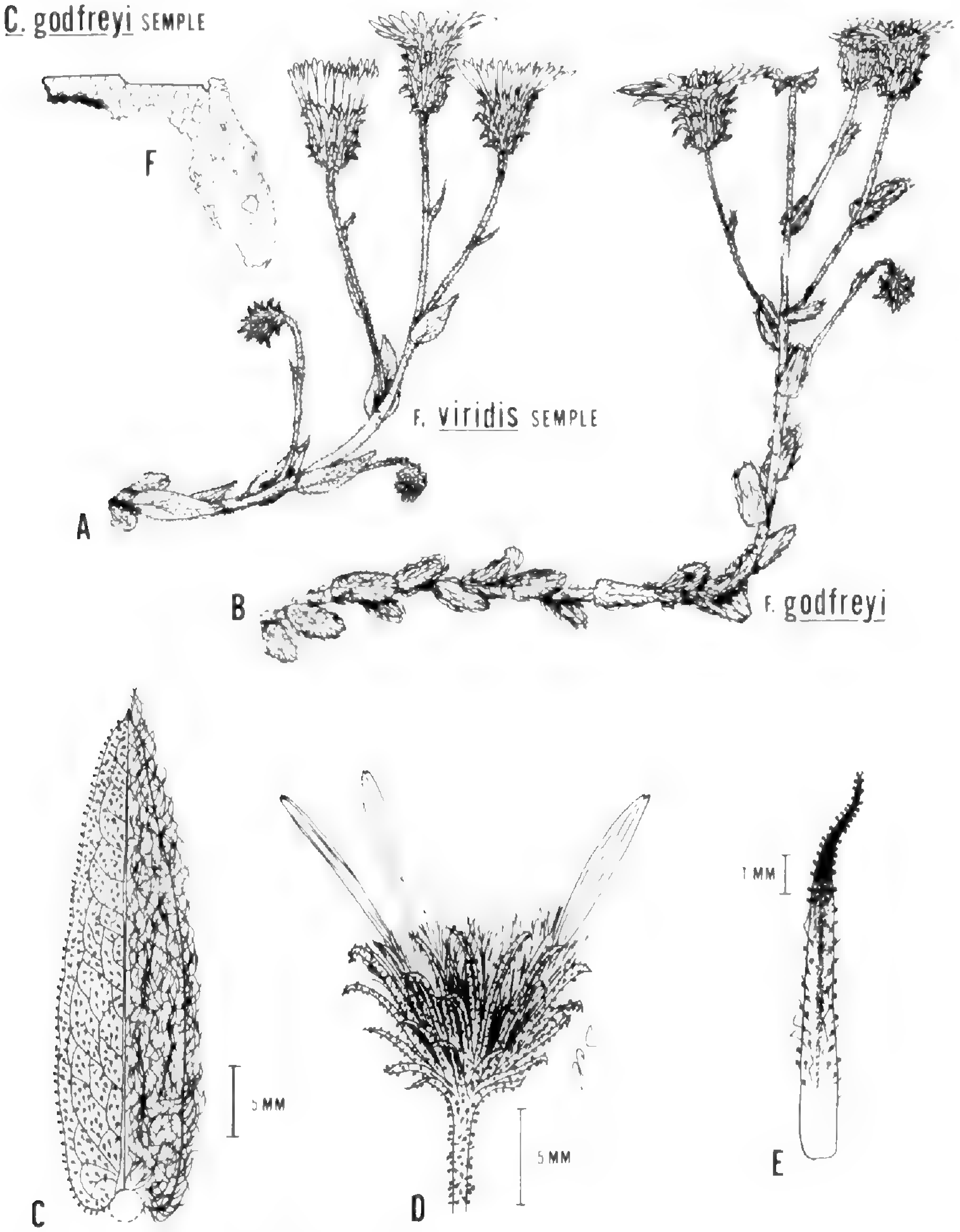

Figure 10. **The morphology and distribution of C. godfreyi. A.** Stem of f. *viridis*. **B.** Stem of f. *godfreyi*. **C.** Mid stem leaf; left side drawn as f. *viridis*, right side drawn as f. *godfreyi*. **D.** Head of either form. **E.** Mid series phyllary. **F.** County dot map of the distribution based on herbarium collections and field observations.

The morphology and distribution of *Chrysopsis godfreyi* are illustrated in Figs. 4A and F and 10A–F. The habit varies from nearly procumbent to fully erect depending upon the habitat and the age of the plant. The shape of the phyllaries varies from west to east, the least subulate occurring in the east in Bay County. The merely attenuate phyllaries and few-headed cymose capitulescence distinguish the eastern plants of f. *viridis* from *C. lanuginosa* to which it is closely related. Two forms occurred at all locations visited.

The species is endemic to the Gulf coast barrier islands of western Florida. The eastern limits are reached in Bay County, the western near Alabama. The species grows in deep sand, often serving to stabilize dunes. It can occur in small populations of a few individuals or in very large populations of hundreds of plants in relatively open natural dunes or open cleared lots.

6a. **Chrysopsis godfreyi** f. **godfreyi**.

This form is distinguished from the next by its densely long-woolly pubescence on the stem leaves and peduncular bracts.

Representative specimens: (see Semple, 1978a).

6b. **Chrysopsis godfreyi** f. **viridis** Semple, Can. J. Bot. **56**: 2093. 1978. Type: Florida, Okaloosa Co.; US 98 E of Destin, dunes N of Silver Beach, Wayside Park, 5 November 1977, *Semple & Godfrey 3,139* (holotype, WAT!; isotypes, FSU!, GH!, MO!, NY!, US!, USF!).

This form is distinguished by its green, densely stipitate-glandular stem leaves and peduncle bracts.

Representative specimens: (see Semple, 1978a).

7. **Chrysopsis latisquamea** Pollard, Proc. Biol. Soc. Wash. **13**: 131. 1900. Type: Florida, Clarona, *M. Meislahn 15a* (holotype US!, isotype NY!).

Heterotheca latisquamea (Pollard) Harms, Castanea **39**: 163. 1974.

Plants biennial or weakly perennial, usually one shoot arising from the basal rosette. *Stems* unbranched to branching from below the middle, 4–7 dm tall, erect, long-woolly pubescent below, becoming densely stipitate-glandular above. *Basal rosette leaves* oblanceolate, obtuse, to 8 cm long and 2 cm wide, densely long-woolly, the hairs flagelliform. *Stem leaves* reduced upward, sessile, elliptic to ovate, entire, obtuse, mucronulate, densely long-woolly, the upper-most leaves less so and stipitate-glandular. *Capitulescence* lax to compact corymbose-cymose, individual branches with 1–5 heads, to 60 heads per plant; *peduncles* densely stipitate-glandular, 1–6 (10) cm long, bracteoles stipitate-glandular, ovate to lanceolate. *Involucres* campanulate, 8–11 mm high; *phyllaries* in 2–3 unequal series, 1.5–2.5 mm broad, stipitate-glandular, oblanceolate, acute. *Ray florets* 10–18 averaging about 14 per head, straps 10–15 mm long, 2–3.5 mm wide. *Disc florets* 6.5–8.5 mm long, lobes 1 mm long. *Cypselas* sparsely strigose, ribbed, 1–3 narrow to broadly clavate, yellow to red-brown translucent ridges per side, 2–3 mm long; *pappus* double, outer bristles short, inner bristles 7–9 mm long. *Chromosome number:* $n = 5$.

The morphology and distribution of *Chrysopsis latisquamea* are illustrated in Figs. 4A and B and 11A–D. The species is distinctive and easily recognised by its light green involucres with broad foliaceous, stipitate-glandular phyllaries, its long-woolly pubescent leaves, and the translucent ridges on the fruits. It occurs sympatrically with *C. gossypina* in the northwestern part of its range; it has been confused with broad-phyllaried forms of the latter. The heads of the *C. gossypina* subsp. *gossypina* in the region of sympatry are never densely stipitate-glandular and have a darker green color, not yellow-tinged. The habit varies from a single erect unbranched stem to ramose, spreading forms. The latter forms also could be confused with forms of *C. gossypina* which can manifest this habit. No evidence of hybridization was found at several populations visited in 1976. One of these sites was a disturbed lot with dozens of individuals of both taxa intermixed and blooming at the same time. No herbarium collections appear to be hybrids either.

The species grows throughout most of northeastern Florida as far south as Tampa. It grows in sandy, open soils of pine woods and scruboak communities and in disturbed soils along road embankments and cleared lots. It blooms from August to October and occasionally as early as May.

REPRESENTATIVE SPECIMENS. **Florida.** ALACHUA CO., Waldo, *Gilman s.n.* (MO); CITRUS CO., Hernando, *Degener 5,237* (NY), 4 mi NW, *Kral 6,891* (USF); COLUMBIA CO., Lake City, *Hitchcock 900* (F), S of town, *Godfrey 50,829* (NY); HERNANDO CO., Brooksville,

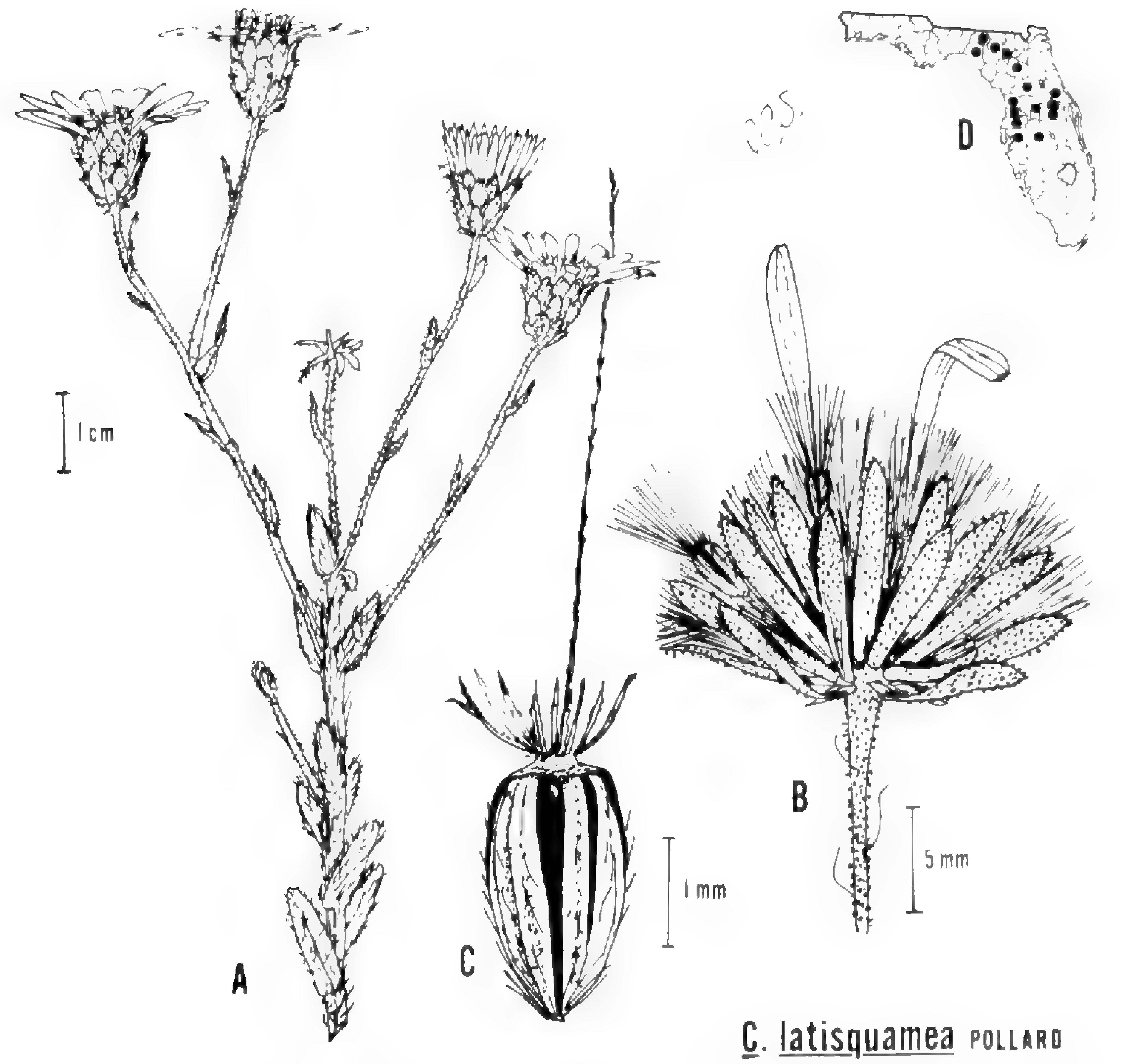

Figure 11. **The morphology and distribution of C. latisquamea. A.** Flowering stem with a few-headed inflorescence; the number of heads can be much greater. **B.** Dried head with only a few ray florets drawn. **C.** Disc floret fruit with only one of 30-35 long pappus bristles drawn. **D.** County dot map of the distribution based on all collections seen.

4.5 mi N, *Godfrey 50,859* (FSU), Choocochattee Hammock, *Small et al. 10,603* (NY), 6 mi N at Chinesequt Hill, *Cooley 6,900* (USF), *Ray 9,393* (USF); HILLSBOROUGH CO., 12 mi N of Tampa, *Blanton 6,644* (F, GH, USF), Tampa, *Garber s.n.* (F, GH, NY, PH, US); LAKE CO., Eustis, *Hitchcock 899* (F, MO), *Nash 970* (PH), *Nash 1,307* (GH, MO, NY, US); MADISON CO., E of Madison *Godfrey 53,960* (USF), *Norris 638* (USF); MARION CO., 3 mi N of Ocala, *Blanton 6,636* (GH, MO); ORANGE CO., Beresford, *Hood s.n.* (MO), Lake Brantley, *Lewton s.n.* (PH), 1 mi E of Orlando, *O'Neill 5,596* (US); SEMINOLE CO., Forest City, *Lewton s.n.* (NY); VOLUSIA CO., Lake Helen, *Webster s.n.* (US).

8. **Chrysopsis linearifolia** Semple, Brittonia **30**:493. 1978. TYPE: Florida. Franklin Co.; US 98 just S of the Ochlockonee River, open sandy ridge, adjacent to longleaf pine-scrub-[oak] road stand, 2 November 1976, *Godfrey 75,745* *(Holotype,* MO!, Isotypes, FSU!, GH!, NY!, USF!, WAT!).

This species is equivalent to *C. hyssopifolia* of nearly all previous authors, who misapplied the name. Semple (1978b) noted the reasons for this incorrect nomenclature.

Plants biennial, rarely perennating by production of basal rosettes. *Stems* erect and unbranched usually, 3–20 dm tall, glabrous, often reddish-purple. *Basal rosette leaves* to 10 cm long, oblanceolate to linear-oblanceolate, glabrous to densely woolly, the hairs flagelliform. *Stem leaves* entire, linear to linear-lanceolate, glabrous, margins occasionally undulate, acute to obtuse. *Capitulescence* subumbellate or loosely open corymbose-cymose (4) 20–100 heads; *peduncles* glabrous. *Involucres* campanulate, 6–10 (12) mm high; *phyllaries* in 4–5 unequal series, glabrous, a few stipitate-glands at the bases of the outer series, acute, appressed. *Ray florets* 10–30, straps 9–12 mm long. *Disc florets* 5–6 mm long, lobes 0.5–1 mm long. *Cypselas* sparsely strigose, straw colored, 2–2.5 mm long, weakly ribbed and with 1–3 golden-yellow to red-brown clavate, translucent ridges per side; *pappus* double, outer bristles short, inner bristles 4–6 mm long. *Chromosome number:* $n = 5$.

The morphology and distribution of *C. linearifolia* are illustrated in Figs. 4B, C and D and 12A–G. Two subspecies are recognised. Both subspecies occur in sandy soils of pine and oak woods and scrublands and in disturbed open soils such as are found along roadsides and in cleared lots. The species blooms from September through November and in the Spring on occasion, particularly in southern Florida.

8. **Chrysopsis linearifolia** subsp. **linearifolia.**

The panhandle Florida taxon is distinguished by its compact subumbellate-paniculate capitulescence of (10) 30–100 heads with 10–20 rays and its very narrow stem leaves. The basal rosettes often have a mixture of woolly and glabrous leaves, the difference appearing to be due to the time of development. Depaupered plants of this subspecies could be confused with linear-leafed forms of *C. gossypina* subsp. *hyssopifolia*, which differ in having ciliate leaf margins and a chromosome number of $2n = 18$.

REPRESENTATIVE SPECIMENS: (see Semple, 1978b).

8b. **Chrysopsis linearifolia** subsp. **dressii** Semple, Brittonia **30**: 493–494. 1978. TYPE: Florida; Brevard Co., Merritt Is.,

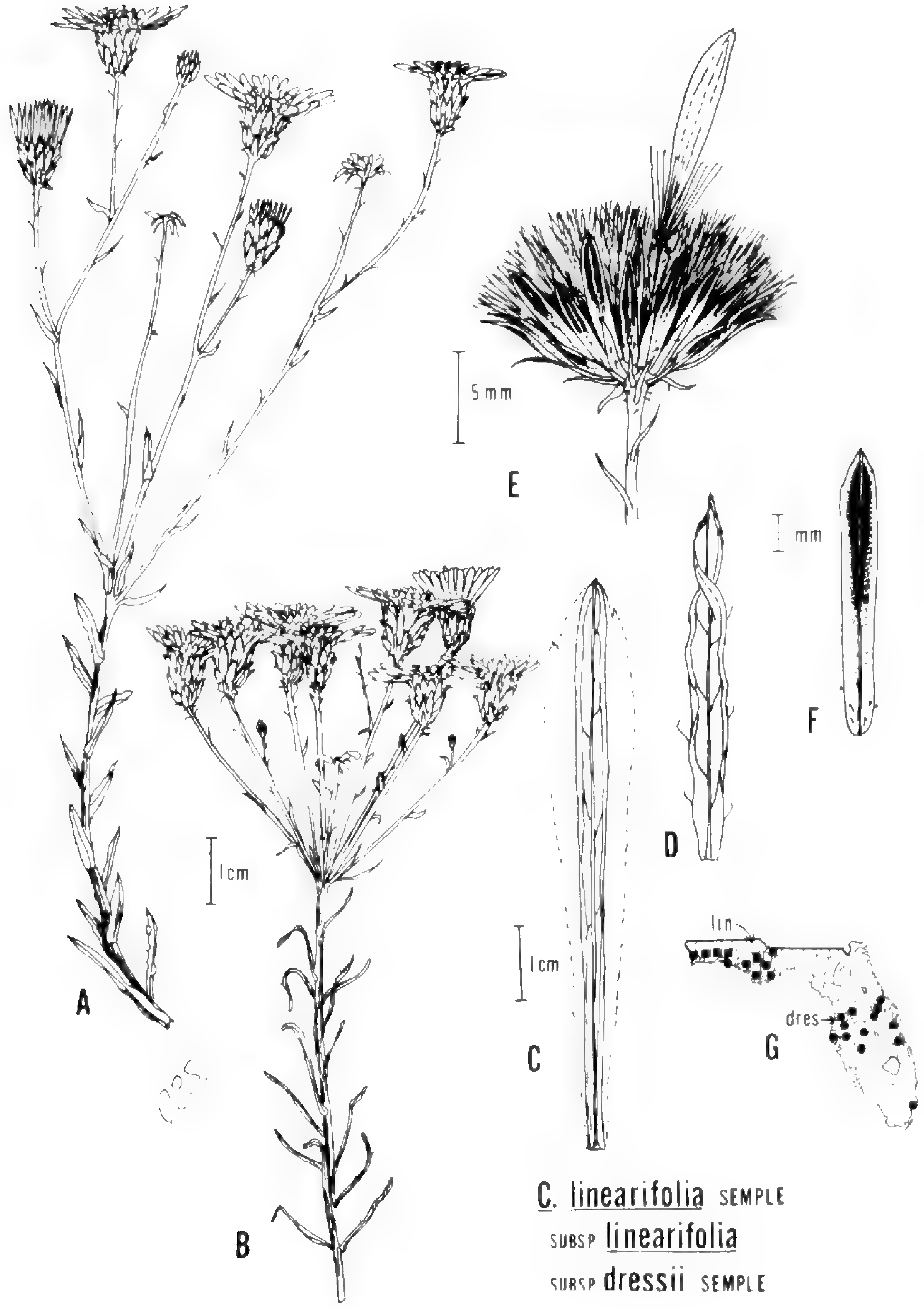

Figure 12. **The morphology and distribution of C. linearifolia. A.** Blooming shoot of subsp. *dressii.* **B.** Small blooming shoot of subsp. *linearifolia;* these shoots can be up to 2m tall with up to 100 heads. **C.** Basal rosette leaf; the broken line indicates an alternative form which can be densely woolly pubescent, as can the linear form; the upper stem leaves of subsp. *linearifolia* are similar to the glabrous linear form. **D.** Undulate stem leaf of subsp. *dressii*; scale same as C. **E.** Dried head with only one ray floret drawn. **F.** Mid series phyllary. **G.** County dot map of the distribution of the two subspecies (subsp. *linearifolia*- "lin"-squares; subsp. dressii- "*dress*"-dots) based on all collections seen.

Dummit Cover, Rte. 3, 2 Oct. 1976. *Semple, Wunderlin, Poppleton & Norman 2530* (HOLOTYPE, MO!; ISOTYPES, US!, USF!, WAT!).

This primarily peninsular Florida taxon is distinguished by its loosely corymbose-cymose capitulescence of 4–30 (50) heads with 20–30 ray florets and its often undulate-margined, narrow, lanceolate-elliptic stem leaves. The plants of the peninsula could be confused with very sparsely pubescent forms of *Chrysopsis subulata,* differing in their twisted, subulate phyllaries. The rare individuals of this subspecies found near the coast of western Florida are similar to forms of *C. gossypina* subsp. *cruiseana*, which differ in having a compact subumbellate capitulescence and a chromosome number of $2n = 18$.

REPRESENTATIVE SPECIMENS: (see Semple, 1978b).

9. **Chrysopsis subulata** Small, Man. SE Fl. 1338. 1933. TYPE: Florida, scrub between Avon Park and Sebring, 17 July 1924, *Small, Small & DeWinkler 11,495* (Holotype, NY!, Isotypes, GH!, US!).

Heterotheca hyssopifolia (Nutt.) Long var. *subulata* (Small) Long, Rhodora **72**: 43. 1970.

Plants biennial, frequently perennating by means of basal rosettes produced at the bases of old stems and at the ends of short lateral rhizomes and roots. *Stems* often much branched near the base, sometimes through damage, 2–7 dm tall, sparsely pubescent, sometimes purple-tinged. *Basal rosette leaves* oblanceolate to linear-oblanceolate, first season leaves densely long-woolly, the hairs flagelliform, other seasons sparsely to densely long-woolly, 5–10 cm long. *Stem leaves* linear-lanceolate, entire, often undulate margined, acute, marginally ciliate, reduced upward and becoming linear, sparsely pubescent. *Capitulescence* lax cymose, a few heads per branch; *peduncles* thin, 1–10 cm long, glabrous-glabrate, bracteoles ciliate margined. *Involucres* campanulate, 8–10 mm high; *phyllaries* in 4–5 unequal series, linear, long subulate (very rarely acute), the tips twisted and reflexed to spreading, glabrous or with a few stipitate glands at the bases. *Ray florets* 10–28, averaging about 18 per head, straps 5–8 (–10) mm long, 1.5–2 mm wide. *Disc florets* 5–6 mm long, lobes 0.5 mm long. *Cypselas* narrowly compressed-obconic, 1.5–2 mm long with several to many yellow to dark red-brown, clavate, translucent ridges; *pappus* double, outer bristles short, inner bristles 6–7 mm long. *Chromosome number:* $n = 5$.

The morphology and distribution of *Chrysopsis subulata* are illustrated in Figs. 13A–E. The species is easily identified by its long subulate phyllaries typical of all populations but a few in Alachua County, Florida. These plants have a normal habit and leaf character, but the phyllaries are merely acute like those of *C. linearifolia*, with which it could be confused for this reason. Such plants could also be confused with *C. gossypina* f. *trichophylla*, with which there has been some nomenclatural confusion as well. The fruits vary in the number of ridges and the size. At one extreme they are similar to those of other species (Fig. 11C). At the other end they are noticeably smaller, narrower, and have many ridges which

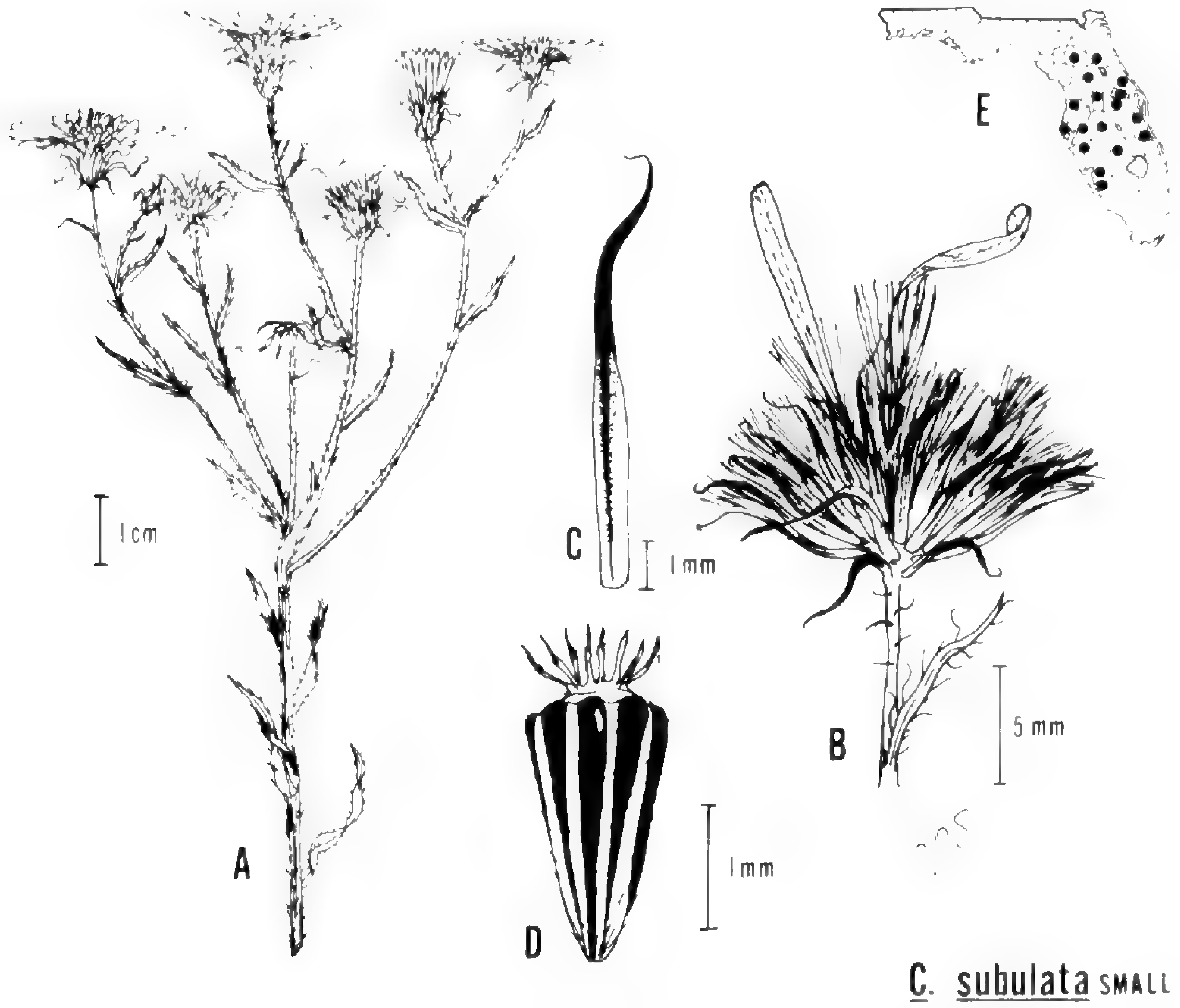

Figure 13. **The morphology and distribution of C. subulata. A.** Flowering branch, upper portion. **B.** Dried head with only a few ray florets drawn. **C.** Mid series phyllary. **D.** The extreme form of disc fruit with narrow body and many translucent ridges; the other extreme is like that shown in Fig. 11C. **E.** County dot map of the distribution based on all collections seen.

nearly cover the entire surface of the fruit (Fig. 13D). The habit also varies from fairly unbranched to much branched from near the bases or along much of the stem. The plants readily perennate by means of basal rosettes produced at the ends of short lateral rhizomes or roots. Small clones can form in this way.

The species grows in a broad central zone of the Florida peninsula. It inhabits open sandy soils of pine woods and oak scrublands and open disturbed soils of roadsides and cleared lots. Its peak blooming period is earlier than the other species native to Florida. It flowers from May to September, peaking in July and August. Dr. R. P. Wunderlin (pers. comm.) has noted that these early blooming shoots often have a second flush of blooming in mid to late Fall. Thus, plants can be found from October to December with flowering heads, but otherwise brown and dried stems, the leaves having dropped off for the most part.

REPRESENTATIVE SPECIMENS. **Florida.** ALACHUA CO., Gainesville, N of Lake Warburg, *Murrill 229* (MO, US); BREVARD CO., Eau Gallie, *Curtiss 1,364* (NY, US), Melbourne, *Curtiss 5,733* (GH, NY, US), N Merritt Is. *Shuey & Poppleton* s.n. (USF); CHARLOTTE CO., Salt Springs, Myakka Peninsula, *Small et al. 10,609* (NY); FLAGLER CO., N of Ormond, *Butts s.n.* (GH); HERNANDO CO., *Hitchcock 898* (MO), Brooksville area, *Jones 29* (US), Choochochattee Hammock, *Small et al. 11,477* (NY), sand hills, *Mosura s.n.* (USF); HILLSBOROUGH CO., Ruskin, *Blanton 6,753* (F), Sutherland, *Barnhart 2,741* (NY), Tampa, *Lakela 32,053* (USF), *Britton & Wilson 17* (NY), U.S.F. campus, *Lakela 24,158* (USF); INDIAN RIVER CO., near Felsmere, *Small 8,901* (GH, NY, US); LAKE CO., near Eustis, *Nash 1,239* (GH, NY, US), *Nash 1,575* (PH); MANATEE CO., Braidentown, *Tracy 7,073* (GH, NY, US), *Genelle & Fleming 2,071* (USF), S of Duette, *Shuey 1,651* (USF); MARION CO., 5 mi W of Asor Park, *Kral 7,672* (USF); ORANGE CO., pine barrens, *Fredholm 5,356* (GH, NY), Bithlo, *O'Neil s.n.* (US), Clarcona, *Meislahn 144b* (US), E of Orlando, *Lakela 24,380* (USF); PINELLAS CO., E of Clearwater, *Kral 7,460* (USF), St. Petersburg, *Williams s.n.* (PH); POLK CO., Crooked Lake area, *Lakela 24,193* (USF); PUTNAM CO.; 2 mi S of Crescent City, *Butts s.n.* (GH). SEMINOLE CO., Banford, *Betting 317* (F); VOLUSIA CO., *Poppleton 891* (USF), Ormond, *Purdie s.n.* (GH), Pierson, *Dowell 7,590* (NY).

10. **Chrysopsis gossypina** (Michx.) Ell. Sketch Bot. S.C. and Ga. **2**: 337. 1824. TYPE: Lieux arides en Basse Caroline, fleurit en Septembre, *Michaux s.n.* (P, seen on microfiche only).

?Erigeron pilosum Walt., Fl. Car. 206. 1788, nom. nud.
Inula gossypina Michx. Fl. Bor. Am. **2**: 122. 1803.
Diplopappus lanatus Cass., Dict. des Sc. Nat. **13**:309. 1819.
Chrysopsis dentata Ell., Sketch Bot. S.C. and Ga. **2**: 337. 1824.
Chrysopsis gossypina (Michx.) Ell. *β dentata* (Ell.) T. & G., Fl. North Amer. **2**: 254. 1842.

Diplogon pilosa (Walt.) Kuntze, Rev. Gen. 334. 1891.
Chrysopsis pilosa (Walt.) Britt., Mem. Torr. Bot. Club **5**: 316. 1894 (non Nutt. 1834).
Heterotheca gossypina (Michx.) Shinners, Field & Lab. **19**: 71. 1951.

Three subspecies are recognized in this highly variable allopolyploid complex. These are described below.

10a. **Chrysopsis gossypina** subsp. **cruiseana** (Dress) Semple, Can. J. Bot. **58**: 147. 1980.

Chrysopsis cruiseana Dress, Gentes Herb. **8**: 404–406. 1954. TYPE: Florida, Santa Rosa Island, about 2 mi E of Pensacola Beach, in white sand on level ground and on dunes well back from the outer beach, 27 December 1953, *Dress & Cruise 2,822* (Holotype, BH); Santa Rosa Island, 28 May 1903, *Tracy 8,539* (Paratypes, F!, GH!, MINN, MO!, US!).

Plants perennial, older ones developing up to 80 shoots from persistent bases of old stems. *Stems* usually decumbent, unbranched, 2–6 dm long, glabrous, often purple-tinged. *Basal rosette leaves,* 3–10 cm long, oblanceolate, densely long-woolly, the hairs flagelliform, apically dentate. *Stem leaves* elliptic to oblanceolate, 1–3 cm long, mucronulate, glabrous, acute to obtuse, entire, the lower ones dropping off stem by the time of flowering. *Capitulescence* subumbellate-cymose, (3) 10–30 heads; *peduncles* glabrous, 2–8 cm long, bracteoles oblanceolate, glabrous. *Involucres* campanulate, 8–12 mm high; *phyllaries* in 4–5 unequal series, linear, 1–1.5 mm wide, acute, the tips appressed to slightly spreading, glabrous, a few stipitate glands at the bases of the outer ones. *Ray florets* 17–27, averaging about 23 per head, straps 7–10 (12) mm long, 2–3 wide. *Disc florets* 6–7 mm long, lobes 0.5 mm long. *Cypselas* sparsely strigose, 2.5–3 mm long, shallowly ribbed, 1–3 yellow to red-brown clavate, translucent ridges per side; *pappus* double, outer bristles short, inner bristles 6–8 mm long. *Chromosome number:* $n = 9$.

The morphology and distribution of *Chrysopsis gossypina* subsp. *cruiseana* are illustrated in Figs. 4H and 14A–C. The plants are perennial; the shoots of older plants are decumbent, while the first shoot may be erect. The number of shoots varies with age and growing conditions. As many as 80 shoots can be produced in a season by plants growing in sheltered dune habitats. Plants more exposed to sea air are often stunted.

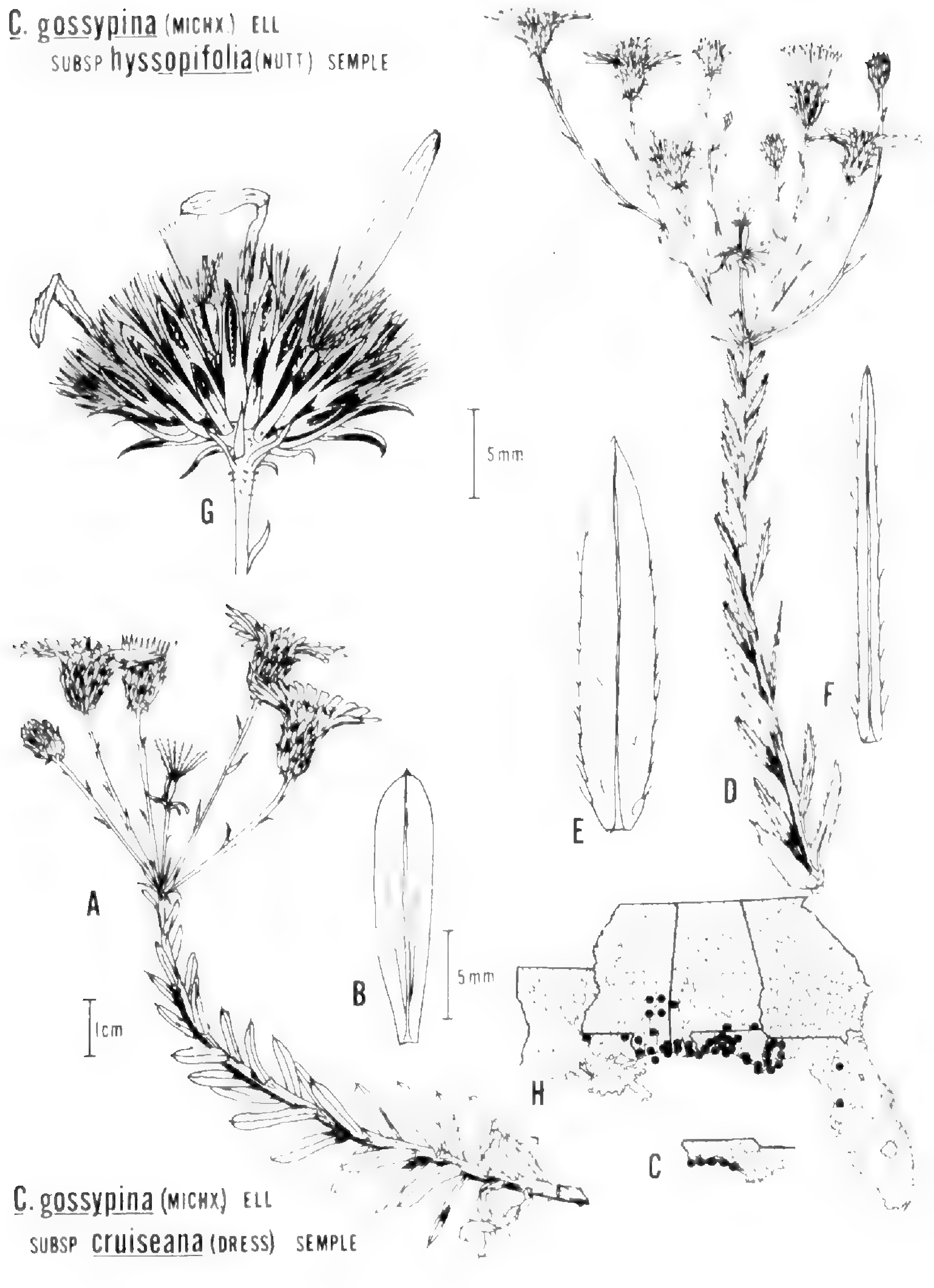

Figure 14. **The morphology and distribution of C. gossypina subsp. cruiseana and subsp. hyssopifolia. A.-C.** subsp. *cruiseana.* **A.** Flowering shoot with a few heads. **B.** Mid stem leaf. **C.** County dot map of the distribution based on all collections seen. **D.-H.** subsp. *hyssopifolia.* **D.** Flowering shoot; scale same as A. **E.** & **F.** Stem leaves; scale same as B. **G.** Dried head; the heads of subsp. *cruiseana* and subsp. *gossypina* f. *trichophylla* are similar. **H.** County dot map of the distribution based on all collections seen.

The subspecies inhabits sandy dunes on the Gulf Coast barrier islands of Alabama and Florida. It blooms from October to December.

REPRESENTATIVE SPECIMENS. **Florida.** ESCAMBIA CO., Santa Rosa Is. Nat'l Seashore area, *Godfrey 73,965* (FSU), 4 mi E of Pensacola Beach, *McDaniel 7,179* (MO); OKALOOSA CO., E of Destin, *Godfrey 73,954* (FSU), 2 mi E of Fort Walton, *McDaniel 5,483* (FSU), E of Fort Walton Beach, *Godfrey 76,165* (FSU); SANTA ROSA CO., 3 mi E of Pensacola Beach bridge, *Ward 1,729* (GH), 17.5 mi E of Pensacola Beach, *McDaniel 7,167* (FSU, MO), W of Gulf Is. Nat'l Seashore, *Boufford et al. 18,584* (MO); WALTON CO., Seagrove Beach, *Godfrey 75,771* (FSU, MO, WAT), E of Grayton Beach State Park, *Ward s.n.* (FSU, USF).

10b. **Chrysopsis gossypina** subsp. **hyssopifolia** (Nutt.) Semple, Can. J. Bot. **58**: 147. 1980. *Chrysopsis hyssopifolia* Nutt., J. Acad. Phila. **7**: 67. 1834. TYPE: W. Florida, *Ware s.n.* (Holotype, PH!).

Chrysopsis trichophylla (Nutt.) Ell. *β hyssopifolia* (Nutt.) T. & G., Fl. North Amer. **2**: 254. 1842.
Chrysopsis trichophylla (Nutt.) Ell. var. *hyssopifolia* (Nutt.) Chapman, Fl. S.U.S. 216. 1860.
Diplogon hyssopifolia (Nutt.) Kuntze, Rev. Gen. 334. 1891.
Chrysopsis gigantea Small, Fl. S.E.U.S. 1939. 1903. TYPE: Florida, *Leavenworth s.n.* (HOLOTYPE, NY!; ISOTYPE, GH!).
Chrysopsis mixta Dress, Gentes Herb. **8**: 404–406. 1954. TYPE: Florida, 5.5 mi E of Argyle on US-90, 2 Oct. 1953. *Dress 2,689* (HOLOTYPE, BH).
Heterotheca hyssopifolia (Nutt.) Long, Rhodora **72**: 42–43. 1970.
Heterotheca hyssopifolia (Nutt.) Harms, Castanea **39**: 163. 1974.

Plants perennial, sometimes biennial, propagating by basal rosettes produced at the lowest nodes of old stems and at the ends of short to long lateral rhizomes or roots. *Stems* erect or ascending, 2 7 dm tall, glabrous or sparsely pubescent, often purple-tinged, solitary or several from a common rosette. *Basal rosette leaves* oblanceolate, 3–10 cm long, apically dentate or entire, sparsely to densely long-woolly, the hairs flagelliform, perennating rosettes often sparsely woolly. *Stem leaves* linear to linear-lanceolate, sparsely pubescent to glabrous, the margins ciliate, reduced upward, ascending. *Capitulescence* subumbellate-cymose, sometimes corymbose-cymose, 1 15(25) heads; *peduncles* glabrate, 1–6 cm long, bracteoles linear to linear-lanceolate, often ciliate along the margins. *Involucres* 8–11 mm high, campanulate; *phyllaries* in 4–5 unequal series, linear, tips spreading to recurved, acute, glabrous. *Ray florets* 9–23, averaging 17 per head, straps 7–11 mm long, 1.5–2 mm wide. *Disc florets* 6–8 mm long, lobes 0.5–1 mm long. *Cypselas* sparsely strigose, 2.5–3 mm long, shallowly ribbed, 1–3 yellow to red-brown clavate, translucent ridges per side; *pappus* double, outer bristles short, inner bristles 5–7 mm long. *Chromosome number:* $n = 9$.

The morphology and distribution of *Chrysopsis gossypina* subsp. *hyssopifolia* are illustrated in Figs. 4I and 14D–H. Usually the plants develop one erect shoot with a compact subumbellate inflorescence of a few heads. Damaged plants in the central and western portion of the range are branched and the peduncles long and branched giving the plant an appearance like those occurring further east within the range of subsp. *gossypina.* Plants found in the central part of the range have the narrowest leaves and look the least like individuals of subsp. *gossypina.* Such linear-leaved plants could be confused with *C. linearifolia* subsp. *linearifolia,* which has a chromosome number of $2n = 10$ and lacks the ciliate leaf margins typical of *C. gossypina* subsp. *hyssopifolia.* The subspecies intergrades with the other two subspecies where ranges overlap. Some plants are assigned to a subspecies only with difficulty, since they have characteristics of both, or of all three. This is particularly true for plants from Bay, Gulf, Liberty, Franklin, Gadsden, Leon, and Wakulla Counties in Florida. In this region the plants are easily confused with subsp. *gossypina* f. *trichophylla.* At points where the mainland is in contact with the barrier island chain on the Gulf coast subspecies *hyssopifolia* hybridizes with subsp. *cruiseana.*

The subspecies grows in open sandy soils and disturbed sites in pine woods and oak scrub and by roadsides and cleared lots. Colonies are usually small under natural conditions, but can include dozens of plants, when disturbed sites are occupied.

The subspecies blooms from October to December.

REPRESENTATIVE SPECIMENS. **Alabama.** BALDWIN CO., Lillian, *Shinners 28,908* (FSU), S of Seminole, *McDaniel 3,918* (FSU); CHOCTAW CO., N of Toxey, *McDaniel 9,826* (FSU); COVINGTON CO., E of Florala, *Kral 33,651* (FSU); ESCAMBIA CO., Wilson, *Mohr s.n.* (US); HOUSTON CO., N of Crosby, *Godfrey 67,508* (FSU); MOBILE CO., NE of Theodore, *Pennell 4,491* (NY). **Florida.** ESCAMBIA CO., Pensacola, *Mohr s.n.* (US), near Bayou San Marcus Creek, *Kral & Godfrey 6,033* (FSU); OKALOOSA CO., E of Crestview, *Godfrey 76,197* (FSU), W of Ft. Walton Beach near county line, *Godfrey &*

Semple 76,173 (FSU), NE of Holt, *Godfrey 59,028* (FSU), NW of Niceville, *Chapman 194* (USF); SANTA ROSA CO., NW of Buxton, *Godfrey & Houk 62,539* (FSU), E of Gulf Breeze, *McDaniel 5,302* (FSU); WALTON CO., W of Portland, *Chapman & Smith, 1,150* (USF), near Mossyhead, *Dress 2,694* (FSU), E of Destin, *McDaniel 5,460* (FSU). **Louisana.** WEST FELICIANA PARISH, Jackson, *Drummond 85* (GH); WASHINGTON PARISH, NW of Sheridian, *Ewan 19,443* (FSU). **Mississippi.** HARRISON CO., Biloxi, *Tracy & Lloyd 5,450* (GH, NY); JONES CO., W of Eastabuchie, *Jones 10,282* (FSU); MOBILE CO., Dauphin Is., *Deramus D-1023* (GH).

The following collections have the capitulescence and habit of subsp. *gossypina* and the ciliate leaf margins and often the leaf shape of subsp. *hyssopifolia:*

Florida. BAY CO., E of Tyndall, *McDaniel 3,830* (FSU); FRANKLIN CO., E of Wright Lake SW of Sumatra, *Godfrey 76,059* (FSU); LEON CO., Tallahassee, *Berg s.n.* (NY); S of Tallahassee, *Norris 643* (TEX), W. of Tallahassee, *Godfrey 75,743* (MO); LIBERTY CO., Bristol, *Mohr s.n.* (NY); WAKULLA CO., Apalachicola Nat'l Forest, Forest Rd.-113, *Godfrey 76,245* (FSU).

10c & d. **Chrysopsis gossypina** subsp. **gossypina.**

Plants biennial or weakly perennial, surviving more than two seasons by means of basal rosettes developing at lower stem nodes. *Stems* erect to procumbent, 2–6 dm long, unbranched or branching, glabrous to densely woolly, sometimes stipitate-glandular. *Basal rosette leaves* oblanceolate, 3–10 cm long, apically dentate or entire, densely long-woolly, the hairs flagelliform. *Stem leaves* lanceolate or ovate-elliptic to oblanceolate, obtuse to acute, margins entire, sometimes ciliate, sparsely to densely woolly, sometimes glabrate with age. *Capitulescence* loosely corymbose-cymose, 1–10 (30) heads; *peduncles* glabrous to woolly, sometimes stipitate-glandular. *Involucres* 8–13 mm high, campanulate to hemispherical; *phyllaries* in 4–5 unequal series, glabrate to densely woolly, sometimes densely stipitate-glandular, usually some glands basally, linear-lanceolate to oblanceolate, 1–2 mm wide, appressed to recurved. *Ray florets* (9) 16–30, averaging about 21 per head, straps 7–12 mm long, 1–2.5 mm wide. *Disc florets* 6–7.5 mm long, lobes 0.5 mm long. *Cypselas* sparsely to moderately strigose, shallowly ribbed, 0–3 yellow to red-brown clavate, translucent ridges per side, 2–3 mm long; *pappus* double, the outer bristles short, the inner bristles 6–8 mm long. *Chromosome number:* $n = 9$.

The morphology and distribution of *Chrysopsis gossypina* subsp. *gossypina* are illustrated in Figs. 4A, 15A–F, and 16A–G. Three

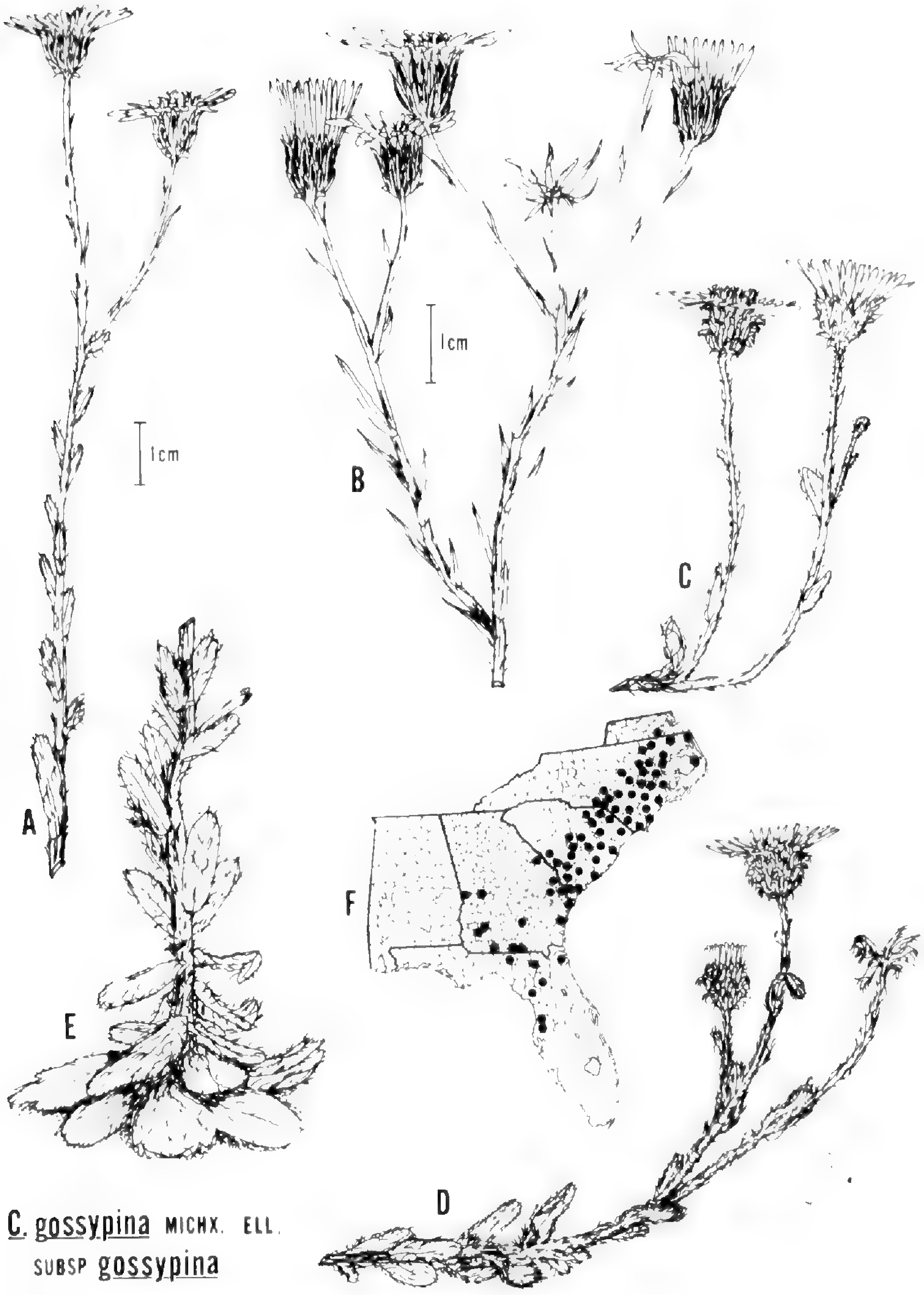

Figure 15. **Morphology and distribution of C. gossypina subsp. gossypina. A.** Flowering shoot of f. *gossypina* with sparsely pubescent, appressed phyllaries. **B.** Upper portion of a shoot of f. *trichophylla* with glabrous peduncles and phyllaries. **C.** Terminal portion of a decumbent shoot of f. *decumbens* with stipitate-glandular peduncles and phyllaries that are stipitate-glandular and spreading recurved. **D.** Procumbent shoot of f. *gossypina* with densely woolly peduncles and phyllaries, which are like the type collection. **E.** Lower stem and portion of shoot of either f. *gossypina* or f. *trichophylla*. **F.** County dot map of the distribution based on all collections seen.

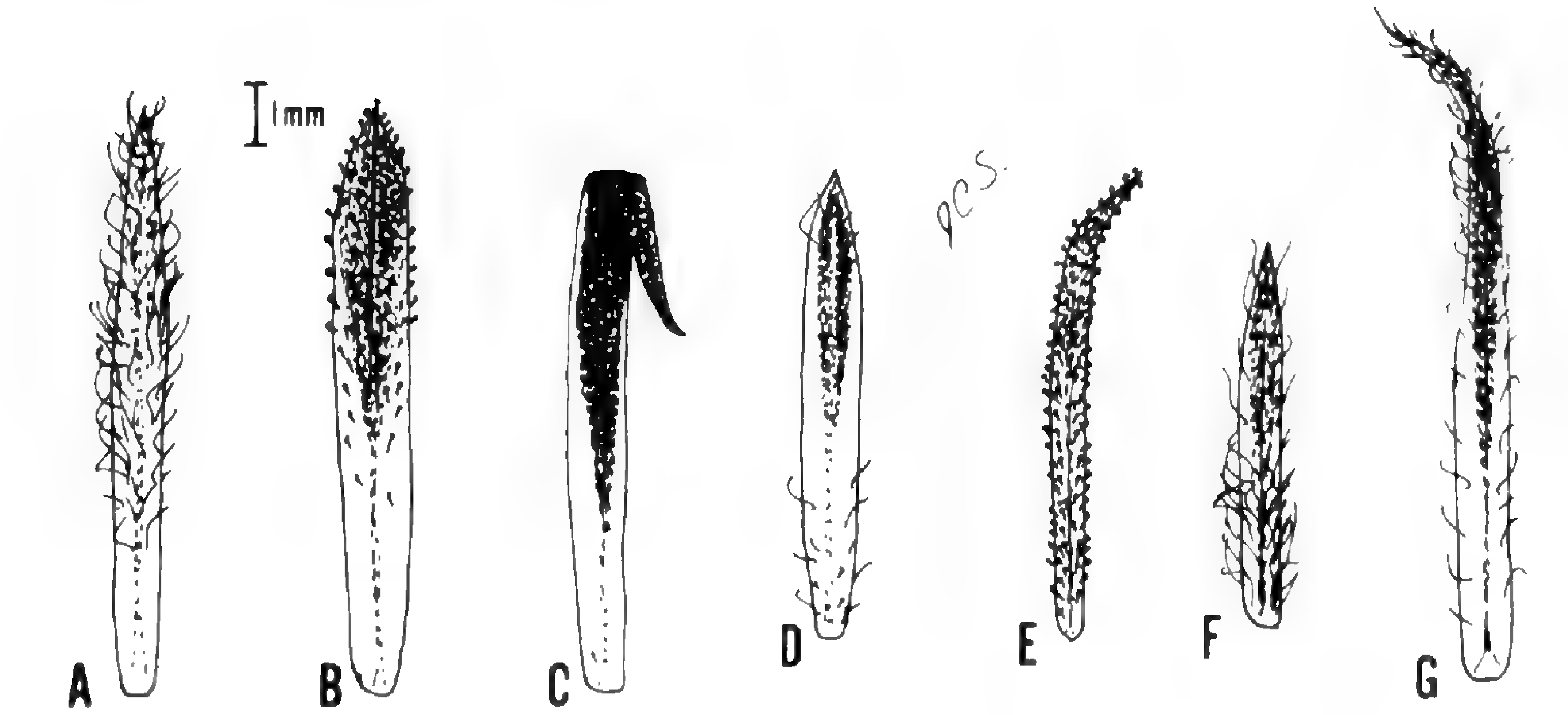

Figure 16. **Phyllaries of C. gossypina subsp. gossypina.** All are drawn to the same scale. **A., D., F. & G.:** f. *gossypina;* **B. & E.:** f. *decumbens;* **C.** f. *trichophylla.* **A.** *Godfrey 48,681* (GA). **B.** *Cronquist 4,728* (GH). **C.** *Eggleston 4,951* (GH). **D.** *Godfrey 48,681* (GA). **E.** *Godfrey & Fox 48,674* (MO). **F.** *Semple & Wunderlin 2,563* (WAT). **G.** *Godfrey 76,102* (FSU).

forms have been given nomenclatural recognition. Intermediates are common and only the most pronounced variants are easily assigned to one of the named forms. The forms can occur in populations by themselves or in mixed populations. The intergradation is such that even varietal level recognition would be overemphasizing single characteristics.

The subspecies occurs in open sandy soils in pine woods and scruboak stands, disturbed sites along roadsides and naturally barren slopes. It blooms from September in the north to November in the south.

10c. **Chrysopsis gossypina** subsp. **gossypina** f. **gossypina**

Chrysopsis longii Fern., Rhodora **40**: 467. 1938. TYPE: Virginia, 7 mi S of Franklin, 7 & 8 Sept. 1937. *Fernald & Long 7,664* (HOLOTYPE, GH!, ISOTYPES, NY!, PH!, US!).

Included in the type form are all individuals of the subspecies with some pubescence on the phyllaries and usually the peduncles as well. The phyllaries may be appressed to recurved. The heads are hemispherical to campanulate and vary greatly in size. The extremely woolly-pubescent morphotypes are most common in northern Georgia, the Carolinas, and Virginia. In Florida heads tend to be less pubescent. Leaf pubescence also varies from moderately to densely woolly, the woolliest forms again occurring mostly in the north. Habit varies from erect to procumbent, sometimes with branches arising from anywhere between the base and the midstem region.

REPRESENTATIVE SPECIMENS. **Florida.** ALACHUA CO., SW of Gainesville, *Todsen & Arnold s.n.* (GA, TEX), Kanapaha, *Murill 399 & 400* (US); DUVAL CO., Jacksonville, *Curtiss 5,318* (F, GA, GH, NY, US); HERNANDO CO., *Cooley et al. 7,021* (USF); LEVY CO., *Garber s.n.* (F, GH, NY, PH, US); MADISON CO., SSW of Ellaville, *Kral 6,172* (GA, GH, USF); PASCO CO., Jessamine, *Barnhart 2,629* (F, NY). **Georgia.** BAKER CO., near Emory U., *Thorne 6,649* (GA); BULLOCK CO., Lott's Creek Church, *Boole 965* (GH); CHATHAM CO., Ft. Argyle Rd. *Mellinger s.n.* (GH); DOUGHERTY CO., Albany, *Eggleston 5,109* (NY); LOWNDES CO., S of Valdosta, *Faircloth 667* (GA, MO); MCINTOSH CO., Pocosin, NE of Ft. Barrington, *Bozeman 2,362* (GA); MUSCOGEE CO., *Smith s.n.* (GH, US); RICHMOND CO., Augusta, *Cuthbert 313* (NY); SCREVEN CO., Blue Springs, *Eyles 7,567* (GA, GH); TAYLOR CO., S of Butler, *Harper 2,240* (F, GH, MO, NY, US). **North Carolina.** BRUNSWICK CO.; Caswell Beach, *Godfrey 12,067* (GH), *Bell 16,297* (TEX); CUMBERLAND CO.; between Fayetteville & Jonesboro, *Radford & Stewart s.n.* (NY); CURRITUCK CO., N of Kitty Hawk, *Bright 15,996* (TEX); DARE CO., Kill Devil Hill, *Morton 11,999* (US); HARNETT CO., S of Spout Springs, *Godfrey 50,119* (F); HOKE CO., S of Antioch, *Godfrey & Fox 50,555* (NY); JOHNSTON CO., S of Benson, *Godfrey & Fox 48,704* (GH); LENOIR CO., SE of Kingston, *Randolph 569* (GH); NEW HANOVER CO., N of Carolina Beach, *Blake 12,436* (LL); ONSLOW CO., S of Jacksonville, *Moldenke 123* (MO, NY, PH); SCOTLAND CO., S of Aberdeen, *Godfrey 6,939* (GH); WAYNE CO., Goldsboro, *Godfrey 6,554* (GH). **South Carolina.** AIKEN CO., Aiken, *Eggleston 5,074* (GH, MO, NY); BAMBURG CO., WNW of Govan, *Ahles 37,644* (GA); CHARLESTON CO., S of Hollywood near Meggetts, *Blake 12,543* (TEX); CHESTERFIELD CO., W of McBee, *Godfrey 8,058* (F, MO, NY, PH, US); DARLINGTON CO., W of Hartville, *Norton 500* (US); GEORGETOWN CO.; S of Georgetown, *Blake 12,546* (LL); HORRY CO., between Ocean Drive and Myrtle Beach, *Godfrey & Boyce 50,451* (GH, NY); MARLBORO CO., N of Cheraw, *Godfrey & Fox 50,582* (NY, PH); ORANGEBURG CO., Eutaville, *Eggleston 4,961* (NY in part); RICHLAND CO., W of Clemson U. Ex. Station, *Crewz 871* (USF); SUMTER CO., Sumter, *Stone 409* (PH). **Virginia.** SOUTHAMPTON CO., S of Franklin, *Townsend 7,725* (F, GH, LL, MO, NY); *Fernald & Long 7,664* (MO), N of Smith's Ferry, *Fernald & Long 8,875* (GH, PH).

10d. **Chrysopsis gossypina** subsp. **gossypina** f. **trichophylla** (Nutt.) Semple, Can. J. Bot. **58:** 147. 1980.

Inula trichophylla Nutt. Gen. N. Am. Pl. **2**: 150. 1818. TYPE: N. Carolina, *Nuttall s.n.* (HOLOTYPE, PH!).
Chrysopsis trichophylla (Nutt.) Ell., Sketch Bot. S.C. and Ga. **2**: 336. 1824.
Diplopappus trichophyllus (Nutt.) Hook. Compan. Bot. Mag. **1**: 97. 1836.
Heterotheca trichophylla (Nutt.) Shinners, Field & Lab. **19**: 71. 1951.

Included in this form are plants with truly glabrous phyllaries and peduncles. The leaves are sparsely woolly to glabrate with sometimes ciliate margins. The heads are frequently large with the phyllaries appressed to slightly spreading at the tips. This morphotype is most common in the southern portion of the subspecies' range. The stems are erect and unbranched or branched below the middle.

This form has nearly always been given species status by authors, who Dress (1953) suggested "took up Nuttall's name" because they were unfamiliar with the *gossypina* complex and assumed it was a valid species. Dress placed the name in complete synonymy under his subsp. *gossypina,* not even giving the morphotype form status. Harms (1974b) felt that the *trichophylla* complex was one of the most difficult problems in *Chrysopsis* and one that was, even following his conspectus, in dire need of a careful study to resolve its phylogeny and nomenclature. Such a study has now been carried out and recognition of *trichophylla* as a form, the conclusion.

REPRESENTATIVE SPECIMENS. **Georgia.** DOOLY CO., Gum Creek, *Harper 567* (F, GH, MO, NY, US); ECHOLS CO., S of Mayday, *Faircloth 4,985* (GA, MO); LOWNDES CO., S of Naylor, *Faircloth 4,915* (GA, MO). **North Carolina.** NEW HANOVER CO., Wilmington, *Bartram s.n.* (PH); BLADEN CO., White Lake, *Godfrey 50,421* (F, NY, PH), near prison camp, *Godfrey & Fox 49,499* (GH). **South Carolina.** BERKELEY CO., S of Monks Corner, *Ahles 35,546* (FSU, GA, GH, USF); COLLETON CO., W of Hendersonville, *Leonard & Radford 1,979* (LL, NY, TEX), *Bell 4,634* (USF), *Ahles & Bell 21,059* (GA); GEORGETOWN CO., S of Waverly Mills, *Radford 31,266* (UNCC); ORANGEBURG CO., Eutaville, *Eggleston 4,961* (NY).

The following specimens are intermediate between f. *gossypina* and f. *trichophylla,* or the duplicates include a range of variants between the two forms:

North Carolina. BLADEN CO., S of Ammon, *Ahles 37,418* (NY). **South Carolina.** BERKELEY CO., Monks Corner, *Pennell 4,887* (PH); ORANGEBURG CO., Eutaville, *Eggleston 4,951* (F, GH, MO, NY, PH, US).

10e. **Chrysopsis gossypina** subsp. **gossypina** f. **ducumbens** (Chapm.) Godfrey, Rhodora **51**: 113. 1949.

Chrysopsis decumbens Chapman, Fl. S.U.S. 217. 1860. TYPE: Florida, *Chapman s.n.* (HOLOTYPE, NY!; ISOTYPES, F!, GH!, NY-ex Princeton Herbarium, PH-2 sheets! US-4 sheets!).

Chrysopsis arenicola Alexander in Small, Man. S.E. Fl. 1339. 1933.

This form occurs in scattered populations from St. Vincent Is., Gulf Co., Florida, to North Carolina, where it is commonly encountered in the fall line counties of the coastal plain. It represents the extreme of the continuum in stipitate-glandularity of phyllaries and peduncles. The stems are decumbent with 1 10 heads in undamaged collections. The leaves are densely woolly. It is very similar morphologically to *Chrysopsis godfreyi* f. *godfreyi* which has a chromosome number of $n = 5$.

REPRESENTATIVE SPECIMENS. **Florida.** Type specimens. **North Carolina.** BRUNSWICK CO., Long Beach, *Godfrey & Boyce 50,962* (GH, NY, PH, TEX); MOORE CO., W of Eastwood, *Godfrey 50,713* (GA, GH, NY); NEW HANOVER CO., Wilmington, *Canby s.n.* (NY in part), *Wherry s.n.* (LL); RICHMOND CO., NE of Rockingham, *Cronquist 4,728* (GA, GH, NY, PH); WAKE CO., between Fugay Springs and Duncan, *Godfrey & Fox 48,674* (MO).

The following collection has traits intermediate between f. *trichophylla* and f. *decumbens*.

Georgia. LAURENS CO., S of Dublin, *Godfrey 50,791* (GA, MO, NY).

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TAXONOMIC REVISION OF POLLALESTA H.B.K. (COMPOSITAE: VERNONIEAE)

John G. Stutts

Pollalesta H.B.K. (Compositae: Vernonieae) is a relatively small genus of trees and shrubs distributed from Costa Rica in Central America and the islands of Margarita and Trinidad in the West Indes, south to northern Peru and Brazil in South America. The center of distribution of *Pollalesta* is Venezuela and Colombia (Figures 4–6).

Pollalesta has been maintained as distinct from *Vernonia* Schreb. mainly on the basis of its pappus structure which is more like that of *Stilpnopappus* Mart. ex DC. than that of *Vernonia* Schreb. (Humboldt, Bonpland, & Kunth, 1820; Bentham & Hooker, 1873; Engler & Prantl, 1894; Aristeguieta, 1964), and has traditionally been placed near *Piptocoma* Cass., *Stilpnopappus* Mart. ex DC., *Piptolepsis* Sch.-Bip., and *Proteopsis* Mart. ex Sch.-Bip. (Bentham & Hooker, 1894; Aristeguieta, 1964).

TAXONOMIC HISTORY

The genus *Pollalesta* H.B.K. was formerly known by the name *Oliganthes* Cass. (Cassini, 1817). *Oliganthes,* as originally conceived by Cassini, consisted of a single species from Madagascar, *Oliganthes triflora* Cass. (Cassini, 1818). In 1820, Humboldt, Bonpland, and Kunth described three new closely related species from the Neotropics (in the group under consideration in this study). However, they considered each of these taxa to constitute separate genera, i.e., *Odontoloma acuminata* H.B.K., *Dialesta discolor* H.B.K., and *Pollalesta vernonioides* H.B.K. In 1825, Cassini reported that *Pollalesta vernonioides* H.B.K. was equivalent to *Oliganthes triflora* Cass. Cassini's interpretation was apparently based solely on the published descriptions of the taxa which do indeed sound exceedingly similar. In 1847, Schultz-Bipontinus published a revision of the genus, retaining the generic name *Oliganthes* Cass. for the Neotropical species. Mattfeld (1935) decided that the name *Oliganthes triflora* Cass. should be used only for the plant from Madagascar and that the species previously known as *Pollalesta vernonioides* H.B.K. was indeed a separate

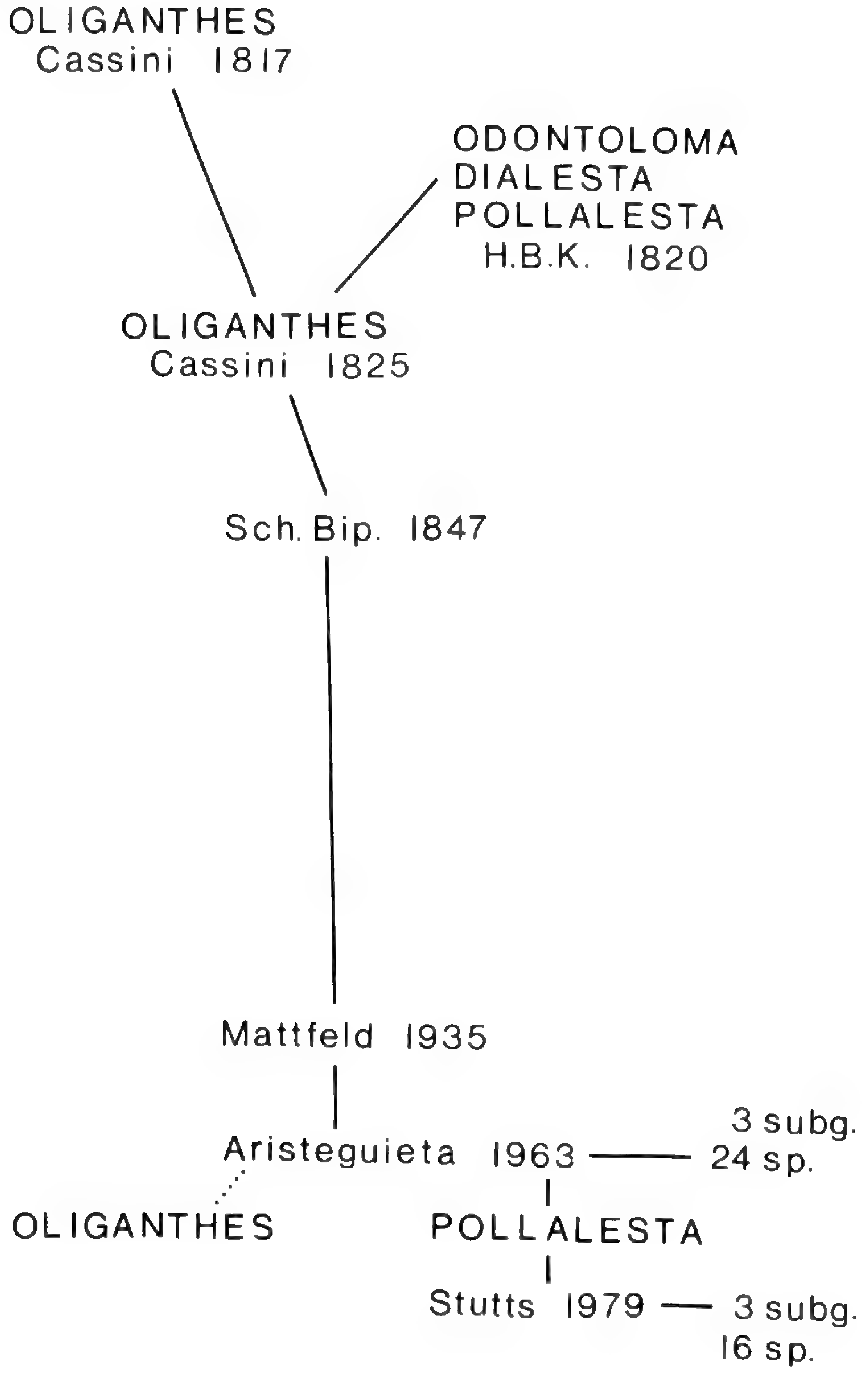

Figure 1. **Taxonomic history of Pollalesta**

species endemic to the Neotropics. He proposed the new combination *Oliganthes vernonioides* (Kunth) Mattf. Since the time of Mattfeld's treatment all new species in this group from the Neotropics have been assigned to the genus *Oliganthes* Cass. sensu Schultz-Bipontinus.

After studying the species of *Oliganthes* from Madagascar and those of the Neotropics, Aristeguieta (1963) separated the Neotropical species from those of Madagascar. He selected the name *Pollalesta* from among the three generic names published simultaneously by Humboldt, Bonpland, and Kunth (1820) to designate the Neotropical species. In addition, he revised the genus and named ten new species. Aristeguieta's treatment resulted in the recognition of twenty-four species in three subgenera, the subgenera being based upon the three original genera of Humboldt, Bonpland, and Kunth.

Recently, study of herbarium specimens of the Flora of Peru project along with a survey of the literature indicated that the number of species of *Pollalesta* was inflated. This apparently resulted from emphasis having been placed on variation in extremely plastic vegetative characters. The tribe Vernonieae is well known for highly variable vegetative morphology (Jones, 1976, 1977).

The purpose of this study was to re-examine the genus in a taxonomic revision in order to develop a workable classification of *Pollalesta*. This treatment is based upon morphological, palynological, and chemical data obtained from herbarium specimens borrowed from appropriate major herbaria in the United States and Europe, as well as throughout the range of the genus. A number of former collection sites for *Pollalesta* in Venezuela were visited but no specimens were located at any of these sites as each had been severely disturbed by human activities. No chromosome counts have been reported for the genus.

PALYNOLOGY

Wodehouse (1928), Smith (1969), Jones (1970, 1973), Kingham (1976), and Keely and Jones (1977) have examined pollen morphology in several members of the tribe Vernonieae and found both external morphology and pollen size to be useful in developing classifications. Thus it was felt that a study of the pollen characters of *Pollalesta* might prove helpful in delimiting taxa.

Pollen grains were acetolized by the procedures of Erdtman (1966) and examined utilizing both light microscopy and scanning electron microscopy.

All species were found to possess similar pollen grains; subechinolophate, triporate grains with prominent spines (Fig. 2). This type of pollen grain has previously been described by Keely and Jones (1977) as Vernonieae type A. Type A pollen is considered by Jones (personal communication) to be primitive for the tribe. No consistent differences were detected between species in size of pollen grains which varied between ca. 44–54 μm in diameter (spine tip to spine tip). Some variation in spine length was noted but could not be correlated with species differences.

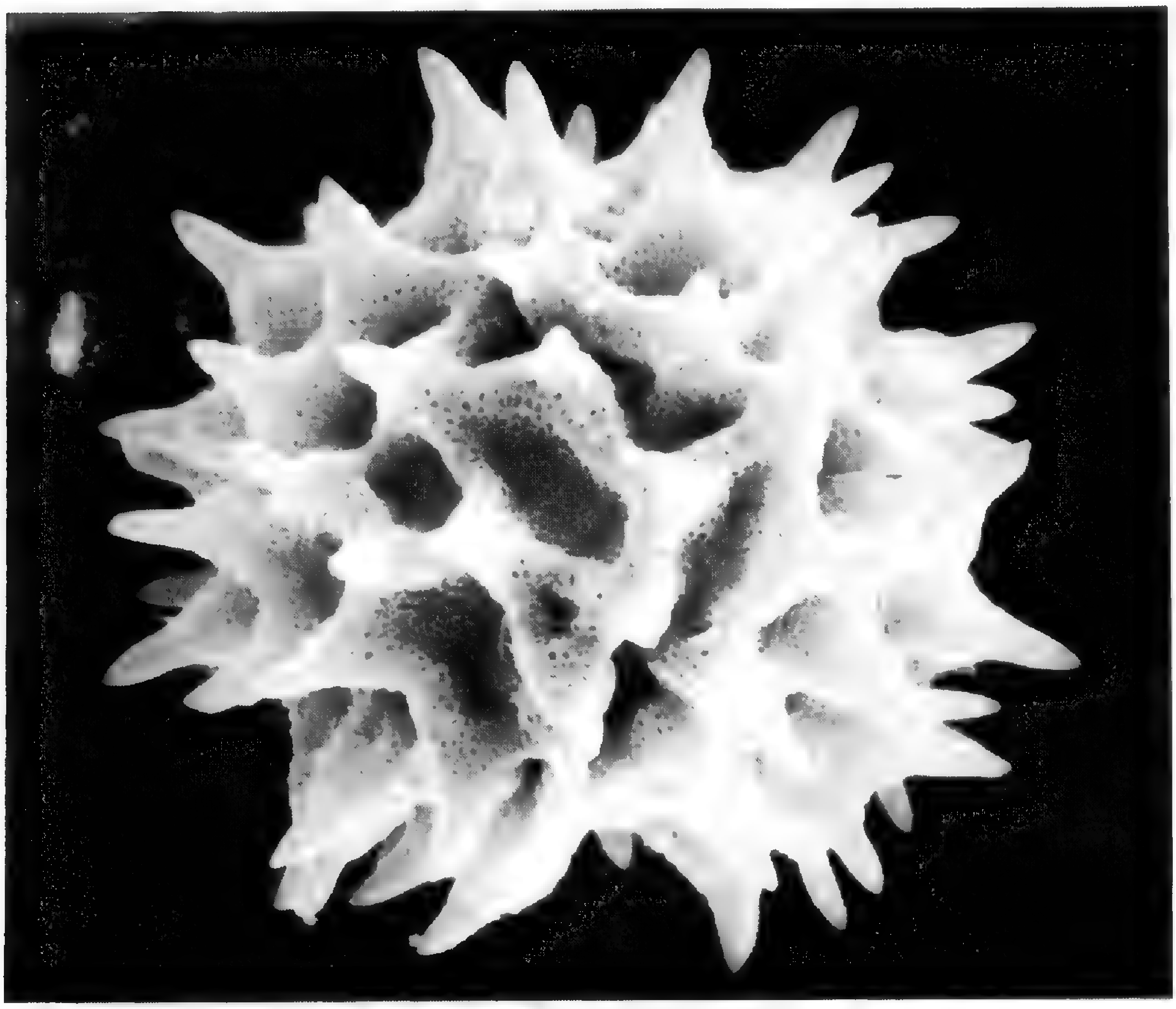

Figure 2. **SEM micrograph of pollen grain of Pollalesta roraimensis.** Actual size: 44 μm spine tip to spine tip.

FLAVONOID CHEMISTRY

A paper chromatographic survey of leaf flavonoids was carried out on twelve of the sixteen species currently recognised in *Pollalesta*. The procedures used were those of Mabry et al. (1970) and Giannasi (1975), with some slight modifications.

Although very little information was available on flavonoids in *Pollalesta*, their occurrence had been previously reported (Harborne & Williams, 1977). J. B. Harborne (pers. comm.) has tentatively identified the common flavones apigenin and luteolin, along with the common flavonols kaempferol and quercetin, all as –7–0–glucosides, and quercetin–3–0–glycoside, from species of *Pollalesta*. The occurrence of these compounds, all except kaempferol–7–0–glucoside and apigenin–7–0–glucoside, in various species of *Pollalesta* was confirmed in this study. Interestingly, the only apigenin that could be identified in this study was apigenin–6,8–C–diglycoside, which was present in all species examined, and the only kaempferol identified was kaempferol–4′–0–glycoside–5,7–dimethyl ether. However, several of the unidentified compounds may be either apigenins or kaempferols.

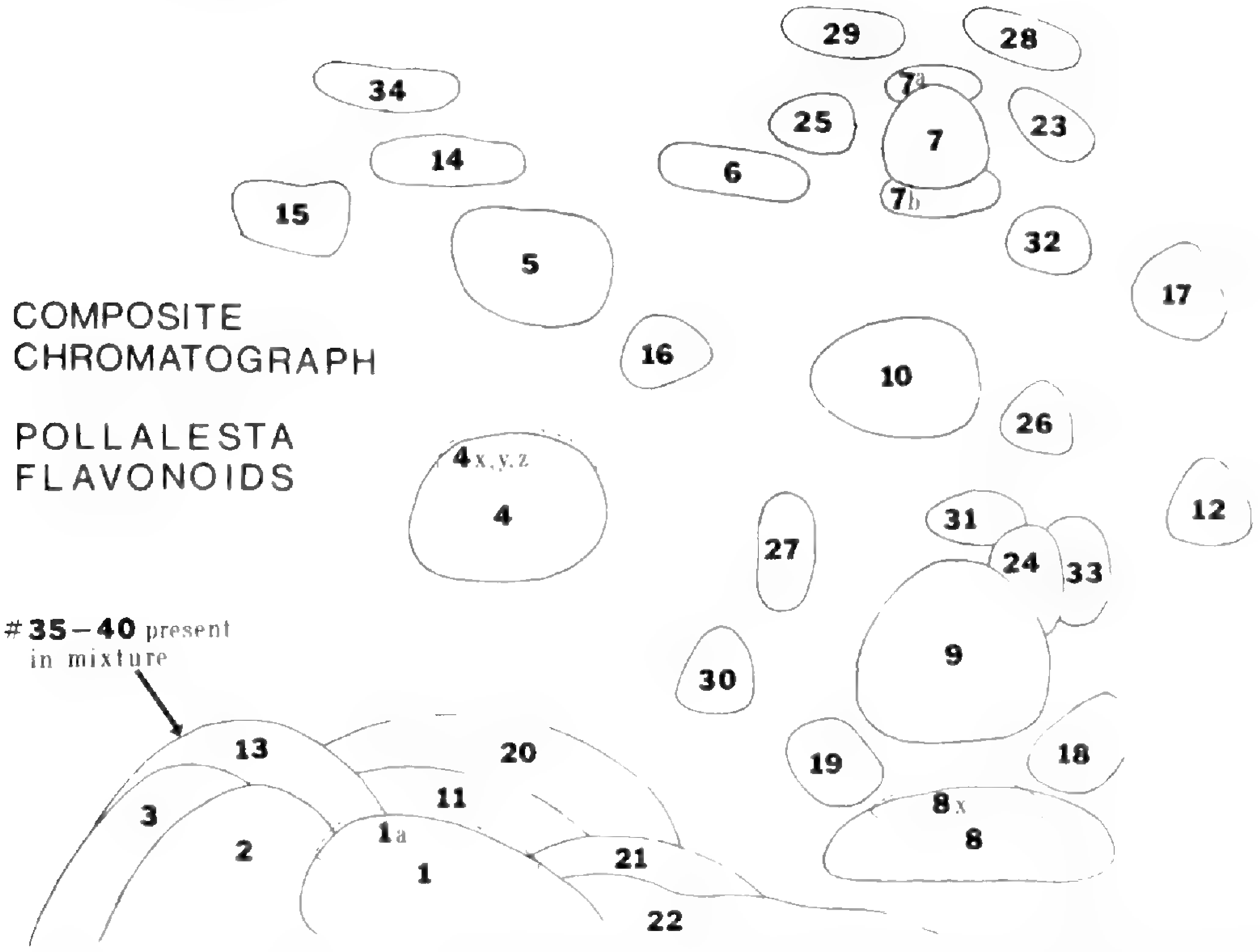

Figure 3. **Composite chromatograph of Pollalesta leaf flavonoids.** (See Tables 1–3 for information concerning each compound.)

A total of forty-seven compounds were separated as discrete spots on paper chromatograms, of which eighteen were tentatively identified on the basis of their spectral properties, R_f values, and color properties (Mabry et al, 1970; Giannasi, 1975; Abdel-Baset, 1973). Due to the small amounts of material available several other compounds were determined only to class; i.e., either flavones or flavonols.

A composite chromatograph of all flavonoids in the taxa examined is given in Figure 3. Spectral data, R_f values, color properties, and tentative identities of the various compounds are recorded in Tables 1 & 2.

Although only eighteen of the forty-seven compounds present were identified, it is possible to draw some systematic conclusions based on structural identification of flavonoids within *Pollalesta.* The various species can be distinguished on the basis of their overall spot patterns and most possess species-specific compounds (Table 3).

Infragenerically, there are differences between the three subgenera in overall number of flavonoid compounds. Subgenus *Odontoloma,* whose species exhibit a trend toward reduction in overall head size, number of florets per head, and pappus, also shows a reduction in overall number of flavonoid compounds as compared to the other two subgenera. The average number of flavonoid compounds per species in subgenus *Odontoloma* is eleven, subgenus *Pollalesta* fourteen, subgenus *Dialesta* twenty-one. Subgenus *Dialesta,* as delimited in this study, is composed of only one species, *Pollalesta discolor* (H.B.K.) Aristeg., which is highly variable in its vegetative morphology. Flavonoid variation within *P. discolor* was equally extensive but apparently not correlated with morphological or geographical data and thus its flavonoid profile represents a composite complement. This phenomenon has been

Table 1. **R_f Values, Color Properties, and Identities of Leaf Flavonoids of Pollalesta.**

Spot No.	Identity	R_f Values TBA	HOAc	Color UV	UV+NH_3
1	Q	.69	.08	Y	Y
1a	Q-4′-methyl ether (?)	.68	.11	Y	Y
2	L	.79	.10	P	Y
3	Q-3-methyl ether	.84	.13	P	Y
4	L-6, 8-C-diglycoside*	.61	.46	P	Y
4x	unknown	.61	NA	P	Y

Table 1. **R_f Values, Color Properties, and Identities of Leaf Flavonoids of Pollalesta.**

Spot		R_f Values		Color	
No.	Identity	TBA	HOAc	UV	UV+NH_3
4y	unknown	.61	NA	P	NA
4z	unknown	.61	NA	P	NA
5	Q-3-0-glucoside**	.60	.66	P	Y
6	Q-3-0-glycoside	.49	.76	P	Y
7	A-6,8-C-diglycoside*	.36	.79	P	Y
7a	unknown	.36	.84	Y	Y
7b	unknown	.36	.73	P	Y
8	L-7-0-glycoside	.33	.11	P	Y
8x	L-7-0-glycoside	.33	.15	P	Y
9	L-7-0-glucoside**	.33	.31	P	Y
10	Q-3-0-glycoside	.34	.56	P	Y
11	unknown	.67	.14	P	Y
12	unknown	.15	.48	P	Y
13	unknown	.80	.19	P	Y
14	unknown	.66	.75	P	Y
15	unknown	.75	.69	P	P
16	unknown	.52	.58	P	Y
17	Q-3,7-0-diglycoside	.16	.66	P	Y
18	unknown	.25	.19	Y	Y
19	undetermined methylated Q-glycoside	.42	.20	YO	YO
20	unknown	.64	.19	P	Y
21	unknown	.54	.11	P	Y
22	undetermined phenolic acid	.50	.06	LB	LB
23	unknown	.27	.79	P	Y
24	unknown	.24	.37	YO	YO
25	unknown	.43	.82	P	Y
26	unknown	.24	.51	P	Y
27	K-4′-0-glycoside-5,7-dimethyl ether	.43	.39	YO	YO
28	unknown	.28	.88	P	Y
29	unknown	.39	.90	P	Y
30	unknown	.50	.29	P	Y
31	unknown	.30	.43	P	Y
32	unknown	.27	.68	P	Y
33	unknown	.20	.39	P	Y
34	unknown	.68	.85	P	Y
35	L-3′-methyl ether (Chrysoeriol)	.70	NA	P	Y
36	Q-3,3′-dimethyl ether	.80	NA	P	Y
37	Q-3,7,4′-trimethyl ether (?)	.75	NA	P	Y
38	Q-3,3′,4′-trimethyl ether (?)	.75	NA	P	Y
39	undetermined methylated flavone	.75	NA	P	Y
40	undetermined methylated flavone	.75	NA	P	Y

A = apigenin, L = luteolin, K = kaempferol, Q = quercetin, P = purple, Y = yellow, YO = yellow-orange, LB = light blue, NA = not available, * = confirmed by acid hydrolysis, ** = confirmed by enzyme hydrolysis.

Table 2. Spectral Data for *Pollalesta* Leaf Flavonoids.

Spot #	MeOH	+AlCl$_3$	+AlCl$_3$/ HCl	+NaOMe	+NaOAc	+NaOAc/ H$_3$BO$_3$
1	372 294 258	448 325 271	427 368 304s 268	DEC. 407 335	389 327 268 260s	460s 386 261
1a	365 332 270s 255	447 335 298s 272	427 327 300s 270	DEC. 388 337 273s	DEC. 380 328 275 268s 255s	455s 365 263
2	352 293 268 256	427 332 302s 274	392 370s 297s 274 267	407 327 270	397 325 269	433s 375 263
3	359 300s 268s 257	439 335 304s 277	405 370s 300 269	410 326 272	397 325 273	450s 378 263
4	337 300s 267 256	430 354 301 273	393 342 298 274	393 273	387 339s 270	357 300s 262
5	356 305s 268s 258	437 340s 304s 275	405 363 302 272	409 333 274	380 330 273	375 300 263
6	348 298s 268s 255	437 364s 305s 274	407 343 300 272	406 337s 273	385 328 273	370 300s 263
7	332 273	388 355 308 282	385 350 304 278 267s	401 338 285	392 340s 308s 283	410s 347 321 276
8	339 287 270 253	426 353 298s 272 263s	391 340 297s 275 270	395 375s 270	405s 347 268s 257	363 260

Table 2. Spectral Data for *Pollalesta* Leaf Flavonoids.

Spot #	MeOH	+AlCl$_3$	+AlCl$_3$/ HCl	+NaOMe	+NaOAc	+NaOAc H$_3$BO$_3$
8x	347 274s 268s 263s 255	422 273 267	387 360 273 262	403 273 268s 263	402 352 263	435s 365 260
9	353 268 257	432 333 300s 275	393 367s 298s 271	405 268	404 363 269s 259	423s 375 261
10	350 292s 268 257	428 340 302s 276	392 362 300s 275	408 338s 278	393 273	433s 373 265
17	347 273 268 262s 256s	423 365s 273 268s 262s	393 362 300s 275 264	413 283 273 268s 262s	393 284s 273 268s 263s	435s 378 275 268 263
18	352 285s 271s 256					
19	350 269s 253	423 350 300s 270	405 353 298s 267	417 278	365 269 255	440s 366 255
24	367 270s 255					
27	325 277 258s	325 277 258s	325 277 258s	DEC. 407s 313s 287 256s	DEC. 350s 322s 273	350s 324 267
35	351 293s 268 253	413 365s 299s 268 253	383 362 299s 274 267	402 330s 269	366 265 257s	437s 360 258
36	357 300s	413 365s	403 363	401 338s	377 320s	362 260

Table 2. Spectral Data for *Pollalesta* Leaf Flavonoids.

Spot #	MeOH	+$AlCl_3$	+$AlCl_3$/HCl	+NaOMe	+NaOAc	+NaOAc H_3BO_3
	268s	300s	299	275	271	
	256	268s	274s			
		256	268			
37	352	396	399	358	355	358
	289s	354	355	267	268	305s
	266s	297	300	257s	257	262
	255	267	269			
38	353	398s	395	353	353	362
	302s	350	352	322s	268	299s
	265s	298s	300s	268		264
	258	268	268			
39	327	390s	393s	380	328	343
	293s	338	335	327s	275	263
	255	298s	298s	274	269	258
		274	274	268	263	
		268	263	263	258	
		263				
40	322	390s	390s	380	380s	350s
	293s	353s	353s	273	323s	298s
	255	325s	328s	267	274	268s
		273	298s	263	268	263s
		267	267		263	

DEC. = decomposed, s = shoulder or inflection.

documented in other taxa in the Compositae, e.g. *Dahlia coccinea* Cav. (Giannasi, 1975).

Structurally, the genus as a whole is characterized by a large number of flavonols compared to number of flavones, a character often considered to be primitive (Harborne, 1967; Giannasi, 1975). However, the fact that many of these flavonols are methylated at one or more positions suggests an advanced state of biosynthesis (Harborne, 1967; Giannasi, 1975). This phenomenon has been observed in a number of taxa in various tribes of the Compositae (Hegnauer, 1977).

Finally, similarities in flavonoid aglycones, as well as methoxylation and glycosylation patterns, between *Pollalesta* and other genera of the tribe such as *Piptocarpha* R. Br. (G. L. Smith, Univ. of

Ga., pers. comm.), *Piptocoma* Cass. (unpublished observations), and *Vernonia* Schreb. (Abdel-Baset, 1973; Mabry et al, 1975) suggest that flavonoids may well prove to be taxonomically valuable at the intergeneric level when enough genera in the tribe have been examined (Harborne, 1977).

MORPHOLOGY

A thorough study of variation was made of many characters to determine those most useful for the species taxonomy. These were, for example, number of florets per head, involucral shape, number of pappus series, and number of inner pappus bristles. Other characters, such as flower color, corolla length, number of pappus bristles, etc. were variable in some species and more or less constant in others. Characters such as leaf length, leaf width, etc. were generally too variable to be useful in the classification.

As a result of this study the total number of species in *Pollalesta* is reduced from twenty-four to sixteen, including three newly described species. Eight of the species are known only from one or a very few collections. Some species seem to form groups or complexes, the members of which are very similar and often extremely difficult to identify. One such assemblage is the *P. niceforoi–P. schomburgkii–P. macrophylla* complex. The lack of thorough collections of these taxa makes it difficult to interpret the situation basing decisions solely on morphology. However, in this case the chemical and habitat data suggest that these three taxa are indeed separate species.

Several species recognized in this treatment exhibit extensive morphological variation. This has previously led to the naming of several ill-defined species whose ranges of variation overlap considerably. The best example of this situation is *Pallalesta discolor,* the most wide ranging species in the genus. As treated in this study it includes nine other species recognized in previous treatments. In this case the chemical and habitat data do not support the previous treatments (summarized in Aristeguieta, 1963). At the present time our state of knowledge is so incomplete that it is not taxonomically sound to divide this species, or the other variable species in the genus, into less-inclusive taxonomic units. It seems advisable to retain a broader concept of species within *Pollalesta* until such time as new information becomes available.

Table 3. **Distribution of Leaf Flavonoids in Pollalesta.** Compounds not correlated with specific taxa are not listed.

Taxon	*Flavonols*								*Flavones*						*Unknowns*					
	K	Q							A	L										
Compound No.	27	1	3	5	6	10	17	19	7	2	4	8	8x	9	7a	7b	11	12	13	14
Subgenus **Dialesta:**																				
P. discolor		X	X	X		X	X		X	X	X	X	X	X	X	X	X		X	X
Subgenus **Pollalesta:**																				
P. vernonioides		X	X	X	X	X	X	X	X	X	X			X	X			X	X	
P. niceforoi		X	X	X	X	X			X	X	X			X	X					
P. areolata		X	X	X	X	X			X	X	X			X				X		
P. schomburgkii		X	X	X	X				X	X	X				X			X		X
P. roraimensis		X	X	X			X	X	X	X	X			X				X		X
P. macrophylla	X	X	X	X			X		X	X	X			X					X	X
P. milleri		X	X	X		X			X	X	X			X	X					
Subgenus **Odontoloma:**																				
P. acuminata		X	X	X	X	X			X	X	X				X	X		X	X	
P. hypochlora	X	X	X	X	X	X			X	X	X				X			X	X	
P. trujillensis	X	X	X	X	X				X	X	X				X			X	X	
P. barinensis		X	X						X	X					X				X	

Taxon	*Unknowns (continued)*																*PA*
Compound No.	15	16	18	20	21	23	24	25	26	28	29	30	31	32	33	34	22
Subgenus **Dialesta:**																	
P. discolor		X	X					X						X	X		
Subgenus **Pollalesta:**																	
P. vernonioides			X				X		X		X		X	X	X		
P. niceforoi																	
P. areolata				X	X												
P. schomburgkii	X	X															X
P. roraimensis		X	X	X		X				X	X					X	
P. macrophylla		X	X									X					
P. milleri																	
Subgenus **Odontoloma:**																	
P. acuminata																	
P. hypochlora																	
P. Trujillensis		X								X		X					
P. barinensis																	

K = kaempferol, Q = quercetin, A = apigenin, L = luteolin, PA = phenolic acid

TAXONOMIC TREATMENT

Pollalesta H.B.K., Nov. Gen. et Sp. **4**: 46. 1820.

Odontoloma H.B.K., Nov. Gen. et Sp. **4**: 43. 1820. TYPE: *O. acuminata* H.B.K.
Dialesta H.B.K., Nov. Gen. et Sp. **4**: 45. 1820. TYPE: *D. discolor* H.B.K.
Adenocyclus Less., Linnaea 4: 337. 1829. TYPE: *A. condensatus* Less.
Oliganthes Cass. sensu Schultz-Bipontinus, Linnaea **20**: 501. 1847, not Cass., Bull. Soc. Philom. Paris, Ser. 3, **4**: 10. 1817, nor Bull. Soc. Philom. Paris, Ser. 3, **5**: 57–58. 1818.

Trees or shrubs, usually diffusely branched, branches often tomentose. Leaves alternate, petiolate; blades lanceolate to ovate, usually elliptic, rounded to long-acuminate at the apex, attenuate to cordate, usually cuneate, occasionally oblique, at the base, becoming glabrous above, densely stellate or lanuginose to becoming glabrous below, punctate-glandular both above and below, margins entire to serrulate. Inflorescences terminal, corymbose-paniculate. Heads with 1–5 florets, pedunculate; involucre cylindric to narrowly campanulate; phyllaries 5–15(25), imbricate, in various series or distichous, membranous to scarious, acute at the apex; receptacle subconvex to flat, naked. Corollas tubular, 5-lobed, white to purple; stamens 5, anthers basally sagittate; style branches slender. Pappus variable, biseriate or rarely one or both series absent, straw-colored; inner series of 0–15 aristate bristles; outer series of distinct short squamelle or coroniform, rarely absent. Achenes obconic, 8–10 ribbed. TYPED SPECIES: *Pollalesta vernonioides* H.B.K.

KEY TO THE SUBGENERA AND SPECIES OF POLLALESTA

a. Phyllaries distichous and imbricate; involucres narrowly campanulate (Subgenus *Dialesta*). .... 1. *P. discolor*.
a. Phyllaries imbricate, arranged in various series, not distichous; involucres elliptic-cylindric to narrowly cylindric. ..... b.
  b. Involucres narrowly cylindric; inner pappus of 0–4(6) bristles; heads with 1–2(3) florets (Subgenus *Odontoloma*). .... c.
    c. Pappus uniseriate (outer) or completely absent; inner pappus absent; heads with 1 floret. .... 5. *P. acuminata*.
    c. Pappus biseriate; inner pappus of 1–4(6) bristles; heads with 1–3 florets. .... d.
      d. Heads with 2–3 florets . ... 2. *P. hypochlora*.

d. Heads with 1(2) florets. .... e.
  e. Inner pappus of 1 bristle ca. 3.5 mm long, occasionally accompanied by 2–3 poorly developed bristles up to ca. 2.4 mm long; heads with 1 floret; achenes 1–1.2 mm long. ...... 4. *P. barinensis.*
  e. Inner pappus of 1–4(6) bristles ca. 3–4 mm long; heads with 1(2) florets; achenes (1.2)1.4–2 mm long. .... f.
    f. Young stems ferruginose-tomentose; achenes 1.2–1.6 mm long; corollas ca. 5 mm long; leaves thinly stellate on the abaxial surface. .... 3. *P. trujillensis.*
    f. Young stems tomentose; achenes 1.5–2 mm long; corollas 5–6.3(8.4) mm long; leaves becoming glabrous on the abaxial surface except along the veins which are stellate. ... 2. *P. hypochlora.*

b. Involucres elliptic-cylindric to cylindric; inner pappus of (4) 6–14 bristles; heads with 2–5 florets (Subgenus *Pollalesta*). .... g.
  g. Achenes glabrous. .... h.
    h. Heads with 2 florets; involucres 7–8.5 mm long; achenes 3–3.7 mm long. .... 6. *P. areolata.*
    h. Heads with (2)3–4(5) florets; involucres less than 7 mm long; achenes 2.5 mm or less long. .... i.
      i. Phyllaries 10–14(16). .... 14. *P. schomburgkii.*
      i. Phyllaries 22–25. .... 15. *P. faustiana.*
  g. Achenes thinly puberulent. .... j.
    j. Leaves thickly lanuginose and velvety to the touch on the abaxial surface; petioles and young stems thickly lanuginose. .... 9. *P. vernonioides.*
    j. Leaves stellate on the abaxial surface; petioles stellate; young stems stellate or tomentose. .... k.
      k. Leaves decidedly oblanceolate, rounded to obtuse at the apex; inner pappus of 4–5 bristles; heads with 2–3 florets. .... 7. *P. spruceana.*
      k. Leaves ovate-elliptic to lanceolate, acute to long-acuminate at the apex; inner pappus of (4)8–14 bristles; heads with (2)3–5 florets. .... l.
        l. Phyllaries 8–14, lanate; heads with 3–5 florets. .... 16. *P. milleri.*

l. Phyllaries 9–18, tomentose to essentially glabrous; heads with (2)3(4) florets. .... m.
  m. Phyllaries 9–10; involucres 6–7 mm long. .. .. 8. *P. roraimensis*.
  m. Phyllaries 11–18; involucres 6.5 mm or less long. .... n.
    n. Phyllaries 16–18. .... 12. *P. rarissima*.
    n. Phyllaries 11–15. .... o.
      o. Heads with 3 florets; phyllaries 11–12; leaf margins serrulate; leaves sparsely long-stalked stellate on the adaxial surface and along margins. .... 13. *P. neglecta*.
      o. Heads with (2)3–4 florets; phyllaries 11–15; leaf margins entire; leaves becoming glabrous on the adaxial surface and along margins. .... p.
        p. Achenes 2.5–3 mm long; abaxial surface of leaves silvery-gray; heads with (2)3–4 florets; inner pappus of (8)10–14 bristles. .... 11. *P. niceforoi*.
        p. Achenes ca. 2 mm long; abaxial surface of leaves buff-brown; heads with (2)3(4) florets; inner pappus of (4)8–12 bristles. .... 10. *P. macrophylla*.

Subgenus **Dialesta** (H.B.K.) Sch.-Bip., Linnaea **20**: 502. 1847.

Dialesta H.B.K., Nov. Gen. et Sp. Pl. **4**: 45. 1820.

1. **Pollalesta discolor** (H.B.K.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 275. 1963.

Dialesta discolor H.B.K., Nov. Gen. et Sp. **4**: 45. 1820. TYPE: Colombia: Honda, *Bonpland s.n.* (HOLOTYPE, P, as IDC microfiche!, as photo, GH!; ISOTYPE, B, as photo GH!).

Eupatorium cuspidatum Willd. ex Less., Linnaea **4**: 315. 1829. TYPE: *Willd. Herb. n. 15156* (HOLOTYPE, B, as IDC microfiche!).

Oliganthes discolor (H.B.K.) Sch.-Bip., Linnaea **20**: 502. 1847.

Oliganthes karstenii Sch.-Bip., Linnaea **30**: 116. 1859–1860. TYPE: Colombia. Depto. Cundinamarca; Guaduas, *Karsten s.n.* (ISOTYPE, F!).

Oliganthes ferruginea Gleas., N. Am. Fl. **33**: 102. 1922. TYPE: Costa Rica. Forests of Alto de Mano Tigre, Diquis Valley, *Pittier 12138* (HOLOTYPE, US!).

Oliganthes corei Cuatrec., Brittonia **8**: 185. 1956. TYPE: Colombia. Depto. Antioquia; El Radio, *Core 720* (HOLOTYPE, WVA!, as photo GH!, NY!; ISOTYPE, US!).

Pollalesta argentia Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 275. 1963. TYPE: Peru. Depto. Cajamarca: Valle del Rio Tabaconas, *Weberbauer 6162* (HOLOTYPE, F!; ISOTYPES, GH!, US!).

Pollalesta brasiliana Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 280. 1963. TYPE: Brazil. Edo. Amazonas: Sao Paulo de Olivencia, *Duke 398* (HOLOTYPE, NY!; ISOTYPE, MO!).

Pollalesta colombiana Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 274. 1963. TYPE: Colombia: Depto. Meta: Villavicencio, *Pennell 1406* (HOLOTYPE, NY!; ISOTYPES, GH!, US!).

Pollalesta corei (Cuatrec.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 276. 1963.

Pollalesta ecuatoriana Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 277. 1963. TYPE: Ecuador. Napo-Pastaza Prov.; Cerca de Puyo, *Skutch 4428* (HOLOTYPE, NY!; ISOTYPE, MO!).

Pollalesta ferruginea (Gleas.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 273. 1963.

Pollalesta karstenii (Sch.-Bip.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 273. 1963.

Pollalesta klugii Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 278. 1963. TYPE: Peru: Depto. Loreto: Fortaleza, cerca de Yurimaguas, *Klug 2819* (HOLOTYPE, GH!; ISOTYPE, MO!).

Pollesta peruviana Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 277. 1963. TYPE: Peru. Depto. Loerto; Mishuyaca, cerca de Iquitos, *Klug 1242* (HOLOTYPE, F!).

Tree, 10–30 m tall, young stems stellate-pubescent, brownish to grayish. Leaves somewhat crowded at tips of stems; petioles stellate-pubescent, 1–3.5 cm long; blades elliptic to lanceolate or ovate, 5–20 cm long, 1.5–9 cm wide, length/width ratio ca. 2.5, acute to long-acuminate at the apex, cuneate to oblique at the base, becoming glabrate above, densely stellate to rarely glabrescent below, margins entire to remotely serrate. Heads with (1)2(3) florets; involucres narrowly campanulate, (4.5)5–7.5(9) mm long; phyllaries (5)7–9(11), distichous, glabrous to thinly pubescent, glandular-dotted near the apex. Corollas 5.5–7.5 mm long, white to light purple, glandular-dotted; tube 1.2–1.6 times as long as the lobes. Pappus biseriate; inner series of 2–8 aristate bristles ca. 3–4.5 mm long; outer series minute to 1.2 mm long at longest point. Achenes 1.8–2.4 mm long, glandular-dotted, glabrous to thinly pubescent.

This species occurs from Costa Rica into Peru in tropical forest or secondary vegetation up to ca. 1,600 m elevation. Flowering and fruiting occur throughout the year but most frequently from December to March.

REPRESENTATIVE SPECIMENS: **Costa Rica.** SAN JOSE PROV., Between San Isidros and Rivas, General Valley, *Burger & Liesner 7063* (MO, NY, US); PUNTARENAS PROV., Forests of Buenos Aires, *Pittier 4910* (GH). **Panama:** CHIRIQUI PROV., Cerro Vaca, *Pittier 5328* (US); VERAGUAS PROV.; Hills W of Sona, *Allen 1036* (F, GH, US); PANAMA PROV.; Canal Zone, Ft. Claton, U.S. Army Tropical Test Center, *Tyson 6433* (MO, UGA, US); DARIEN PROV., W ridge of Cerro Mali, near Rio Pucuro Valley, *Gentry & Mori 13835* (MO). **Colombia:** DEPTO. CHOCO, Rio Atrato above Quibdo, Sabuidero, *Cuatrecasas & Llana 24071* (US); DEPTO. ANTIOQUIA, Rio Verde de las Montes, Sonson, Plya Rica, *Gutierrez 35644* (UC); DEPTO. SANTANDER, Lebrija, *Molina 380* (LP); DEPTO. CUNDINAMARCA, Icononzo, *Pennell 2764* (GH, NY, US); DEPTO. BOYACA, El Umbo region, near Mt. Chapon, *Lawrence 510* (F, GH, K, MO, NY, S); DEPTO. VALLE, Costa de Pacifico, Rio Yurumangui, 5–50 m elev., *Cuatrecasas 15954* (F, US); DEPTO. TOLIMA, Chicoral, *Haught 6259* (GH, NY, UC, US); DEPTO. META: Intendencia del Meta, La Serrania, Rio Meta, *Cuatrecasas 7784* (F); DEPTO. NARINO, Comisaria del Rio Putumayo, near Umbria, *Klug 1924* (F, GH, MO, NY, S, US). **Ecuador.** ESMERALDAS PROV., Tobar Donoso, junct. of Rio San Juan and Rio Camumbi, *Jativa & Epling 1120* (NY, US); NAPO-PASTAZA PROV., Vicinity of Puyo, *Skutch 4428* (K, NY, US). **Peru:** DEPTO. LORETO, Florida, Rio Putumayo at mouth of Rio Zubineta, *Klug 2220* (BM, F, GH, MO, NY, S, US); DEPTO. AMAZONAS: Rio Cenepa, *Ancuash 302* (MO); DEPTO. CAJAMARCA, Valle del Rio Tabaconas, *Weberbauer 6162* (F, GH, US); DEPTO. SAN MARTIN: Maynas, *Poeppig 2190* (F, GH, NY).

Subgenus **Odontoloma** (H.B.K.) Sch.-Bip., Linnaea **20**: 502. 1847.

Odontoloma H.B.K., Nov. Gen. et Sp. Pl. **4**: 43. 1820.
Adenocyclus Less., Linnaea **4**: 337–338. 1829.
Oliganthes Cass. subgenus *Adenocyclus* (Less.) Sch.-Bip., Linnaea **20**: 501. 1847.

2. **Pollalesta hypochlora** (Blake) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 280–281. 1963.

Oliganthes hypochlora Blake, Contr. U.S. Natl. Herb. **20**: 533. 1924. TYPE: Venezuela: Edo. Carabobo: Near Valencia, vicinity of Las Trincheras, *Pittier 8185* (HOLOTYPE, US!; ISOTYPE, GH!).

Tree or shrub, 2–12 m tall, young stems tomentose. Petioles stellate pubescent, 1–2.5 cm long; leaf blades lanceolate to elliptic, 8–20 cm long, 3–9.5 cm wide, length/width ratio ca. 2.3, long-acuminate to acuminate at the apex, cuneate to rounded, occasionally oblique, at the base, becoming glabrous above, becoming glabrous below except along the veins which remain stellate, margins entire to rarely subserrulate. Heads with (1)2–3 florets;

involucres cylindric, 4.5–6(7.2) mm long; phyllaries 9–14, glabrous to villous along margins, lower phyllaries occasionally tomentose, glandular-dotted near the apex. Corollas 5–6.3(8.4) mm long, white to light purple, glandular-dotted; tube (1.3) 1.6(2) times as long as the lobes. Pappus biseriate; inner series of 1–4(6) bristles ca. 3–4 mm long; outer series coroniform, ca. 0.3–1.5 mm long at longest point. Achenes 1.5–2 mm long, glandular-dotted, glabrous.

This species occurs in northern Venezuela and Trinidad on dry sites in scrub woodland or forest between ca. 250–1,000 m elevation. Flowering and fruiting occur throughout the year but most frequently from December to March.

REPRESENTATIVE SPECIMENS: **Venezuela:** EDO. CARABOBO, Near Valencia, vicinity of Las Trincheras, *Pittier 8185* (GH, US); EDO. ARAGUA, Near de Yuma, *Williams 10348* (F, US); DTO. FED., Between Caracas and La Guayra, *Fendler 667* (GH, MO); EDO. MIRANDA, Road to Ocumare, National Park, *Garcia 5* (US). **Trinidad:** Mt. St. Benedict, *Broadway 7738* (BM, MO, S).

3. **Pollalesta trujillensis** Aristeg., Bol. Soc. Venez. Ci. Nat. 23(103): 281–282. 1963. TYPE: Venezuela: Edo. Trujillo: Cerca de Valera, Loma Moron, *Pittier 10732* (HOLOTYPE, VEN; ISOTYPES, B!, GH!, K!, NY!, US!).

Small tree or shrub, 3–7 m tall, young stems ferruginose-tomentose. Petioles ferruginose-tomentose, 1–2.2 cm long; leaf blades ovate to elliptic-lanceolate, 7–15 cm long, 3.5–7 cm wide, length/width ratio ca. 2.1, long-acuminate to acute at the apex, cuneate to rounded at the base, becoming essentially glabrous above but usually retaining a few scattered stellate trichomes, stellate below but becoming less so with age, margins entire. Heads with 1(2) florets; involucres narrowly cylindric, 5–6 mm long; phyllaries 8–12, glabrous to villous along margins, lower phyllaries occasionally tomentose. Corollas ca. 5 mm long, white to light purple, glandular-dotted; tube ca. 1.5 times as long as the lobes. Pappus biseriate; inner series of 1–4(6) bristles ca. 3 mm long; outer series coroniform, ca. 0.4–1.2 mm long at longest point. Achenes (1.2)1.4–1.6 mm long, glandular-dotted, glabrous.

This species is known to occur only in the state of Trujillo in northwestern Venezuela on dry sites in sparsely wooded areas at elevations of ca. 1,500 m. Flowering and fruiting occur throughout the year but most frequently from December to March.

Representative specimens: **Venezuela.** Edo. Trujillo, Near Escuque, *Pittier 13139* (F, GH, M, MO, NY).

4. **Pollalesta barinensis** Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 282. 1963. Type: Venezuela. Edo. Barinas, Near Barinas, *Aristeguieta 3256* (HOLOTYPE, VEN; ISOTYPE, NY!).

Shrub, ca. 4 m tall, young stems tomentose. Petioles tomentose with few scattered stellate trichomes, 1–2 cm long; leaf blades lanceolate to elliptic-lanceolate, 10–14 cm long, 3.5–6 cm wide, length/width ratio ca. 2.6, acuminate at the apex, cuneate at the base, thinly tomentose above, stellate along major veins and thinly tomentose on the blade below, margins entire. Heads with 1 floret; involucres narrowly cylindric, 5–5.2 mm long; phyllaries 11–13, glabrous or occasionally lower phyllaries tomentose. Corollas ca. 5.5 mm long, white, glandular-dotted; tube ca. 1.5 times as long as the lobes. Pappus biseriate; inner series of 1 bristle ca. 3.5 mm long, rarely accompanied by 2–3 poorly developed bristles up to ca. 2.4 mm long; outer series coroniform, ca. 0.45–0.8 mm long at longest point. Achenes 1–1.2 mm long, thinly glandular-dotted, glabrous.

This species is known only from the type collection. Times of flowering and fruiting are not known.

5. **Pollalesta acuminata** (H.B.K.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 282–283. 1963.

Odontoloma acuminata H.B.K., Nov. Gen. et Sp. **4**: 44. 1820. Type: Venezuela: Cresit in Convalli Caracasana, *Humboldt & Bonpland s.n.* (HOLOTYPE, P).
Adenocyclus condensatus Less., Linnaea **4**: 337–338. 1829. Type: Trinidad: *Sieber 17* (HOLOTYPE, P, as photo, GH!; ISOTYPES BM!, G!, K!, M!, MO!, NY!).
Oliganthes acuminata (H.B.K.) Sch.-Bip., Linnaea **20**: 502. 1847.
Oliganthes condensata (Less.) Sch.-Bip., Linnaea **20**: 501. 1847.
Pollalesta condensata (Less.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 283-285. 1963.

Small tree or shrub, 2–15 m tall, young stems stellate-pubescent. Petioles stellate-pubescent, 1–3.5 cm long; leaf blades lanceolate to elliptic, 8–20(27) cm long, 3–11 cm wide, length/width ratio ca. 2.4,

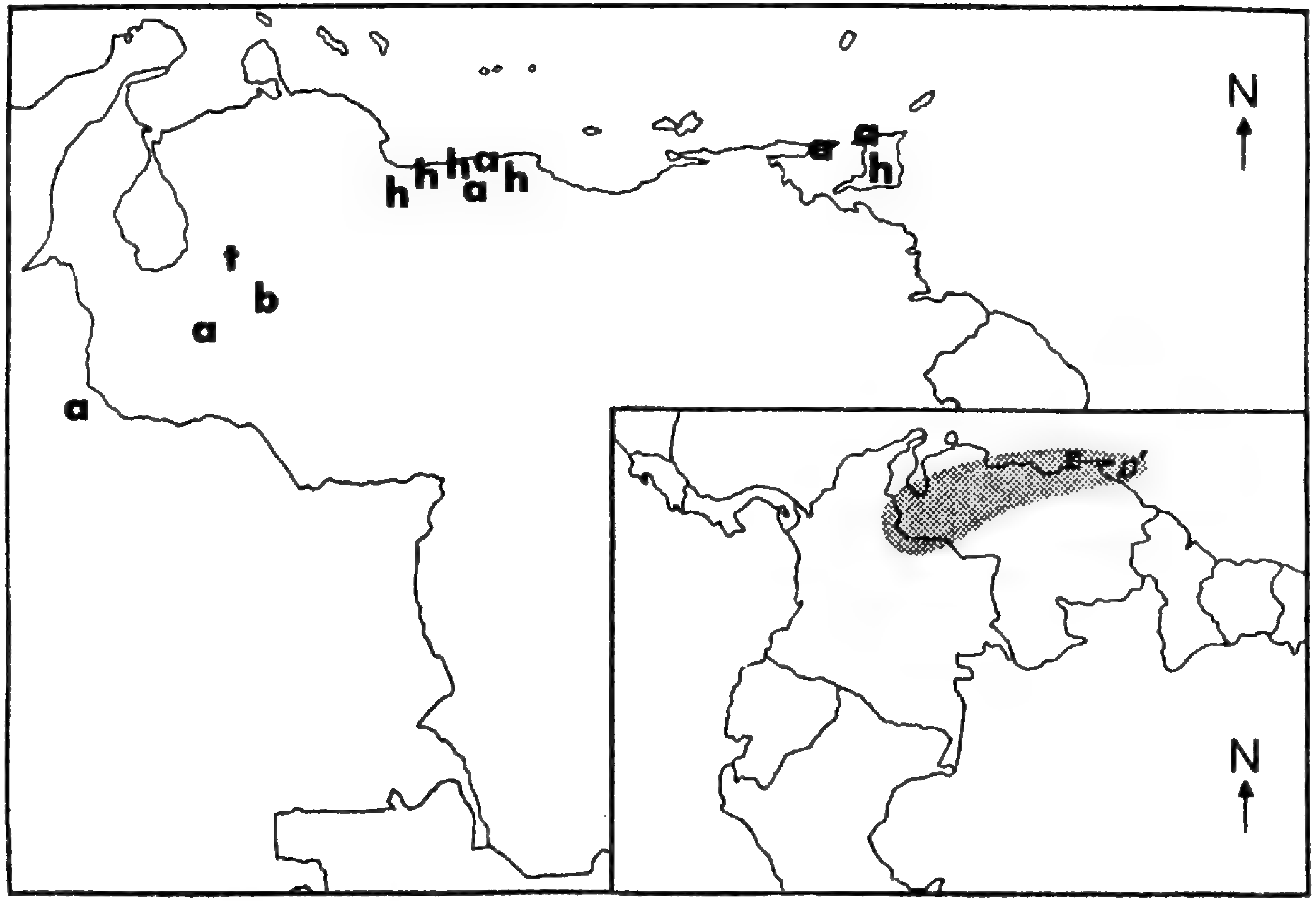

Figure 4. **Distribution of Pollalesta, subgenus Odontoloma:** Shaded area of inset map represents the distribution of the subgenus; species on large map are **b** = *P. barinensis*, t = *P. trujillensis*, a = *P. acuminata*, & h = *P. hypochlora*

long-acuminate to acute at the apex, cuneate to rounded, occasionally oblique, at the base, becoming glabrous above, becoming glabrous below except along the veins which remain stellate, margins entire. Heads with 1 floret; involucres narrowly cylindric, 4–6 mm long; phyllaries 7–11, glabrous or occasionally lower phyllaries tomentose. Corollas 4–6 mm long, white, glandular-dotted; tube ca. 1.5 times as long as the lobes. Pappus uniseriate (outer) or completely absent; inner series completely absent; outer series up to ca. 1.7 mm long at longest point or rarely completely absent. Achenes 1.5–2 mm long, thinly glandular-dotted, glabrous.

This species occurs from Trinidad and northern Venezuela westward into extreme eastern Colombia in forest or areas of secondary vegetation up to ca. 1,500 m elevation. Flowering and fruiting occur throughout the year but most frequently from December to March.

REPRESENTATIVE SPECIMENS: **Colombia.** DEPTO. NORTE DE SANTANDER, Cordillera Oriental, region del Sarare, Hoya del Rio Chitaga entre Chorro Colorado y Bata, *Cuatrecasas, Schultes, & Smith 12214* (F, GH, US). **Venezuela:** EDO. BARINAS, Ticoporo Forest Reserve, ca. 80 km SW of Barinas along road to San Cristobal, bank of Bumbun river, *Breteler 4604* (MO, SP); DTO. FED., Old road from Caracas to La Guayra, *Alston 5501* (BM, GH, S, US); EDO. MIRANDA; Siquire Valley, Guinand Estate, *Pittier 5994* (MO, US); EDO SUCRE: Near Aricagua, vicinity of Cristobal Colon, *Broadway 424* (GH, NY, US). **Trinidad:** Botanic Gardens, Look-out hill, *Broadway 7404* (BM, K, MO, S).

Subgenus **Pollalesta**

Oliganthes Cass. subgenus *Euoliganthes* Sch.-Bip., Linnaea **20**: 502. 1847.
Pollalesta H.B.K. subgenus *Eupollalesta* Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 260. 1963.

6. **Pollalesta areolata** (Wurdack) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 270. 1963.

Oliganthes areolata Wurdack, Mem. New York Bot. Gard. **8**(2): 144. 1953. TYPE: Venezuela. Terr. Fed. Amazonas, Cerro Sipapo, east-central drainage, 1,800 m elevation, *Maguire & Politi 28366* HOLOTYPE, NY!; ISOTYPE, US!).

Small tree or shrub, ca. 8 m tall, young stems stellate-pubescent. Petioles densely stellate-pubescent, 1–2.5 cm long; leaf blades elliptic-lanceolate, 9–14 cm long, 3–4.5 cm wide, length/width ratio ca. 3.2, acuminate at the apex, attenuate at the base, glabrous above, densely subsessile-stellate below, margins serrulate to entire. Heads with 2 florets; involucres cylindric, 7–8.5 mm long; phyllaries 9–15, tomentulose to glabrous. Corollas 4.5–6.5 mm long, white, glandular-dotted; tube essentially equal in length to the lobes. Pappus biseriate; inner series of 6–10 bristles ca. 5–5.6 mm long; outer series of distinct laciniate squamelle ca. 0.5–1.2 mm long at longest point. Achenes 3–3.7 mm long, glandular-dotted, glabrous.

This species is known to occur only near the type locality in forest between ca. 1,500–2,000 m elevation. Times of flowering and fruiting are not known.

REPRESENTATIVE SPECIMENS: **Venezuela:** TERR. FED. AMAZONAS, Cerro Sipapo, Cano Profundo, vicinity of Cano Negro, *Maguire & Politi 28272* (BM, K, NY).

7. **Pollalesta spruceana** (Benth.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 270–271. 1963.

Oliganthes spruceana Benth., Benth. & Hook. Gen. Pl. **2**: 233. 1873. TYPE: Venezuela: Terr. Fed. Amazonas: Rio Atabapo, near Maypures, *Spruce 3705* (HOLOTYPE, K!; ISOTYPES, as fragment F!, P, as photo GH!).

Tree or shrub, range of height uncertain, young stems stellate-pubescent. Petioles stellate-pubescent, ca. 0.5 cm long; leaf blades oblanceolate, 3–6 cm long, 1–2 cm wide, length/width ratio ca. 3.3, rounded to obtuse at the apex, attenuate to subcuneate at the base, becoming glabrous above, densely stellate below, margins entire. Heads with 2–3 florets; involucres cylindric, ca. 5 mm long; phyllaries ca. 9, tomentose to essentially glabrous. Corollas ca. 4 mm long, white, glandular-dotted; tube ca. 0.75 times as long as the lobes. Pappus biseriate; inner series of ca. 4–5 bristles ca. 3–4 mm long; outer series of distinct laciniate squamelle ca. 0.3–1.2 mm long at longest point. Achenes ca. 2.2 mm long, thinly puberulent.

This species is known only from the type collection. Times of flowering and fruiting are not known.

8. **Pollalesta roraimensis** (Steyerm.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 271. 1963.

Oliganthes roraimensis Steyerm., Fieldiana, Bot. **28**: 662 663. 1953. TYPE: Venezuela. Edo. Bolivar, Mt. Roraima, near Rondon Camp, forested SW-facing quebrada, *Steyermark 58678* (HOLOTYPE, F!; ISOTYPE, NY!).

Shrub, 1-5 m tall, young stems stellate-pubescent. Leaves somewhat crowded near ends of stems; petioles densely appressed stellate-pubescent, 1-1.5 cm long; leaf blades oblong-elliptic to elliptic-lanceolate, 3.5-8 cm long, 1-3.2 cm wide, length/width ratio ca. 3, acuminate to acute at the apex, subcuneate at the base, glabrous above, densely subsessile stellate below, margins entire. Heads with 3 florets; involucres cylindric, 6-7 mm long; phyllaries 9-10, thinly puberulent near apex and along margins. Corollas ca. 4.5 mm long, white, glandular-dotted; tube essentially equal in length to the lobes. Pappus biseriate; inner series of 8-12 bristles ca. 3.9-4.2 mm long; outer series of distinct laciniate squamelle 0.2-1 mm long at longest point. Achenes ca. 2.5 mm long, glandular-dotted, thinly puberulent apically.

This species is known to occur only on the forested upper slopes of Mt. Roraima at ca. 2,000 m elevation. Times of flowering and fruiting are not known.

REPRESENTATIVE SPECIMEN: **Venezuela.** EDO. BOLIVAR, Mt. Roraima, *Ule 8794* (K).

9. **Pollalesta vernonioides** H.B.K., Nov. Gen. et Sp. **4**: 47. 1820. TYPE: Venezuela: Edo. Sucre: Cresit in temperatis Provinciae Novae Andalusiae juxta Caripe et El Purgatorio, *Bonpland 239* (HOLOTYPE, P, as IDC microfiche!, as fragment F!, as photo GH!).

Oliganthes triflora Cass. sensu Schultz-Bipontinus, Linnaea **20**: 504, 1847, not Cass., Bull. Soc. Philom. Paris, Ser. 3, **5**: 57 58. 1818.
Oliganthes vernonioides (Kunth) Mattf., Notizbl. Bot. Gart. Berlin-Dahlem **12**: 687 688. 1935.

Tree or shrub, 3-15 m tall, young stems thickly lanuginose. Petioles thickly lanuginose with scattered subsessile stellate trichomes, 2-4 cm long; leaf blades ovate-elliptic, 10-20 cm long, 6-10 cm wide, length/width ratio ca. 1.7, acute to acuminate at the apex, cuneate at the base, becoming essentially glabrous above, thickly

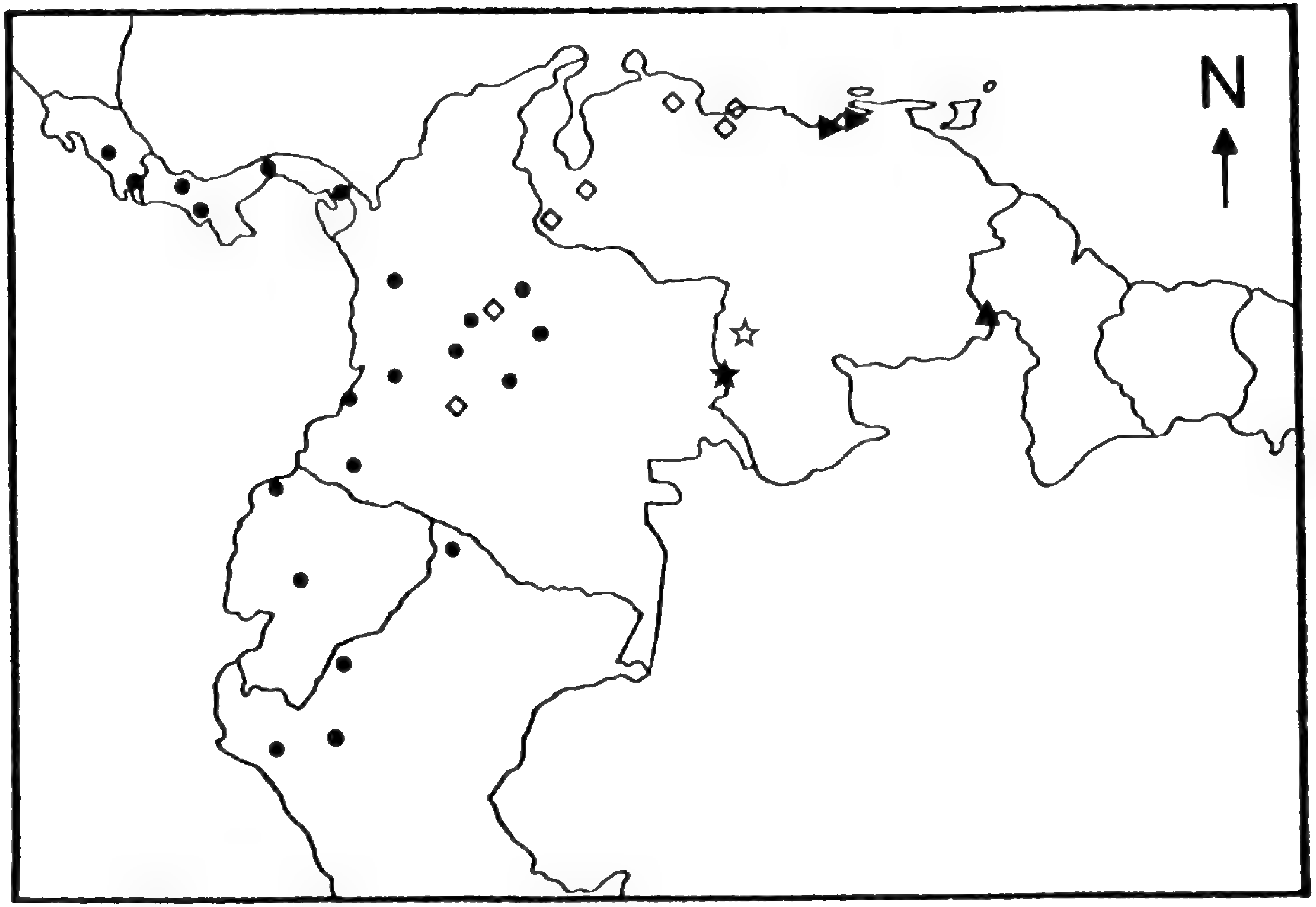

Figure 5. **Distribution of Pollalesta**: ● = *P. discolor*, ◇ = *P. niceforoi*, ☆ = *P. spruceana*, ★ = *P. areolata*, ▶ = *P. vernonioides*, ▲ = *P. roraimensis*

lanuginose with few stellate trichomes and velvety to the touch below, margins entire. Heads with 3–4 florets; involucres widely elliptic-cylindric, 6–7.2 mm long; phyllaries 14–16, thinly tomentose to essentially glabrous. Corollas ca. 5 mm long, white, glandular-dotted; tube ca. 1.3 times as long as the lobes. Pappus biseriate; inner series of 8–10 bristles ca. 3.6–5.2 mm long; outer series of distinct lanceolate fimbriate squamelle ca. 1.2–2.4 mm long at longest point. Achenes ca. 3 mm long, glandular-dotted, thinly puberulent.

This species is known to occur only in the states of Anzoategui and Sucre in northern Venezuela in cloud forest between ca. 1,800–2,400 m elevation. Flowering and fruiting occur throughout the year but most frequently from December to March.

REPRESENTATIVE SPECIMENS. **Venezuela:** EDO. ANZOATEGUI, Cerro Peonia, above Santa Cruz, headwaters of Rio Manantiales, E of Bergantin, SW-facing slope, *Steyermark 61603* (F, K, NY); EDO. SUCRE, Cerro Turumuquire, between headwaters of Rio Colorado and summit of S peak, *Steyermark 62636* (F, NY, VEN).

10. **Pollalesta macrophylla** (Sch.-Bip.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 266–267. 1963.

Oliganthes macrophylla Sch.-Bip., Linnaea **20**: 503–504. 1847. TYPE: Venezuela: Dto. Fed., Galipan, *Moritz 1358* (HOLOTYPE, B, as photo GH!; ISOTYPE BM!).

Pollalesta lilacea Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 267. 1963. TYPE: Colombia: Depto. Santander: Cordillera Oriental, alta cuenca del Rio Pienta, entre El Limite y Encino, *Cuatrecasas 10436* (Holotype US!; Isotype F!).

Tree or shrub, 2–12 m tall, young stems stellate-pubescent. Petioles densely stellate-pubescent, occasionally with scattered straight trichomes, 2–5.5 cm long; leaf blades elliptic to ovate-elliptic, (6)10–20 (25) cm long, 4–11 cm wide, length/width ratio ca. 2.3, acute at the apex, cuneate, occasionally oblique, at the base, becoming glabrous above, densely stellate and buff-brown in color below, margins entire. Heads with (2)3(4) florets; involucres cylindric, (4)5–6 mm long; phyllaries 11–15, tomentose and glandular-dotted near the apex. Corollas 4.5–6.5 mm long, white, glandular-dotted; tube ca. 1.3 times as long as the lobes. Pappus biseriate; inner series of (4)8–12 bristles ca. 3.4–4.3 mm long; outer series of distinct fimbriate squamelle ca. 0.3–2.1 mm long at longest point. Achenes (1.8)2(2.3) mm long, glandular-dotted, thinly puberulent.

This species occurs in Colombia and Venezuela in forest and occasionally in savanna between ca. 1,000–2,200 m elevation. Flowering and fruiting occur throughout the year but most frequently from December to March.

REPRESENTATIVE SPECIMENS: **Colombia:** Depto. Santander, Cordillera Oriental, alta cuenca del Rio Pienta, entre El Limite y Encino, *Cuatrecasas 10436* (F, US). **Venezuela**: EDO. ARAGUA, Parque Nacional H. Pittier, on summit of La Mesa, above El Limon, *Steyermark 89859* (NY); DTO. FED, Cerro Naiguata, Lomas de Las Delicias, entre Quebrada de Basenilla y Quebrada Guayoyo, 9–12 km SE de Hacienda de Cocuizal, *Steyermark 91952* (NY, VEN).

11. **Pollalesta niceforoi** (Cuatrec.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 267–268. 1963.

Oliganthes niceforoi Cuatrec., Revista Acad. Colomb. Ci. Exact. **9**: 243. 1954. TYPE: Colombia: Depto. Norte De Santander, Rio Zulia, *Niceforo 35* (Holotype F!, as photo NY!).

Small tree or shrub, 2–8 m tall, young stems stellate-pubescent. Petioles densely stellate-pubescent, occasionally with scattered straight trichomes, 1–2.5 cm long; leaf blades elliptic to occasionally lanceolate, (5)8–14 cm long, (1.5)2.5–6(10) cm wide, length/width ratio ca. 2.8, acute to acuminate at the apex, cuneate, often oblique at the base, becoming glabrous and often shiny above, densely stellate and silvery-gray in color below, margins entire. Heads with (2)3–4 florets; involucres cylindric, 4.2–5.2(6) mm long; phyllaries 11–15, tomentose and glandular-dotted near the apex. Corollas 4–5(6) mm long, white to purple, glandular-dotted; tube ca. 1.4 times as long as the lobes. Pappus biseriate; inner series of (8) 10–14 bristles ca. 3.3–4.4 mm long; outer series of distinct fimbriate squamelle ca. 0.2–1.8 mm long at longest point. Achenes 2.5–3 mm long, glandular-dotted, thinly puberulent.

This species occurs in Colombia and Venezuela on dry sites in sparsely wooded areas and savanna up to ca. 1,200 m elevation. Flowering and fruiting occur throughout the year but most frequently from December to March.

REPRESENTATIVE SPECIMENS: **Colombia:** DEPTO. HUILA, Cordillera Oriental, E of Neiva, open foot hills, *Pennell & Rusby 451* (GH, NY); DEPTO. SANTANDER, Cordillera Oriental, N slope of Mesa de los Santos, *Killip & Smith 15410* (GH, NY, US). **Venezuela:** EDO. TACHIRA: Along road from San Cristobal to San Antonio, *Aristeguieta & Montoya 2121* (F, VEN); EDO. MERIDA, Vicinity of Tovar, *Pittier 12802* (GH, M, NY, US, VEN); EDO. YARACUY, San Felipe-Nirgua, *Aristeguieta 1177* (VEN); EDO. CARABOBO, Hills of Guaremales, *Pittier 9399* (US); EDO. ARAGUA: Parque Nacional H. Pittier, SW-facing slope of mt., *Steyermark 89756* (VEN).

12. **Pollalesta rarissima** Stutts, *sp. nov.*

Frutex vel arbor, ca. 3-meteralis, caulibus tomentosis. Petioli ca. 2 cm longi; folia elliptica, 8.5–10 cm longa, 2.8–3.6 cm lata, longitudo cum latitudine ratione ca. 2.8, apicibus acutis, basibus cuneatis, supra glabrescentia, infra stellata-tomentose, marginibus integris. Capitula 3(4) flora; involucra cylindrica, 5–5.5 mm longa; phyllaria 16–18, imbricata, tomentulosa vel glabra. Corollae ca. 5–5.5 m longae, albae, glandulosae; tubus cum lobis ratione ca. 1.6. Pappus biserialis; aristae interiorae 8–12 elongatae lineares ca. 4 mm longae; aristae exteriorae inaequales breves ca. 0.25 mm longae irregulariter lanciniatae. Achaenia ca. 2 mm longa, tenuiter puberulentia et glanudulosa. TYPUS: Venezuela, Edo. Tachira, Between La Muleta and Independencia, *Alston 7070* (HOLOTYPE, MO!; ISOTYPES, BM!, F!, GH!, NY!, S!, US!, VEN!).

This species is known only from the type collection. Times of flowering and fruiting are not known. This species can be distinguished from the related species *Pollalesta niceforoi* by its larger number of phyllaries per head and its smaller achenes.

13. **Pollalesta neglecta** Stutts, *sp. nov.*

Frutex, ca. 2.5-meteralis, caulibus tomentosis. Petioli ca. 1–2 cm longi; folia lanceolata, 10–18 cm longa, 4–8 cm lata, longitudo cum latitudine ratione ca. 2.5, apicibus acuminatis, basibus cuneatis, supra tenuiter stellata-tomentosa, infra conferta stellata-tomentosa, marginibus serrulatis et tenuiter stellata-tomentosa. Capitula 3 flora; involucra cylindrica, 4–5 mm longa; phyllaria 11–12, imbricata, tomentosa. Corollae 5–6 mm longae, albae, glandulosae; tubus cum lobis ratione ca. 1.2. Pappus biserialis; aristae interiorae 8–12 elongatae lineares ca. 4 mm longae; aristae exteriorae inaequales breves ca. 0.8–1.4 mm longae irregulariter laciniatae. Achaenia ca. 1.7–2 mm longa, tenuiter puberulentia et glandulosa.

TYPUS: Venezuela, Edo. Sucre, Peninsula de Paria, entre Cumana y Carupano, *Steyermark & Rabe 96443* (Holotype NY!).

This species in known only from the type collection. Times of flowering and fruiting are not known. This species can be distinguished from similar species by its having consistently 3 florets per head, 11–12 phyllaries per head, serrulate leaf margins, and long-stalked stellate trichomes thinly scattered on the adaxial surface and margins of the leaves.

14. **Pollalesta schomburgkii** (Sch.-Bip.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 269–270. 1963.

Oliganthes schomburgkii Sch.-Bip., Linnaea **20**: 504–505. 1847. TYPE: Guyana: Essequibo State, Mt. Roraima, *Schomburgk 921* (Holotype B, as photo GH!).

Small tree or shrub, 3–8 m tall, young stems tomentose. Petioles densely stellate-tomentose, 0.5–2.5 cm long; leaf blades lanceolate to elliptic, 6–18 cm long, 2–7 cm wide, length/width ratio ca. 3, acute to long acuminate at the apex, cuneate to attenuate at the base, becoming glabrous and often shiny above, densely stellate below, margins entire to rarely subserrulate. Heads with (2)3–4(5) florets; involucres cylindric to elliptic-cylindric, 4–6 mm long; phyllaries 10–14(16), glabrous or often tomentose near the apex and along the margins, glandular-dotted near the apex. Corollas 4–6 mm long, white to purple, glandular-dotted; tube ca. 1.3 times as long as the lobes. Pappus biseriate; inner series of (4)6–12 bristles ca. 3.5–4.5 mm long; outer series of distinct fimbriate squamelle ca. 0.4–1.6 mm long at longest point. Achenes 1.8–2.5 mm long, glandular-dotted, glabrous.

This species occurs in Colombia, Venezuela, Guyana, Surinam, and northern Brazil in rain-forest and other moist areas up to ca. 1,500 m elevation. Flowering and fruiting occur throughout the year but most frequently from December to March.

REPRESENTATIVE SPECIMENS. **Colombia:** DEPTO. VAUPES, Rio Papuri, mt. below Teresita, *Schultes & Cabrera 19471* (GH, NY, US). **Venezuela:** EDO. BOLIVAR, 6° 15′ N lat., 62° 47′ E long., *Steyermark 106354* (VEN); TERR. FED. AMAZONAS, Upper slopes of Piedra Arauicaua, Rio Yatua, *Wurdack & Adderley 43467* (F, NY, S, US, VEN). **Guyana:** ESSEQUIBO STATE: Mt. Kanaima, *Whitton 134* (K), Pakaraim Mts., W bank of Kamarang River, upper Mazaruni River basin, above mouth of Utsch River, *Tillett & Tillett 45788* (NY, US), Mt. Roraima, along Kukenam River at Roraima ford, Paulo, *Tate 169* (NY), Kanuku Mts., Wabuwak, mt. top, *Woodblock 5814* (K, NY). **Surinam:** NICKERIE STATE, Wilhelmina Gebergte, *Stahel 7045* (NY). **Brazil:** EDO. PARA, Maloca, Uecran, *Von Luetzelburg 21592* (M).

15. **Pollalesta faustiana** Stutts, *sp. nov.*

Frutex vel arbor, 3–6-meteralis, caulibus tomentosis. Petioli ca. 0.7–2 cm longi; folia ovalis-elliptica vel elliptica, 6–11 cm longa, 3–5 cm lata, longitudo cum latitudine ratione ca. 2, apicibus acuminatis, basibus cuneatis, supra glabrescentia, infra conferta stellata tomentosa, marginibus subserrulatis. Capitula 3–4 flora; involucra cylindrica, 5.75–6.75 mm longa; phyllaria 22–25, imbricata, marginibus villousis, apicibus tomentosis et glandulosis. Corollae ca. 4.5 mm longae, albae, glandulosae; tubus cum lobis ratione ca. 0.9. Pappus biserialis; aristae interiorae 8 elongatae lineares ca. 3.5–4 mm longae; aristae exteriorae inaequales breves ca. 0.5–1 mm longae irregulariter laciniatae. Achaenia ca. 2.2 mm longa, glabra et glandulosa. TYPUS: Venezuela, Edo. Bolivar: Rio Suapure, along river between Raudal Budare and Raudal Pta. Brava, 70–80 river km from mouth, *Wurdack & Monachino 41267* (HOLOTYPE, K!; ISOTYPES, F!, GH!, NY!, US!).

This species is known only from the type collection. Times of flowering and fruiting are not known. This species can be distinguished from the related species *Pollalesta schomburgkii* by its having 22–25 phyllaries per head. This species is named in honor of Dr. W. Zack Faust, whose teaching ability and enthusiasm for the subject was very instrumental in the development of my interest in botany.

16. **Pollalesta milleri** (J. R. Johnst.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 268. 1963.

Vernonia milleri J. R. Johnst., Proc. Amer. Acad. Arts **2**: 698. 1905. TYPE: Venezuela, Edo. Nueva Esparta, El Valle, *Miller & Johnston 254* (HOLOTYPE, GH!: ISOTYPES, GH!, K!, NY!, US!).

Oliganthes milleri (J. R. Johnst.) Gleas., Bull. Torrey Bot. Club **46**: 251. 1919.

Shrub, 1–4 m tall, young stems stellate-tomentose. Petioles densely stellate-tomentose, 0.3–1.5 cm long; leaf blades elliptic to rarely ovate-elliptic or elliptic-lanceolate, (2.5)3.5–7.5(11.5) cm long, 1.1–5.2 cm wide, length/width ratio ca. 2.3, acute at the apex,

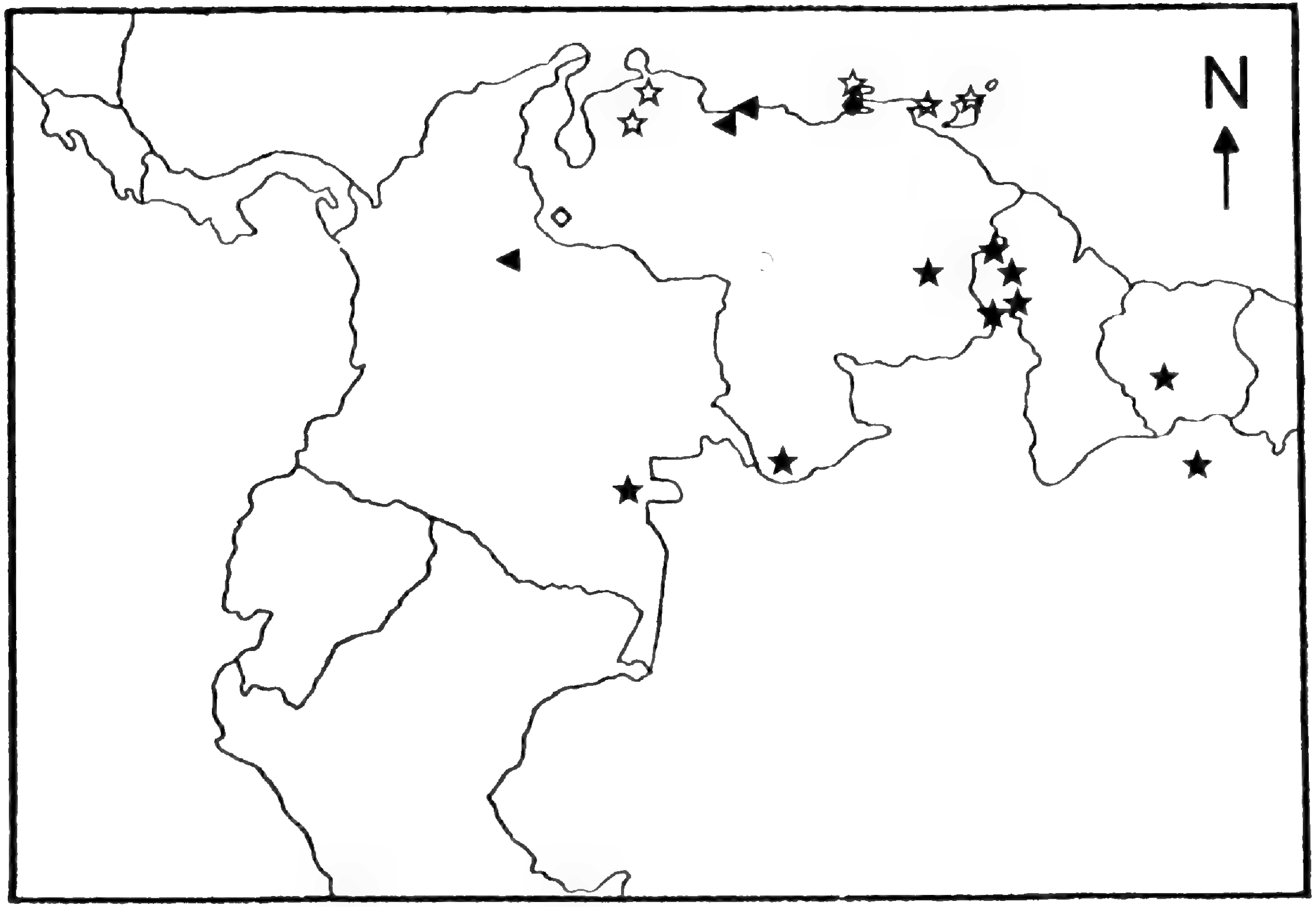

Figure 6. **Distribution of Pollalesta:** ☆ = *P. Milleri*, ★ = *P. schomburgkii*, ◆ = *P. neglecta*, ◇ = *P. rarissima*, ◀ = *P. macrophylla*, ○ = *P. faustiana*.

cuneate to obtuse at the base, becoming glabrous above, densely stellate below, margins entire to rarely subserrulate. Heads with 3–5 florets; involucres elliptic-cylindric, 4–5.5 mm long; phyllaries 8–14, lanate, glandular-dotted near the apex. Corollas 4–6 mm long, white, glandular-dotted; tube ca. 1.4 times as long as the lobes. Pappus biseriate; inner series of 8–10 bristles ca. 3–4 mm long; outer series of distinct fimbriate squamelle ca. 0.3–0.8 mm long at longest point. Achenes 1.9–2.4 mm long, glandular-dotted, thinly puberulent.

This species occurs in Venezuela and Trinidad in sparsely wooded areas up to ca. 1,300 m elevation. Flowering and fruiting occur throughout the year but most frequently from December to March.

REPRESENTATIVE SPECIMENS: **Venezuela**: EDO. FALCON, Along road near La Pena, *Lasser & Foldats 2968* (NY, VEN); EDO. LARA: Sicarigua, *Tomayo 306* (US, VEN); EDO. NUEVA ESPARTA, Guayamuri, *Gines 4000* (US); EDO. SUCRE: La Planisa, vicinity of Cristobal Colon, point near the sea, *Broadway 509* (GH, NY, US). **Trinidad**: Monos Island, W end, hillside, *Britton, Britton & Brown 2738* (GH, NY, US).

EXCLUDED NAMES

The following names have been refered to *Pollalesta* but were either never validly published (*), or should properly be referred to taxa unrelated to this genus.

Dialesta discolor* H.B.K. var. *polychaeta* Steetz ex Seem., Bot. Voyage Herald pp. 140–141. 1854. = *Pollalesta discolor* (H.B.K.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23(103): 275. 1963.

Dialesta staavioides Mart. ex DC., Prod. **5**: 79. 1836. = *Lychnophora staavioides* Mart., Denkschr. Konigl.-Baier. Bot. Ges. Regensburg **2**: 154. 1822.

Eupatorium condensatum* Reichb. ex Less., Linnaea **4: 337–338. 1829. = *Pollalesta acuminata* (H.B.K.) Aristeg. Bol. Soc. Venez. Ci. Nat. **23**(103): 282–283. 1963.

Eupatorium cornifolium* Willd. ex Less., Linnaea **4: 337. 1829. = *Pollalesta acuminata* (H.B.K.) Aristeg., Bol. Soc. Venez. Ci. Nat. **23**(103): 282–283. 1963.

Eupatorium cydoneifolium* (*cydoniaefolium*) Willd. ex Less., Linnaea **4: 269. 1892. = *Pollalesta vernonioides* H.B.K., Nov. Gen. et Sp. **4**: 47. 1820.

Eupatorium domingense Spreng., Systema Vegetabilium, Ed. 16 (= Ed. 17) **3**: 412. 1825. = *Piptocoma rufescens* Cass., Bull. Soc. Philom. Paris Ser. 3. **5**: 58. 1818.

Oliganthes condensata* (Less.) Sch.-Bip. var. *aristata* Aristeg., Mss. = *Pollalesta hypochlora* (Blake) Aristeg., Bol. Soc. Venez. Ci. Nat. **23(103): 280–281. 1963.

Oliganthes jelskii Hieron., Bot. Jahrb. Syst. **36**: 461 462. 1905. This plant is known only from the original description and photographs of the type specimen (Peru: *Jelski 624*) which was destroyed at Berlin. While no definite placement can be made from the available information, the plant does not appear to belong in *Pollalesta*.

Oliganthes karwinskii Sch.-Bip., Linnaea **20**: 505. 1847. = *Vernonia tarchonanthifolia* (DC.) Sch.-Bip., Linnaea **20**: 507. 1847.

Oliganthes oxylepis Benth., Gen. Pl. **2**: 233. 1873. = *Harleya oxylepis* (Benth.) Blake, J. Wash. Acad. Sci. **22**: 381. 1932.

Oliganthes rufescens (Cass.) Sch.-Bip., Pollichia **20**–**21**: 338. 1863. = *Piptocoma rufescens* Cass., Bull. Soc. Philom. Paris Ser. 3. **5**: 58. 1818.

Vernonia dichocarpha* Spreng., Systema Vegetabilium, Ed. 16 (= Ed. 17) **3: 437. 1825. = *Pollalesta vernonioides* H.B.K., Nov. Gen. et Sp. **4**: 47. 1820.

Vernonia dichocarpha* Less., Linnaea **4: 269. 1829. = *Pollalesta vernonioides* H.B.K., Nov. Gen. et Sp. **4**: 47. 1820.

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STUDIES ON THE *GYMNOCARPIUM ROBERTIANUM* COMPLEX IN NORTH AMERICA

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Abstract: The cytology and distribution of *Gymnocarpium robertianum* (Hoffm.) Newman and *G. jessoense* (Koidz.) Koidz. subsp. *parvulum* Sarvela in North America are presented, together with the distinguishing features of these two species. *Gymnocarpium robertianum* is confirmed as a tetraploid species with n=80 and the newly recognized *G. jessoense* subsp. *parvulum* also has n=80.

In a previous paper (Sarvela, 1978) the senior author pointed out that of the six species of the genus *Gymnocarpium* in the world, two have a wide circumboreal range, *G. dryopteris* (L.) Newman and *G. jessoense* (Koidz.) Koidz., while the third species *G. robertianum* (Hoffm.) Newman, has a smaller distribution area.

The genus *Gymnocarpium* in North America was last treated by Wagner (1966). He considered there were two basic species over most of the circumboreal range to which he applied the names *G. dryopteris* and *G. robertianum.* In addition, he introduced "the apparent cross of *G. dryopteris* and *G. robertianum*" as a new species of hybrid origin with the name *G. heterosporum* W.H. Wagner. *G. dryopteris* subsp. *dryopteris* has been known as a tetraploid since the work of Manton (1950) and eastern Canadian material was examined by Britton in 1953 (n = ca. 80). The larger, tripinnate taxon of the Pacific Northwest, *G. dryopteris* subsp. *disjunctum* (Rupr.) Sarvela, is a diploid (n = 40) (Wagner 1966). This has been sufficient reason for some workers to recognize the diploid entity as a separate species—*G. disjunctum* (Rupr.) Ching—although the relationship between the diploid and the tetraploid is obscure.

New investigations (Sarvela, 1980) have indicated that the *Gymnocarpium robertianum* complex may include as many as four taxa, i.e. two species, *G. robertianum* and *G. jessoense,* and two hybrids, *G. heterosporum* W.H. Wagner (*G. dryopteris* × *robertianum*) and *G.* × *intermedium* Sarvela (*G. dryopteris* × *jessoense*). Our studies indicate that *G.* × *intermedium* is a common hybrid of wide occurrence. So much so that, when this taxon is identified by its aborted spores and reduced glandularity, many sheets and localities of *G. jessoense* subsp. *parvulum* Sarvela are eliminated from consideration. The other hybrid, *G. heterosporum,* is considered to be rare indeed.

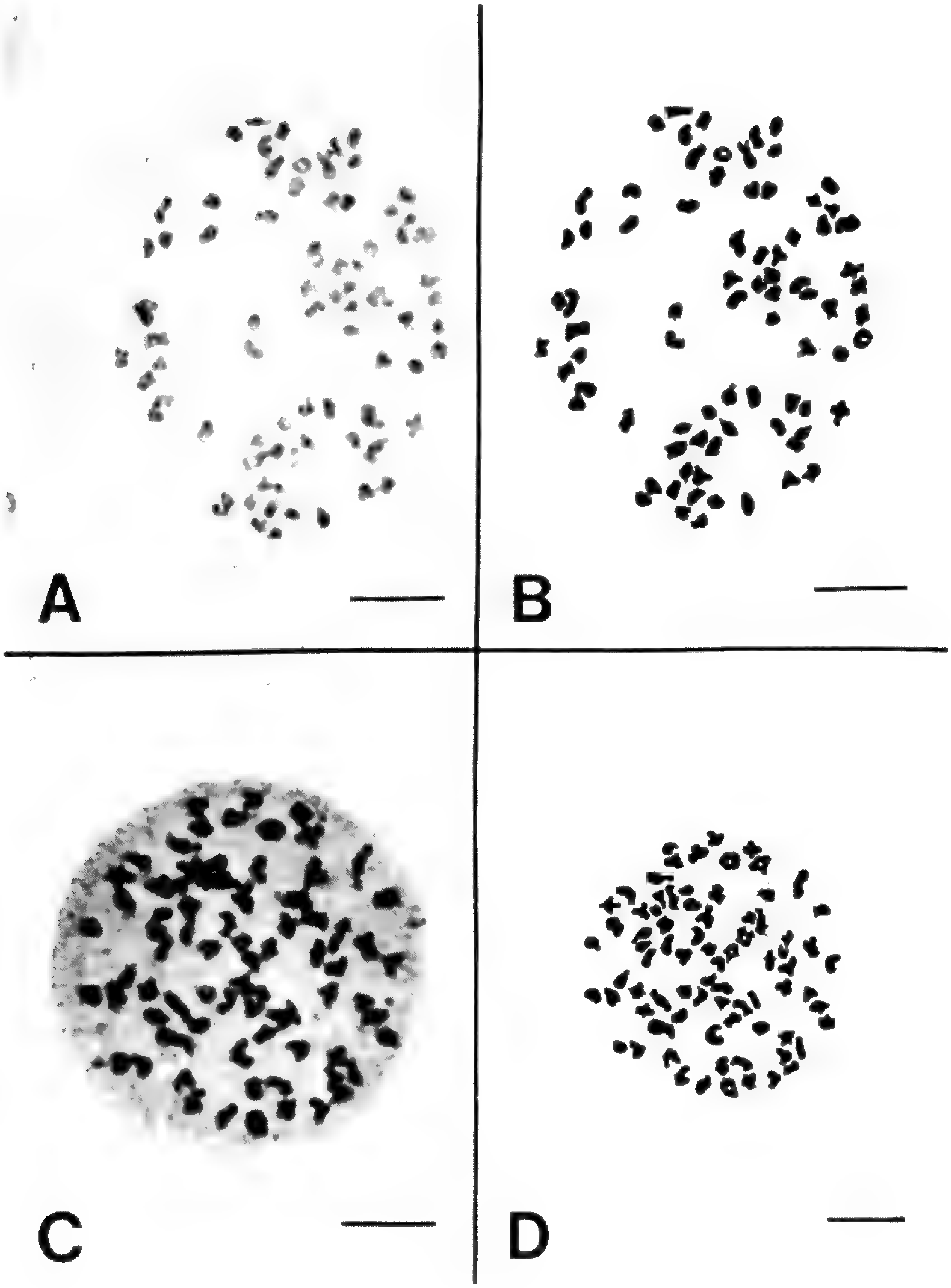

Figure 1. Chromosome numbers in *Gymnocarpium*. **A.** *Gymnocarpium jessoense* subsp. *parvulum*, $n = 80$ pairs, *K. Pryer 460* and *D. M. Britton*, from Pass Lake, Sibley, Ontario. **B.** Camera lucida interpretation of A. **C.** *Gymnocarpium robertianum*, $n = 80$ pairs, *K. Pryer 390* and *D. M. Britton*, from Bruce Peninsula, Ontario. **D.** Camera lucida interpretation of C. Bar represents 10 μ.

Gymnocarpium robertianum s. str. is an amphiatlantic species growing in most of Europe, but in Asia it is limited to the Caucasus. In America it occurs from Newfoundland to Minnesota (Fig. 4). Both in Europe and America it seems to be restricted to limestone or calcareous habitats. It prefers to grow on the talus below limestone cliffs rather than in cliff crevices. It occurs not only in apparently dry habitats, but also occasionally in moist places; for example, in the Great Lakes region it may occur in *Thuja* swamps. *G. robertianum* has been known as a tetraploid species since Manton (1950). Material examined by us from Bruce Co., Ontario has $n = 80$ as one would expect (Fig. 1, C and D).

Two subspecies of *Gymnocarpium jessoense* can be distinguished. Subspecies *jessoense* occurs only in Asia from Afghanistan to Japan and southeastern Siberia. Material examined by Mitui (1970) in Japan was diploid with $n = 40$. The other subspecies, subspecies *parvulum* Sarvela, is circumboreal. The distribution area of the latter in Eurasia does not reach the Atlantic Ocean, ending in Finland; neither does it reach the Pacific in the East as pure subsp. *parvulum* but is intermixed with subsp. *jessoense*. In America the distribution of subsp. *parvulum* (Fig. 5) extends from Alaska to New Brunswick, but even here it is a continental taxon which is rare in areas close to oceans. Typical habitats for this subspecies are cool northern rock crevices. Therefore it remains usually small, the length of the leaf blade being mostly less than 12 cm. More information is required about its habit of avoiding dolomitic limestone, as well as about the habitats where tall specimens have been collected occasionally as seen in herbaria. *Gymnocarpium jessoense* subsp. *parvulum* is a tetraploid with $n = 80$ (Fig. 1, A and B), according to our investigation of Canadian material.

Gymnocarpium robertianum (Fig. 2) and *G. jessoense* (Fig. 3) can be distinguished with the naked eye by the aspect of the pinnules and lobes which in the former are mostly straight and form an angle of ca. 90° with the rachis of the pinnae. In the latter they are somewhat oblique and frequently somewhat curved. Since the position of the pinnules and lobes varies to some extent in different parts of the frond, the difference is best seen in central parts of the basal pinnae. In Europe, the proximal basiscopic pinnule of the basal pinna in *G. robertianum* is always much larger than the corresponding acroscopic pinnule (Sarvela, 1978). In America, this character is not as reliable.

Figure 2. *Gymnocarpium robertianum*. Voucher specimen, $n = 80$, *D. M. Britton 6902* (OAC).

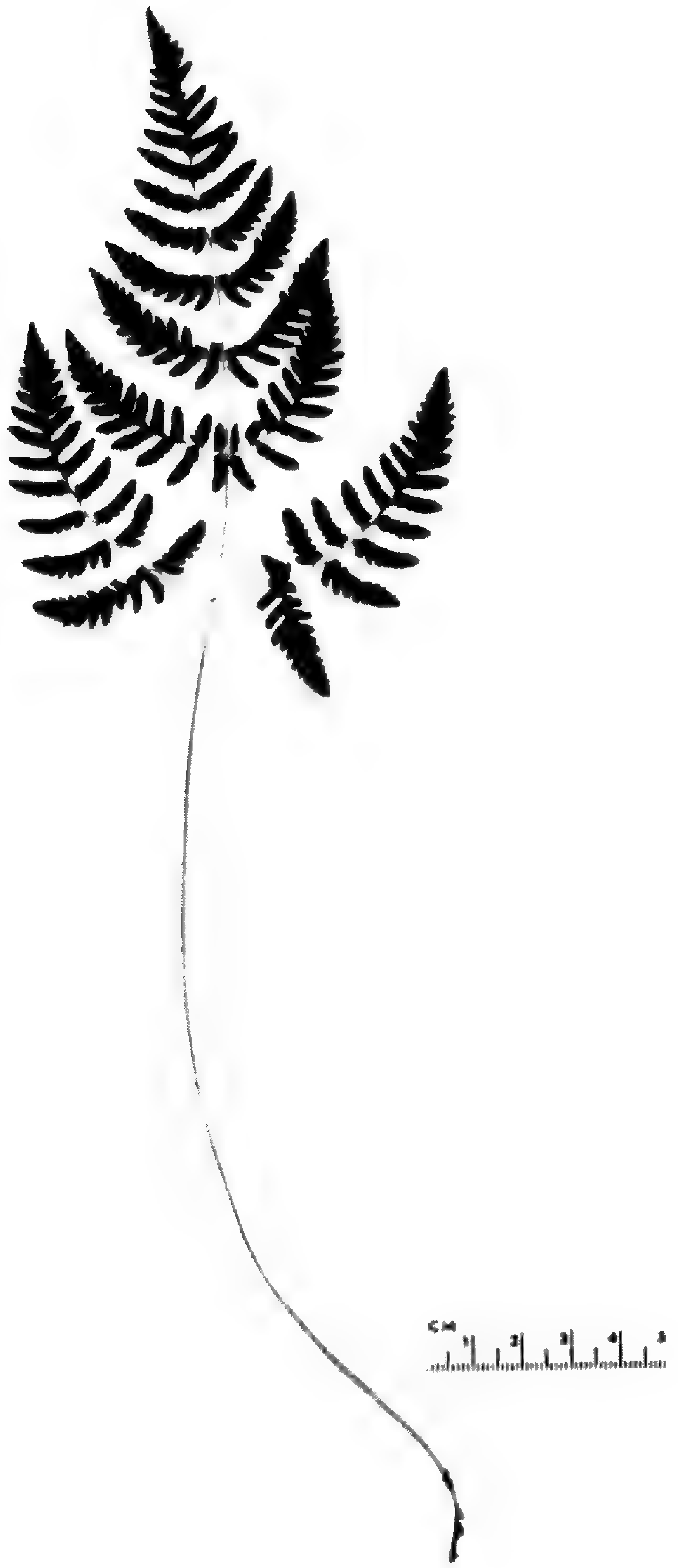

Figure 3. *Gymnocarpium jessoense* subsp. *parvulum*. Voucher specimen, *n* = 80, *K. Pryer 423* (OAC).

The glands, including their stalks, on the main rachis of *Gymnocarpium robertianum* are longer (at least 10% of the glands reaching 50–70 μm) than in *G. jessoense*, which has almost all the glands of the rachis ca. 20–30 μm long, fewer than 1% reaching the length of 50 μm. In addition, the glands of the latter are seldom as close together as those of the former. The rule that the distance between the glands of *G. robertianum* is shorter than the glands, whereas in *G. jessoense* the distance is longer than the glands, seems to hold quite well. The spores of *G. jessoense* always have a tan or brownish colour which appears "glassy" and is quite similar to that seen for *G. dryopteris*. The spores of *G. robertianum* are deeper brown in colour. Detailed dimensions of spores are given in Sorsa (1980).

Material was examined from CAN, DAO, OAC, TRT, TRTE, QUE, SFS, QFA, NFLD, UNB, WIN, SASK, ALTA, UBC, V, UVIC, MIN, WISC, MICH, H, and S. Approximately 360 sheets were annotated by J. Sarvela or D.M. Britton. Representative collections to show the distribution of *G. robertianum* and *G. jessoense* subsp. *parvulum* in North America are listed below.

REPRESENTATIVE COLLECTIONS

Gymnocarpium robertianum (Hoffm.) Newman

CANADA. **New Brunswick:** Restigouche Co., Restigouche River, *P.R. Roberts and N. Bateman 64-3942* (UNB); **Newfoundland:** Humber West Distr., Bay of Islands, *M.L. Fernald, B. Long and J.M. Fogg, Jr. 1128* (WIS); Port au Port Distr., Port au Port Peninsula, *E. Rouleau 3698* (CAN, DAO, NFLD); St. Barbe Distr., Bonne Bay, *E. Rouleau 3345* (NFLD); St. John Bay, *M.L. Fernald, B. Long and J.M. Fogg, Jr. 1129* (MIN, WIN); **Ontario:** Algoma Distr., 2 mi. n.e. of Boisey Lake, *K.A.L. Reading* in 1966 (CAN); Bruce Peninsula, Moore Lake, *P.V. Krotkov 9618* (DAO); Carleton Co., Gloucester Twp., *H.A. Senn 1906* (DAO); Frontenac Co., Ompah, *J. and G. Goltz 436* (OAC); Kenora Distr., Lonely Lake, *R. Bell 28417* (CAN); Manitoulin Island, Providence Bay, *C.O. Grassl 5857* (MICH); Meldrum Pt., *C.O. Grassl 5865* (MICH); Thunder Bay Distr., Blackwater River, Kitto Twp., *C.E. Garton 7738* (DAO); Ravine Lake, Sibley Twp., *T.M.C. Taylor, S.T. Losee and M.W. Bannan 77* (CAN); Timiskaming Distr., Haileybury, *E. Lepage and W.K.W. Baldwin 8113* (CAN); **Quebec:** Anticosti Island, La Loutre River, *FF. Marie-Victorin and Rolland-Germain 24408* (SFS, WIS); Bonaventure Co., Bonaventure River, *J.F. Collins, M.L. Fernald and A.S. Pease* 8 August 1904 (CAN, DAO, MIN, QFA, WIS); Charlevoix Co., Cap-a-l'Aigle, *L. Cinq-Mars, N. David and C. Bourque 69-31* (DAO, QUE, SFS); Chicoutimi Co., Shipshaw River, *J. Cayouette 73-481* (CAN, QFA, SFS); Gaspé Co., Grande-Rivière River, *M. Thibault* 10 August 1972 (QFA); Mistassini Terr.,

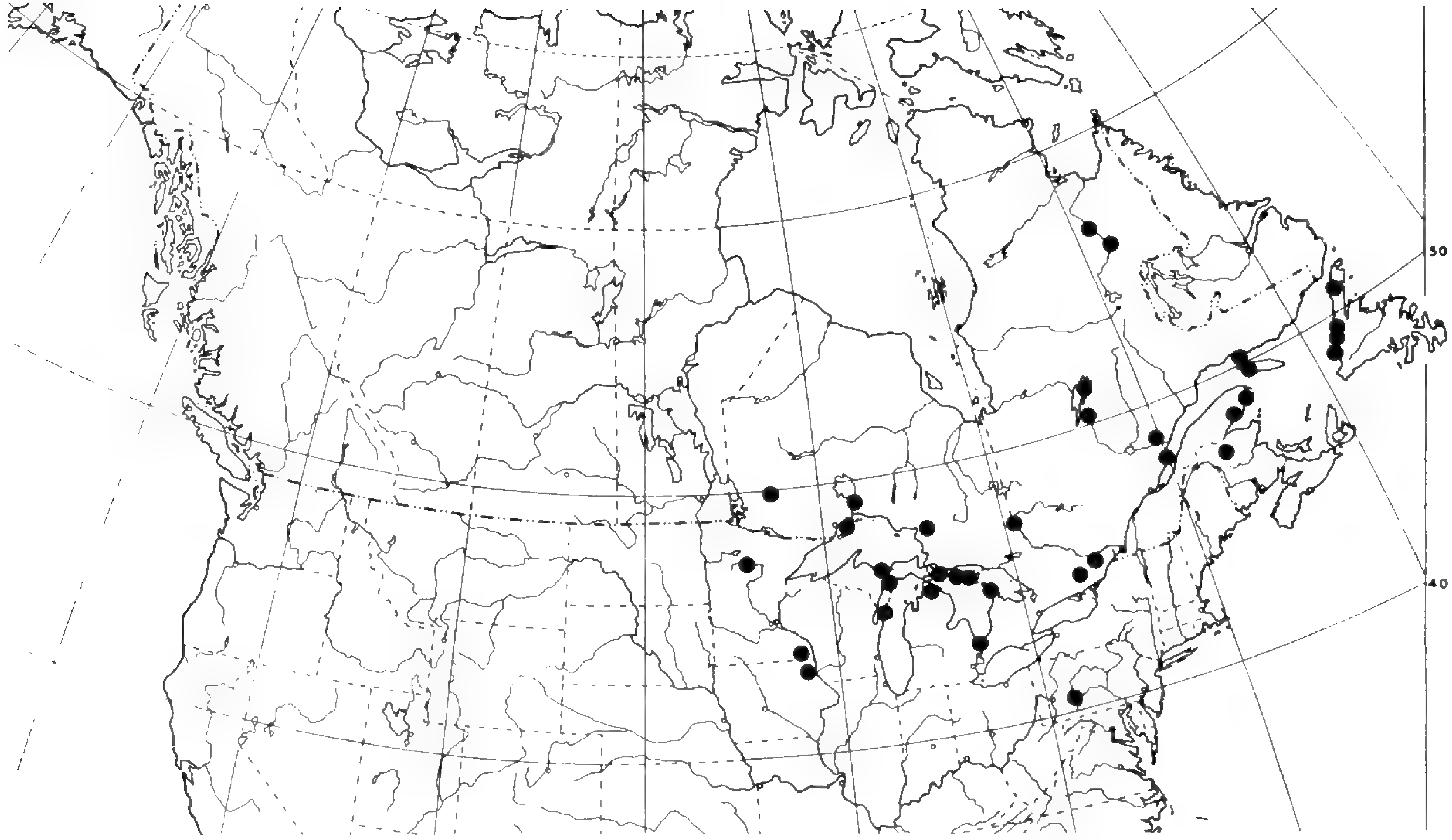

Figure 4. Distribution map of *Gymnocarpium robertianum.*

Mistassini Lake—Pointe Dutilly, *J. Rousseau 1863* (QUE); Mistassini Lake—Peninsule du Dauphin, *J. Rousseau and E. Rouleau 1132* (QUE); Nouveau Québec Terr., Caniapiscau River, *A. Dutilly and E. Lepage 39433* (QFA); Swampy Bay River, *A. Dutilly and E. Lepage 39290* (QFA, QUE); Saguenay Co., Archipel de Mingan—Grande Ile, *FF. Marie-Victorin and Roland-Germain 18082* (SFS).

U.S.A. **Iowa:** Allamakee Co., Yellow River, *T.G. Hartley and R.F. Thorne 6254* (WIS); **Michigan:** Cheboygan Co., Burt Lake, *C.D. La Rue* 13 August 1927 (MICH, WIS); Chippewa Co., Drummond Island, *R. McVaugh and Carroll E. Wood, Jr. 11344* (MICH); Delta Co., Burnt Bluff, *M.L. Fernald and A.S. Pease 3044* (MICH, WIS); Marquette Co., Presque Isle Park, *Dachuorski* 13 July 1906 (MICH); St. Clair Co., Port Huron, *C.K. Dodge* 6 October 1888 (MICH); **Minnesota:** Clearwater Co., 1.5 mi. west of Lake Itasca Post Office, *G.B. Ownbey 3236* (DAO, MIN); Fillmore Co., 2½ mi. northwest of Wyboff, *J.W. Moore and N.L. Huff 19870* (MIN); **Pennsylvania:** Blair Co., Duncansville, *L.K. Henry* 8 October 1957 (SFS); **Wisconsin:** Door Co., Ephraim, *A. Chandler 40760* (WIS).

Gymnocarpium jessoense (Koidz.) Koidz subsp. **parvulum** Sarvela

HOLOTYPE: CANADA, **Northwest Territories,** Mackenzie Distr., Nahanni National Park, below Virginia Falls, *Teuvo Ahti 31910* (H), isotype in DAO.
CANADA. **Alberta:** Jasper Park, North of Cavell Creek, *J.M. Macoun* 13 August 1917 (CAN); Lake Athabasca (north shore), Sand Pt., *H.M. Raup and E.C. Abbé 4477* (CAN); Lake Athabasca, Shelter Pt., *H.M. Raup 16* (CAN); **British Columbia:** Alaska Highway, (Mile 520), Liard River, *J. Grant 23* (DAO); Alaska Highway, Beatton River, *H.M. Raup and D.S. Correll 10269* (S, CAN); Cassiar Distr., Wheaton Creek, *A.F. Szczawinski* 25 July 1961 (DAO); **Keewatin;** Nueltin Lake - n.w. extremity at mouth of Windy River, *Francis Harper 2361* (CAN, MIN); **Manitoba:** Fort Churchill, *W.B. Schofield and H.A. Crum 7150* (CAN); Herb Lake, south end of Wekusko Lake, *H.J. Scoggan 6584* (WIN, CAN, ALTA); Pipestone Lake, Entrance of Nelson River, *H.J. Scoggan 3303* (CAN, WIN); Reindeer Lake, Paskwachi Bay, *W.K.W. Baldwin 2387* (WIN, CAN); Scotty Lake, south of Flin Flon, *G.M. Keleher 92* (WIN); Seal River, 2 mi. n.w. of Great Island, *J.C. Ritchie 1936* (DAO); Tramping Lake (South end), *H.J. Scoggan 6880* (MIN, ALTA, CAN); **New Brunswick:** Upper Restigouche, *J. Brittain,* 19 July 1888 (QK) photo in DAO; Restigouche River, *John Brittain,* July 1888 (CAN), on the same sheet *G. robertianum.* **Northwest Territories:** Eastern Great Slave Lake Region, 3 mi. n.e. of Mountain Lake, *E.A. Johnson, W. Harris, K. Traynor 881* (SASK); Mackenzie Distr., Blackford Lake (southeast shore), *G.W. Scotter 978* (DAO); Enterprise-MacKenzie River Highway (mile 15½), *J.W. Thieret and R.J. Reich 5156* (DAO); Lac Du Mort (east side), *G.W. Scotter 1142* (DAO); Nahanni National Park—north end of Liard Range, *Teuvo Ahti 31909* (H); MacKenzie Mountains, Keele River, *W.J. Cody and G.W. Scotter 19196* (DAO); MacKenzie River, Lone Mtn., confluence of the North Nahanni and the MacKenzie Rivers, *V.C. Wynne-Edwards 8416* (CAN); MacKenzie River, Bosworth Lake—Norman Wells, *V.C. Wynne-Edwards 8587* (CAN); **Ontario:** Algoma Distr., Michipicoten Harbour—1 mi. south of Helen, *R.C. Hosie, H.M. Harrison and E.O. Hughes 1095* (CAN); Cochrane Distr., Missinabi River—Thunder House Rapids, *A. Dutilly and E. Lepage 36272* (DAO); Kenora Distr., Patricia portion, 54° 31′ N, 84° 53′ W,

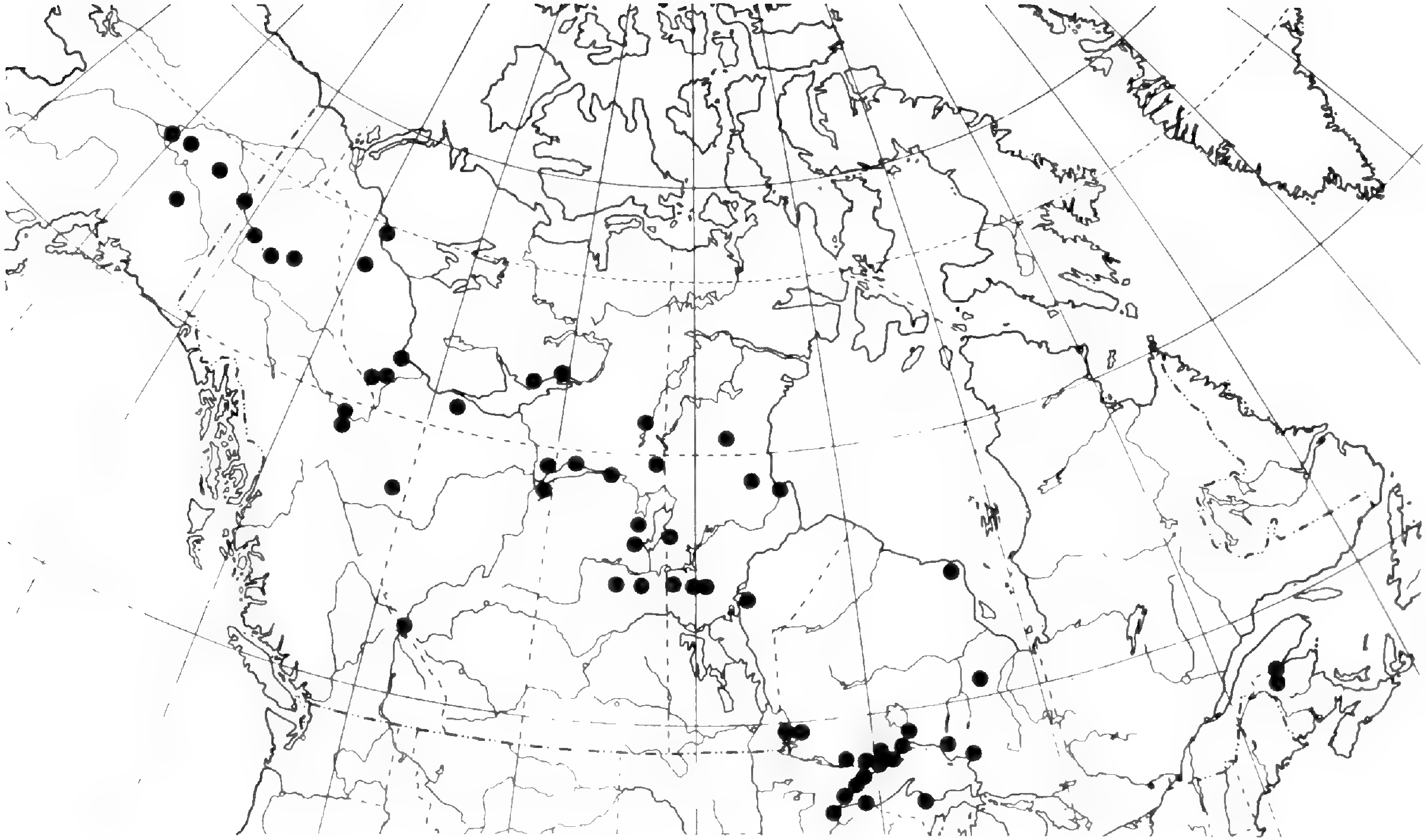

Figure 5. Distribution map of *Gymnocarpium jessoense* subsp. *parvulum*.

locality 352B, *J.L. Riley 9488* (TRT); McMeekin Twp., Andy Lake, *P.F. Maycock and D. Gregory 32728* (TRTE); south side of Hwy. 17 about 5 miles east of Manitoba border, *E. Medhurst EM-58* (OAC); Rainy River Distr., Quetico Provincial Park—Glacier Lake, *S. Walshe 76-179* (OAC); Thunder Bay Distr., Crooks Twp., *Cormack and Mayall* 19 August 1936 (MICH); Cliffs of Current River bank at Trowbridge Falls, *C.E. Garton 1411* (DAO); Hardwick Twp., Roundtable Lake, *C.E. Garton 1497* (DAO); Kamanistiquwa River, *D.M. Britton, A. Anderson and C.E. Garton 6811* (OAC); ca. 25 mi. n.e. of Marathon, *E.G. Voss 11668* (TRT, MICH); Red Rock slope near Highway 17, *D.M. Britton and J.H. Soper 723* (OAC); Reflection Lake—6 mi. south of MacDiarmid, *C.E. Garton 7493* (OAC); **Saskatchewan:** Hansen Lake Road, Limestone Lake, *G.W. Argus and J.H. Hudson 4575* (DAO, SASK); Highway 102 (mile 6.7), 5 mi north of La Ronge, *V.L. Harms 21134* (SASK); Highway 105 (mile 56), 1.5 mi. south of Bothwell Lake, *J. Ternier and M. Jasieniuk 1783* (SASK); Lake Athabasca (east end), Chet Lake, *R.S. Campbell* 30 July 1935 (CAN); Lake Athabasca, Cornwall Bay, *H.M. Raup 6568* (CAN); Patterson Lake, *G.W. Argus 361-63* (CAN, SASK, SFS); Wollaston Lake Road, Highway 105 (mile 107.5), *J. Ternier and M. Jasieniuk 2418* (SASK); **Yukon Territory:** Haggert Creek, near Keno Hill north of Mayo, *Catherine Broadfoot 18* (DAO, S); McQuesten Area, west of Sunshine Creek, *J.D. Campbell 476* (CAN); Moosehide Mtn., Dawson, *J.A. Calder and L.G. Billard 2963* (DAO).

U.S.A. **Alaska:** Canyon Creek, Mile 301 Richardson Highway, *W.J. Cody and T.J.M. Webster 5524* (DAO); Livengood, 80 mi. n.w. of Fairbanks, *Edith Scamman 1679* (MIN, CAN); Miller House, 115 mi. north of Fairbanks on Steese Highway, *Edith Scamman 1972* (SASK); Taylor Highway (mile 156), 6 mi. south of Eagle, *V.L. Harms 4872* (SASK); Yukon River, between Rampart and Tanana, *L.J. Palmer 39* (CAN); **Michigan:** Marquette Co., ca. 6 mi. n.w. of Ishpeming, *E.G. Voss, W.H. Wagner, Jr., and D.J. Hagenah 4709* (MICH); **Minnesota:** Cook Co., Watab Lake, *F.K. Butters, E.C. Abbé and L.B. Abbé 226* (MIN); Lake Co., 4 mi. west of Illgen City, *N.C. Fassett and J.T. Curtis 19217* (WIS); Pine Co., Cliffs of Kettle River, *F.K. Butters* June 1935 (MIN); St. Louis Co., Gooseberry River, *G.H.C., and M.F. Somerville 832* (WIS); **Wisconsin:** Bayfield Co., Orienta Falls (Iron River), *M.F. Somerville 1125* (WIS, DAO).

EXCLUDED RECORD

Conn., Fish Hatchery west of Hartford, 11-19-1924, *G.H.C. 831* (WIS). No species of this alliance are listed in "Rare and Endangered Vascular Plant Species in Connecticut" (1978).

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FERNS OF THE SHAWNEE NATIONAL FOREST (ILLINOIS)

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During the last thirty years, the author has been studying the vegetation of the Shawnee National Forest in southern Illinois. Among the groups of plants well represented in the Shawnee are the ferns and the fern allies. This paper briefly describes the major regions for ferns in the Shawnee National Forest and follows with a complete list of the taxa of ferns and fern allies known.

Of the 101 taxa of ferns and fern allies recorded from Illinois (Mohlenbrock, 1967; Mohlenbrock, 1970; Mohlenbrock & Ladd, 1981), 65 have been found within the boundaries of the Shawnee National Forest. This is 64% of the ferns known from all of Illinois.

A variety of habitats accounts in part for the great diversity of plants known from the Shawnee National Forest. Major habitat types include beech-maple forests, oak-hickory forests, sandstone escarpments, limestone cliffs, and seep spring woods.

The Shawnee National Forest lies in several natural divisions in Illinois (Schwegman, 1975). It includes part of the Wabash Border Division, the Ozark Division, the Lower Mississippi River Bottomlands Division, the Shawnee Hills Division, and the Coastal Plain Division.

The Wabash River Border Division includes the bottomlands of the Wabash River. Only a small portion of this division occurs within the forest. These bottomland forests are dominated by pin oak, overcup oak, swamp white oak, basket oak, bur oak, cherrybark oak, and Shumard oak. Other associated woody species are sweet gum, common hackberry, American elm, kingnut hickory, silver maple, and pecan. Ferns which occupy this habitat are sensitive fern (*Onoclea sensibilis*), fragile fern (*Cystopteris fragilis* var. *protrusa*), and rattlesnake fern (*Botrychium virginianum*). On low ridges may be found the Christmas fern (*Polystichum acrostichoides*) and maidenhair fern (*Adiantum pedatum*).

The Lower Mississippi River Bottomlands Division includes the Mississippi River and its floodplain at the extreme western edge of the Shawnee National Forest. Typical floodplain forests are dominated by pin oak, overcup oak, Shumard oak, cherrybark oak, kingnut hickory, sugarberry, and sweet gum. Ferns include sensitive fern (*Onoclea sensibilis*), fragile fern (*Cystopteris fragilis* var. *protrusa*), silvery spleenwort (*Athyrium thelypterioides*), rattlesnake fern (*Botrychium virginianum*), and grape fern (*Botrychium dissectum* var. *obliquum*). In the bottomland swamps which are found in the Lower Mississippi River Bottomlands Division, mosquito fern (*Azolla mexicana*) grows at the surface of the water.

The Ozark Division cuts into the western extremity of the Shawnee National Forest and is marked by a range of limestone cliffs overlain by chert. The division contains many Ozarkian, southern, and southwestern species of vascular plants, many of which are rare or absent elsewhere in Illinois. The forests contain a rich assemblage of trees, including cucumber magnolia, sour gum, butternut, black walnut, bitternut hickory, red oak, sugar maple, basswood, white oak, black oak, Ohio buckeye, beech, and tulip tree. Stands of the uncommon shortleaf pine occur here, as well. Numbered among the ferns confined to the Ozark Division of the Shawnee National Forest are several spleenworts (*Asplenium* × *kentuckiense, A.* × *trudellii, A.* × *herb-wagneri, A. resiliens*) and interrupted fern (*Osmunda claytoniana*). Commonly encountered ferns are walking fern (*Asplenium rhizophyllum*), ebony spleenwort (*Asplenium platyneuron*), baby lip fern (*Cheilanthes feei*), purple cliffbrake (*Pellaea atropurpurea*), glade fern (*Athyrium pycnocarpon*), and lady fern (*Athyrium filix-femina*).

The greatest diversity of ferns in the Shawnee National Forest is found in the Shawnee Hills Division, an unglaciated escarpment of sandstone cliffs of the Pennsylvanian running in an east–west direction across the forest. The cliffs, together with their intervening ravines, provide habitats for a rich assemblage of ferns. Shaded sandstone cliff-faces are suitable for the spinulose woodfern (*Dryopteris carthusiana*), intermediate fern (*Dryopteris intermedia*), marginal shield fern (*Dryopteris marginalis*), walking fern (*Asplenium rhizophyllum*), pinnatifid spleenwort (*Asplenium pinnatifidum*), maidenhair spleenwort (*Asplenium trichomanes*), and common polypody (*Polypodium vulgare* var. *virginianum*). Of less common occurrence on moist, shaded sandstone ledges are hayscented fern (*Dennstaedtia punctilobula*), netted chain fern (*Woodwardia areolata*), royal fern (*Osmunda regalis*), cinnamon fern (*Osmunda cinnamomea*), and three clubmosses (*Lycopodium lucidulum, L. porophilum,* and *L. digitatum*).

The exposed sandstone blufftops and the dry, wooded slopes are home to the common woodsia (*Woodsia obtusa*), hairy lip fern (*Cheilanthes lanosa*), and ebony spleenwort (*Asplenium platyneuron*). In moist depressions on exposed sandstone bluffs is quillwort (*Isoetes melanopoda*) (Taylor, Mohlenbrock, & Murphy, 1975). These upland woods and blufftops are dominated by a number of species of oaks and hickories.

By contrast, the deep, intervening mesic canyons are inhabited by beech-maple forests. In addition to beech and sugar maple, other common trees are tulip tree, white ash, black walnut, Ohio buckeye, basswood, and honey locust. The fern flora of the ravines is luxuriant. Among the more widespread ferns are maidenhair fern (*Adiantum pedatum*), glade fern (*Athyrium pycnocarpon*), lady fern (*Athyrium filix-femina*), silvery spleenwort (*Athyrium thelypterioides*), and Christmas fern (*Polystichum acrostichoides*).

Only a small tongue of the Coastal Plain Division extends into the Shawnee National Forest. Although this division is primarily composed of cypress-tupelo swamps, some woodland acidic seep springs occur in the eastern side of the Shawnee National Forest. These seep springs contain an interesting flora dominated by ferns, orchids, and sedges, with sphagnum moss covering much of the ground. Ferns in abundance are cinnamon fern (*Osmunda cinnamomea*), royal fern (*Osmunda regalis*), netted chain fern (*Woodwardia areolata*), and marsh fern (*Thelypteris thelypterioides*).

Following is a list of ferns and fern allies known from the Shawnee National Forest. Voucher specimens for each taxon in the list are deposited in the herbarium of Southern Illinois University (SIU) or in the author's personal herbarium, with the exception of *Thelypteris phegopteris* which is at the University of Illinois (UI).

FERNS AND FERN ALLIES OF THE SHAWNEE NATIONAL FOREST (ILLINOIS)

EQUISETACEAE—HORSETAIL FAMILY

Equisetum arvense L. Horsetail. Wet ground; common.

Equisetum hyemale L. var. *affine* (Engelm.) A.A.Eaton. Scouring Rush. Wet ground; common.

Equisetum variegatum Schleich. Horsetail. Wet ground; scattered.

Equisetum × *ferrissii* Clute. Intermediate Scouring Rush. Wet ground; scattered.

LYCOPODIACEAE—CLUBMOSS FAMILY

Lycopodium porophilum Lloyd & Underw. Clubmoss. Shaded sandstone ledges; three localities in the Shawnee.

Lycopodium lucidulum Michx. Shining Clubmoss. Shaded sandstone ledges; scattered but not common.

Lycopodium lucidulum Michx. var. *tryonii* Mohlenbrock. Clubmoss. Shaded sandstone ledge; Little Grand Canyon, the only known station in Illinois.

Lycopodium digitatum A. Braun. Ground Pine. Shaded sandstone ledge at Lusk Creek, apparently native; under pines in several plantations, apparently adventive.

SELAGINELLACEAE—LITTLE CLUBMOSS FAMILY

Selaginella apoda (L.) Spring. Little Clubmoss. Wet soil; scattered.

Selaginella rupestris (L.) Spring. Rock Clubmoss. On sandstone, Jackson Hollow; on chert, Pine Hills.

ISOETACEAE—QUILLWORT FAMILY

Isoëtes melanopoda Gay & Dur. Quillwort. Depressions on sandstone; scattered.

OPHIOGLOSSACEAE—ADDER'S-TONGUE FERN FAMILY

Ophioglossum vulgatum L. var. *pycnostichum* Fern. Adder's-tongue. Exposed sandstone under *Juniperus virginiana*; scattered but uncommon.

Ophioglossum vulgatum L. var. *pseudopodum* (Blake) Fern. Adder's-tongue. Moist woods; scattered.

Ophioglossum engelmannii Prantl. Adder's-tongue. Exposed limestone; Pine Hills.

Botrychium dissectum Spreng. var. *dissectum.* Cut-leaved Grape Fern. Woodlands; scattered.

Botrychium dissectum Spreng. var. *obliquum* (Muhl.) Clute. Blunt-leaved Grape Fern. Woodlands; scattered, but more common than var. *dissectum.*

Botrychium biternatum (Sav.) Underw. Grape Fern. Moist woods; Little Grand Canyon and Draper's Bluff.

Botrychium virginianum (L.) Sw. Rattlesnake Fern. Woodlands; common.

OSMUNDACEAE—ROYAL FERN FAMILY

Osmunda regalis L. var. *spectabilis* (Willd.) Gray. Royal Fern. Sandstone ledges and seep spring woods; scattered but not common.

Osmunda cinnamomea L. Cinnamon Fern. Sandstone ledges and seep spring woods; scattered but not common.

Osmunda claytoniana L. Interrupted Fern. Woodland; along Grapevine Trail.

HYMENOPHYLLACEAE—FILMY FERN FAMILY

Trichomanes boschianum Sturm. Filmy Fern. Under overhanging sandstone bluffs; scattered and rare.

POLYPODIACEAE—FERN FAMILY

Dennstaedtia punctilobula (Michx.) Moore. Hay-scented Fern. Shaded sandstone ledge; Lusk Creek Canyon.

Adiantum pedatum (Tourn.) L. Maidenhair Fern. Moist woodlands; common throughout the forest.

Pteridium aquilinum (L.) Kuhn var. *latiusculum* (Desv.) Underw. Bracken Fern. Open woods, roadsides; scattered.

Pellaea atropurpurea (L.) Link. Purple Cliffbrake. Crevices of limestone; common where limestone outcrops.

Pellaea glabella Mett. Smooth Cliffbrake. Crevices of limestone; scattered and rare.

Cheilanthes feei Moore. Baby Lip Fern. Crevices of limestone; scattered.

Cheilanthes lanosa (Michx.) D.C.Eaton. Lip Fern. Dry woods, sandstone crevices; common.

Polypodium vulgare L. var. *virginianum* (L.) Eaton. Common Polypody. Rocky woods, mostly on sandstone; scattered.

Polypodium polypodioides (L.) Watt var. *michauxianum* Weatherby. Gray Polypody. Rocky woods; scattered.

Polystichum acrostichoides (Michx.) Schott. Christmas Fern. Woods and shaded bluffs; common.

Onoclea sensibilis L. Sensitive Fern. Moist woods; common throughout the forest.

Thelypteris hexagonoptera (Michx.) Weatherby. Broad Beech Fern. Rich woods; common.

Thelypteris phegopteris (L.) Slosson. Long Beech Fern. Rich woods; Fountain Bluff. This species may no longer be extant in the Shawnee National Forest.

Thelypteris noveboracensis (L.) Nieuwl. New York Fern. Rich wooded slope; Long Spring.

Thelypteris thelypterioides (Michx.) Holub. Marsh Fern. Marshy woods; scattered and rare.

Dryopteris carthusiana (Villars) H.P.Fuchs. Spinulose Fern. Shaded sandstone cliffs; scattered but not common.

Dryopteris intermedia (Muhl.) Gray. Intermediate Fern. Shaded sandstone cliffs; scattered but not common.

Dryopteris goldiana (Hook.) Gray. Goldie's Fern. Rich, rocky woods; scattered and rare.

Dryopteris × *neo-wherryi* W.H.Wagner. Wherry's Shield Fern. Rocky woods; Lusk Creek Canyon.

Dryopteris marginalis (L.) Gray. Marginal Shield Fern. Rocky woods and sandstone ledges; common.

Woodwardia areolata (L.) Moore. Netted Chain Fern. Marshy woods and sandstone cliffs; Jackson Hollow and Mill Spring.

Athyrium pycnocarpon (Spreng.) Tidestrom. Glade Fern. Rich woods; common.

Athyrium thelypterioides (Michx.) Desv. Silvery Spleenwort. Rich woods; scattered but not common.

Athyrium filix-femina (L.) Roth var. *rubellum* Gilib. Lady Fern. Rocky woods; common throughout the forest.

Athyrium filix-femina (L.) Roth var. *asplenioides* (Michx.) Farw. Southern Lady Fern. Deep canyon woods; scattered and rare.

Asplenium rhizophyllum L. Walking Fern. Rocky woods; on limestone; on sandstone; scattered.

Asplenium pinnatifidum Nutt. Pinnatifid Spleenwort. Crevices of sandstone cliffs; scattered.

Asplenium × *gravesii* Maxon. Graves' Spleenwort. Crevices of limestone cliff; Pine Hills. Only Illinois locality.

Asplenium × *kentuckiense* McCoy. Kentucky Spleenwort. Crevices of limestone cliff; Pine Hills. Only Illinois locality.

Asplenium × *herb-wagneri* Mohlenbr. & Taylor. Wagner's Spleenwort. Crevices of limestone cliff; Pine Hills. Only Illinois locality.

Asplenium bradleyi D.C.Eaton. Bradley's Spleenwort. Crevices of limestone and sandstone cliffs; Pine Hills and Panther's Den.

Asplenium × *ebenoides* R.R.Scott. Scott's Spleenwort. Crevices of limestone cliffs; rocky woods; scattered and rare.

Asplenium trichomanes L. Maidenhair Spleenwort. Crevices of sandstone or limestone cliffs; scattered.

Asplenium resiliens Kunze. Black Spleenwort. Crevices of limestone cliffs; scattered and rare.

Asplenium × *trudellii* Wherry. Trudell's Spleenwort. Crevices of limestone cliff; Pine Hills.

Asplenium platyneuron (L.) Oakes. Ebony Spleenwort. Moist or dry woods; common.

Woodsia obtusa (Spreng.) Torr. Common Woodsia. Dry woods, often on bluffs; common.

Cystopteris bulbifera (L.) Bernh. Bladder Fern. Rocky, limestone woods; scattered but not common.

Cystopteris fragilis (L.) Bernh. var. *fragilis.* Fragile Fern. Rich woods; Pine Hills.

Cystopteris fragilis (L.) Bernh. var. *protrusa* Weatherby. Common Fragile Fern. Woods; common.

Cystopteris fragilis (L.) Bernh. var. *mackayi* Laws. Mackay's Fragile Fern. Rich woods; Little Grand Canyon.

Cystopteris × *tennesseensis* Shaver. Tennessee Fragile Fern. Woods; Pine Hills and Fountain Bluff.

SALVINIACEAE—MOSQUITO FERN FAMILY

Azolla mexicana Presl. Mosquito Fern. Standing water, usually in swamps; scattered but not common.

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LATE PLEISTOCENE BRYOLOGICAL RELICTS IN WESTERN MASSACHUSETTS

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There is a considerable literature documenting the persistence in New England of high boreal to arctic taxa of flowering plants. The majority of such species today find suitable niches on alpine summits, as in the White Mountains, Mt. Katahdin, and, to a lesser extent, on Mt. Mansfield. However, there are isolated cases of persistence at lower elvations (e.g., *Saxifraga aizoön, S. aizoides,* and *S. oppositifolia* at Smuggler's Notch, Vt.; *S. oppositifolia* on cliff faces at Willoughby, Vt.). The assumption is that these populations represent relicts left behind in isolated stands as arctic and alpine taxa reinvaded recently deglaciated areas subsequent to the Wisconsin Glaciation. An opposite assumption, that these pockets represent recent invasions from far northern loci is much less likely; indeed, in view of the precarious status of many of these relict populations, it seems much more likely that the "persistence" theory is correct.

To date there is little literature dealing with persistence of arctic and alpine taxa of Bryophyta in New England, although we find a diversity of reports intercalated in the taxonomic literature. Perhaps the two most striking cases are *Scapania spitsbergensis,* an arctic species found in the United States only on the Knife-Edge of Mt. Katahdin (Schuster, 1974), and *Marsupella boeckii,* an alpine and arctic taxon found in eastern North America only in Greenland (Schuster & Damsholt, 1974) and on a headwall of the Davis Pond basin of Mt. Katahdin (Schuster, 1974). To my knowledge, there is no prior documented case of persistence of arctic-alpine and high boreal bryophyte taxa at low elevations anywhere in New England. The following case, thus, appears to be unique and deserves documentation, especially since the several small niches are today threatened by a proposed dam construction.

HIGH BOREAL AND ARCTIC-ALPINE HEPATICAE IN THE GREEN RIVER VALLEY

During the last twenty years I have botanized almost annually— usually several times each collecting season—on the east and northeast facing slopes of the Green River valley, in Colrain, Massachsuetts. A brief description of the niches where "critical" species occur follows. Along a narrow dirt road, usually closely following the river, are a series of schistose rock exposures where basic to weakly basic seepage occurs during the entire growing season. The exposure of these ledges and cliffs is such that, apart from limited early morning sunlight, they are in shade the remainder of the day. There are many crevices, fissures, and undercuts where direct sunlight never penetrates. The total area of these "critical" loci is perhaps no more than 200–300 sq. ft., along about 3.5–4.5 miles of the Green River. Nowhere above the Colrain–Leyden bridge over the Green River do suitable loci occur; hence the taxa cited below all occur in the lower portions of the Green River valley. This fact is cited because it is crucial to the future of the following populations.

I do not have accurate microclimatological data at hand. Unfortunately there is no practical way to acquire such data since the stations where measurements would have to be taken all lie within 3–12 feet of the dirt road and no instruments would survive there for more than a day or two. However, during the past several years, I have had class field trips to the Green River gorge in early May, from ca. May 5–15. In the single most crucial site, where six "critical" taxa survive (*Lophozia gillmani, L. heterocolpos, L. bantriensis, Jungermannia cordifolia, Scapania gymnostomophila* and *Pellia megaspora*), ice hangs on a rock wall each year into May, and I have seen the one and only microhabitat of *Scapania gymnostomophila* ice-covered as late as May 15. There is near-by a spring where *Jungermannia cordifolia* and *Lophozia bantriensis* occur. The spring water temperature apparently never exceeds ca. 60–64° F. Indeed, the most critical niche probably does not occupy more than 30–40 sq. ft.; to this area three of the taxa are confined: *Scapania gymnostomophila* (present in two populations, possibly covering less than a square foot), *Jungermannia cordifolia* (in a single population around a spring; less than 5–6 sq. ft.), *Lophozia bantriensis* (a single population, under 1 sq. ft.).

These facts suggest that three out of seven of the taxa cited below occur today under absolutely marginal conditions; the *Jungermannia cordifolia* and *Lophozia bantriensis* are not known to occur anywhere else today in eastern United States. From this I would conclude that even minor environmental alteration, especially anything done to even marginally elevate the temperature, to introduce more light, or to equalize the temperature, would probably prove lethal to these populations.

ANNOTATED LIST OF THE TAXA

1. **Jungermannia cordifolia** Hook. (*Solenostoma cordifolium* (Hook.) Steph.)

Found in constantly irrigated, spongy mats around a spring gushing from a rock cleft. In spite of the fact that a short pipe has been driven into the cleft and countless people stop there to sample the water, especially during the fishing season, the species persists, and the population does not seem to be declining.

Although there are several early reports from southern New England (Evans, 1904; Evans & Nichols, 1908; Frye & Clark, 1944), these are based on errors in determination (Schuster, 1969); apparently only two early reports of the species, from Waterville, N.H. and Hartland, Vt. (Schuster, 1969, p. 940), are correct, although a report from Round Mt. Lake, Maine, may be authentic. *Jungermannia cordifolia* has not been found in these areas in over 50 years. Thus the taxon is known in eastern United States at most from the former 2–3 stations which are considerably further to the north; it becomes much more frequent under alpine and low arctic to boreal conditions in Quebec, Nova Scotia, and Newfoundland (Schuster, 1969).

2. **Scapania gymnostomophila** Kaal.

The presence of this species, in two small populations each consisting of perhaps only 20–35 plants (others perhaps have been overlooked owing to the fact that the plants are small, creep amidst the moss *Gymnostomum,* and are often nearly hidden from view), is remarkable. *Scapania gymnostomophila* is a common species in the Arctic and High Arctic, extending northward to 82°32′ N. in Ellesmere I. (Schuster et al., 1959) and to 83° in north Greenland (Schuster, 1974); it is frequent in basic sites in west Greenland (Schuster & Damsholt, 1974). Southward it extends, as a rarity, to Percé (where it occurs in a deep chasm with *Saxifraga oppositifolia*), Quebec, Newfoundland (Schuster, 1974), the Bruce Peninsula in Ontario, Nova Scotia, and Maine (Round Mt. Lake, Franklin Co.), Vermont (Willoughby; Quechee Gulf, Hartford; Smuggler's Notch), northern New York (Ausable Chasm, Clinton Co.). In its southern stations it is everywhere rare and local and occurs as small populations.

3. **Lophozia gillmani** (Aust.) Schust.

Although Steere (1937), reporting *Lophozia gillmani* from northern Michigan, characterized it as a Cordilleran species, the plant is basically high boreal and arctic-alpine, with rare and scattered loci south of the upper edges of the boreal forest; 90% of its range lies within the Tundra, and it occurs northward to northern Ellesmere Island at 82°31′ N. (Schuster et al., 1959), and to 82°12′ N. in northernmost Greenland (Schuster, 1969). Although remaining frequent as far south as northern and western Newfoundland, the Gaspé, and the Lake Superior region (Schuster, 1969), it becomes exceedingly rare in New England, where it is known from Maine (Round Mt. Lake, Franklin Co.), New Hampshire (Beaver Brook Falls, Colebrook; Lime Pond, Columbia), Vermont (Hartland; Quechee Gulf, Hartford; Smuggler's Notch, Mt. Mansfield; Willoughby). In Massachusetts it occurs in only two stations: the Green River, where it is frequent but scattered in areas with basic seepage along less than two miles of the river, and in the Bear River, Conway. Both Massachusetts stations are at low elevations; both are in loci where ice may persist late into the spring.

4. **Lophozia bantriensis** (Hook.) Steph.

This is a rather widespread species in Europe (where it extends from Spitsbergen south to the Alps and Pyrenees, but also into Siberia, at ca. 60° N.). Even though there are numerous stations cited from western boreal and arctic North America, it is rare in the east, where it is known from isolated stations in Greenland, Ellesmere Island, northern Quebec, northern Ontario, and Newfoundland; some of these reports are doubtful (Schuster, 1969, p. 389).

Lophozia bantriensis is closely allied to *L. gillmani,* which is paroicous. Plants of *Lophozia bantriensis* are typically larger, often sterile, and dioicous. On all three bases, the Green River population can only be referred to *L. bantriensis,* even though the superfically similar *L. gillmani* occurs in the same area (although never admixed).

5. **Lophozia heterocolpos** (Thed.) Howe

Although widespread in the Arctic, where it occurs northward to 82°26′ N. in Ellesmere I. (Schuster et al., 1959) and 83°06′ N. in north Greenland (Schuster, 1969), this species occurs with some frequency southward into the boreal forest. In areas with mixed coniferous-deciduous forests it becomes rare, and in deciduous-forested areas, such as the Green River, it is very rare. It is known from several stations in Maine, northern Vermont, and northern New York (Schuster, 1969), but occurs southward as a disjunct into the Catskills and to Grandfather Mt. in North Carolina; there a small population has been found very near the summit, at over 5900 ft. In Massachusetts, the Green River gorge population is the only one known; it occurs in at least three small populations, none covering more than a square foot in area.

6. **Lophozia badensis** (G. ex G. & Rabenh.) Schiffn.

Although this species is the "least" arctic of the four *Lophozia* species here cited from the Green River, the last station is still the only one known for *L. badensis* in Massachusetts. The species occurs northward to 82°26′ N. in Ellesmere Island (Schuster et al., 1959) and to 82°42′ N. in north Greenland (Schuster, 1969) and, if infrequently, southward into northern New England (Beaver Brook Falls, Colebrook, New Hampshire; Quechee Gulf, Hartford, Vermont). In southern New England it is known from the Green River station cited above, and from Salisbury, Litchfield Co., Conn. (Evans, 1910). *Lophozia bantriensis* is also found as a disjunct in several of the deep gorges of the Finger Lakes area of Central New York (Schuster, 1949)—areas where such northern disjuncts as *Pinguicula vulgaris, Primula mistassinica,* and *Sedum roseum* occur; it recurs in the Smoky Mts. of Tennessee, and in Ohio.

7. **Pellia megaspora** Schust.

Of the species here cited, this is perhaps the most interesting. Since its phytogeography will be shortly dealt with in some detail in Schuster, Newton, and Krzakowa (1980), only the esentials are given here. The species is endemic to eastern North America. I know of isolated stations in Newfoundland, Cape Breton, Nova Scotia, the Gaspé, northern Michigan, northern Minnesota, Vermont, central New York (a single station in a deep gorge), and from the Green River gorge in Massachusetts. Basicaly it is a local, boreal species that is restricted to areas with constant basic seepage. It is assumed that *Pellia megaspora* survived the Pleistocene south of Massachusetts and has shown only limited ability to reinvade its former pre-Pleistocene range. The species is unisexual and lacks asexual propagula; as the name suggests, it also produces very large spores (64–80 × 100–120 μ)—the largest spores of any hepatic from northern areas known to me. These spores, furthermore, are green and appear to show short duration of viability (a topic currently under investigation). Hence dispersibility appears to be limited by spore size, spore duration, and restriction of the plant to sheltered loci where strong winds are not likely to occur. The species is an ecological specialist strictly limited to cool or cold areas with basic seepage. Since it is unisexual, establishment of bisexual "centers" from which it could spread seems difficult to accomplish. In fact, of the 20-odd stations of this species I have seen in 35 years of active collecting, the Green River population is the only one known to me. It also is the only population I know which has both ♂ and ♀ plants, thus enabling the species to go through its life-cycle. Although impossible to document with any certainty, it is likely that the Green River plants represent, if not the only viable (bisexual) population, then one of only a few such populations of this rare species. (One should mention that the only near relative of this species, *P. endiviifolia,* is able freely to reproduce asexually by fragmenting systems of narrow, autumnally produced branches. Such a system of asexual reproduction does not occur in *P. megaspora.*)

PHYTOGEOGRAPHIC AND ECOLOGICAL CONCLUSIONS

The seven species cited above occur in the Green River gorge in their only Massachusetts station, with the exception of *L. gillmani,* which is known from a single additional station. Most of the taxa are far northern in range, and four occur well northward into the middle latitudes of Greenland. Of perhaps even more significance are these two facts: (1) The group of seven species cited represents by far the largest assemblage of high boreal to arctic-alpine species known from any lowland area in New England; (2) at no other station in Massachusetts does this ensemble of species occur. (Relevant are the facts that I have actively botanized in New England for 35 years, and for the last 21 years have resided in Massachusetts. Even though, possibly, future field work will result in discovery of one or the other of these species in one or two additional loci in the state, I very greatly doubt this. The combination of a very cool site plus constant basic seepage has not been seen at any other point in the state.)

Why the high concentration of "critical" taxa at this one site, from which no arctic-alpine flowering plants are known? The answer obviously lies in the fact that plants as small as the mosses and hepatics can occupy very small niches in which pockets of at least marginally suitable sites persist. As stated in Schuster (1958, p. 257):

> "Bryophytes are able to survive in small niches, or "pockets," because their size is so small that their distribution is, within limits, largely a factor of the microenvironment....For this reason we may expect Hepaticae (and mosses) to persist in small pockets where a suitable microenvironment persists, long after the general climate of the region has become very definitely 'inimical.' It would appear that, especially in the case of the 'boreal' relicts, the bryophytes can persist for a much longer period than the larger vascular plants which are more restricted by the macroenvironment."

From these facts one must also conclude that any alteration of the general environment—especially anything done that would increase the temperature even marginally—would wipe out such relict populations which today survive under precarious and perhaps marginal conditions. The proposed creation of a dam on the Green River would almost surely guarantee that the aforementioned taxa would be exterminated there and that six members of our flora would become extinct in Massachusetts. Even if the species were not physically drowned out, the creation of a considerable body of water would serve as enough of an influence on the temperature that this alone, in my opinion, would be almost enough in itself to guarantee the demise of these populations.

One final note: I have not systematically surveyed all possible niches in the Green River valley, and I have made a study of only the Hepaticae. Thus the aforementioned is a minimal list. There may still be additional relict taxa to be found, especially if the mosses are carefully searched for.

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DISTRIBUTION AND ABUNDANCE OF *EUPATORIUM LEUCOLEPIS* VAR. *NOVAE-ANGLIAE*

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Although *Eupatorium leucolepis* (DC.) Torrey & Gray had been known as a rare member of the New England flora since 1908 (Fernald, 1911), it was not until 1937 that M. L. Fernald recognized the varietal status of these plants, which inhabit a few of the pond shores of that region. In his brief formal description of the variety Fernald (1937) gives several good characters by which *novae-angliae* can be distinguished from nominate *leucolepis*, which occurs locally from Louisiana and Florida to New Jersey and rarely to Long Island, New York. All herbarium and field material that I have examined from New England are clearly referrable to *novae-angliae*. Fernald cited specimens from five ponds in Plymouth County, Mass. and two ponds in Washington County, Rhode Island; so far as I can determine from available herbarium specimens, these seven ponds constituted the total known range of the taxon at that time and, in fact, until this study. Fernald provided no information on abundance, and there are no collections more recent than 1930. For these reasons the plant has been proposed for federal listing as "Threatened" by the Smithsonian Institution (1975) and by Ayensu and DeFelipps (1978), and placed in category 2 (more study needed) by the Office of Endangered Species (1980).

In conjunction with other studies conducted during 1973–1975, I visited nearly every natural pond, large and small, in southeastern Massachusetts and southern Rhode Island, including all historical sites for the plant. Thus it is likely that the localities enumerated below support practically the whole population of the variety *novae-angliae*. Many of the ponds were revisited in 1979 and 1980, when voucher specimens were collected; these are deposited at the NEBC herbarium and my own. In addition, J. A. Coddington visited the Plymouth county sites in 1978 while preparing a status report for the U.S. Fish & Wildlife Service (Coddington & Field, 1978).

The list of localities is compiled from my own field work and from specimens at the following herbaria: BRU, GH, MASS, NEBC, RI. All stations, whether extant or not, are included. Ownership, unless otherwise stated, refers to land down to the "natural high water mark"; the water and the land thereunder normally are property of the State.

Note: population estimates given by Coddington are of discrete clumps (counted as one plant) and solitary plants of all ages, whereas I only counted each flowering shoot, whether clumped or not. Censusing techniques are necessarily somewhat arbitrary due to the difficulty of distinguishing between clumps consisting of a single, multiple-shoot plant and those consisting of several individual plants.

PLYMOUTH COUNTY, MASSACHUSETTS

1. **Muddy Pond, Kingston.** Moist cobbly-sandy shores, 475 flowering shoots counted 2 September 1975, 1700 flowering shoots 3 September 1980: *Sorrie 715* (NEBC), ca. 2000 clumps counted by Coddington 27 August 1978. Privately owned by a Catholic Order, which operates a summer camp there.

2. **Smelt Pond, Kingston.** Specimen: Shore, 30 August 1908, *W. P. Rich & C. H. Knowlton, s.n.* (GH). The first specimen of *E. leucolepis* taken in New England. No plants present here, nor at adjacent Little Smelt Pond, in August 1973, 9 August 1975, 13 September 1979, nor in 1978 by Coddington. Privately owned and used by seasonal residents, a scout camp, and a cranberry grower.

3. **Loon Pond, Lakeville.** Specimens: Damp sandy shore, 20 August 1913, ISOTYPE, *M. L. Fernald & B. Long 10492* (NEBC). Damp sandy shore, 26 August 1913, *M. L. Fernald & B. Long s.n.* (NEBC). Sphagnous grassy place, 10 September 1930, *S. F. Blake 11287* (GH). No plants present in August 1974 nor 1 September 1975, but 7 flowering shoots were found in damp sandy soil 10 September 1979: *Sorrie 249* (NEBC) and 5 on 26 August 1980. Coddington found none in 1978. Privately owned and used by residents and an athletics camp.

4. **Cook's Pond, Plymouth.** Damp sandy shore, a single plant blooming among *Vaccinium atrococcum* (Gray) Heller shrubs 19 August 1975; none present 2 September 1979 nor 26 August 1978 by Coddington. Privately and municipally owned (partly bordered by a town forest) and used by residents, a cranberry grower, and picknickers.

5. **Great South Pond, Plymouth.** Cobbly-sandy and moist sandy shores, less than 100 flowering shoots found in August 1973, 250 shoots in bud or flower 12 August 1975, less than 75 flowering shoots 2 September 1979: *Sorrie 239* (NEBC), 160 shoots 7 August and 8 October 1980, and 199 clumps counted by Coddington 26 August 1978. Municipally owned as a water supply, but numerous private residences are situated along the shores where the plants grow.

6. **Harlow Pond, Plymouth.** Sandy-peaty border, 16 shoots finishing blooming 22 September 1975, 72 shoots blooming there 2 September 1979: *Sorrie 245* (NEBC), 103 clumps counted by Coddington 27 August 1978. Privately owned, including the water.

7. **"King" Pond, Plymouth.** Specimen: Gravelly upper beach, 6 plants, 30 August 1928, *M. L. Fernald & L. Griscom 1076* (NEBC). Current topographic maps (USGS, 1977) identify what is no doubt this pond as Kings Pond. No plants present in August 1973, 26 & 29 August 1975, 2 September 1979, nor in August 1978 by Coddington. Privately owned and used by residents.

8. **Little Micajah Pond, Plymouth.** Sandy-peaty border, ca. 100 shoots found in August 1973, 150 shoots in bud 19 July 1975, 285 shoots blooming 2 September 1979: *Sorrie 242* (NEBC), 223 clumps counted by Coddington 26 August 1978. Privately owned, including the water, and used by residents.

9. **Little Widgeon Pond, Plymouth.** Moist to dry sandy shores, 13 shoots blooming 23 August 1975, 25 shoots blooming 2 September 1979: *Sorrie 243* (NEBC), 30 clumps counted by Coddington 27 August 1978. State-owned, part of the Myles Standish State Forest.

10. **Micajah Pond, Plymouth.** Specimen: Muddy pond margin, 13 September 1925, *L. B. & F. E. Smith, Jr., s.n.* (NEBC). No plants present in August 1973, 19 July & 5 September 1975, nor 2 September 1979. On the original collection label there is no pond named, yet in his description of the variety Fernald (1937) cites "Micajah's" as the locality. The extant station at Little Micajah Pond lies less than 30m from the southeast shore of Micajah, so the former is possibly the Smiths' locality. Privately owned and used by residents.

11. **Triangle Pond, Plymouth.** Specimen: Edge, 26 August 1928, *L. Griscom 12706* (NEBC). There are two ponds with this name in the town of Plymouth, plus a third named South Triangle Pond; none supported any *novae-angliae* on various dates from 1973–1975. Apparently Griscom collected his specimen at the Triangle Pond near current routes 44 and 80, for on 1 September 1979 197 shoots were blooming in moist sandy to sandy-peaty soil: *Sorrie 237* (NEBC). Coddington counted 80 clumps 4 September 1978. Privately owned and used by residents.

NEWPORT COUNTY, RHODE ISLAND

12. **Beavertail Point, Jamestown.** Some 35 plants grow in "permanently damp soil of an open swale" (Champlin, pers. comm.) near the southern end of Conanicut Island. Colony discovered by R. L. Champlin. Ownership has been recently transferred from the U.S. Navy to the State; proposals for development as a state park threaten the site (Church, 1980).

WASHINGTON COUNTY, RHODE ISLAND

13. **Hot House Pond, South Kingstown.** Cobbly-sandy point, a few small shoots without blooms 10 September 1975. Privately owned, including the water, and used by residents.

14. **Lily Pond, South Kingstown.** Sandy-gravelly cove, 2 shoots blooming 10 September 1975. Privately owned, including the water, and used by residents.

15. **Long Pond, South Kingstown.** Specimen: Sandy and peaty shore, 5 September 1914, *J. F. Collins & M. L. Fernald 11444* (GH, NEBC). On 10 September 1975 180 shoots were blooming there. Privately owned and used by residents.

16. **White Pond, South Kingstown.** Sandy coves, 8 shoots blooming 10 September 1975. Privately owned and used by residents.

17. **South Kingstown.** Specimen: Granitic gravel and sand about small pond east of Long Pond, 5 September 1914, *J. F. Collins & M. L. Fernald,* Plant. Exsicc. Gray. 280 (GH, NEBC). This pond may

be #13, 14, or 16 above, or perhaps one of the Spectacle Ponds (USGS, 1971) which I was unable to visit.

DISCUSSION

Of the seventeen localities only twelve are definitely known to harbor current stands of *novae-angliae*, yielding a total population estimate of only 2500 mature plants. As is obvious from Coddington's counts and mine (despite different methodology) the number of plants which emerge and bloom varies considerably from year to year, due to the marked fluctuations in the water level of the ground-water ponds that the variety inhabits. The propensity of *novae-angliae* to grow only along the drier, uppermost reaches of the pond margin was observed at every pond where I found the plant. This habit may be related to the plant's water tolerance during the growing season, or more likely to its inability to survive extended periods of time submerged during consecutive high-water years. This variety is perennial and can reproduce vegetatively from the caudex-like base, but such questions as how long it can survive without photo-synthesizing, and what minimum depth of water will prevent it from sending up shoots in a given year are not known.

Even though ten new stations were found during field work, it is noteworthy that they represent only a small fraction of the habitat apparently available to the variety. I visited at least 300 other ponds which supported anywhere from a few to many other Coastal Plain species, but which were devoid of *novae-angliae*.

Three of the seven historical stations have been destroyed, all apparently due to shorefront development and recreational activities. Construction of major highways has made rural areas accessible and desirable, so that homes are being built around the shores of many fine and botanically rich ponds. Planned highway construction now threatens station No. 1. Despite State ownership of the water and land under it at ponds over ten acres in size (Nos. 1–5, 7, 10, 11, 15, 16), there is no legal protection given to the plant life. Only at stations 5 and 9 is some measure of safety provided, due to the nature of ownership and usage of the ponds. Thus *none* of the stands of *novae-angliae* are in any way permanently preserved.

I favor retention of "Threatened" status for *Eupatorium leucolepis* var. *novae-angliae* and strongly urge that steps be taken to insure continued survival in native habitat.

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ASTRAGALUS SECTION DESPERATI (LEGUMINOSAE) AND A NEW SPECIES FROM THE UINTA BASIN OF UTAH

Elizabeth Neese and Stanley L. Welsh

In the course of recent field studies in the Uinta Basin and in Emery County, Utah, specimens were taken which add to the total knowledge of the species placed in the section *Desperati* of the genus *Astragalus*. These additions, along with other changes within the section, which have accrued since the publication of the monumental "Atlas of North American Species of *Astragalus*" (Barneby, 1964), require that the section be expanded to accommodate the new taxa and new information. The section consists of a suite of eight taxa in two subsections, *Desperati* and *Naturitenses*. The constituent taxa are specialized species of sandstone crevices, rimrock depressions, and sand or sandy gravels of eastern Utah, western Colorado, and northern Arizona. The first named taxon of this series of delightful narrow endemics was *Astragalus desperatus* by M. E. Jones (1891). At the time of publication of Jones' (1923) revision of *Astragalus,* he was acquainted with only three of the taxa currently known. Jones (1923) had misinterpreted material of *A. naturitensis* taken from along McElmo Creek in Colorado as *A. arientinus* var. *stipularis*. *Astragalus naturitensis* was named by E. B. Payson, and was thought by Jones to be *A. desperatus*. *Astragalus desperatus* var. *petrophilus* was described by Jones (1923) on the basis of specimens from the San Rafael Swell region of Utah. *Astragalus deterior* and *A. monumentalis* were named by Barneby (1953) on the basis of specimens taken from the Mesa Verde in Colorado and along White Canyon in Utah respectively. Barneby had earlier (1948) named *A. desperatus* var. *conspectus* based on materials from Navajo County, Arizona. This taxon was elevated to specific rank by Welsh and Atwood (Welsh, Atwood, & Reveal, 1975) as *A. barnebyi*. Segregated from *A. monumentalis* in a broad sense was *A. cottamii* Welsh (1970). Because of lack of materials of a definitive nature *A. desperatus* var. *petrophilus* was included within an expanded *A. desperatus* by Barneby (1964).

To this remarkable assemblage of plants belongs yet another species. The populations occur in the vicinity of Horseshoe Bend east of the Green River south of Vernal, Utah, where they grow on Pleiocene to Quaternary river terrace sands and gravels overlying the Duchesne River Formation. The plants are short-lived small perennials bearing few to several scapose inflorescences carried well above the sparingly branched acaulescent to subcaulescent stems and strigose leaves. This novelty, *Astragalus equisolensis,* shares features with members of the section *Desperati,* subsection *Desperati.*

Segregation and reevaluation of taxa belonging to the section *Desperati* since 1964 has produced a need for an overview of the group. The publication by Welsh (1978) on Utah legumes is likewise dated by this discovery. The following summary key will provide such an overview, awaiting a more definitive treatment.

ASTRAGALUS L. SECTION DESPERATI BARNEBY

1. Pods dorsiventrally compressed, declined or deflexed, hirsute with spreading lustrous hairs (subsection *Desperati*) . . . 2.
    2. Calyx 3.5–6 mm long, the tube campanulate, 2.5–4 mm long; flowers 6–11 mm long . . . . 3.
        3. Pods lunately curved, at maturity mainly 11–19 mm long; plants commonly shortly caulescent; racemes mainly with 6–28 flowers; widespread from west-central Colorado through southeastern Utah and north-central Arizona . . . . *A. desperatus* Jones var. *desperatus*
        3. Pods straight or nearly so, at maturity 6–11 mm long; plants commonly acaulescent; racemes mainly with 3–6 flowers; northern and northwestern San Rafael Swell, Emery Co., Utah *A. desperatus* var. *pertrophilus* Jones
    2. Calyx 6–8.5 mm long, the tube short-cylindric, 4.5–6.5 mm long; flowers 12–16 mm long . . . . 4.
        4. Plants 5–15 cm tall, not pulvinate-caespitose; racemes usually with more than 8 flowers per raceme, the axis 1.5–7 cm long in fruit; Uintah Co., Utah . . . . *A. equisolensis* Neese & Welsh
        4. Plants 1.5–5 cm tall, pulvinate-caespitose; racemes 2- to 8-flowered, the axis 0.5–2.5 cm long in fruit; Navajo and Coconino counties, Arizona and Wayne and Garfield counties, Utah . . . . *A. barnebyi* Welsh & Atwood
1. Pods dorsiventrally or trigonously compressed, ascending, strigose to strigulose with appressed hairs (subsection *Naturitenses*) . . . . 5.

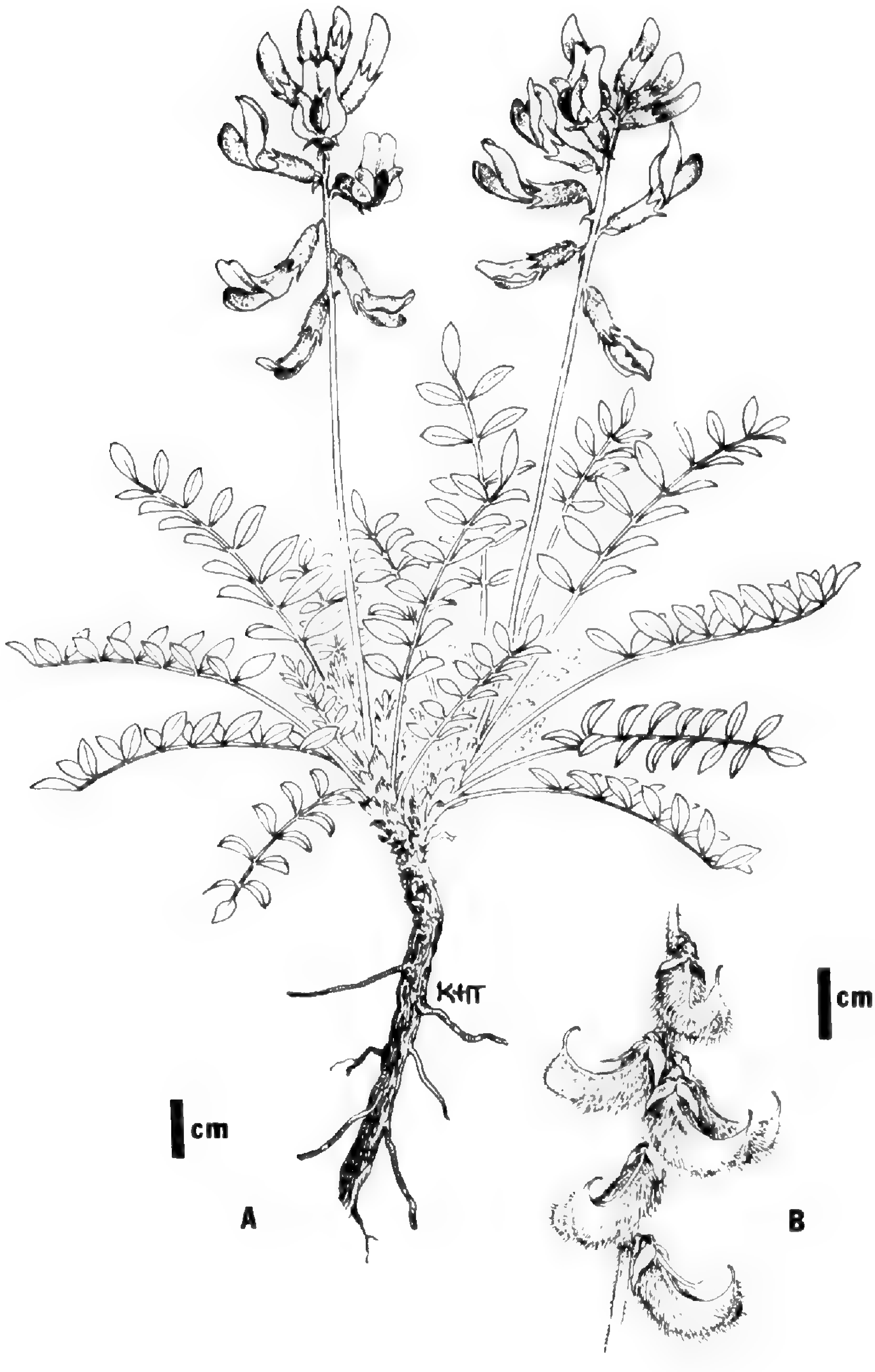
5. Stipules connate, at least the lowermost; calyx tube 3–3.5 mm long; petals ochroleucous, tinged purplish; ovules 8–10; from Mesa Verde, Montezuma Co., Colorado .... *A. deterior* Barneby
5. Stipules all distinct; calyx tube 3–6.7 mm long; petals pink-purple or white tipped with purple; ovules 16–31; distribution otherwise .... 6.
    6. Pods narrowly ellipsoid, dorsiventrally compressed, only semi-bilocular; plants of Montrose, Sam Miguel and Montezuma counties, Colorado*A. naturitensis* Payson
    6. Pods narrowly oblong in outline, compress-triquetrous, bilocular or nearly so; plants of Utah and Arizona 7.
        7. Calyx tube cylindric, 4.8–6.7 mm long; flowers 11–17 mm long; pods 20–25 mm long, conspicuously arcuate; plants of central to south-central San Juan County, Utah and northern Navajo County, Arizona .... *A. cottamii* Welsh
        7. Calyx tube campanulate, 3–3.5 mm long; flowers 8–9 mm long; pods 12–21 mm long, straight to somewhat surved; plants of San Juan and Garfield counties, Utah .... *A. monumentalis* Barneby

The discovery of *A. equisolensis* in the Uinta Basin of Utah extends the known area of distribution of members of the section northward, out of the Navajo Basin. The extension seems logical when one considers that the locality of this previously unknown taxon is remote from the nearest populations of *A. desperatus* by only about 145 km. The specific epithet was chosen in reference to the area from which the species was discovered.

Astragalus equisolensis Neese & Welsh *sp. nov.*

Ab *Astragalo desperato* M. E. Jones differt floribus majoribus calyce cylindraceo et habitu stricto; e *A. barnebyi* Welsh differt calyce breviore et latiore habitu stricto et elatiore pedunculis longioribus et inflorescentiis longioribus et leguminibus hirsutis paucioribus.

Plantae perennes acaulescentes vel subacaulescentes, 5–15 cm altae, caudicibus ramificantibus enascentibus; pubescentiae basifixae; stipulae 2–5 cm longae; folia 1.5–9 cm longa; foliola 5–17, 3–12 mm longa 1.5–5 mm lata elliptica oblanceolata vel obovata acuta vel obtusa utrinque strigosa; pedunculi strictissimi 2–9 cm



Astragalus equisolensis Neese & Welsh **A**. Habit of growth **B**. Fruit longi; racemi 4–13 floribus, floribus adscendentibus vel patentibus ad anthesin, axibus 1.5–7 cm longis in fructum; bracteae 2–4.5 mm longae; pedicelli 0.5–2 mm longi; bracteolae nullae; calyx 6–8.5 mm longus tubo 4.5–6 mm longo cylindraceo strigoso dentibus 1.2–2.5 mm longis subulatis; flores 12–16 mm longi purpurei; legumina declinata vel deflexa sessilia vel substipitata oblique ovoidea vel lance-ellipsoidea lunate curva dorsali-ventraliter compressa, distaliter constricta ad rostrum laterale compressa incurva, 10–14 mm longa, 3.5–6.5 mm lata, hirsuta unilocularia valvis crasse papyraceis; ovula 20.

HOLOTYPE: Utah, Uintah Co., T6S, R22E, SE¼ of Sec. 29, 4.8 km south of the Green River, 5.6 km west of Walker Hollow road, 1580 m elev., mixed desert shrub community, Duchesne River Formation, silty sand, *Neese & Welsh 7380*, 27 May 1979 (BRY; 6 isotypes to be distributed).

PARATYPES: Utah, Uintah Co., T7S, R22E, Sec. 4, near Horseshoe Bend, 3.2 km east of Baser Wash, 1525 m elev., sagebrush-shadscale community, Duchesne River Formation, *Neese 4313*, 1 May 1978 (BRY); T6S, R22E, Sec. 29–30, ca. 14.5 km southwest of Jensen, Horseshoe Bend vicinity, 1460–1525 m elev., salt desert shrub community, Duchesne River Formation, *Neese et al. 7251*, 17 May 1979 (BRY); T6S, R21E,SEc. 23, meander spur north of Horseshoe Bend, ca. 17.7 km west-southwest of Jensen, ca. 1450 m elev., on terrace gravels, *Neese et al. 7254,* 17 May 1979 (BRY); T6S, R22E, SE¼ of Sec. 29, 4.8 km south of the Green River, 5.6 km west of Walker Hollow road, 1580 m elev., mixed desert shrub community, Duchesne River Formation, silty sand, *Neese & Welsh 8278*, 10 August 1979 (BRY).

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CHROMOSOME NUMBERS OF SOME NORTHERN NEW JERSEY CARICES

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Carex is the largest genus of vascular plants in northeastern North America with 214 species treated in Gleason and Cronquist (1963). Chromosome counts for this group are still few and many of the reports have not been confirmed by additional counts. Aneuploid series have been documented in some species (Faulkner, 1972) and additional work is needed to determine if such series exist in other species. It is hoped that this paper will add some useful data to the knowledge of the group by reporting chromosome numbers taken from samples of the genus found growing in northern New Jersey.

All chromosome counts are taken from anther squashes using the procedure of Cooperrider and Morrison (1967). I prefer the 2% lactic-acetic-orcein stain because of the ease of staining the chromosomes (no heating), the excellent contrast obtained between the cytoplasm and chromosomes, and the convenience of a temporary mount without the necessity of sealing. In instances when the figures are too light, they can be left overnight to darken. Table 1 presents the chromosome counts obtained for eleven species along with locality data. Nomenclature follows that in Gleason and Cronquist (1963) except for *Carex emmonsii* Dewey (see discussion). Vouchers collected from plants in the field or from transplants grown outside the greenhouses on the Newark Campus of Rutgers University are on deposit at the New York Botanical Garden (NY). At least one drawing of a countable figure is affixed to each voucher sheet.

DISCUSSION

Carex blanda Dewey. The count of $n = 18$ is the first for this species. This is a close relative to *C. laxiflora,* and is regarded as a variety by Gleason and Cronquist (1963), while other authors (Small, 1933; Wiegand, 1922) maintain the taxon as a species. Until a revision is made, I have decided to follow the latter example.

Carex brunnescens (Pers.) Poir. A well counted species. The number of $n = 28$ agrees with the counts of Heilborn (1939), Wahl (1940), Levan (1942), Jörgenson, Sörensen, and Westergaard (1958),

Table 1. **Chromosome number and location of species of Carex examined in northern New Jersey.**

Species	*n*	Location and Voucher
C. blanda Dewey[1]	18	SUSSEX CO. : Old, wet field, Summit Lake, Stockholm. *Whitkus 221.*
C. brunnescens (Pers.) Poir.	28	PASSAIC CO. : Wet woods, Bearfort Waters, Upper Greenwood Lake. *Whitkus 130.*
C. crinita Lam. var. *gynandra* (Schw.) Schw. & Torr.	34	PASSAIC CO. : Swamp, south end Bearfort Waters, Upper Greenwood Lake, *Whitkus 125.*
C. emmonsii Dewey	20	MORRIS CO. : Woods, north end Troy Meadows. *Whitkus 471.*
	20	MORRIS CO. : Woods, north end Troy Meadows. *Whitkus 473.*
	20	MORRIS CO. : Woods, north end Troy Meadows. *Whitkus 475.*
C. folliculata L.	28	PASSAIC CO. : Swamp, south end Bearfort Waters, Upper Greenwood Lake. *Whitkus 492.*
C. gracillima Schw.	27	SUSSEX CO. : Swamp, Summit Lake, Stockholm. *Whitkus 188.*
C. pensylvanica Lam.	18	PASSAIC CO. : Pine slope, south end Bearfort Waters, Upper Greenwood Lake. *Whitkus 135.*
C. scoparia Schk.	34	PASSAIC CO. : Swamp, south end Bearfort Waters, Upper Greenwood Lake. *Whitkus 493.*
C. seorsa Howe.	24	SUSSEX CO. : Swamp, Summit Lake, Stockholm. *Whitkus 179.*
C. stipitata Muhl.	26	BERGEN CO. : Disturbed meadowlands, jt. of Rts. 80 and 17. *Whitkus 461.*
	26	BERGEN CO. : Disturbed meadowlands, jt. of Rts. 80 and 17. *Whitkus 464.*
	26	BERGEN CO. : Disturbed meadowlands, jt. of Rts. 80 and 17. *Whitkus 465.*
C. stricta Lam.	34	SUSSEX CO. : Budd Lake. *Morton 7285.*
	35	SUSSEX CO. : Budd Lake. *Morton 7286.*
	34	MORRIS CO. : Troy Meadows. *Whitkus 451.*
	34	MORRIS CO. : Troy Meadows. *Whitkus 454.*
	34	MORRIS CO. : Troy Meadows. *Whitkus 458.*
	34	MORRIS CO. : Troy Meadows. *Whitkus 459.*
	34	MORRIS CO. : Troy Meadows. *Whitkus 467.*
	34	MORRIS CO. : Troy Meadows. *Whitkus 468.*

[1] Identification provided by Charles T. Bryson.

Löve and Löve (1965), Löve and Ritchie (1966), Taylor and Mulligan (1968), and Dietrich (1972).

Carex crinita Lam. var. **gynandra** (Schw.) Schw. & Torr. Wahl (1940) reported two different numbers, n = 33 and n = 33 + 2, neither of which agrees with the count of n = 34. However, this is a highly variable species and a chromosome series may be present.

Carex emmonsii Dewey. This species is placed, with *C. arctitecta* Mack., under variety *muhlenbergii* of *C. nigromarginata* Schw. in Gleason and Cronquist (1963). Fernald (1950) and Seymour (1969), however, recognize *C. emmonsii* as being specifically distinct from *C. arctitecta* and provide descriptions which seemingly fit the vouchers better than that given by Gleason and Cronquist. For this reason, I have decided to recognize *C. emmonsii*, and the count of n = 20 is the first for the species.

Carex folliculata L. The count of n = 28 agrees with that of Wahl (1940).

Carex gracillima Schw. Wahl (1940) reported a series with n = 25, 26, and 27. The count of n = 27 fits into this series.

Carex pensylvanica Lam. The count of n = 18 agrees with that of Wahl (1940).

Carex scoparia Schk. The count of n = 34 differs from n = 32 of Wahl (1940) and n = 30 of Moore and Calder (1964).

Carex seorsa Howe. The count of n = 24 appears to be the first published count of this species.

Carex stipata Muhl. The counts of n = 26 confirm that of Wahl (1940) but differ with n = 24 of Japanese material by Okuno (1939, 1940) and Tanaka (1939a, b).

Carex stricta Lam. The counts of n = 34 confirm that of Tischler (1934). The Budd Lake population is unique in having both n = 34 and 35 plants.

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THE TYPIFICATION OF THE GENUS *FORESTIERA* (OLEACEAE)

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Forestiera Poiret, a small oleaceous genus of approximately twenty species, has had a surprising number of papers published dealing with the typification of its generic name but the matter still seems unresolved. Shinners (1959) suggested that the difference between his conclusion as to the proper typification of the generic name and that of Wilson (1958), who was supposedly correcting Johnston (1957), was "hardly anything but a bit of pedantic quibbling." Still, if one intends to be pedantic, one at least ought to be correct.

The lectotypification of generic names originally published without accompanying binomials is not explicitly covered by the ICBN and consequently the problem has been treated by different authors in a variety of ways. Generic names of this type sometimes have been lectotypified either by choosing from among the first binomials assigned to the genus or by that species most strongly indicated by the generic protologue or by interpretation and eventual identification of the specimens available to the author. This diversity in approach to generic typification does not augur well for stability. *Forestiera* is such a case and the conflicting approaches to typification and the resultant confusion in stated types is due at least in part to the different approaches to typification mentioned above.

The first effort at lectotypification was by Britton and Brown (1913) who chose *Forestiera acuminata* (Michx.) Poiret, one of the original species assigned to the genus *Adelia* P. Browne which is the rejected name upon which *Forestiera* is ultimately based. Johnston (1957) stated that *Adelia porulosa* Michx. should be the type species of *Adelia* P. Br. and hence of *Forestiera* Poiret. In contrast Wilson (1958) stated that the type of *Forestiera* should be *Borya cassinoides* Willd., the first binomial explicitly applied to the Jamaican plants upon which P. Browne based the original description of the generic name upon which *Forestiera* was based. Shinners (1959) rejected Wilson's reasonings and argued that the type must be chosen from among the three species originally named by Michaux since *Forestiera* was based not upon *Adelia* P. Br. but upon "*Adelia*

Michx." Shinners' lectotypic species was the same as Johnston's but they reached the same conclusion by different byways.

Britton and Brown (1913) were the first to designate a type for the genus *Forestiera* and their choice was *F. acuminata*; Rehder (1949) accepted this choice. No explanation was given by Britton and Brown for this specific selection. It probably was chosen as implied by Johnston (1957), "merely on the grounds that it was the only one of Michaux's three species which was illustrated." Practitioners of the American Code (1907) were directed by their Canon 15b that "A figured species is to be selected [as the generic type] rather than an unfigured species in the same work" and the introduction of Britton and Brown's Illustrated Flora quotes these provisions approvingly and extensively. However selections made under these provisions are considered arbitrary by Article 8 of the ICBN and may be superseded.

Johnston (1957) indicated that it "seems clear that *Adelia porulosa* Michx. should be the type species of *Adelia* P. Br. (and thus of *Forestiera* Poir.)...". This conclusion seems to rest upon Johnston's apparently erroneous statement that *Borya cassinoides* Willd. was based partly on Patrick Browne's Jamaican reference and partly on a "Michaux" specimen in Richard's herbarium "from 'maritimis Floridae' upon which Richard based the *Adelia porulosa* of Michaux's Flora." If Johnston were correct, then *Borya cassinoides* Willd. would be a synonym of *Adelia porulosa* Michx. (Article 63.2) and Johnston's conclusion as to the proper lectotype would appear unassailable. Willdenow (1806) stated that the habitat of *Borya cassinoides* Willd. was "in Antillis." There hence seems to be no apparent reason to conclude that *Adelia porulosa* Michx. and *Borya cassinoides* Willd. were based upon the same type and therefore were homotypic synonyms.

Wilson (1958) argued that the type of *Adelia* P. Br., and hence of *Borya* Willd. and *Forestiera* Poiret, was the Jamaican species described by P. Browne (1756) but first provided with a binomial by Willdenow (1806) as *Borya cassinoides* Willd.

Shinners (1959) published "as an illustration of the pitfalls that surround our modern efforts to graft a type method onto the work of botanists who had no conception of such, reasons for rejecting Wilson's choice." He pointed out that Poiret had established the genus *Forestiera* as a necessary substitution for the oleaceaous plant. Poiret found this necessary for the oleaceous genus since the later *Adelia* L. was a euphorbiaceous plant and Willdenow's substitute name *Borya* was a later homonym of an Australian genus in the Liliaceae. Poiret also stated that the oleaceous genus was established by Michaux, under the name *Adelia.* Shinners then concluded that since both *Borya* Willd. and *Forestiera* Poir. were based upon the genus he alleged was Michaux's, the lectotype must be one of the three species included by Michaux. Shinners chose *Adelia porulosa* Michx. as the "type" since it was the species most like the Jamaican plant described by Browne. If Michaux actually were the author of a newly published genus *Adelia* as claimed by Shinners, there would be no reason that the lectotype of Michaux's genus should be the species most like Browne's Jamaican plant.

The card in Index Genericorum, apparently published in 1962, lists *F. acuminata* (Michx.) Poiret as the lectotype of the genus while Hardin (1974) stated that "Shinners (1959) has determined *F. porulosa* as the correct type of the genus."

Patrick Browne (1756) first published the generic name *Adelia* for a Jamaican oleaceous plant but provided only a polynomial as was his custom rather than a binomial. Linnaeus (1759) employed the name *Adelia* for his newly differentiated euphorbiaceous genus. Linnaeus' genus has been wisely conserved by the ICBN as this usage has been adopted by almost all botanists in the Linaean sense for the small neotropical euphorbiaceous genus while apparently only Otto Kuntze has attempted to restrict the name to Browne's original sense for an oleaceous plant.

Michaux (1803) did adopt the generic name *Adelia,* attributing it to "Brown" and described three species: *A. porulosa* Michx. "Hab. in maritimis Floridae," *A. ligustrina* Michx. "Hab. in fruticetis Illinoensibus, Tennasee, &c" and *A. acuminata* "Hab. and ripas fluviorum Carolinae et Georgiae." The last of these binomials was accompanied by a full page plate.

Willdenow (1806) published the generic name *Borya* (Sp. Pl. 4: 711.) as a substitute for "*Adelia* Michaux" doubtless because the latter name was used by him (Sp. Pl. 4: 867.) in the Linnaean sense for the euphorbiaceous genus although this explanation was not stated. Three of the four species included by Willdenow were those first published by Michaux: *Borya porulosa* (Michx.) Willd., *B. ligustrina* (Michx.) Willd., and *B. acuminata* (Michx.) Willd. All three rested completely upon Michaux's account. The fourth, *Borya cassinoides* Willd., was based upon Browne's polynomial diagnosis of the Jamaican species together with its accompanying illustration and also upon a specimen seen in Richard's herbarium which reportedly came from the Antilles.

Poiret (1810 & 1812), finding that *Borya* Willd. (1806) was a later homonym of *Borya* Labill. (1804) and that the later *Borya* had been substituted as most authors had accepted the euphorbiaceous *Adelia* L. (1759) rather than the oleaceous *Adelia* Browne (1756), renamed the genus *Forestiera.* Later Poiret (1812) treated the four species included by Willdenow providing the proper binomial combinations.

Certainly there can be no argument that the type of Browne's *Adelia* must be the sole Jamaican species first given the binomial *Borya cassinoides* Willd. and later the combination *Forestiera cassinoides* (Willd.) Poiret. It was not the first species however to be given a binomial under the oleaceous *Adelia*; Linnaeus (1759) had of course provided binomials for the euphorbiaceous *Adelia.* Michaux (1803) provided the first three binomials in the oleaceous *Adelia;* he made no claim of publishing a new genus but attributed the genus to "Brown." Both Willdenow (1806) and Poiret (1810 & 1812), however, possibly attributed the generic name to Michaux as reference was prominently made to Michaux's treatment and only incidentally as synonyms within the species treatment to Browne's original publication. Still, I do not believe the evidence is present to claim, as did Shinners, that "Michaux had in reality taken the genus over from Browne, whom he cited as author; we might list the former's version as *Adelia* Browne emend. Michaux." The demonstrable fact is that Michaux accepted Patrick Browne's genus *Adelia,* attributed the genus to him (although as "Brown"), and described three species——one of which (*A. porulosa* Michx.) is considered by recent students of the group to be conspecific with Browne's Jamaican plant. Willdenow cited "*Adelia* Mich. amer. 2. p. 223" in synonymy under *Borya* Willd. but, since he had under Dioecia Monadelphia (Sp. Pl. 4: 867) treated *Adelia* L., it would seem reasonable to consider this as a reference to Michaux's treatment which was by far the most extensive and original treatment published about the group. Poiret (Encycl. Meth. Bot. **1**: 152 [132] 1810) in treating *Adelia* L. pointed out that the earlier *Adelia* P. Br. should be sought under *Borya* Willd. and would be treated by Poiret under *Forestiera.* Shinners' claim that Poiret "stated unequivocally that his *Forestiera* was a renaming of *Adelia* as treated by Michaux, not by Browne" seems to me unproven. It seems more certain that Poiret in his encyclopedic account of the plants of the world merely referred to Michaux's account which together with Willdenow's were the most extensive treatments of the group. Poiret was not intentionally providing a complete bibliography or a nomenclator of the group; there is no reason to believe that Poiret or Willdenow considered Michaux to be the author of *Adelia* in the strict bibliographic sense. It therefore does not follow as concluded by Shinners that "the type species of *Forestiera* Poiret must be selected from those included by Michaux." It surely would be a mistake for us to interpret the bibliographic references of such authors as Willdenow and Poiret by the bibliographic standards of today. There never was a genus *Adelia* Michx. and the references of Willdenow and Poiret to Michaux neither established such a genus not altered the fact that their references indirectly do refer to Browne, the sole author of the oleaceous *Adelia.*

Article 7.9 of the ICBN states that "A new name published as an avowed substitute (*nomen novum*) for an older name is typified by the type of the older name."

It seems certain that Willdenow's *Borya* was a new name published as a substitute for Browne's *Adelia* and hence is typified by the Jamaican species originally provided with a polynomial, and first given a binomial as *Borya cassinoides* Willd. It also seems apparent that Poiret, finding that the Linnaean *Adelia* was generally employed for the euphorbiaceous genus and that *Borya* Willd. was a later homonym, offered *Forestiera* as a new name as a substitute. Consequently *Forestiera* Poiret and *Borya* Willd. would have the same type as *Adelia* P. Br.——*ie. Borya cassinoides* Willd. or *Forestiera cassinoides* (Willd.) Poiret. The conclusion reached here is in full accord with that reached by Wilson (1958) and repeated by Wilson and Wood (1959) but differs from that reached by Rehder (1949), Johnston (1957), Shinners (1959) and Index Genericorum (1962). According to the most recent synopsis of the genus by Johnston (1957), both *Forestiera cassinoides* (Willd.) Poiret and *F. porulosa* (Michx.) Poiret are synonyms of *Forestiera segregata* (Jacq.) Krug & Urban, a species reportedly ranging from coastal Georgia through Florida and into the West Indies including Jamaica.

It would seem that no universally applicable regulations can be drawn from this case to serve as a guide for the proper typification of genera first described without included, named species. There seems to be no substitute for careful study of the generic protologue and for a full understanding of the nomenclatural history of the group in choosing a lectotype. Typification based upon the first binomial published under the generic name subsequent to its original publication would appear arbitrary and in any event would seem insensitive to the essential aim of reflecting the intent of the protologue when this is discernible.

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______, & C. E. WOOD, JR. 1959. The genera of Oleaceae in the Southeastern United States. Jour. Arnold Arbor. **40**: 369–384 (*Forestiera*, pp. 379–380).

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GALACTIA SMALLII: A NEW NAME FOR *G. PROSTRATA* SMALL

ALAN HERNDON

When Small published his *Galactia prostrata* (Manual of the South-eastern Flora, 1933) he was either unaware of or considered irrelevant the earlier use of the name by Bentham (1838). In either case, his name is a later homonym and unavailable for use. This was discovered by Dr. Hollis J. Rogers during his study of *Galactia* in America (unpublished PhD dissertation, Duke University, 1949). He proposed the name *G. smallii* as a replacement for the name *G. prostrata* Small, but the proposal was never effectively published and the older, incorrect name has persisted (in Long & Lakela, 1971).

To set the record straight, I propose the following name change with the kind permission of Dr. Rogers:

Galactia smallii H. J. Rogers ex Herndon *nom. nov.*

Galactia prostrata Small, Manual of the Southeastern Flora, pp. 719 and 1505, 1933 (not Bentham 1838). TYPE: for flowers, *Small 8633* (NY); for fruit, *Small, Mosier and Small 6453* (NY).

Galactia smallii, G. pinetorum Small and *G. floridana* T&G form a natural group of species in South Florida. They are all perennial herbs with numerous trailing stems (which may twine at the tip) radiating from large woody taproots and with relatively large flowers (calyx 6–8 mm long, standard and keel 1–1.5 cm long). In addition, all of these species grow in pineland habitats and have similar phenology (flowering normally in spring and early summer). *G. floridana* is usually found in lower, wetter pinelands, while *G. smallii* and *G. pinetorum* are restricted to more elevated locations. They may be separated by characters of stem and leaf pubescence as given in the following key.

1. Stem pubescence strigose, retrorse-appressed, thin. Upper leaflet surface glabrous. .... *G. pinetorum*
1. Stem pubescence ascending or spreading-sericeous. Upper leaflet surface pubescent or puberulent. .... 2.
    2. Upper leaf surface puberulent (hairs 0.1–0.2 mm long). Hairs on stem less than 0.5 mm long. .... *G. smallii*

2. Upper leaf surface densely pubescent (hairs 0.4–1 mm long). Hairs on stem greater than 0.5 mm long. . . . . *G. floridana*

There seems to be some intergrading between *Galactia smallii* and *G. floridana* as described above, but their appearance in the field is strikingly distinct. *G. floridana* has conspicuously sericeous pubescence covering stem and leaves but the pubescence of *G. smallii* leaves is not apparent without close inspection. Until this problem can be studied in detail with more adequate material, it seems best to leave the species as they stand.

ACKNOWLEDGMENTS

Drs. Patricia Holmgren and Tetsuyo Koyama of the New York Botanical Garden kindly supplied enlarged photographs of the type of *G. pinetorum* and *G. prostrata* Small which were essential in establishing the identity of those species. Their assistance is greatly appreciated. I would also like to acknowledge a debt to Dr. Helen Correll for assistance in preparing this note and to Mr. George Avery for advice and encouragement and his generous sharing of knowledge regarding *Galactia* in South Florida.

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NOTICES OF PUBLICATION

CBE Style Manual, 4th edition. 1978. 265 pp., hardbound. The CBE Manual (to which contributors to Rhodora are advised to refer) is a guide for authors, editors, and publishers. Included are most of the stages of the writing, editing, and eventual printing of an article, from advice on general formats to standardized abbreviations. Included are both general and specific (field) conventions, advice on word usage, punctuation, and indexing, and explanations of the stages of editorial processing of an article.

Scientific Writing for Graduate Students. Reprinted 1976. 190 pp., softbound. This volume is for those who are starting to write for scientific journals. Nine chapters are designed to assist in the planning, writing, revision, (and editing) of a journal article. The remainder of the book deals with such related topics as theses, research proposals, and literature searches.

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Bethesda, MD 20014

BOOKS RECEIVED

DUNCAN, WILBUR H. & JOHN T. KARTESZ. 1981. *Vascular Flora of Georgia. An Annotated Checklist.* ix+143 pp. 1981. University of Georgia Press, Athens, Georgia. (Price $5.00).

This is primarily a checklist of 3,686 species, subspecies, varieties, and hybrids occuring in Georgia. The annotations indicate the physiographic province in which the plant occurs, the plants of the state protected list, and the species for which there are no specimens in the University of Georgia herbarium.

ROBERTSON, KENNETH R. *Observing, Photographing, and Collecting Plants.* 62 pp. 1980. Illinois Natural History Survey, Circular **55**, Urbana, Illinois. (Single copy free).

A booklet for the beginning naturalist which explains the elements of botany, and gives suggestions for the study of plants in the field. There are several up-to-date, well-selected bibliographies.

LITERATURE FOR NEW ENGLAND BOTANISTS

HEMOND, HAROLD F. 1980. Biogeochemistry of Thoreau's Bog, Concord, Massachusetts. Ecol. Mono. **50**:507–526.

A detailed technical study of a bog, which is particularly interesting because its physical characteristics are such that it is an invaluable recorder of atmospheric fallout. Hemond believes the bog to be of fairly recent origin and wonders how this may affect the usual plant migration theories.

JOHNSON, CHARLES. *The Nature of Vermont.* 276 pp. 1980. University Press of New England, Hanover, N.H. (Price $7.50, paper).

The first modern survey of Vermont. Written for the average person with an interest in the state, "it is neither a field guide, nor a complete inventory of the fauna and flora...It is history, natural history, and general discovery brought together...".

MITCHELL, JOHN. 1981. Whither the Yankee Forest? Audubon **83**:78–99.

Mitchell, in a thought-provoking long article, explores the many facets of the problem of increasing use of New England's forests for energy.

MARY M. WALKER
BOTANICAL LIBRARIAN
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N.E.B.C. FIELD TRIP
NEW HAVEN, CONNECTICUT

In conjunction with the 773rd meeting of the New England Botanical Club held at Yale University, a field trip to local sites was planned for May 2nd. A group of approximately 12 people met at The Biology Department at 9:00 am on Saturday morning to the accompaniment of a light rain. It was agreed to pay a visit to the adjacent Peabody Museum of Natural History for approximately an hour in hopes that the weather would improve. The weather did improve, and the group set off to the basaltic cliff near New Haven, which had been suggested by Lauren Brown. A short walk over swampy ground led to the cliff, and provided a host of southern New England woodland herbs including:

Anemonella thalictroides
Viola cucullata
Arabis drummondii
Anemone qinquefolia
Carex stricta/oe
Asarum canadense
Trillium erectum
Osmunda regalis
Polypodium virginianum
Barbarea verna
Uvularia sessilifolia
Straphylea trifolia
Sanguinaria canadensis
Athyrium filix-foemina
Rubus pheonicolasius
Carya tomentosa
Chimaphila maculata
Lycopodium lucidulum
Cirsium muticum
Viola sororia
Lindera benzoin
Ranunculus abortivus
Maianthemum canadense
Symplocarpus foetidus
Dioscoraea villosa
Arisaema atrorubens
Polystichum acrostichoides
Hepatica americana
Zizia aurea
Polygonatum biflorum
Viola pallens
Fragaria virginiana
Onoclea sensibilis
Rhus typhina
Cornus florida
Nepetum catarium
Viburnum lentago

The cliff held many of the same species, but also *Aquilegia canadensis, Saxifraga virginiensis* and *Myosotis verna.* The fascination of the locality lay in the pteridophytes, however, which included *Pellaea atropurpurea, Cystopteris fragilis* and *Cheilanthes lanosa,* the latter at the northern margin of its range. Collecting was limited to photographs. The trip ended about 1:30.

After lunch, a reduced field party headed north to a second basaltic cliff locality in Wallingford, this one suggested by Bruce Tiffney. A short hike led us up the ridge through open Oak-Hickory forest to the top, where the group spread out to look at the varied spring flora. Many of the same species which were seen in the morning were seen here. The new taxa seen at this site included:

Trillium erectum
(yellow-white form)
Sassafras albida
Anthoxanthum odoratum
Luzula multiflora
Erythronium americanum
Selaginella rupestris
Triosteum aurantiacum
Caulophyllum thalictroides
Botrychum virginianum
Geranium maculatum
Dicentra cucullata
Houstonea caerulea
Quercus velutina
Viola fimbriatula
Viola palmata
Scirpus verecundus
Athyrium thelypteroides
Quercus prinus

The most important find at this locality was a large stand of *Corydalis flavula,* which according to the publication "*Rare and Endangered Plant Species in Connecticut*", is known from only three localities in Connecticut. Several collections of this plant were made, and specimens have been deposited in the Pringle Herbarium at the University of Vermont, the Hodgdon Herbarium at the University of New Hampshire, the Eaton Herbarium at Yale University and the Club Herbarium. The second field trip ended with the setting sun at about 7:30 PM.

Only those plants seen in flower (or spore) were reported in the foregoing list. The secretary wishes to thank Dr. David Barrington for tallying the species seen.

BRUCE H. TIFFNEY
RECORDING SECRETARY

Vol. 83, No. 834, including pages 161–322, was issued April 28, 1981.

FIELD TRIP TO MOUNT WASHINGTON, NH
WEDNESDAY, AUG 12

This trip will be a hike from the Auto Road (or Summit) to the Alpine Gardens, the Headwall of Great Gulf, and possibly Lakes of the Clouds. Meet at the base of the Auto Road to carpool at 9:30 AM. Please contact

Dr. George Newman
60 Carriage Lane (603) 472-3416
Bedford, NH 03102
by August 4th for further details.

RHODORA **July 1981** **Vol. 83, No. 835**

CONTENTS

A revision of the goldenaster genus Chrysopsis (Nutt.) Ell. Nom. cons. (Compositae:Astereaea)
John C. Semple 323
Revision of Pollalesta
John G. Stutts 385
Studies on the Gymnocarpium robertianum complex in North America
Jaako Sarvela, Donald M. Britton, and *Kathleen Pryer* . . . 421
Ferns of the Shawnee National Forest (Illinois)
Robert H. Mohlenbrock 433
Late Pleistocene bryological relicts in western Massachusetts
Rudolf M. Schuster 441
Distribution and abundance of Eupatorium leucolepis var novae-angliae
Bruce A. Sorrie 449
Astragalus section Desperati (Leguminosae) and a new species from the Uinta Basin of Utah
Elizabeth Neese and *Stanley L. Welsh* 455
Chromosome numbers of some northern New Jersey Carices
Richard Whitkus 461
Typification of the genus Forestiera
Robert L. Wilbur 465
Galactia smallii: a new name for G. prostrata Small
Alan Herndon 471
Notices of Publication 473
Books received and additional literature for New England Botanists . . . 474
Notes on the May field trip 475
Notice of August field trip . . . . Cover III

Rhodora

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Cover illustration

Caltha palustris L., known to Thoreau as "Cowslip" and commonly called Marsh Marigold, is a low perennial herb which provides a bright accent to wet woods and meadows, swamps, bogs, and other wet places across the northern United States and Canada and south along the Appalachians to the Carolinas and Tennessee.

Original artwork by Carol Ann Kearns

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TAXONOMIC AND NOMENCLATURAL NOTES ON THE FLORA OF ISLA DE LOS ESTADOS (STATEN ISLAND), TIERRA DEL FUEGO, ARGENTINA.

T. R. DUDLEY[1]

A large and comprehensive manuscript entitled *A Contribution to the Flora and Vegetation of Isla de los Estados (Staten Island), Tierra del Fuego, Argentina* has been completed and submitted for ultimate publication in hard-back book format by the American Geophysical Union (Washington, D.C.). This book will appear as No. 11 of Volume 30 of the *Antarctic Research Series: Terrestrial Biology*. This rather massive manuscript summarizes in detail, for the first time, the vascular plant, fern, and fern-ally components of the vegetation, and the ecological structure and associations of this remote and inhospitable Argentine island that lies directly off the southeastern tip (Península Mitre) of South America. More specifically this in-depth floristic study is based primarily on the extensive vascular plant, fern, and fern-ally collections accumulated principally from Isla de los Estados and Península Mitre during the 1971 early austral spring joint U.S.–Argentine botanical exploration of Isla de los Estados conducted as Research Vessel Hero Cruise 71-5 under the auspices of the Office of Polar Programs, National Science Foundation, Washington, D. C. The vascular plant collectors were: Dr. T. R. Dudley, Herbarium, U. S. National Arboretum, Washington, D.C., 20002; Mrs. R.N.P. Goodall,

---

[1] Research Botanist, U. S. National Arboretum, Science and Education Administration, USDA, Washington, D. C., 20002, and scientist-in-charge of vascular plant collections on the joint 1971 U.S. Argentine botanical expedition, Research Vessel Hero 71-5 Cruise to Isla de los Estados, Argentina, under the auspices of the Office of Polar Programs, National Science Foundation, Washington, D.C., 20550.

Sarmiento s.n. and Estancia Harberton, 9410 Ushuaia, Tierra del Fuego, Argentina; and Dr. G. E. Crow, Curator of the Albion R. Hodgdon Herbarium, Department of Botany and Plant Pathology, University of New Hampshire, Durham, New Hampshire, 03824.

Since this volume of the Anarctic Research Series: Terrestrial Biology may be delayed in its publication and since it may not be generally available to botanists because of limited edition and distribution, a summary of the results is provided here.

As the collections, numbering nearly 2,000 numbers and amounting to nearly 6500 actual specimens, from the 1971 botanical exploration of Isla de los Estados were being collated, determined, and duplicates being distributed (the first set and all unicates are deposited in the Herbarium of the U.S. National Arboretum–NA) four collection numbers were ascertained as representing two new and previously undescribed taxa. At the same time it also became evident that four new epithet combinations had to be made. These new taxa and combinations are described and discussed below.

NEW COMBINATIONS

COMPOSITAE (Asteraceae)

Gamochaeta Weddell, Chloris Andina, **1**(4–6): 151. 1856.

Gamochaeta malvinensis (H. Koyama) T. R. Dudley, *comb. nov.*

Basionym:

Gnaphalium malvinense H. Koyama, *nom. nov.*, Acta Phytotax. Geobot. **29**: 84. 1978.

Synonyms:

Gnaphalium affine Dumont d'Urville, *Flores des Îles Malouines*, p. 42, October 1825.—*non Gnaphalium affine* D. Don, *Prodromus Florae Nepalensis*, p. 173, February 1825.

Gamochaeta affinis (Dumont d'Urville) Cabrera, Bol. Soc. Argent. Bot. **9**: 363. 1961.

Koyama (1978) correctly pointed out that *Gnaphalium affine* Dumont d'Urville is a later homonym of *Gnaphalium affine* D. Don by virtue of D. Don's epithet having a seven month nomenclatural priority. Accordingly, Cabrera's 1961 combination of the South American taxon as *Gamochaeta affinis*, using *Gnaphalium affine* Dumont d'Urville as the basionym, is superfluous and can no longer be regarded as valid. Cabrera in Correa (1971), however, continues to apply the epithet *Gamochaeta affinis* to the perennial herb which he maintains as a strict endemic only to Islas Malvinas (the Falkland Islands). These nomenclatural facts of priority stimulated Koyama to rename the taxon previously known as *Gnaphalium affine* Dumont d'Urville or *Gamochaeta affinis* (Dumont d'Urville) Cabrera and indigenous to the Falkland Islands, Tierra del Fuego and Patagonia as *Gnaphalium malvinense*, a *nomen novum*. However, since this New World plant truly is assignable to the genus *Gamochaeta* rather than to *Gnaphalium*, Koyama's *Gnaphalium malvinense nomen novum* must be recombined under *Gamochaeta*.

Gamochaeta malvinensis (H. Koyama) T. R. Dudley is represented among the 1971 R/V Hero Cruise 71-5 to Isla de los Estados collections by *T. R. Dudley, R.N.P. Goodall & G. E. Crow 303* (BAB, E, MO, NA, RNG, RNPG[1], SGO, SI) from Península Mitre of Isla Grande, and from Isla de los Estados by numbers *1789* (NA), *880* (BAB, NA, RNG, RNPG, SI), *986* (NA), and *1266* (NA). Spegazzini (1896) also reports this species by the synonym *Gnaphalium affine* Dumont d'Urville with three new *formae* (f. *pusillum*, f. *parvulum*, and f. *medium*) from Puerto Cook, Puerto Vanvouver, and Puerto San Juan del Salvamento, all three being collecting stations on Isla de los Estados.

LAGENIFERA Cassini
Bull. Sci. Soc. Philom Paris **1816** (fasc. 1): 199. 1816.

vs.

LAGENOPHORA Cassini
Bull. Sci. Soc. Philom. Paris **1818** (fasc. 7):34. 1818.

Regarding the acceptance of *Lagenophora* Cassini (1818) as the legitimate name of this genus and while rejecting *Lagenifera* Cassini (1816), Cabrera (1966) argues that although *Lagenophora* was published originally as a *nomen nudum*, it was simply the Latinized equivalent of the original Greek root of *Lagenifera* and that Cassini's *Lagenophora* (1818) was intended as a correction to Cassini's *Lagenifera* of 1816. It is, however, my view that the earlier published generic name, *Lagenifera* (1816) clearly has nomenclatural priority. Koster, in Backer and Bakkhizen van den Brink (1965), clearly accepts the generic name *Lagenifera* and regards

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[1] The herbarium acronym "RNPG" denotes the private herbarium of Mrs. R.N.P. Goodall of Estancia Harberton, 9410 Ushuaia, Tierra del Fuego, Argentina.

Lagenophora as an etymological variant. But the issue is further complicated by Cabrera (1966) who states: "This would imply that under *Lagenifera* no new combinations are necessary". However, since the Type Species of *Lagenifera,* as well as of *Lagenophora,* is *Aster nudicaulis* Commerson ex Lamarck (1783), the specific epithet *nudicaulis* must be re-combined under the earliest legitimate and correct name available at generic rank, which certainly appears to be *Lagenifera.* However, before any new re-combinations can be proposed it must be established without any question that the later 1818 name, *Lagenophora,* is not a conserved name, i.e. a *nomen conservanda.*

As it turns out the spelling *Lagenophora* was indeed proposed for conservation by Bullock (1966) on the grounds that the original 1816 spelling as *Lagenifera* had not been adopted, even as a *nomen nudum,* by any authors subsequent to the 1818 publication of *Lagenophora.* The Bullock proposal to regard *Lagenophora* as a *nomen conservanda* was not enacted. Rather, it was soundly rejected by Crosswhite (1967) and McVaugh (1968), both of whom presented excellent independent rebuttals to the Bullock conservation proposal. Appendix III "Nomina Generica Conservanda et Rejicienda" in the latest (Leningrad) *International Code of Botanical Nomenclature* (Stafleu, et al., 1978) does not refer to either *Lagenifera* or *Lagenophora.* However, the published card file of *Index Nomenum Genericorum* (Card No. 14/18072) clearly implies that *Lagenophora* is a nomenclatural synonym, being based on the same type species as *Lagenifera.* Likewise Card No. 75/32528 designates *Lagenophora* as a taxonomic synonym of *Lagenifera:* "...only the earliest legitimate one, if any, being listed. Based on the same nomenclatural type as the conserved name" (cf. Stafleu, et al., p. 258, 1978). The view that *Lagenifera* is the only legitimate and validly published generic name is maintained by Airy Shaw (1966 & 1973), and also by Drury (1974) in his excellent appraisal and taxonomic treatment of the genus as it occurs in New Zealand. More recent final proof is to be found in E. R. Farr, et al., *Index Nominum Genericorum (Plantarum),* volume 2 (*Regum Vegetabile 101*, 1979). *Lagenifera* is cited on page 928 of the above mentioned work as being the valid legitimate generic name, while on page 929 *Lagenophora* is equated to *Lagenifera* with a triple line identity sign (i.e. ≡) with the accompanying comment: "intended as correction to Cassini's earlier name". The (≡) identity sign is defined on page xvi of volume 1 of E. R. Farr, et al. *Index Nominum Genericorum* (*Plantarum*) (*Regnum Vegetabile 100,* 1979) as "denoting nomenclatural synonymy for names based on the same type species".

With the acceptance of *Lagenifera* Cassini (1816) as the correct and legitimate generic epithet, *Lagenophora hariotii* Franchet (Mission Scientifique de Cap Horn, 1882–1883, Phanérogamie, Botanique **5**: 344. 1889) and the combination of *Lagenophora nudicaulis* (Commerson ex Lamarck) Dusén, Gefässpflanzen Magellansländer (in Wissensch. Ergebnisse Svenska Exped. Magellansländerna, 1895–1897 **3**(5), Botanik: 98. 1900) automatically become superfluous and synonymous with the necessary new specific combinations under *Lagenifera.* Only two species of *Lagenifera* are pertinent to the flora of Isla de los Estados and Tierra del Fuego. These are *Lagenifera hariotii* (Franchet) T. R. Dudley, *comb. nov.* and *Lagenifera nudicaulis* (Commerson ex Lamarck) T. R. Dudley, *comb. nov.* Without conducting a comprehensive monographic and systematic investigation of the other 28 or so species that have been ascribed to the genus *Lagenophora* on a world-wide basis, I feel it would be presumptive and inappropriate at this time to make any additional re-assignment or new combinations to *Lagenifera* other than the two that follow below.

> *Lagenifera* Cassini, Bull. Sci. Soc. Philom. Paris, **1816** (fasc. 1): 199. 1816——*non Lagenophora* Cassini, Bull. Sci. Soc. Philom. Paris, **1818** (fasc. 7): 34. 1818.

Lagenifera hariotii (Franchet) T. R. Dudley, *comb. nov.*

Basionym:

Lagenophora hariotii Franchet, Mission Scientifique de Cap Horn 1882–1883. Phanérogamie, Botanique **5**: 344. 1889.

Although the 1971 explorations of Isla de los Estados and the Península Mitre of Isla Grande did not yield any collections of *Lagenifera hariotii* from these locations, logically it definitely should have been evident, especially since it is well documented from a number of sites in Southern Tierra del Fuego, including from Bahía Thetis on the north coast of Península Mitre. Since Moore (1974) considers *L. hariotii* a component of Vegetation Zone 3

(Evergreen Forests) and Vegetation Zone 4 (Magellanic Moorlands) of Tierra del Fuego, I am convinced that more intensified exploration into the interior, very mountainous terrain of Isla de los Estados will demonstrate the presence of this taxon. However, failing actual documentation of *L. hariotii* in 1971 it has been included in the section entitled "Selected Taxa Unrecorded for Isla de Los Estados, and Bahías Buen Suceso and Valentín of Península Mitre" which will appear in *A Contribution to the Flora and Vegetation of Isla de los Estados (Staten Island), Tierra del Fuego, Argentina.*

From nearby Isla Grande of Tierra del Fuego and southern Fuegia *Lagenifera hariotii* has been verified by Cabrera in Correa (1971), and I have examined and verified the following representative specimens: CHILEAN TIERRA DEL FUEGO, Río Bueno, *E. Pisano 2485* (HIP, NA); Bahía Cuevas, Fiordo Parry, *E. Pisano 2969* (HIP, NA); Orange Harbor, *Wilkes Expedition* (US). ARGENTINE TIERRA DEL FUEGO, Bahía Thetis, Península Mitre, Rio Moat, Estancia Moat, *D. M. Moore 1679* (LP, NA, RNG); Departmento Ushuaia, Estancia Harberton, No Top Mountain above Estancia, *R. N. P. Goodall 767* (NA, RNPG, US); Departmento Los Logos, Villa la Angostura, 1400 m. on Cerro Burro, 16 February 1952, *T. M. Pedersen* (C, US).

Lagenifera nudicaulis (Commerson ex Lamarck) T. R. Dudley, *comb. nov.*

Basionym:

Aster nudicaulis Commerson ex Lamarck, Encyclopédie Méthodique, Botanique 1(1): 308. 1783.

Synonyms:

Lagenophora commersonii Cassini, Dict. Sci. Nat. Paris 1: 110. 1826.

Lagenophora nudicaulis (Commerson ex Lamarck) Dusén, Gefässpflanzen Magellansländer in Wissensch. Ergebnisse Svenska Exped. Magellansländerna 1895 1897, 3(5). Botanik: 98. 1900.

Lagenifera nudicaulis (Commerson ex Lamarck) T. R. Dudley is represented among the 1971 R/V Hero Cruise 71-5 to Isla de los Estados collections by *T. R. Dudley, R.N.P. Goodall & G.E. Crow 456* (NA), *741* (BAB, NA, RNPG), *753* (NA, RNPG), *889* (BAB, NA, RNPG), *907* (NA, RNPG), *1008* (NA, RNPG), *1058* (AAS, BAB, E, HIP, NA, RNG, RNPG, SI), *1069* (NA, RNPG), *1355* (NA), *1391* (NA, RNPG), *1543* (NA), *1611* (BAB, NA, RNG, RNPG), *1642* (NA), *1658* (HIP, NA, RNPG), *1697* (NA, RNPG), *1723* (NA), and *1809* (NA, RNPG).

Just recently I discovered in the Smithsonian Herbarium (US) a very historically interesting specimen of *Lagenifera nudicaulis*. It was distributed by NYS from the Lewis C. Beck collection, and was originally collected by Captain J. Eights, "Staten Island. Cape Horn". This specimen is Accession No. *920040* in US. The original collector, Captain Eights, was a famous 18th Century Sea Captain and is commemorated by *Senecio eightsii* Hooker & Arnott.

GRAMMITIDACEAE (Grammitaceae)

Grammitis Swartz, Jour. Bot. (Schrader 2), **1800**(1):17. 1801.

Grammitis magellanica Desvaux, Ges. Naturf. Freunde Berlin Mag. **5**: 313. 1811.

This epiphytic fern is quite common on Isla de los Estados, and is very variable, particularly with respect to the length of the leaves. The average leaf length is 5–12 cm. All but one of the 25 separate collections of *Grammitis magellanica* made from Península Mitre of Isla Grande and from Isla de los Estados while participating on the 1971 R/V Hero Cruise 71 5 are readily identifiable as *G. magellanica* f. *magellanica*. The leaves of one collection, *T. R. Dudley, R.N.P. Goodall & G. E. Crow 981* (NA) are suspiciously and atypically shorter, measuring to ¼–½ the length of those of most of the other collections. However, this number, No. *981*, does not demonstrate the diagnostic character of simple and translucent trichomes scattered along the margins of the very short leaves, along the upper portions of the petioles, or intermixed with the indusia. These trichome characters and their orientation correlated with very small leaves serve to distinguish *G. magellanica* f. *nana* from f. *magellanica*.

Grammitis magellanica f. **nana** (Brackenridge) de la Sota ex T. R. Dudley, *comb. nov.*

Basionym:

Grammitis nana Brackenridge in Wilkes, U.S. Explor. Exped. Filices **16**: 1. 1854. (CHILEAN TIERRA DEL FUEGO, Orange Harbor, frequent among loose rocks; TYPE Specimen No. *2759* (US No. *60716*), *Brackenridge 1*. (K, US).

Synonyms:

Polypodium poeppigianum Mettenius, Abh. Senckenberg. Naturf. Ges. **2**: 37. 1856.

Grammitis australis var. *nana* Franchet, Mission Scientifique de Cap Horn 1882 1883, Phanérogamie, Botanique **5**: 397. 1889.

Polypodium billardieri var. *magellanica* f. *nana* (Franchet) Skottsberg, Ver. Kungl. Svenska Vetens. Akad. Handl. Stockholm **56**(5): 167. 1916.

Grammitis billardieri var. *magellanica* f. *nana* (Franchet) de la Sota, Opera Lilloana **5**: 208. 1960.

Grammitis armstrongii Tindale, Contrib. New South Wales Natl. Herb. III **2**: 88. 1961.

Grammitis kerguelensis Tardieu-Blot, Adansonia **2**: 114. 1962.

Grammitis poeppigiana (Mettenius) Pichi Sermolli, Webbia **32**(2): 461. 1978.

Grammitis magellanica f. *nana* (Brackenridge) de la Sota ex T. R. Dudley is represented among the 1971 RV Hero Cruise 71-5 to Isla de los Estados collections by only one collection number, *T. R. Dudley, R.N.P. Goodall & G. E. Crow 1269* (GH, NA, RNPG). The extreme rarity of this taxon on Isla de los Estados is indicated by the field notes accompanying the collection: "rare, only one population seen with *Hymenophyllum* sp. and *Serpyllopsis caespitosa,* steep wet sea cliffs and over-hanging ledges. . .".

This very dwarfed expression of *Grammitis magellanica* had been previously regarded by E. de la Sota (1960) as *G. billardieri* var. *magellanica* f. *nana.* However, subsequently de la Sota reaffirmed in 1966 (and in 1976 by personal conversation) the conclusion that *G. magellanica* was indeed the correct species name for the Fuegian plant. Although de la Sota discusses (1966) at some length the foliar anatomy of f. *magellanica* as compared to that of f. *nana*, regrettably he did not make the essential formal and documented new combination (*comb. nov.*) of f. *nana* under *G. magellanica* which is essential and required to legitimize the epithet *nana* at the rank of forma. Accordingly, the necessary new combination is made above citing the Brackenridge basionym.

Although the *Grammitis australis* var. *nana* Franchet (1889) is clearly based on different type material and specimens than the basionym *Grammitis nana* Brackenridge (1854), both names are referrable to the same taxon. When treated at the infraspecific rank of *forma,* this should be designated as *Grammitis magellanica* f. *nana* (Brackenridge) de la Sota ex T. R. Dudley, the Brackenridge epithet, *Grammitis nana,* being regarded as the basionym with a 35-year publication priority.

R.N.P. Goodall interestingly reports (pers. comm. in 1977 and 1978) that most of her collections (RNPG) of *Grammitis magellanica* from Isla Grande of Tierra del Fuego have leaves as small or smaller than those of *G. magellanica* f. *nana* (*T. R. Dudley, R.N.P. Goodall & G. E. Crow 1269*) from Isla de los Estados. I have examined most of the small-leaved duplicates of Mrs. Goodall's collections deposited at NA and US and find that they are completely glabrous and otherwise characteristic and congruous with *G. magellanica* f. *magellanica*. However, two exceptional collections from among the Goodall materials do possess the trichomes diagnostic for *G. magellanica* f. *nana*. These two collections clearly document the presence of this morphological expression and f. *nana* from the "Mainland" of Isla Grande, Tierra del Fuego. These Fuegian collections of *G. magellanica* f. *nana* are: *R.N.P. Goodall 1443b* (NA, RNPG) from Punta Segunda near Río Encojonado and *R.N.P. Goodall 3338* (NA, RNPG) from along Río Rancho Lata and the Bridges trail near Mte. Moore. With respect to leaf dimensions it is curious that only one of the 1971 collections of *G. magellanica* from Isla de los Estados (no. *1269*) is clearly within the circumscription of f. *nana*, 0.5–1 (–2) cm long.

Parris and Given (1976) regard *Grammitis nana* Brackenridge, the basionym of *G. magellanica* f. *nana* (Brackenridge) de la Sota ex T. R. Dudley, as a synonym of a new species, *Grammitis armstrongii* Tindale (Contrib. New South Wales Natl. Herb., III **2**: 88. 1961). If the taxonomic appraisal that the plant merits recognition at full specific rank, rather than at infraspecific status as *G. magellanica* f. *nana*, is to be accepted unquestionably, then *Grammitis armstrongii* Tindale should be used (*fide* Parris & Given, 1976). *Grammitis nana* Brackenridge (1854) cannot be used at specific rank because it is pre-dated by one year by *Grammitis nana* Fée (1853)—now considered to be a synonymn of *Polypodium lasiosorum* (Blume) Hooker from Malaysia. Following the Parris and Given (1976) appraisal the 1971 *Dudley et al. 1269* from Isla de los Estados, and the *Goodall Nos. 1443b and 3338* from Isla Grande could be reannotated as *Grammitis armstrongii* Tindale, if specific recognition is desirable. I have examined an isotype specimen of *G. armstrongii* from Australia (*Johnson & Constable 3086*, US) and confirm that it, *Haumann* (US No. *691533*), *Kidder* (US Nos. *653674* and *653675*)—all from Kerguelen, and *D. Walton SG-19* (AAS, NA-det. *G. kerguelensis*) from South Georgia, all refer to the taxon I have designated as *G. magellanica* f. *nana* from Isla Grande and Isla de los Estados of Tierra del Fuego.

It is essentially a matter of degree of emphasis or weight placed on a given set of correlated morphological continuities (or discontinuities) that determines whether full specific rank is warranted or whether an infraspecific rank, such as a *forma*, is more appropriate. However, at the present time I will take a conservative and perhaps simplistic view and regard the taxon first documented and described by Brackenridge, and documented from Isla de los Estados for the first time in 1971, as *Grammitis magellanica* f. *nana* (Brackenridge) de la Sota ex T. R. Dudley. I am fully aware, moreover, that this taxonomic judgement and nomenclatural placement may be altered by the publication of "An Analysis of the *Grammitis armstrongii-G. magellanica* Complex in the South Atlantic and South Indian Oceans" announced as being "In Press" in the British Fern Gazette by B. S. Parris (cf. Parris & Given, 1976). To my current knowledge this very important paper has not yet been published, and in fact, Dr. Parris wrote to me from the University of Cambridge, Great Britain, in October 1979 with the news that she had withdrawn this paper while waiting for additional and pertinent collections to be made available to her.

A different view, very strongly conflicting with that proposed by Parris and Given (1976) has been recently presented by R. E. G. Pichi Sermolli (1978). Dr. Pichi Sermolli maintains that since Parris and Given (1976) regard *Polypodium poeppigianum* Mettenius (1856) as conspecific and synonymous with *Grammitis armstrongii* Tindale (1961) the oldest epithet at specific rank clearly is *Polypodium poeppigianum* Mettenius, and must be used if the taxon is to be treated at specific rank. Accordingly, Professor Pichi Sermolli proposes the new combination of *Grammitis poeppigiana* (Mettenius) Pichi Sermolli, *comb. nov.* (1978).

If specific recognition, either as *Grammitis poeppigiana* or *G. armstrongii* is preferred for No. *1269* from Isla de los Estados which I have designated herein as *G. magellanica* f. *nana*, then all of the other 1971 *Grammitis* collections from Península Mitre of Isla Grande and the additional 1971 materials from Isla de los Estados would have to be referred to as *G. magellanica* subsp. *magellanica* (cf. Parris & Given, 1976). These authorities, in fact, cited only one specimen from Isla de los Estados ("Statenland: 1787. Menzies"), which is deposited at E and K. The other subspecies of *G. magellanica* is subsp. *nothofageti* Parris, which is confined to the North and South Islands of New Zealand and one station in Tasmania.

NEW TAXA

PLUMBAGINACEAE

Armeria Willdenow, *Enumeratio Plantarum Horti Regi Botanici Berolinensis,* p. 222. 1809.

Armeria maritima (Miller) Willdenow, *Enumeratio Plantarum Horti Regi Berolinensis,* p. 133. 1809.

subsp. **andina** (Poeppig ex Boissier) D.M. Moore & Yates, Bot. Not. **127**(2): 191. 1974. (var. *andina,* typical *varietas).*

The current information about the population dynamics of the "Thrifts", in particular the amphiarctic and amphiantarctic *Armeria maritima* by D. M. Moore and Yates (1974), indicates that the nomenclatural combination of *Statice chilensis* var. *magellanica* (Boissier) Macloskie (1905) should be treated as a synonym of *Armeria maritima* subsp. *andina.* This taxon (as var. *andina*) was well documented in 1971 from Isla de los Estados by 16 separate collections resulting from the botanical exploration while participating on the R/V Hero Cruise 71-5.

Throughout the entire natural geographical range of *Armeria maritima* in both the Old and New Worlds, and the northern and southern hemispheres, the morphological variation expressed between individual plants and within populations is enormous (cf. Lawrence, 1940; D. M. Moore & Yates, 1974). One is often tempted to recognize and describe some of the variations that appear to be clearly manifested, or at the very least to assign infraspecific, or occasionally specific, epithets to some of the most obvious or aberrant morphological variants and phenotypic expressions. Until such a time as far more herbarium collections are available for critical analyses and transplant experiments are evaluated from the geographical, ecological, and populational viewpoints, the solution of *Armeria maritima* subsp. *andina* as provided by D. M. Moore & Yates (1974) to the seemingly impervious dilemma of excessive "splitting", both at the specific and infraspecific levels, within the *A. maritima* complex as it occurs in South America, is certainly adequate—if not verging on being extremely conservative.

An example of the problem of identification is provided by two *T. R. Dudley, R.N.P. Goodall & G. E. Crow* collections (Nos. *70* & *103*) from Provincia Magallanes, Chile. These specimens initially appeared to fall within the broad morphological circumscription of *A. maritima* var. *magellanica* (Willdenow) Skottsberg (= *A. maritima* subsp. *andina, sensu lato*). Upon closer examination, however, particularly when compared with materials in the Philippi Herbarium in Santiago, Chile (SGO), our two 1971 collections from Provincia Magallanes, with their long, slender flowering scapes, and their long, very narrow, nearly fistulose leaves, could readily be referred to as *A. patagonica* Philippi (= *A. maritima* var. *patagonica* (Philippi) Lawrence, considered by Moore & Yates (1974) to be yet another synonym of *A. maritima* subsp. *andina, sensu lato*).

With only one exception, the 1971 collections of *Armeria maritima* from numerous sites on Isla de los Estados were extremely uniform morphologically with respect to habit, foliage, floral characters, and inflorescence coloration. Until further studies are conducted, utilizing more than the 112 collections (the number of specimens analysed and correlated by Moore & Yates in 1974), subspecific rank as *A. maritima* subsp. *andina* is preferred at the present time for the common Southern Hemisphere New World, rosy-pink to purplish flowered representatives (= var. *andina,* the typical *varietas*).

The one exceptional population collection, *T. R. Dudley, R.N.P. Goodall & G. E. Crow 1034* mentioned above, was discovered as an intact, self-contained, discrete population on the south coast of Isla de los Estados, and must also be included taxonomically and nomenclaturally under *A. maritima* subsp. *andina.* However, because of its striking and consistent dissimilarity of having yellowish to greenish-white or pale cream-coloured involucral bracts, calyces, and corollas, it is described below as a new *varietas,* having a limited but uniform and isolated distribution.

Armeria maritima subsp. **andina** var. **goodalliana** T. R. Dudley, *var. nov.*

Diagnosis: Affinis manifestis *A. maritimae* subsp. *andinae* var. *andinae* a qua in involucri phyllis exterioribus et interioribus, calicis et tubis bracteolis interfloralibus et corollae cum tubae in vivo albidis vel pallidis cremeis ad luteolis et viridulis albicans differt.

Obviously allied to *A. maritima* subsp. *andina* var. *andina,* variety *goodalliana* differs from it by the external and internal involucral bracts, the calyces and their tubes, the interfloral bracts on the capitulum and the corollas with their tubes all being whitish or pale cream to yellowish or greenish-white in the living state.

HOLOTYPE: República Argentina, Territorio Nacional de la Tierra del Fuego, Antártida e Islas del Atlántico Sur, Departamento

Ushuaia, ISLA DE LOS ESTADOS, Puerto Vancouver, 54°48′S., 64°03′W., common at this site *only*, several hundred individual plants forming a compact self-contained population occupying about 20 square meters on wet ledges and in the crevices of rocks at the top of sea cliffs at the tip (Punta) Gilbert, the easternmost headland of Puerto Vancouver, exposure SW., 15 meters altitude, 29 October 1971, *T. R. Dudley, R.N.P. Goodall & G. E. Crow 1034* (NA). ISOTYPES of this new variety have been distributed to (AAS, BAB, E, HIP, MO, MSC, P, RNG, RNPG, SI).

This very extraordinary, very striking, seemingly self-contained, and "apparently self-breeding" population having consistently white to cream or yellowish flowers and infloresencence parts was discovered by R.N.P. Goodall and T. R. Dudley while on a foray of Punta Gilbert. An exhaustive search of this eastern headland, Punta Gilbert of Puerto Vancouver, surprisingly failed to discover or unveil any possible contaminatory plants or populations having the rosy-pink or purplish flowers and infloresencence parts characteristic of *Armeria maritima* subsp. *andina* var. *andina*. The closest geographical collection of *A. maritima* subsp. *andina* var. *andina* (*T. R. Dudley, R.N.P. Goodall & G. E. Crow 1022*) with typical rose-pink flowers and inflorescences was found about two kilometers north of Punta Gilbert at the end of Caletta Goodall, just before attaining the narrow, low isthmus between Puerto Cook on the north coast and Puerto Vancouver on the south coast of Isla de los Estados.

Although white and cream-coloured flowers are known in the genus *Armeria* in the Old World (i.e. *A. maritima* var. *maroccana* (Font Quer) Lawrence), the *T. R. Dudley, et al. No. 1034* collection from Punta Gilbert headland of Puerto Vancouver on the South Coast of Isla de Los Estados is the first New World record and population collection that I know of at this time: a population of several hundred individual plants, in South America, having white-yellowish - cream coloured inflorescence and floral parts.

This variant and self-containing population, presumably true-breeding, discrete within the population, and which we hope will maintain the white-yellowish flower's identity upon introduction into cultivation is named in honour of Natalie Rae Prosser Goodall, who was one of my superlative vascular plant exploration collecting assistants on the R/V Hero Cruise 71-5 to Isla de los Estados, in the very early austral spring of 1971. Mrs. R.N.P. Goodall unstintingly shared her knowledge and experiences in Tierra del Fuego. (cf. R.N.P. Goodall, The National Geographic Magazine, vol. 139 (**1**): 130–150. 1971).

HELLEBORACEAE

Caltha L. *Species Plantarum 1*: 558. 1753.

Caltha × **goodalliana** T. R. Dudley, *hybrida nova.*

Synonym:

Caltha (*dionaeifolia* Hooker *f.* × *appendiculata* Persoon) D. M. Moore & R.N.P. Goodall, Bol. Soc. Argent. Bot. **15**(1): 72–76. 1973.

Diagnosis: Planta inter *C. dionaeifoliae* Hooker f. et *C. appendiculatae* Persoon quasi intermedia et verisimiliter ex hybridatione harum specierum orta, ab ambobus foliis appendicibus numero multo magus et marginibus foliorum multo valde ciliato-fimbriatis differt, quad floribus cum *C. appendiculatae* sat congruens sed similis *C. dionaeifoliae* brevis pedicellatis differt.

Caltha × *goodalliana* is a plant almost intermediate between the putative parents, *C. dionaeifolia* and *C. appendiculata,* and it probably originated from hybridization of these two species. It differs from both by possessing a much larger number of leaf appendages, and by having leaf margins that are much more strongly ciliate-fimbriate. With regard to its flower structure *C.* × *goodalliana* agrees well with *C. appendiculata,* but differs in the primary feature that they are short-pedicellate like *C. dionaeifolia.*

HOLOTYPE: República Argentina, Territorio Nacional del Tierra del Fuego, Departamento Ushuaia, Isla Grande, Sierra Lucas Bridges, 54°45′S., 67°13′W., Monte Spion Kop, steep west-facing slope, February 1971, *R.N.P. Goodall 3367* (BAB). Isotypes of this new hybrid were distributed to LTR, NA, and RNPG.

PARATYPES: República Argentina, Territorio Nacional de la Tierra del Fuego, Antártida e Islas del Atlántico Sur, Departamento Ushuaia.

ISLA DE LOS ESTADOS. Puerto Parry, 54°46′S., 64°23′W., rare at only one site, completely submerged in icy cold pool in boggy *Astelia pumila* heath on open, exposed and steep slopes SW. of inner caleta, Mte. Fantasma to the SE., Mte. Fitton to the N., exposure N., 150 meters altitude, 10 November 1971, *T. R. Dudley, R.N.P. Goodall & G. E. Crow 1715A* (NA, RNPG); Bahía Capitán

Cánepa, 45° 51′S., 64° 31′W., intermixed with *C. appendiculata* on wet subalpine slopes and ridges above W end of upland laguna feeding cascades that descend to narrow inlet on the W side of the Bahía, exposure E., 120–180 meters altitude, 4 November 1971, *T. R. Dudley, R.N.P. Goodall & G. E. Crow 1411A* (BAB, NA, P, RNPG); *ibid.*, intermixed with *C. dionaeifolia* in extensive *Astelia pumila* bog on very steep slopes of Mte. Crow, between the eastern inlet of Bahía Capitán Cánepa and Bahía Liberty, opposite the northwestern tip of Ite. Alexander, exposure W., 400 meters altitude, 3 November 1971, *T. R. Dudley, R.N.P. Goodall & G. E. Crow 1344B* (NA, P, RNPG).

Recently while perusing several herbaria I uncovered yet another paratype of *Caltha* × *goodalliana* from República Argentina. This collection is designated as: Southern Patagonia, Provincia Santa Cruz, east of Lago Buenos Aires, near town of Perito Moreno, observed growing only in moist boggy areas within steppe region, near steppe-forest transition zone, 29 October 1975, *T. A. Ager 437* (DUKE, US).

Regarding the paratype collections from Isla de los Estados, the minor "B" portions of *T. R. Dudley, et al.* Nos. *1715* and *1411* clearly represent *Caltha dionaeifolia,* whereas the predominate "A" portions are distinguished as *C.* × *goodalliana,* the naturally occuring hybrid between *C. dionaeifolia* and *C. appendiculata.* Reversely, the predominate "A" portion of *T. R. Dudley, et al. 1344* represents *C. dionaeifolia,* while the minor "B" portion is identifiable as the hybrid, *C.* × *goodalliana.*

Moore and Goodall (1973) report the first record of interspecific hybridization for the genus *Caltha,* specifically between the sympatric *C. dionaeifolia* and *C. appendiculata* from the southern part of Isla Grande, Tierra del Fuego. They demonstrate that the putative hybrid collection (*R.N.P. Goodall 3367*), now designated as the TYPUS of *C.* × *goodalliana,* was intermediate between the parental species. Three additional populations of this new hybrid combination were found in 1971 on Isla de los Estados (*T. R. Dudley et al. Nos. 1715A, 1411A & 1344B*), and yet another was discovered in 1975 in Provincia Santa Cruz of southern Patagonia (*T. A. Ager 437*). With this further confirmation of five independent collections from populations that demonstrated naturally occurring hybrid plants when *C. dionaeifolia* and *C. appendiculata* are sympatric, it now seems appropriate and desirable to recognize this hybrid with the epithet *Caltha* × *goodalliana, hybrida nova.*

Moore and Goodall (1973) provided an excellent table of differentiating characters that can be used to distinguish *C. dionaeifolia,* the putative hybrid (= *C.* × *goodalliana*) and *C. appendiculata.* Since the original *R.N.P. Goodall 3367* material of this hybrid was sterile, Moore and Goodall could not compare floral characters. However, the *T. R. Dudley, et al. Nos. 1411A & 1344B* from Isla de los Estados and the *T. A. Ager 437* from southern Patagonia all possessed flowers which are similar in size to those of *C. appendiculata,* but are shortly pedicellate like those of *C. dionaeifolia.*

The following table is based primarily on analysis of the abundant collections of *Caltha dionaeifolia, C. appendiculata,* and the hybrid *C.* × *goodalliana* amassed while participating on the R V Hero Cruise 71-5 to Isla de los Estados. The sympatric *C. appendiculata* and *C. dionaeifolia,* and the putative hybrid of these two species, *C.* × *goodalliana,* which occurs sporadically as small populations or even as individual plants intermixed with the presumed parents on Isla Grande and Isla de los Estados, are distinguished.

This new hybrid, *C.* × *goodalliana,* is named in honour of Mrs. Rae Natalie Prosser Goodall of Ushuaia and Estancia Harberton in Territorio National de la Tierra del Fuego, who recognized the hybridity of her original collection. Mrs. Goodall was one of the indefatigable and competent collecting assistants (the other assistant was Dr. Garrett E. Crow) of vascular plants, ferns, and fern allies during the R/V Hero Cruise 71-5 to Isla de los Estados. With Dr. David M. Moore, Department of Botany, The University of Reading, Reading, England, Mrs. Goodall is co-author of the eagerly anticipated definitive *Flora of Tierra del Fuego.*

A summary of the vascular plant, fern, and fern ally collections resulting from the R/V Hero Cruise 71-5 to Isla de los Estados (Staten Island), Territorio Nacional de la Tierra del Fuego, Argentina in the early austral spring of 1971 follows. Unless otherwise indicated all of the specimens cited below are designated as *T. R. Dudley, R.N.P. Goodall & G. E. Crow* numbers. The collection numbers cited are accompanied by very general geographic locality designations; *i.e.* Argentina—Isla de los Estados (I), Argentina—Islas de Años Nuevos (II), Argentina—Península Mitre of Isla Grande (III), and Chile—Provincia Magallanes (IV). A

Table 1. **Distinguishing Caltha dionaeifolia, C. appendiculata, and C. × goodalliana.**

Significant characters	*C. dionaeifolia.*	*C. × goodalliana.*	*C. appendiculata.*
Leaf blades	2-4 mm long & wide, coriaceous, margins involute & ciliate.	6-11 mm long, 5-10 mm wide, coriaceous, margins more or less involute & very strongly ciliate-fimbriate.	5-20 mm long, 2-12 mm wide, membraneous, margins flat, smooth & glabrous
Leaf appendages	2	2-6	0-4
Petiolar sheaths.	3-10 mm long, adnate to petioles for 1-5 mm	6-20 mm long, adnate to petioles for 4-12 mm	10-30 mm long, adnate to petioles for 5-20 mm
Perianth segments.	3-6 mm long.	4-10 mm long.	5-12 mm long.
Stamens.	5-10 in number, 1/2-3/4 the length of the perianth.	6-10 in number, 1/2-3/4 the length of the perianth.	8-12 in number, 1/4 the length of the perianth.
Pedicels.	2-5 mm long.	3-7 mm long.	8-15 mm long.

single representative collection, sometimes from over 40, and having had wide herbaria distribution, is cited from each of these primary geographic localities (*e.g.* I, II, III, IV).

SUMMARY OF PLANT COLLECTIONS FROM THE R/V HERO 1971 (71-5) EXPLORATION OF ISLA DE LOS ESTADOS

PTERIDOPHYTA

ASPIDIACEAE
Polystichum multifidum (Mettenius) Moore
I-*1103* (AAS, BAB, E, GH, HIP, LP, MO, MSC, NA, P, RNG, RNPG, SI).
II-*513A* (BAB, GH, HIP, LP, NA, RNG, RNPG, SI).
III-*198* (BAB, E, GH, MO, NA, P, RNG, RNPG, SI).
IV-*16* (GH, NA, RNPG, SGO).

ASPLENIACEAE
Asplenium dareoides Desvaux
II-*609* (AAS, BAB, BLFU, GH, NA, RNG, RNPG).
III-*262* (BAB, GH, NA, P, RNG, RNPG).

ATHRYIACEAE
Cystopteris fragilis (L.) Bernhardi
I-*1261* (GH, LP, MSC, NA, P, RNPG).
II-*512* (AAS, GH, HIP, NA, RNG, RNPG, SI).

BLECHNACEAE
Blechnum magellanicum (Desvaux) Mettenius
I-*1211* (AAS, BAB, GH, HIP, LP, MSC, NA, P, RNG, RNPG, SI).
III-*256* (BAB, GH, NA, P, RNG, RNPG, SI).
Blechnum penna-marina (Poiret) Kuhn
I-*1453* (GH, LP, MSC, NA, RNPG).
II-*517* (BAB, GH, NA, RNPG).
III-*222* (GH, NA, RNPG).
IV-*11* (NA, RNPG).

GLEICHENIACEAE
Gleichenia cryptocarpa Hooker
I-*1170* (AAS, BAB, E, GH, LP, MSC, NA, P, RNG, RNPG, SI).

GRAMMITIDACEAE (Grammitaceae)
Grammitis magellanica Desvaux f. *magellanica* (typical *forma*)
I-*1593A* (BAB, GH, LP, NA, RNG, RNPG).
III-*237* (GH, NA, P, RNPG, SI).

G. magellanica f. *nana* (Brackenridge) de la Sota ex T. R. Dudley, *comb. nov.* (cf. p. 483).
I-*1269* (GH, NA, RNPG).

HYMENOPHYLLACEAE

Hymenophyllum darwinii Hooker *f.*
I-*780* (BAB, GH, HIP, LP, NA, RNG, RNPG).

Hymenophyllum dentatum Cavanilles
I-*1185* (GH, LP, NA, P, RNPG).
II-*525* (GH, NA, RNG, RNPG).
III-*146A* (BAB, E, GH, NA, P, RNG, RNPG, SI).

Hymenophyllum falklandicum Baker
I-*1052* (AAS, BAB, GH, HIP, LP, MO, NA, P, RNG, RNPG).

Hymenophyllum ferrugineum Colla
I-*1565* (BAB, GH, HIP, LP, NA, RNG, RNPG).

Hymenophyllum secundum Hooker & Greville
I-*508* (BAB, GH, LP, NA, P, RNG, RNPG).
III-*228* (BAB, GH, NA, P, RNG, RNPG).

Hymenophyllum tortuosum Hooker & Greville
I-*590* (BAB, E, GH, LP, NA, P, RNG, RNPG).
III-*258* (BAB, GH, NA, RNG, RNPG).

Serpyllopsis caespitosa (Gaudichaud) C. Christensen
I-*874* (BAB, E, GH, LP, MSC, NA, RNG, RNPG).
III-*356* (AAS, BLFU, GH, HIP, NA, P, RNG, RNPG, SI).

LYCOPODIACEAE

Lycopodium confertum Willdenow
I-*1738* (AAS, BAB, E, GH, HIP, LP, MO, MSC, NA, P, RNG, RNPG, SI).

Lycopodium magellanicum (Beauvois) Swartz
I-*1720* (GH, HIP, LP, MSC, NA, P, RNPG, SI).
III-*403* (BAB, GH, NA, RNPG).

SPERMATOPHYTA

GYMNOSPERMAE

CUPRESSACEAE

Cupressus sempervirens L.
IV-*45*-cult. (AAH, NA).

ANGIOSPERMAE - DICOTYLEDONAE

BERBERIDACEAE

Berberis buxifolia Lamarck
  I-*1113* (BAB, NA, P, RNPG).
  III-*311* (NA).
  IV-*65* (MO, NA, P, SGO).
Berberis empetrifolia Lamarck var. *magellanica* Schneider
  IV-*114* (BAB, NA, RNPG).
Berberis ilicifolia Forster *f.*
  I-*1054* (BAB, MSC, NA, RNG, RNPG).
  II-*599* (BAB, NA, RNG, RNPG).
  III-*160* (NA, P, RNPG).
  IV-*47* (BAB, NA, SGO).

CALLITRICHACEAE

Callitriche antarctica Engelmann ex Hegelmaier
  I-*1031* (BAB, E, HIP, MO, MSC, NA, P, RNG, RNPG, SI).
  II-*601* (NA, RNPG).
Callitriche deflexa A. Braun ex Hegelmaier
  I-*384* (AAS, BAB, NA, RNPG).
  II-*608* (BAB, HIP, NA, RNG, RNPG, SI)

CARYOPHYLLACEAE

Cerastium arvense L. var. *arvense* (typical *varietas*)
  III-*325* (BAB, NA, RNG, RNPG).
Cerastium arvense var. *fuegianum* Hooker *f.*
  I-*1293* (BAB, E, NA, P, RNG, RNPG, SI).
  III-*215* (BAB, NA, RNG, RNPG).
Cerastium fontanum Baumgarten
  I-*783* (BAB, NA, RNG, RNPG).
Colobanthus quitensis (Humboldt, Bonpland, & Kunth) Bartling
  I-*1753* (AAS, BAB, HIP, NA, P, RNG, RNPG, SI).
  II-*527* (AAS, BAB, HIP, E, NA, P, RNG, RNPG).
  III-*376* (BAB, NA, RNG, RNPG).
  IV-*20* (NA, RNPG, SGO).
Colobanthus subulatus (Dumont d'Urville) Hooker *f.*
  I-*379A* (AAS, BAB, BLFU, E, HIP, MO, NA, P, RNG, RNPG, SI).
  II-*522A* (BAB, NA, RNG).
  III-*207* (BAB, NA, P, RNG, RNPG, SI).
  IV-*118* (BAB, NA, RNG, RNPG).
Stellaria debilis Dumont d'Urville
  I-*1709* (BAB, HIP, MSC, NA, RNG, RNPG).

Stellaria media (L.) Villars

- I-*1796* (BAB, MSC, NA, RNG, RNPG).
- IV-*42* (NA, RNPG).

COMPOSITAE (Asteraceae)

Abrotanella emarginata (Cassini) Cassini

- I-*1327* (AAS, E, HIP, LP, MSC, NA, RNPG, SI).
- III-*364* (AAS, BAB, NA, RNPG).

Abrotanella linearifolia A. Gray

- I-*1381* (NA, RNPG).

Aster vahlii (Gaudichaud) Hooker & Arnott

- I-*1583* (BAB, NA, RNPG).
- III-*280B* (NA).

Baccharis patagonica Hooker & Arnott

- IV-*6* (BAB, MO, NA, RNPG, SGO, SI).

Chiliotrichum diffusum (Forster *f.*) Kuntze

- I-*912* (BAB, MSC, NA, RNG, RNPG).
- II-*582* (AAS, BAB, E, NA, P, RNG, RNPG).
- III-*149* BAB, MO, NA, P, RNG, RNPG, SI).
- IV-*63* (BAB, NA, P, RNPG, SGO, SI).

Cotula scariosa (Cassini) Franchet

- I-*328* (BAB, NA, RNG, RNPG).
- II-*588* (NA, RNPG).

Gamochaeta malvinensis (H. Koyama) T. R. Dudley, *comb. nov.* (cf. p. 478).

- I-*880* (BAB, NA, RNG, RNPG, SI).
- III-*303* (BAB, E, MO, NA, RNG, RNPG, SGO, SI).

Gamochaeta nivalis Cabrera

- I-*481* (AAS, BAB, NA, RNG, RNPG).

Hypochaeris incana (Hooker & Arnott) Dusén

- IV-*93* (NA).

Lagenifera nudicaulis (Commerson ex Lamarck) T. R. Dudley, *comb. nov.* (cf. p. 482).

- I-*1058* (AAS, BAB, E, HIP, NA, RNG, RNPG, SI).

Lepidophyllum cupressiforme (Lamarck) Cassini

- IV-*82* (NA, RNPG, SGO, SI).

Macrachaenium gracile Hooker *f.*

- I-*1790* (NA, RNPG).

Nardophyllum bryoides (Lamarck) Cabrera

- IV-*84* (NA, RNG, RNPG, SGO, SI).

Nassauvia latissima Skottsberg
I-*679* (BAB, NA, RNG, RNPG).
Nassauvia pygmaea (Cassini) Hooker *f.*
I-*1330* (AAS, BAB, HIP, NA, P, RNG, RNPG, SI).
III-*425* (NA, RNPG).
Perezia magellanica (L. *f.*) Lagasca
I-*1602* (BAB, E, HIP, NA, RNG, RNPG, SI).
III-*365* (NA, RNPG).
Perezia recurvata (Vahl) Lessing
IV-*8* (BAB, NA, RNPG, SGO).
Perezia variabilis (Philippi) Reiche
I-*1262* (BAB, NA, RNPG).
Senecio acanthifolius Hombron & Jacquinot
I-*890* (HIP, NA, P, SGO, SI).
II-*604* (BAB, BLFU, HIP, NA, RNPG).
III-*130* (BAB, NA, RNG).
IV-*67* (NA, RNPG, SGO).
Senecio alloeophyllus O. Hoffmann
III-*428* (BAB, NA, RNPG).
Senecio argyreus Philippi
IV-10 (NA, RNPG, SGO).
Senecio candidans De Candolle
I-*716* (AAS, BAB, NA, RNG, RNPG, SI).
III-*213* (NA, RNG, RNPG).
IV-*94* (BAB, NA, P, RNPG, SGO, SI).
Senecio eightsii Hooker & Arnott
I-*1366* (AAS, BAB, E, HIP, MSC, NA, P, RNG, RNPG, SI, UC).
II-*208* (BAB, NA, P, RNG, RNPG, SGO, SI, UC).
Senecio humifusus (Hooker *f.*) Cabrera
III-*366A* (BAB, NA, RNG, RNPG).
Senecio magellanicus Hooker & Arnott
IV-*95* (NA, RNPG, SGO).
Senecio patagonicus Hooker & Arnott subsp. *patagonicus* (typical *subspecies*)
IV-*81* (BAB, MO, NA, P, RNG, RNPG, SGO, SI, UC).
S. patagonicus subsp. *alyssoides* (C. H. Schultz-Bipontinus) Cabrera
IV-*116* (NA, RNG, RNPG, SGO).
Senecio smithii De Candolle
I-*1710* (BAB, NA, RNPG).
II-*515* (BAB, E, NA, RNPG).

Senecio [*smithii* De Candolle × (?) *S. candidans* De Candolle]
II-*536* (BAB, HIP, NA, RNPG).
Senecio trifurcatis (Forster *f.*) Lessing
I-*1422A* (AAS, BAB, NA, RNG, RNPG, SI).
Senecio websteri Hooker *f.*
I-*1037* (AAS, BAB, E, GH, HIP, LP, MO, MSC, NA, P, RNG, RNPG, SI, UC).
II-*605* (AAS, BAB, NA, RNG, RNPG).
Taraxacum gilliesii Hooker & Arnott
I-*1511* (NA, RNPG).
Taraxacum officinale Weber ex Wiggers
I-*1510* (NA).
II-*595* (NA).
III-*263* (NA).

CRASSULACEAE
Crassula moschata Forster *f.*
I-*1030* (AAS, HIP, MSC, NA, P, RNG, RNPG).
II-*607* (AAS, BAB, E, HIP, MO, NA, P, RNG, RNPG, SI).
III-*205* (BAB, E, NA, P, RNG, RNPG, SI).

CRUCIFERAE (Brassicaceae)
Cardamine geraniifolia (Poiret) De Candolle
I-*1201* (NA).
III-*232* (NA, RNPG).
Cardamine glacialis (Forster *f.*) De Candolle—*sensu lato* (including the glabrous and hirsute-pubescent phases).
I-*1023* (AAS, BAA, BAB, E, GH, HIP, MO, MSC, NA, P, RNG, RNPG, SI, UC).
II-*524* (NA).
III-*214* (BAB, NA, RNPG).
IV-*101* (NA, RNPG).
Draba magellanica Lamarck
IV-*110* (NA).
Erophila verna (L.) Chevallier
IV-*100* (BAA, MO, NA, P, RNG, RNPG, SI).
Hesperis matrionalis L.
IV-*44*-cult. (AAH, NA).
Onuris oligosperma (Spegazzini) Gilg & Muschler
IV-*112* (NA, RNPG).
Thlaspi magellanica Commerson ex Persoon
IV-*41* (NA, RNPG).

DROSERACEAE

Drosera uniflora Willdenow

I-*885* (AAS, BAB, E, HIP, MO, NA, P, RNG, RNPG, SI, UC).
III-*357* (BAB, NA).

EMPETRACEAE

Empetrum rubrum Vahl ex Willdenow

I-*333* (BAB, BLFU, HIP, NA, RNG, RNPG).
II-*537* (BAB, HIP, NA, P, SI).
III-*139* (MO, NA, P, RNG, RNPG, SI).
IV-*33* (BAB, MO, NA, P, RNG, RNPG, SGO, SI).

EPACRIDACEAE

Lebetanthus myrsinites (Lamarck) Dusén

I-*1010* (BAB, E, MO, NA, RNG, RNPG, SI).
III-*152* (BAB, MO, NA, RNG, RNPG).

ERICACEAE

Gaultheria antarctica Hooker *f.*

I-*891* (BAB, E, MSC, NA, P, RNG, RNPG).
III-*245* (NA, RNPG).

Pernettya mucronata (L. *f.*) Gaudichaud ex A. Sprengel

I-*1212* (AAS, HIP, MSC, NA, RNPG, SI).
II-*540* (BAB, BLFU, HIP, NA, P, RNG, RNPG, NI).
III-*285* (BAB, MO, NA, P, RNG, RNPG, SI).
IV-*6* (BAB, NA, P, SGO).

Pernettya pumila (L. *f.*) Hooker

I-*790* (AAS, BAB, NA, P, RNPG, SI).
II-*528* (AAS, BAB, HIP, E, NA, P, RNG, RNPG, SI).
III-*421A* (BAB, NA, RNG, RNPG).
IV-*28A* (NA).

ESCALLONIACEAE

Escallonia serrata J. E. Smith

I-*763* (BAB, E, HIP, NA, RNG, RNPG, SI).
II-*590* (BAB, E, HIP, NA, RNG, RNPG).
III-*212* (BAB, E, NA, P, RNG, RNPG).

EUPHORBIACEAE

Dysopsis glechomoides (Richard) Mueller-Argoviensis

I-*722* (AAS, BAB, HIP, NA, RNG, RNPG).
II-*531* (BAB, NA, RNG, RNPG).
III-*235* (BAB, NA, RNPG).

FAGACEAE

Nothofagus antarctica (Forster *f.*) Oersted
I-*625* (BAB, E, NA, RNG, RNPG, SI).
III-*200* (BAB, NA, P, RNG, RNPG).
IV-*57* (NA, RNG, RNPG, SGO, SI).

Nothofagus betuloides (Mirbel) Oersted
I-*1522* (A, BAB, HIP, MO, MSC, NA, P, RNG, RNPG, SI).
III-*155* (BAB, MO, NA, P, RNG, RNPG, SI).
IV-*30* (BAB, E, MO, NA, P, RNG, RNPG, SGO, SI).

Nothofagus pumilio (Poeppig & Endlicher) Krasser
I-*1061* (NA).
III-*174A* (BAB, NA, RNG, RNPG).

GROSSULARIACEAE

Ribes magellanica Poiret
I-*1124* (A, E, MO, NA, P, RNPG).
IV-*37* (BAB, NA, RNG, RNPG).

GUNNERACEAE

Gunnera lobata Hooker *f.*
I-*751* (BAB, NA, RNG, RNPG, SI, UC).
III-*247* (NA, RNPG).

Gunnera magellanica Lamarck
I-*881* (BAB, MSC, NA, RNG, RNPG).
II-*585* (AAS, BAB, NA, RNG, RNPG).
III-*187* (NA, P, RNG).

HELLEBORACEAE

Caltha appendiculata Persoon
I-*343* (AAS, BAB, NA, P, RNG, RNPG).
II-*541* (NA, P, RNPG).
III-*162* (NA, P, RNG, RNPG).

Caltha dionaeifolia Hooker *f.*
I-*642* (AAS, BAB, BLFU, HIP, NA, P, RNG, RNPG).
III-*277* (BAB, NA, P, RNPG).

Caltha × *goodalliana* T. R. Dudley, *hybrida nova* (cf. p. 490).
I-*1411A* (BAB, NA, P, RNPG).

Caltha sagittata Cavanilles
I-*1273* (BAB, E, MSC, NA, P, RNG, RNPG).
III-*308* (NA, P, RNG, RNPG).
IV-*68* (NA, P, RNPG).

HIPPURIDACEAE

Hippuris vulgaris L.
IV-*66* (BAB, MO, NA, P, RNPG, SGO).

HYDROCOTYLACEAE

Azorella caespitosa Cavanilles
IV-*24* (NA, RNPG, UC).
Azorella filamentosa Lamarck
I-*1024* (BAB, E, NA, RNG, RNPG, SI, UC).
Azorella fuegiana Spegazzini
I-*1509B* (NA).
IV-*111* (NA, RNPG).

Azorella lycopodioides Gaudichaud
I-*903* (AAS, BAB, NA, RNG, RNPG, UC).
III-*368* (NA).
IV-*23* (NA, RNPG, SGO, UC).

Azorella selago Hooker *f.*
I-*1419* (AAS, BAB, HIP, MSC, NA, P, RNG, UC).
III-*354* (BAB, HIP, NA, RNG, RNPG, UC).

Azorella trifurcata Persoon
III-*265* (BAB, MO, NA, P, RNG, RNPG, SI, UC).
IV-*7* (BAB, NA, P, RNPG, SGO, UC).
Bolax caespitosa Hombron & Jacquinot ex Decaisne
I-*1640* (AAS, BAB, BLFU, HIP, MO, MSC, NA, P, RNG, RNPG, SI, UC).
Bolax gummifera (Lamarck) Sprengel
I-*1460* (AAS, BAB, E, HIP, MO, MSC, NA, P, RNPG, SI, UC).
III-*427* (BAB, BLFU, NA, RNG, RNPG, UC).

HYDROPHYLLACEAE

Phacelia magellanica (Lamarck) Coville
IV-*80* (BAB, NA, P, RNPG, SGO).

LEGUMINOSAE (Fabaceae)

Vicia sericella Spegazzini
IV-*39* (BAB, HIP, NA, RNPG, SI).

LENTIBULARIACEAE

Pinguicula antarctica Vahl
I-*734* (BAB, NA, P, RNG, RNPG).
III-*405* (NA).

LOBELIACEAE

Pratia repens Gaudichaud
I-*656A* (BAB, BLFU, NA, RNG, RNPG, SI).
II-*532* (BAB, NA, RNG, RNPG).

MISODENDRACEAE

Misodendrum brachystachyum De Candolle
I-*877* (AAS, BAB, E, MSC, MO, NA, RNG, RNPG, SI).
III-*217A* (A, BAB, E, MO, NA, RNG, RNPG, SI).
Misodendrum punctulatum Banks & Solander ex De Candolle
I-*915* (AAS, BAB, E, MSC, MO, NA, RNG, RNPG, SI).
III-*300* (BAB, E, MO, NA, P, RNG, RNPG, SI, UC).
IV-*17* (BAB, MO, NA, P, RNG, RNPG, SGO, SI).

MYRTACEAE

Myrteola nummularia (Poiret) Berg
I-*738* (AAS, BAB, HIP, NA, RNG, RNPG).
III-*226* (BAB, E, MO, NA, P, RNG, RNPG, SI).

ONAGRACEAE

Epilobium cunninghamii Haussknect
I-*1274* (AAS, BAB, E, MO, NA, P, RNG, RNPG, SGO, SI, UC).

OXALIDACEAE

Oxalis magellanica Forster *f.*
I-*1281* (NA, P, RNPG).

PLANTAGINACEAE

Littorella australis Grisebach ex Skottsberg
I-*1613* (BAB, HIP, NA, P, RNG, RNPG).
III-*306A* (BAB, NA, RNG, RNPG).
Plantago barbata Forster *f.*
I-*847* (AAS, BAB, HIP, NA, P, RNG, RNPG).
III-*148* (BAB, E, NA, P, RNG, RNPG, US).
IV-*19* (NA, RNPG, SGO).
Plantago lanceolata L.
IV-*96* (NA).
Plantago maritima L.
IV-*18* (NA, RNPG, SGO).

PLUMBAGINACEAE

Armeria maritima (Miller) Willdenow subsp. *andina* (Poeppig ex

Boissier) D. M. Moore & Yates var. *andina* (typical *varietas*)
I-*1708* (BAB, HIP, MSC, NA, P, RNG, RNPG, SI).
IV-*103* (BAB, NA, RNG, RNPG, SGO, SI).
A. maritima subsp. *andina* var. *goodalliana* T. R. Dudley, *var. nov.* (cf. p. 488).
I-*1034* (AAS, BAB, E, HIP, MO, MSC, NA, P, RNG, RNPG, SI).

POLYGONACEAE
Polygonum maritimum L.
IV-*97* (BAB, MO, NA, P, RNPG, SGO).
Rumex acetosella L.
II-*587* (NA).
IV-*74* (BAB, NA, P, RNPG, SGO).
Rumex magellanica Campdéra
IV-*40* (NA, RNPG, SGO).

PORTULACACEAE
Montia fontana L.
I-*846* (BAB, HIP, NA, RNG, RNPG).
III-*374* (AAS, BAB, BLFU, NA, P, RNG, RNPG).

PRIMULACEAE
Anagallis alternifolia Cavanilles var. *repens* (Dumont d'Urville) Pax & Kunth
I-*888* (BAB, NA, RNPG).
Primula magellanica Lehmann
I-*930A* (BAB, MSC, NA, RNG, RNPG, SI).

PROTEACEAE
Embothrium coccineum Forster & Forster *f.*
IV-*12* (BAB, NA, P, RNPG).

RANUNCULACEAE
Hamadryas delfinii Commerson ex A. L. Jussieu
IV-*104* (NA, P, RNPG, SGO).
Hamadryas magellanica J. F. Gmelin f. *paniculata* (Hooker) Lourteig
I-*1310* (AAS, BAB, BLFU, E, HIP, MO, NA, P, RNG, RNPG, SGO, SI, UC).
Ranunculus biternatus J. E. Smith
I-*1370* (BAB, NA, P, RNPG).
III-*307* (NA, P, RNG, RNPG).

ROSACEAE

Acaena antarctica Hooker *f.*

I-*1719A* (AAS, NA, RNG, RNPG).

III-*359* (AAS, NA, RNG, RNPG).

Acaena magellanica (Lamarck) Vahl

I-*1299* (AAS, BAB, E, MO, NA, P, RNG, RNPG).

II-*592* (AAS, BAB, NA).

III-*309* (AAS, NA, RNG, RNPG).

IV-*64* (AAS, BAB, NA, RNG, RNPG, SGO).

Acaena ovalifolia Ruiz & Pavón

I-*469* (AAS, NA, RNPG).

II-*529* (AAS, BAB, NA, P, RNG, RNPG).

IV-*61* (AAS, NA, P, RNG, RNPG, SGO).

Acaena pumila Vahl

I-*1412* (AAS, BAB, NA, RNG, RNPG).

III-*164* (AAS, BAB, NA, RNG, RNPG).

Acaena sericea Philippi

IV-*113* (AAS, NA, RNG, RNPG, SGO).

Rubus geoides J. E. Smith

I-*1494A* (AAS, BAB, HIP, NA, RNG, RNPG).

II-*530* (NA).

III-*145A* (BAB, NA).

RUBIACEAE

Galium antarcticum Hooker *f.*

I-*1320A* (BAB, NA, RNG, RNPG).

Galium fuegianum Hooker *f.*

I-*1105* (BAB, HIP, NA, P, RNG, RNPG).

IV-*71* (NA, P, RNPG, SGO).

Nertera depressa Banks & Solander ex J. Gaertner

I-*883* (AAS, BAB, E, HIP, NA, P, RNPG, SI).

II-*526* (BAB, BLFU, HIP, NA, RNG, RNPG, SI).

SANTALACEAE

Nanodea muscosa Banks ex C. F. Gaertner

I-*923* (AAS, NA, RNG, RNPG).

II-*544* (NA).

III-*142* (NA, RNG, RNPG).

IV-*51* (NA).

SAXIFRAGACEAE

Chrysosplenium macranthum Hooker

I-*1021A* (AAS, BAB, E, HIP, MO, NA, P, RNG, RNPG, SI).
II-*597* (BAB, MO, NA, RNG, RNPG).
III-*204* (BAB, NA, RNG, RNPG).
Saxifraga magellanica Poiret
I-*1244* (AAS, BAB, HIP, MSC, NA, P, RNG, RNPG, SI).
IV-*105* (NA).

SCROPHULARIACEAE
Calceolaria darwinii Bentham
IV-*88* (NA, RNPG).

Hebe elliptica (Forster *f.*) Pennell
I-*1036* (AAS, BAB, E, HIP, MO, NA, P, RNG, RNPG, SI).

Ourisia breviflora Bentham
I-*1717* (BAB, NA, NY, RNPG).

Ourisia ruelloides (L.) Kuntze
I-*1268* (A, AAS, BAB, BLFU, E, HIP, LP, MO, MSC, NA, NY, P, RNG, RNPG, SGO, SI, UC).

Ourisia uniflora Philippi
I-*1373A* (BAB, HIP, NA, NY, P, RNG, RNPG, SI).

THYMELIACEAE
Drapetes muscosoides Banks ex Lamarck
I-*921* (AAS, BAB, MSC, NA, RNG, RNPG, SI).
III-*419* (AAS, NA, RNPG).

TRIBELACEAE
Tribeles australis Philippi
I-*1714A* (AAS, BAB, E, HIP, MSC, NA, P, RNG, RNPG, SI).
III-*243* (BAB, NA, RNPG).

UMBELLIFERAE (Apiaceae)
Apium australe Thouars
I-*381* (BAB, BLFU, NA, RNG, RNPG, SI, UC).
II-*538* (AAS, BAB, HIP, NA, RNG, RNPG, SI, UC).
III-*206* (BAB, NA, P, RNG, RNPG, UC).
Lilaeopsis macloviana (Gandoger) H. H. Hill
I-*557* (BAB, NA).

VERBENACEAE
Verbena tridens Lagasca
IV-*98* (BAB, NA, P, RNG, RNPG, SGO).

VIOLACEAE

Viola commersonii De Candolle ex de Gingins

I-*1722* (NA, P, RNPG).

Viola magellanica Forster *f.*

I-*1267A* (BAB, NA, P, RNG, RNPG).

III-*305B* (NA).

Viola tridentata Menzies ex de Gingins

I-*1341* (BAB, E, HIP, NA, RNG, RNPG, SI).

WINTERACEAE

Drimys winteri Forster & Forster *f.*

I-*1039* (BAB, MSC, NA, RNG, RNPG).

II-*539* (E, MO, NA, RNG, RNPG, SI).

III-*161* (BAB, MO, NA, RNG, RNPG, SI).

IV-*46* (BAB, HIP, MO, NA, P, RNG, RNPG, SGO, SI).

ANGIOSPERMAE-MONOCOTYLEDONAE

CENTROLEPIDACEAE

Gaimardia australis Gaudichaud

I-*1336* (AAS, BAB, BLFU, HIP, NA, RNG, RNPG, SI).

III-*352A* (BAB, NA, RNG, RNPG, SI).

CYPERACEAE

Carex banksii Boott var. *banksii* (typical *varietas*).

I-*1271* (AAS, BAB, E, HIP, MO, NA, P, RNG, RNPG, SI, UC).

Carex microglochin Wahlenberg subsp. *fuegina* Kükenthal

III-*373B* (AAS, BAB, E, LP, MO, NA, P, RNG, RNPG, SI).

Eleocharis albibracteata Nees & Meyen ex Kunth

I-*460* (BAB, NA, RNPG).

II-*586* (AAS, BAB, NA, P, RNG, RNPG).

Oreobolus obtusangulus Gaudichaud

I-*1152* (AAS, HIP, NA, P, RNG, RNPG, SI).

III-*241* (AAS, BAB, HIP, LP, NA, P, RNPG, SI).

Schoenus antarcticus (Hooker *f.*) Dusén

I-*1384D* (NA).

III-*273* (BAB, NA, RNG, RNPG).

Scirpus cernuus Vahl

I-*1033* (BAB, HIP, MSC, NA, RNG, RNPG, SI).

Uncinia brevicaulis (Thouars) Kunth

I-*1134* (AAS, BAB, HIP, MSC, NA, RNG, RNPG, SI).

III-*176* (NA, RNPG).

GRAMINEAE (Poaceae)

Agropyron magellanicum (Desvaux) Hackel
I-*715* (BAB, HIP, NA, RNG, RNPG, SI).
IV-*85* (BAB, E, NA, P, RNG, RNPG, SGO, SI).

Agrostis sp.
I-*1005* (BAB, HIP, NA, RNPG, SI).
III-*323* (BAB, NA, RNG, RNPG).
IV-*69* (BAB, NA, RNG, RNPG, SI).

Deschampsia kingii (Hooker *f.*) Desvaux
I-*1432* (AAS, BAB, HIP, NA, RNG, RNPG, SI).
II-*543* (NA).
III-*220* (NA, RNPG).

Festuca longidiurna Parodi
I-*562* (BAB, NA, RNG, RNPG).

Festuca sp.
I-*646* (BAB, NA, RNG, RNPG, SI).
III-*431* (BAB, NA, RNPG).

Hierochloë redolens (Solander ex Vahl) Roemer & Schultes
I-*718* (AAS, BAB, E, MO, NA, RNG, RNPG, SI).
II-*577* (AAS, BAB, BLFU, HIP, NA, RNG, RNPG).
III-*211* (BAB, NA, P, RNG, RNPG).

Hordeum parodii Covas var. *parodii* (typical *varietas*).
III-*398* (BAB, NA, RNG, RNPG).
IV-*87* (NA, RNPG, SGO).

Poa alopecurus (Gaudichaud) Kunth subsp. *alopecurus* (typical *subspecies*).
I-*1301A* (AAS, BAB, MSC, NA, RNG, RNPG).

P. alopecurus subsp. *fuegiana* (Hooker *f.*) D. M. Moore & Doggett
I-*1291* (BAB, HIP, NA, RNG, RNPG).
II-*606* (NA)

Poa annua L.
I-*1284C* (NA).
III-*122* (NA).

Poa darwiniana Parodi
I-*551* (BAB, NA, RNG, RNPG).
II-*516* (BAB, NA, RNPG).
IV-*28B* (NA).

Poa flabellata (Lamarck) Raspail
I-*382* (AAS, BAB, E, HIP, LP, MO, NA, P, RNG, RNPG, SI).
II-*548* (AAS, BAB, E, HIP, MO, NA, P, RNG, RNPG, SI).

Poa rigidifolia Steudel
I-*1130* (BAB, HIP, NA, RNG, RNPG).
IV-*22* (BAB, NA, RNG, RNPG, SGO, SI).
Poa robusta Steudel
I-*1707* (BAB, HIP, NA, RNG, RNPG, SI).

JUNCACEAE

Juncus balticus Willdenow var. *mexicanus* (Willdenow ex Roemer & Schultes) Kuntze
IV-*78* (BAB, NA, RNPG, SGO, SI).
Juncus depauperatus Philippi
I-*892* (BAB, NA, RNPG).
Juncus scheuchzerioides Gaudichaud
I-*1614* (NA, RNPG).
III-*373A* (AAS, BAB, E, LP, MO, NA, RNG, RNPG, SI).
Luzula alopecurus Desvaux
I-*1367* (AAS, BAB, E, HIP, MSC, NA, P, RNG, RNPG, SI).
Luzula antarctica Hooker *f.*
I-*1466* (AAS, BAB, HIP, MO, NA, P, RNG, RNPG, SI).
Marsippospermum grandiflorum (L. *f.*) Hooker *f.*
I-*1619* (BAB, E, HIP, NA, P, RNG, RNPG, SI).
II-*578* (AAS, BAB, E, NA, RNG, RNPG).
III-*252* (BAB, NA, RNG, RNPG).
Marsippospermum reichei Buchenau
III-*273* (AAS, NA, RNG, RNPG).
Rostkovia magellanica (Lamarck) Hooker *f.*
I-*1459* (AAS, BAB, E, HIP, MO, MSC, NA, P, RNG, RNPG, SI).

JUNCAGINACEAE

Tetroncium magellanicum Willdenow
III-*272* (BAB, NA, RNPG).

LILIACEAE

Astelia pumila (Forster *f.*) Banks & Solander ex R. Brown
I-*1174* (AAS, BAB, HIP, MSC, NA, RNG, RNPG, SI).
III-*257* (BAB, MO, NA, P, RNG, RNPG, SI).

PHILESIACEAE

Luzuriaga marginata (Banks & Solander ex J. Gaertner) Bentham & Hooker *f.*
I-*666A* (AAS, BAB, NA, RNG, RNPG, SI).
II-*534* (BLFU, NA, P, RNPG, SI).
III-*230* (MO, NA, P, RNG, RNPG, SI).

ORCHIDACEAE

Codonorchis lessonii (Dumont d'Urville) Lindley
I-*946* (BAB, NA, RNPG).
III-*124B* (NA).

Gavilea lutea (Persoon) Correa
IV-*49* (BAB, NA, RNPG, SGO).

The following records of additional plant taxa are reported to occur on Isla de los Estados (I), Islas Años Nuevos (II), or from Península Mitre (III) of Isla Grande, Tierra del Fuego. These plants, however, were *not* re-collected or documented in 1971 by the collecting team of the R V Hero Cruise 71-5 to Isla de los Estados. This enumeration hopefully will stimulate further botanical exploration of Isla de los Estados, as well as other nearby land masses and islands, throughout the austral spring, summer, and autumn. The rugged mountain massifs of the interior of Isla de los Estados, which are the southernmost terminus of the South American Andes, particularly await the critical eyes of plant collectors and systematists.

BERBERIDACEAE

Berberis empetrifolia Lamarck. I-Spegazzini (1896).

CHENOPODIACEAE

Chenopodium antarcticum (Hooker *f.*) Bentham & Hooker *f.* I-Dusén in Macloskie (1904); I-Stuckert in Macloskie (1915).

COMPOSITAE (Asteraceae)

Adenocaulon chilensis Lessing. I-Spegazzini (1896); II-Cabrera in Correa (1971).

CYPERACEAE

Carpha alpina Banks & Solander ex R. Brown var. *schoenoides* (Banks & Solander) Kükenthal. I-Barros in Correa (1969).

Uncinia kingii Boott. I-Spegazzini (1896); I-Macloskie (1904); I-Barros in Correa (1969). *U. lechleriana* Steudel subsp. *triquetra* (Kükenthal) Kükenthal. I-Barros in Correa (1969).

DESFONTAINIACEAE

Desfontainea spinosa Ruiz & Pavón. I-Hooker (1847); I-Macloskie (1903).

GLEICHENIACEAE

Gleichenia quadripartita Hooker. I-Spegazzini (1896).

GRAMINEAE (Poaceae)

Agrostis magellanica Lamarck. I-Spegazzini (1896); I-Rúgolo de Agrassar in Nicora (Correa, 1978). *A. uliginosa* Philippi. I-Rúgolo de Agrassar in Nicora (Correa, 1978).

Cortaderia pilosa (Dumont d'Urville) Hackel. I-Nicora in Correa (1978).

Deschampsia flexuosa (L.) Trinius. I-Spegazzini (1896). *D. parvula* (Hooker *f.*) Desvaux. I-Nicora in Correa (1978).

Festuca contracta T. Kirk. I-Nicora in Correa (1978). *F. purpurascens* Banks & Solander ex Hooker. I-Spegazzini (1896).

Hierochloë moorei De Paula de Brooks. I-De Paula de Brooks in Nicora (Correa, 1978).

Orthachne rariflora (Hooker *f.*) Hughes. I-Spegazzini (1896). I-Macloskie (1904). I-Dusén in Macloskie (1915).

Poa chrysantha Lindman. I-Nicora in Correa (1978). *P. shuka* (Spegazzini) Parodi. I-Nicora in Correa (1978).

Puccinellia magellanica (Hooker *f.*) Parodi. I-Spegazzini (1896); I-Macloskie (1904). *P. pusilla* (Hackel ex Dusén) Parodi. II-Macloski (1915).

Trisetum phleoides (Dumont d'Urville) Kunth. I-Nicora in Correa (1978); II-Dusén in Macloskie (1915). *T. spicatum* (L.) Richter. I-Spegazzini (1896); I-Nicora in Correa (1978).

HYDROCOTYLACEAE

Schizeilema ranunculus (Dumont d'Urville) Domin. I-Spegazzini (1896); I-Dusén in Macloskie (1905); I-Domin in Macloskie (1915).

HYMENOPHYLLACEAE

Hymenophyllum pectinatum Cavanilles. I(?)-Spegazzini (1896).

IRIDACEAE

Tapeinia pumila (Forster *f.*) Baillon. I(?)-Ravenna in Correa (1969); III-Moore (1979).

JUNCACEAE

Juncus inconspicuus Dumont d'Urville. II-Barros in Correa (1969); II-Moore (1974).

Luzula pumila Hooker *f.* I-Spegazzini (1896); I-Moore (1974).

MISODENDRACEAE

Misodenrum quadrifolium De Candolle. I-De Candolle (1830); I-Macloskie (1904); III-Goodall (pers. comm., 1977).

ONAGRACEAE

Fuchsia magellanica Lamarck. I-Macloskie (1905).

OPHIOGLOSSACEAE

Botrychium lunaria (L.) Swartz. I-Spegazzini (1896); I-Macloskie (1911); I-Alston (1960); III-Alston (1960).

ORCHIDACEAE

Gavilea lutea (Persoon) Correa. I-Spegazzini (1896)—by the synonym *Chloraea commersonii* Brongiart.

PHILESIACEAE

Philesia magellanica F. J. Gmelin. I-Goodall (pers. comm., 1977).

PRIMULACEAE

Anagallis alternifolia Cavanilles var. *densiflora* Hooker *f.* II-Macloskie (1905).

ROSACEAE

Geum magellanicum Commerson ex Persoon. I-Spegazzini (1896) by the *pro parte* synonym *G. chiloense multo auct.;* III-Goodall (pers. comm., 1977). *G. parviflorum* Commerson ex J. E. Smith. I-Goodall (pers. comm., 1977).

SAXIFRAGACEAE

Saxifragella bicuspidata (Hooker *f.*) Engler. I-Spegazzini (1896) – by the synonym *Saxifraga bicuspidata* Hooker *f.*; I-Macloskie (1915).

STYLIDIACEAE

Phyllachne uliginosa Forster. I-Dusén in Macloskie (1905); III-Dusén in Macloskie (1905).

VALERIANACEAE

Valeriana sedifolia Dumont d'Urville. I-Spegazzini (1896); I-Macloskie (1905).

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AN ECOGEOGRAPHICAL ANALYSIS OF THE DISTRIBUTION OF *ASTER ACUMINATUS* MICHAUX AND *A. NEMORALIS* AITON (ASTERACEAE: ASTEREAE)

Luc Brouillet and Jean-Pierre Simon

RÉSUMÉ

Certains aspects pertinents de la biologie et de l'écologie de deux espèces d'*Aster* de l'Est de l'Amérique du Nord: *A. acuminatus (espèce* de sous-bois frais), *A. nemoralis* (espèce de tourbière à sphaigne) et de leur hybride *A.* × *blakei* ont été analysées dans le contexte de leurs adaptations à leurs milieux respectifs. Cette analyse permet de mieux comprendre la distribution géographique actuelle de chacun des taxons en fonction de l'histoire post-glaciaire du nord-est américain et du Québec.

ABSTRACT

Pertinent aspects of the biology and ecology of two north american species of *Aster: A. acuminatus* (a forest species), *A. nemoralis* (a sphagnum-bog species) and their hybrid *A.* × *blakei* are analysed in relation to their adaptations to contrasting environments. This analysis gives a better framework for the understanding of present geographic distribution of the taxa in relation to post glacial events in north-eastern America.

Aster acuminatus Michaux and *A. nemoralis* Aiton are two closely related northeastern North American species. They have been placed traditionally in the artificial section *Orthomeris* of genus *Aster* (Fernald, 1950). However, Semple and Brouillet (1980a) prefer to relate them to subgenus *Doellisgeria.* Their closeness is emphasized by the existence of a natural hybrid, *Aster* × *blakei* (Porter) House (Pike, 1970; Hill & Rogers, 1973).

These taxa are polycarpic perennials, propagated by elongated rhizomes and anenochorous cypselas. They flower from the end of July to mid-September (Brouillet & Simon, 1979). Pollination is entomophilous and unspecialized: Coleoptera, Diptera, Hymenoptera, Homoptera, and Lepidoptera are frequent visitors. Both species are diploid ($2n = 18$, $x = 9$), and no cytogeographical variation has been found (Nelson, 1966; Hill, 1972, 1976; Hill & Rogers, 1970, 1973; Van Faasen & Sterk, 1973; Semple & Brouillet, 1980b). Although they show distinct flavonoid patterns (Hill & Rogers, 1973), the geographical variation of this characteristic was not studied.

Morphological differences are summarized in Table 1. These traits are closely related to ecological preferences. *Aster acuminatus* is a forest herb, while *A. nemoralis* belongs to Sphagnum bogs and other moist, oxylophytic habitats. *Aster* × *blakei* is found at ecotones between forests and bogs.

The purpose of this paper is to synthesize information from various sources to relate distributional limits with specific ecological factors, and to comment on the post-glacial history of these two species.

METHODOLOGY

We followed the methods of Dansereau and Pageau (1966). First, precise distribution maps are needed. Dot maps are better suited for this purpose since they do not reflect authors' biases (Daubenmire, 1978). The second step consists in comparing the limits obtained with isopleths of biotic and abiotic factors.

Distribution maps already available for these two taxa appeared inadequate for our purpose (Dansereau, 1957; Radford et al., 1968; Pike, 1970; Van Faasen, 1971; Rousseau, 1974). Therefore, we compiled more detailed dot maps. The following herbaria were consulted (acronyms follow Holmgren & Keuken, 1974, and supplements): CAN, DAO, GH, MT, MTJB, MTMG, NY, OAC, QFA (in part), SFS, TRT, WAT. Information was retrieved also from literature (Baldwin, 1958; Erskine, 1960; Marie-Victorin & Rolland-Germain, 1969; Radford et al., 1968; Roland & Smith, 1969; Rousseau, 1974; Van Faasen, 1971). Dr. Rouleau (Université de Montréal) and Dr. Argus (National Museum, Ottawa) respectively made their distribution maps available for Newfoundland and Ontario.

Climatological and other physical data were obtained from the following sources: Anonymous (1957, 1974), Baker (1936), Chapman & Putnam (1973), Damman (1965), Ferland & Gagnon (1967), Grandtner (1966) and Hunt (1974). A list of references regarding biotic factors would be too extensive here: relevant information may be found in the following text.

ECOLOGY

Differences in leaf morphology are shown in Figure 1 and summarized in Table 1.

Table 1. **Summary of morphological differences between Aster acuminatus, A. nemoralis and their natural hybrid**

	A. acuminatus	*A.* × *blakei*	*A. nemoralis*
stem diameter	2-4 mm	1.5 4 mm	1 2 mm
Stem pubescence	molliform hairs abundant	molliform hairs present	no molliform hairs, often with glandular hairs
number of leaves	less than 20, distant	20 40	300 100+, crowded
leaf shape	oblanceolate to oval, acuminate	lanceolate to oblong, acute	linear to narrowly lanceolate, ± obtuse
leaf margin	flat, coarsely serrate, ciliate	flat to slightly rolled, serration small to coarse, ciliate to scabrous	recurved, entire, scabrous
upper surface	sparsely hairy	hairy scabrous	scabrous
lower surface	pilose along veins; glands scarce	more pilose; glands ± abundant	densely pilose to glandular
leaf length and width (larger blade)	1 6 cm; 1 8 mm	4 10 cm; 5 25 mm	5 10 cm; 10 60 mm
inflorescence	lax corymbiform, many heads	corymbiform, many heads	1 capitate or corymbose (2 15 heads)
ray	white	white to pink	pink

Following Fernald (1950) and Pike (1970). See also Table 2.

Aster acuminatus has longer, less numerous leaves. It is adapted to lower light intensities. In woodland individuals, the subverticillate leaf arrangement suggests an optimization of total photosynthetic surface (Brouillet & Simon, 1979). Such an arrangement is frequent in forest herbs (e.g. *Trillium, Medeola, Trientalis*). Grime (1977) suggested that sciaphytes are adapted more to survival through prolonged periods of low light intensity than to maximizing light interception. It is not clear, however, whether the whorled form (forma *subverticillata* Fernald) of woodland plants represents a genetically fixed "ecotype" or a phenotypic variant, as opposed to the typical form with its more regular leaf distribution along the stems.

Conversely, the small, ericoid, numerous and crowded leaves of *Aster nemoralis* suggest an adaptation to strong irradiance and/or other physiological stresses, like a waterlogged, low pH, cool substrate. These characteristics could represent also an adaptation to nutritionally-deficient conditions (Small, 1973; Grime, 1977; Brouillet & Simon, 1979). Intense intra-stratum competition forces this species to shed its lower leaves, after reassimilating vital nutrients (Moore & Bellamy, 1974; Bradbury & Hofstra, 1977). No such shedding was observed in *A. acuminatus*, which is subjected to lower levels of competition.

HABITAT AND DISTRIBUTION

Aster acuminatus Michaux This species was classified by Dansereau (1957) and Rousseau (1974) as an appalachian element (Figure 2). Its distribution follows the Appalachian Mountains from Rabun County, Georgia, northeastward to southwestern Pennsylvania. There is a gap in central Pennsylvania and Maryland. It is then continuous from eastern Pennsylvania and northern New Jersey northward to eastern Ontario, the Laurentian Hills of Québec, Lac St-Jean, Haute Côte-Nord, Gaspé and the Maritimes. Disjunct populations occur in the Iles de la Madeleine, southwestern Newfoundland, and the eastern end of Lake Erie (south-east Ontario and adjacent New York). A report for Anticosti is not confirmed (Marie-Victorin & Rolland-Germain, 1969). This species is rare in Ontario (Argus & White, 1977), Newfoundland (Damman, 1965), and Georgia.

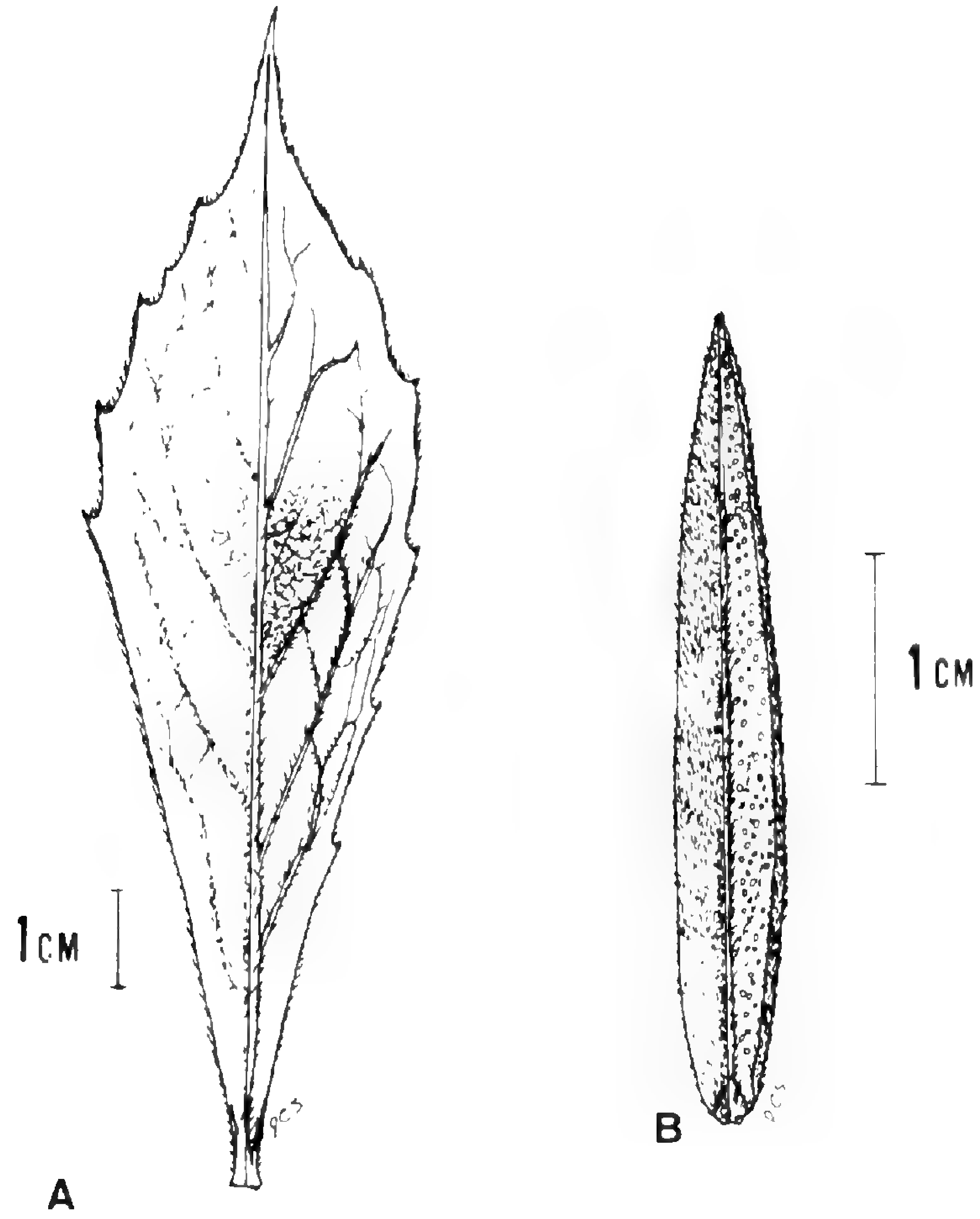

Figure 1. **Leaf shape in Aster acuminatus (A) and A. nemoralis (B).** Left side represents uper surface, right side represents lower surface. (Drawings courtesy of Dr. J. C. Semple).

Aster acuminatus inhabits cool forests of northeastern North America. In the mixed mesophytic forest region, it is associated with red spruce at the higher elevations of the Alleghenys. It is commonly found within northern hardwood forests in the oak-chestnut forest region, and becomes a frequent element in the hemlock-white pine-northern hardwoods forest region (Braun, 1950). The limits of these two regions coincide with the southern boundary of *A. acuminatus* range, except in their northwestern part.

Further north, Pike (1970) reports it from moist or mesic coniferous forests in New England and the Maritimes (acadian forest region of Rowe, 1972). Similarly, protected coniferous forests

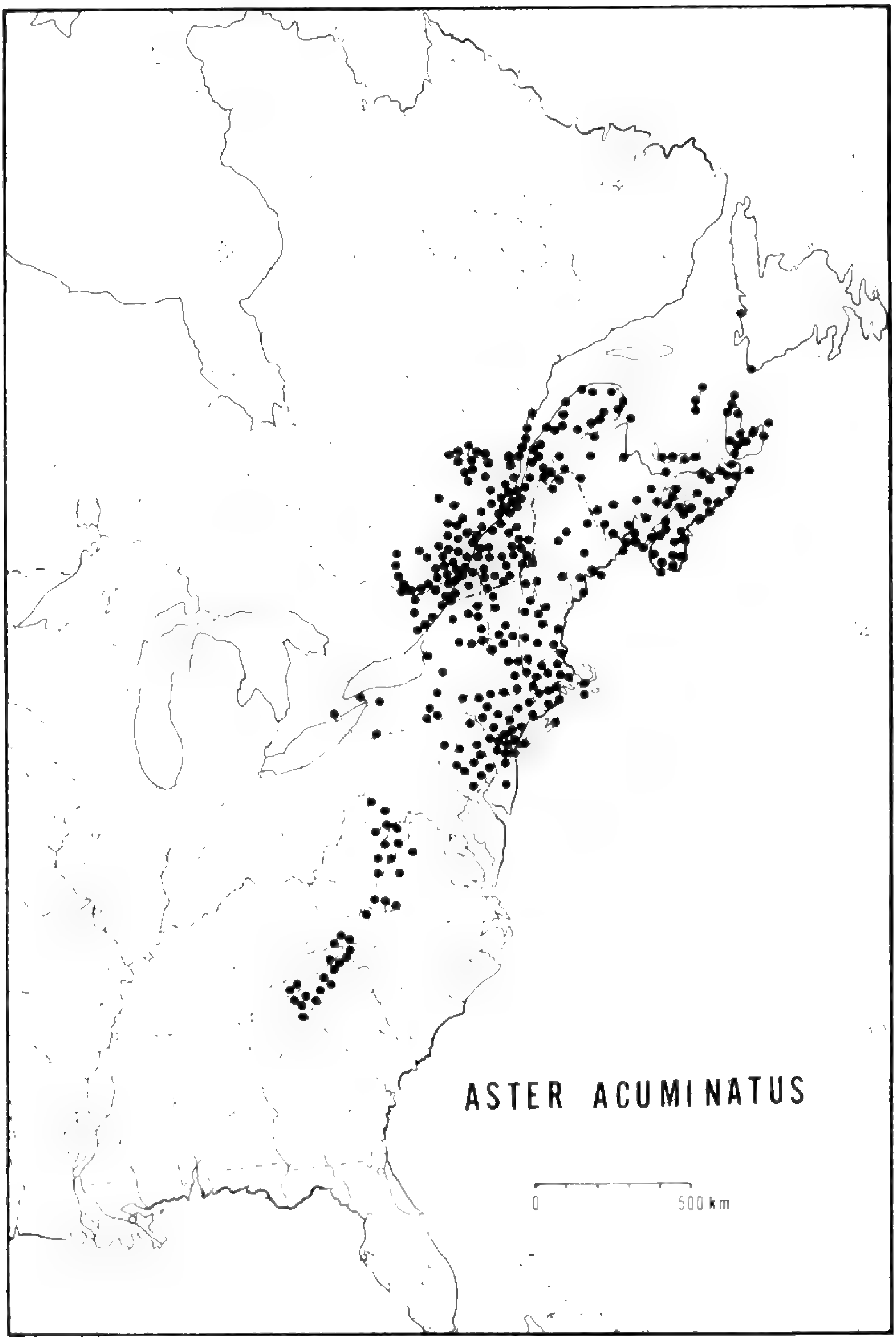

Figure 2. **Distribution of Aster acuminatus** Michaux in eastern North America (black dots; empty circles represent major cities).

shelter it in Newfoundland (Damman, 1965). In Nova Scotia, it colonizes also deciduous forests, clearing and woods' edges (Roland & Smith, 1969).

In central Canada, it is found in the eastern sections of the Great Lakes—St. Lawrence forest region (Rowe, 1972). In Québec, it occurs in a variety of forest associations: hickory-sugar maple, laurentian maple, yellow birch-sugar maple, and yellow birch forests, as well as some red spruce or yellow birch-balsam fir forests of the summits of Appalachian hills and Laurentian hills, respectively (Dansereau, 1957; Dansereau & Pageau, 1966; Grandtner, 1966; Bouchard, 1970; Payette & Lavoie, 1971; Op de Beeck, 1972). Its northern limit corresponds to yellow birch-sugar maple forest's northern boundary. We frequently observed it in laurentian maple forests and successional white birch forests in St. Hippolyte (Terrebonne County, Québec), but never on granitic outcrops where white pine predominates. In Repentigny (L'Assomption County, Québec), it was present in a well-drained, cool laurentian maple wood with yellow birch, while it was absent from a lower (by 2m), moister hickory-sugar maple wood. Interestingly, it was also associated with *Trillium undulatum,* a species replaced in the lower forest by *T. grandiflorum,* of more southern affinity. It was also observed in a few moister cedar swamps bordering bogs in St. Hippolyte, an observation corroborated by Gauthier & Grandtner (1975) studies in the lower St. Lawrence region.

Thus, there appear to be two main factors controlling *Aster acuminatus* distribution: 1) reasonably cool, humid areas; 2) good soil drainage. Bouchard (1970) and Op de Beeck (1972) establish that its maximum frequency is in the mesic segment of the moisture gradient, confirming our observations. This explains the irregular occurrence of this taxon in the St. Lawrence lowlands of southwestern Québec and eastern Ontario. The presence of fine-textured, clay soils, particularly in the clay plains of eastern Ontario (Chapman & Putnam, 1973) could be an important factor. On these lowlands, *A. acuminatus* seems to be confined to areas of morainic deposits. The coarse-textured, dry sandy soils of the outwash plain of western Ottawa valley, which support *inter alia* extensive jack pine stands, are likewise inhospitable for this species and act as a barrier to westward migration. A need for acidic substrate (or for a low calcium content) could also play a role at its western limit in Ontario, where substrate is made of limestone.

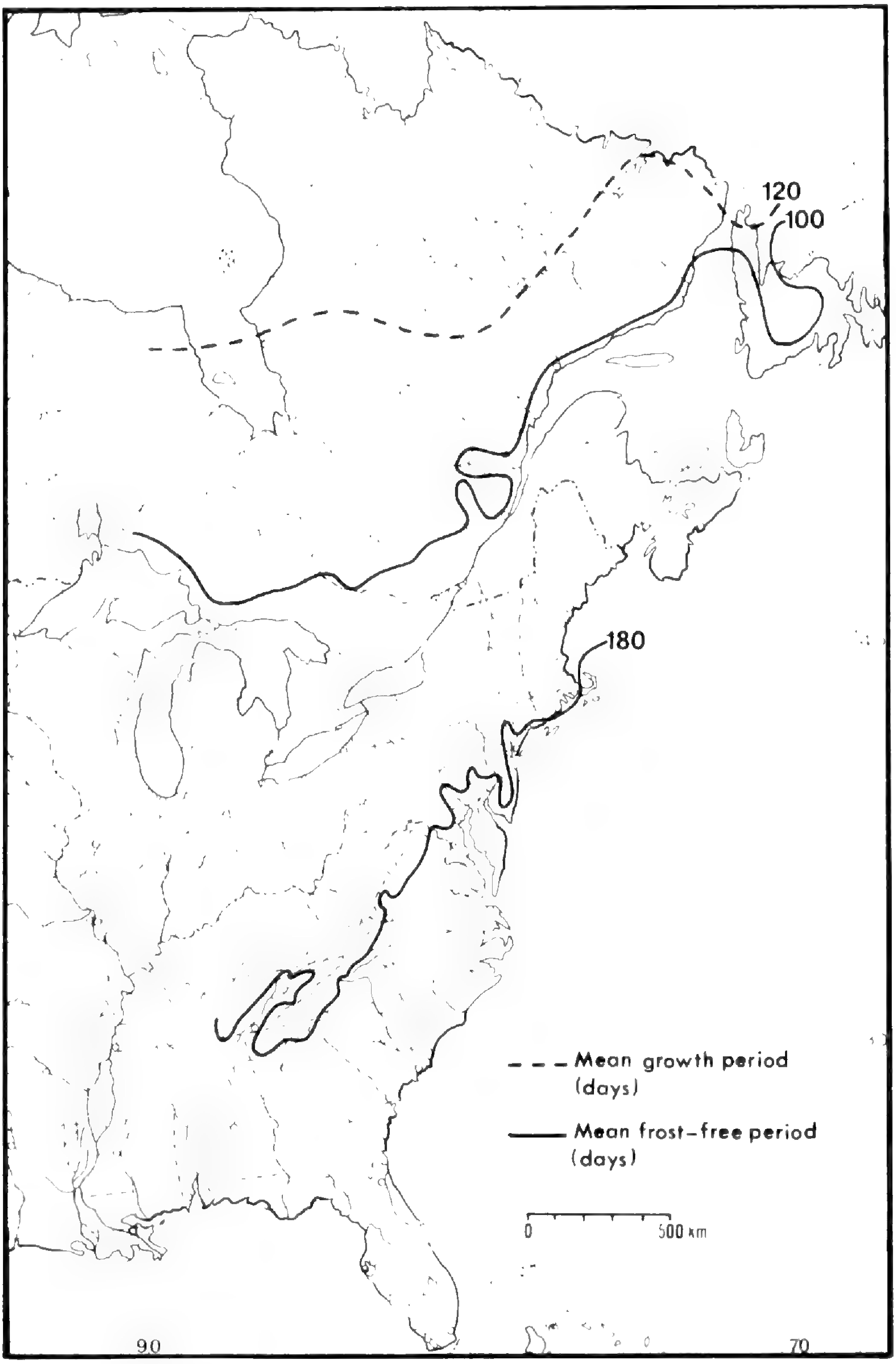

Figure 3. **Isopleths of frost-free period and growth period** (these two climatic parameters are not equivalent) in eastern North America.

At a larger scale, the same factors control its distribution. The impact of the Appalachian Mountains on climate in the south is of major importance. Figures 3 and 4 illustrate this point: frost-free period of 180 days, mean summer and mean July temperatures of, respectively, 21° C and 24° C follow their contour. These parameters coincide closely with *Aster acuminatus'* southern limit. A decrease in humidity could be responsible for the western limit.

The gap in distribution in central Pennsylvania seems also to be related to moisture factors. The mountains are lower and covered with drier forest types (oak, pine). Furthermore, the Piedmont region of Maryland consists of a lower, gently rolling landscape where oaks and hickories are dominant (Braun, 1950). These formations, established on dry soils, seem also unsuitable for the survival of *Aster acuminatus.*

A frost-free period of 100 days (Figure 3) and a mean August temperature of 10° C (Figure 4) are two of many parameters that correlate with the northern range limit (Ferland & Gagnon, 1967). The length of the growing season could play a prominent role, the plant requiring a minimum amount of time to complete its life-cycle. Damman (1965) shows that *Aster acuminatus* on Newfoundland's west coast occupies only a few protected localities where the growth period is warmer and longer and where temperature variations in the spring are less extreme.

Aster nemoralis Aiton—This species has a more northern distribution (Figure 5). It was included among the elements restricted to northeastern North America by C. Rousseau (1974). It ranges from the New Jersey's Pine Barrens to eastern James Bay and Quebec's Basse Côte Nord, and from eastern Lake Superior to the Maritimes and Newfoundland. Disjunct populations occur in central Labrador (northern limit, Rousseau, 1974) and on Anticosti Island. It is rare in Michigan's Upper Peninsula (Wagner et al., 1977) and New Jersey, where its habitat has been severely reduced (Robichaud & Buell, 1973).

Aster nemoralis inhabits characteristically true bogs, *sensu* Dansereau & Segadas-Vianna (1952): blocked drainage, *Sphagnum* mat, organic and acidic substrate, with dominance of Ericaceae, etc. Our observations in St.-Hippolyte lead us to believe that it is a member of the *Caricetum rostratae* (Dansereau & Segadas-Vianna, *loc. cit.*) in southern Québec, a pioneer zone where *Carex*

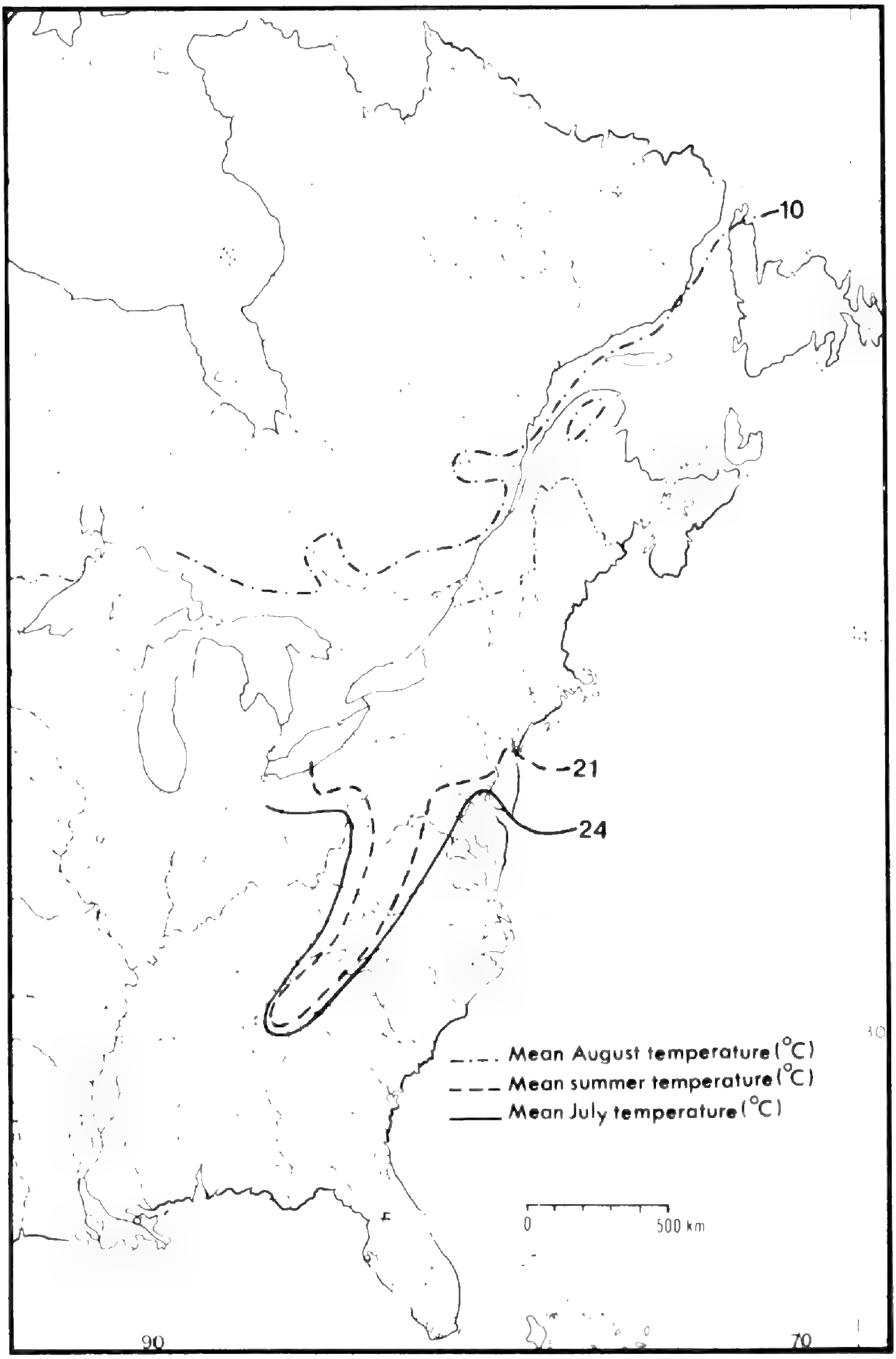

Figure 4. **Isotherms in eastern North America.**

dominates, with invasion of ericaceous shrubs like *Chamaedaphne calyculata* and *Andromeda glaucophylla*. In Abitibi (Québec), Gaudreau (1975) reports it from a similar association: *Sphagno-Chamaedaphnetum calyculatae*, subassociation *Myricetum galio*, *Carex rostrata* variant. It was not found in similar associations of the Lower St. Lawrence region (Gauthier & Grandtner, 1975), an area where the species becomes rather infrequent. In New Jersey, it colonizes acidic bogs of poorly drained areas in the Pine Barrens (Stone, 1911; Robichaud & Buell, 1973). It occupies similar habitats in Newfoundland (Bouchard, Hay & Rouleau, 1978). However, an organic substrate is not essential. It was thriving along with many other bog elements, in a water-saturated sandy beach of a lake in Parry Sound District (Ontario), not far from a bog in formation. It is unaffected by salt spray in Nova Scotia's coastal bogs (Rousseau, 1938).

The northern limit of the range of *Aster nemoralis* corresponds *grosso modo* with that of the boreal forest, as delimited by Rowe (1972). A length of the growing season of 120 days (Figure 3) (it does not correspond exactly to frost-free period!) could be playing the same role as with *A. acuminatus*. Another factor that may act as a barrier northward is the presence of permafrost (Rowe, 1972).

The close ties between this species and its bog habitat gives us further clues to understnd its distribution. Three factors are involved: 1) availability of impondments; 2) cool, moist climate; and 3) acidic substrate (or low calcium content). The Wisconsin glaciation favored the creation of countless lakes, ponds, and marshes, many adequate for bog development. With the exception of New Jersey, the entire range of *Aster nemoralis* lies within the limits of Wisconsin glaciation (Figure 6). South of this glaciated region, higher temperatures and inadequate geological conditions do not favour this type of bog development (Moore & Bellamy, 1974).

Finally, acidic substrate plays a key role in shaping *Aster nemoralis*' range (Figure 6). It correlates closely with the metamorphic rocks of the Canadian Shield and the Adirondacks. Outside of this formation, *A. nemoralis* is present mostly in regions of acidic bedrock: New England, parts of the Eastern Townships (Québec), the Maritimes and Newfoundland. On Anticosti Island, the only location of this species is Sand-Top, where a bog overlies thick sandy terraces in an area otherwise dominated by limestone

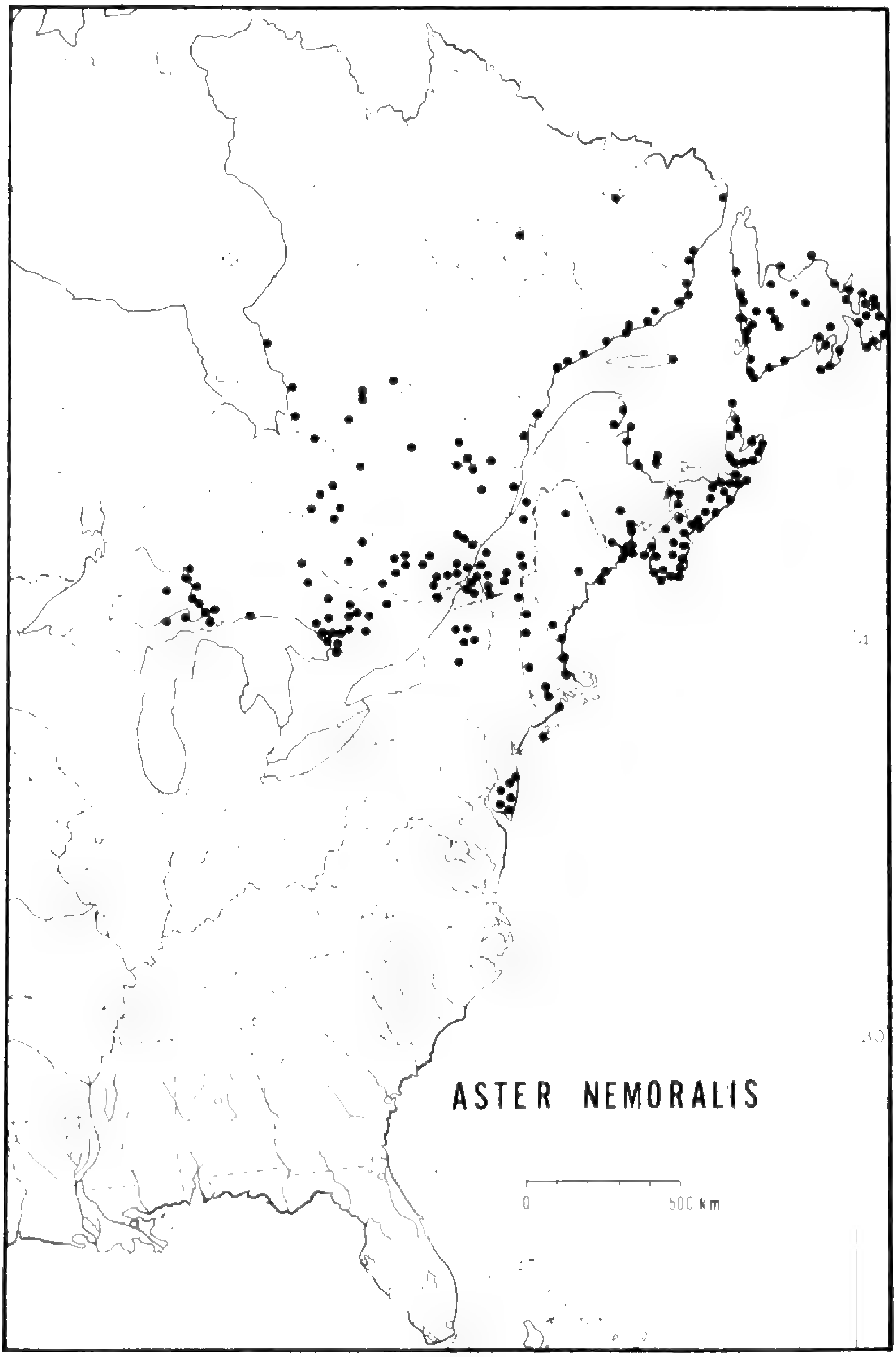

Figure 5. **Distribution of Aster nemoralis** Aiton in eastern North America (black dots; empty circles represent major cities).

(Marie-Victorin & Rolland-Germain, 1969). The high calcium content of soils of the area north of Lake Huron (Rowe, 1972) and the Ontario part of the Clay Belt (Baldwin, 1958) could explain the distribution gap observed in this region. The absence of this taxon from the Hudson Bay Lowlands (Figure 6) and Manitoulin Island (Morton, 1977) is also symptomatic.

Aster × blakei (Porter) House—Hybrid populations are scattered throughout the area of overlapping of the two parents (Figure 7). They occur wherever ecological conditions foster contact between the parental taxa, mostly at the bog-forest ecotone where tall shrubs like *Myrica gale* and *Nemopanthus mucronatus* dominate. The hybrid often survives today in areas where one parent is absent (Pike, 1970).

The population structure was determined for many sites at St.-Hippolyte (Terrebonne Co., Québec) (Figure 8). We used the index designed by Pike (1970), following the methods of Anderson (1949). Table 2 summarizes the characters used, the value of their different states, and the scores of the various entities. As noted by Pike (1970) and Hill and Rogers (1973), the distribution deviates toward *Aster nemoralis.* A greater success of crosses made using the latter taxon as female parent, as well as the greater similarity between the bog and the ecotone where *A.* × *blakei* survives, could explain this feature (Hill & Rogers, 1973). Figure 8 (A, C) also shows that even in a sympatric area, and at a local scale, the parent populations maintain their integrity when ecologically isolated. We were unable to find signs of introgression, at least in using this morphological index.

POST-GLACIAL HISTORY

The absence of macrofossils, and the impossibility of distinguishing specific tubiflorae Composite pollens leaves no alternative but circumstancial evidences to reconstruct the post-glacial biogeographical history of these two taxa. Two kinds of data are relevant in this context. First, the history of revegetation after ice retreat, as recorded in radio-carbon dated pollen sequences. Second, fossil and present distribution of plants showing ecological and biogeographical affinities. The discussion presented below is speculative, but nevertheless provides a model that could eventually be tested with the aid of direct fossil evidences.

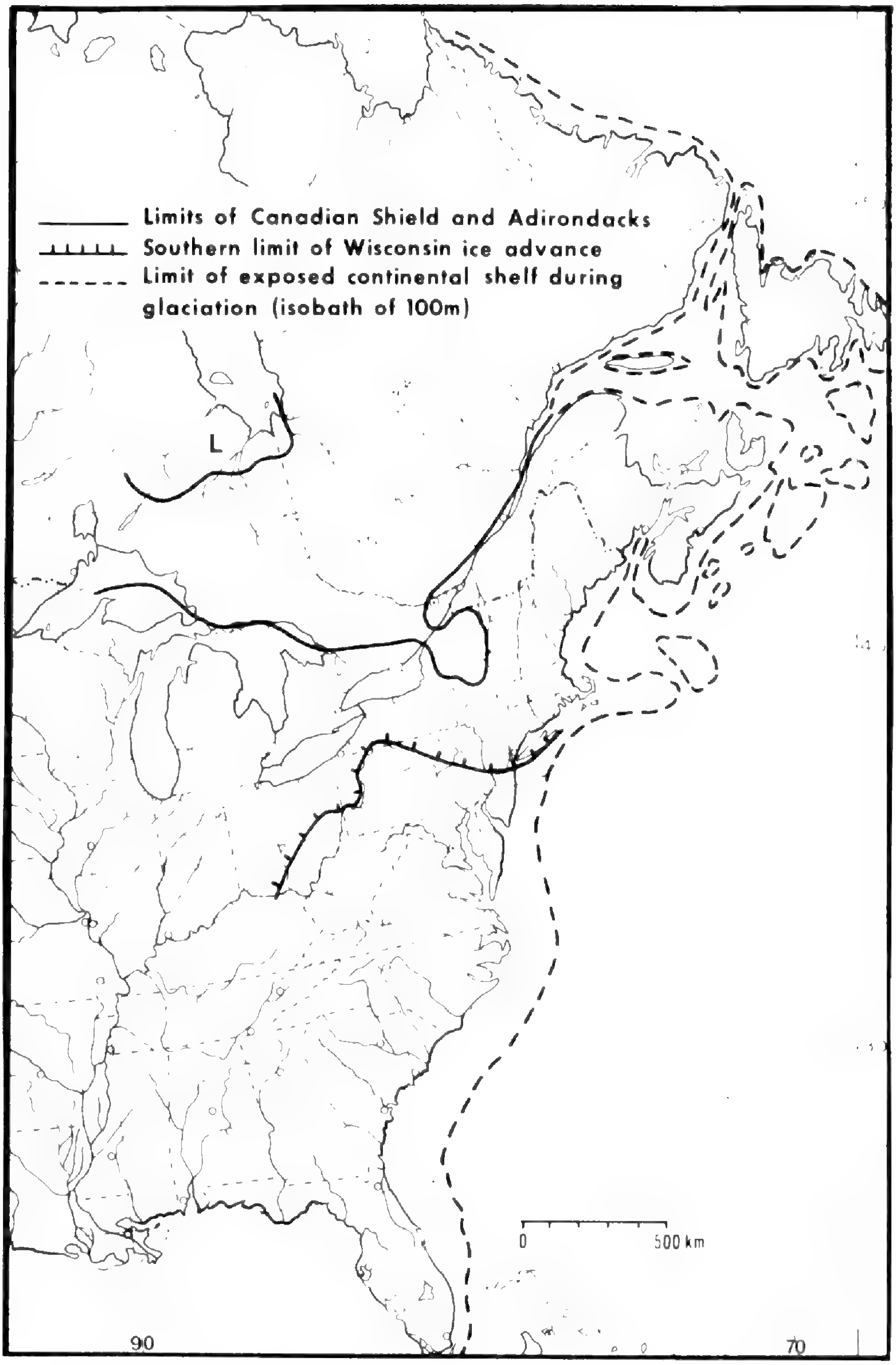

Figure 6. **Past and present geographical factors** in eastern North America. L = Hudson Bay Lowlands. The 100 m depth contour has been redrawn from Flint (1971) and Ogden (1977).

Table 2. **Hybrid index of Pike (1970).**

Character	Character state value 0	1	2	3	4	5	6
number of leaves	100+35	34 32	31 29	28 26	25 23	22 20	19
ratio leaf length width	10 7	7 5	<5 4	<4 3.33	<3.33		
internodes length (mm)	1 8	9 11	12 14	15 18	19 23	24 30	
degree of revoluteness	revolute	±revolute	±flat	flat			
degree of scabrosity	scabrous	intermediate	hairy				
leaf serration	entire	tip gland	small	big			
number of bracts peduncle	4+	3	2	1 0			
number of heads inflorescence	1	2+					
ray colour	pink	trace	white				
1 zebra hair on stem (molliform)	absent	occur	abundant				

Individuals with total score of 0 4 are assigned to *A. nemoralis*, 8 19 to *A.* × *blakei*, 25 31 to *A. acuminatus*.

During the last (Wisconsin) glacial maximum (ca. 20,000 yrs B.P.), ice covered entirely northeastern North America (Figure 6). Tundra covered a belt south of the ice front, particularly in Pennsylvania and central New York State, stretching southward along the Appalachian Mountains for a few hundred kilometers. A spruce forest covered most of eastern North America, at least from Georgia northward. At the same time, a spruce- (jack) pine forest occurred on the Atlantic coastal plain. Substantial areas of the continental shelf, to a depth of ca. 100 m below present sea levels (Figure 6) were available to colonization by animals and plants (Flint, 1971; Davis, 1976; Ogden, 1977). *Aster acuminatus* and *A. nemoralis* were eliminated from over one half and more than ninety percent, respectively, of their modern ranges. The former may have survived in parts of the heterogeneous spruce forest of the southern Appalachians, and perhaps the adjacent Piedmont, particularly in association with red spruce. This habitat may have resembled those where this species is found today in the Appalachian Mountains and coastal New England/Maritimes. The extent of this 'refugium' is unknown, as is the exact location of ice-age refugia of most deciduous forest elements (Davis, 1976). The presence of fossil bogs on the continental shelf and in the Piedmont (Whitehead, 1972) indicates that suitable habitats existed that could have harbored *A. nemoralis* during that period. It may even have survived close to the ice edge in New Jersey, particularly if permafrost was negligible. Davis (1976) brings evidences of the probable survival of white pine and hemlock on the continental shelf.

From the terminal ice front position, deglaciation did not proceed as a uniform northward movement. In eastern North America, an ice lobe lingered over the Great Lakes, while ice was retreating rapidly along the eastern seaboard, from New England to Newfoundland. Much of the shelf was exposed still. Thus, by 12,000 yrs B.P. a wide corridor existed along the east coast, east of the St. Lawrence Valley (Ogden, 1977). Open spruce parkland already existed in New England and the Maritimes (Davis, 1976; Ogden, 1977).

It would not seem unreasonable to approximate the northward movement of closed boreal forest with a similar migration of *Aster nemoralis,* since their northern limits are correlated. One can envisage the following scenario. The dates used follow Davis (1976), Ogden (1977), and Richard (1977) (Figure 9).

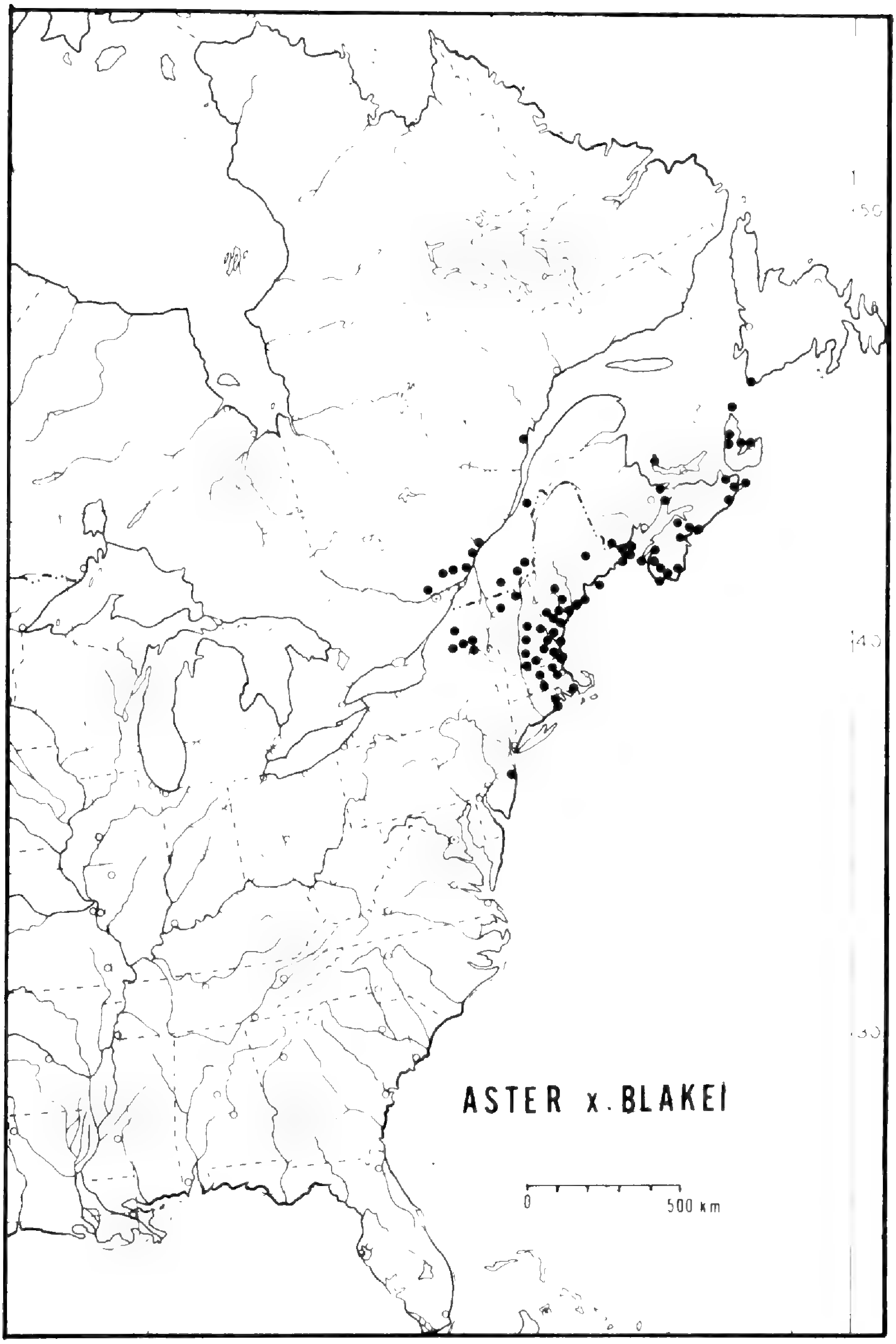

Figure 7. **Distribution of Aster × blakei** (Porter) House in eastern North America.

From its coastal plain-continental shelf "refugium", *Aster nemoralis* migrated northward through New Jersey and Long Island, spreading across bogs and pine barrens, mostly on the shelf. By about 11,500 yrs. B.P. It may have reached New England where the acidic substrate and the abundant pools were favorable to bog formation. At the same time, it would have taken a foothold in the maritimes, via the milder coastal route. Migration inland must have been slower due to proximity of ice. From Cape Breton Island (N.S.), this species was able to cross a then narrower Cabot Strait, probably in association with a number of boreal, bog (e.g. *Andromeda, Sarracenia,* etc.), and perhaps coastal plain (e.g. *Bartonia paniculata, Schizaea pusilla*) elements (Bouchard et al., 1978; Damman, 1965). This supposedly occurred between 11,000 and 9,000 yrs. B.P. Within the same time interval, it reached the Adirondack Mountains and southern Québec south-east of the Champlain Sea (Richard, 1977). From this position, migration may have followed this pattern: Laurentian Hills, ca. 8,500 years B.P.; Lac St-Jean area, 8,000 yrs. B.P.; Côte Nord, ca. 7,000 yrs. B.P. It ultimately reached its northern limit in the Churchill Falls area (Labrador) by ca. 5,000 yrs. B.P., the last remnant of ice having just melted in that region (ca. 6,000 yrs. B.P.) (Figure 9).

Northwestward expansion in northern Ontario is a different issue. *Aster nemoralis* may have reached the Algonquin highlands by about 8,000 yrs B.P., spreading afterwards toward the Districts of Muskoka, Parry Sound, and Sudbury. The lingering of an ice lobe over James Bay and the presence of lake Ojibway-Barlow delayed northward migration into Abitibi, eastern James Bay area (Québec), and northern Ontario. The first two areas may have been colonized by respectively 6,000 and 5,000 yrs. B.P. Westward migration from this front was probably blocked by the Tyrrell Sea and the high calcium levels of Hudson Bay Lowlands (see Fig. 6). Similarly, westward migration from Sudbury District was delayed by higher soil calcium content in glacial deposits north of Lake Huron (Baldwin, 1958). Moreover, we cannot use boreal forest progress as a yardstick of *A. nemoralis* migration, since elements of this formation may have come from the Upper Peninsula of Michigan as well as from the east. Thus *A. nemoralis* may have migrated in an area settled long before its arrival. Long-distance dispersal and chance establishment in suitable bogs west of the edaphic barrier are probably responsible for its establishment in the eastern Lake

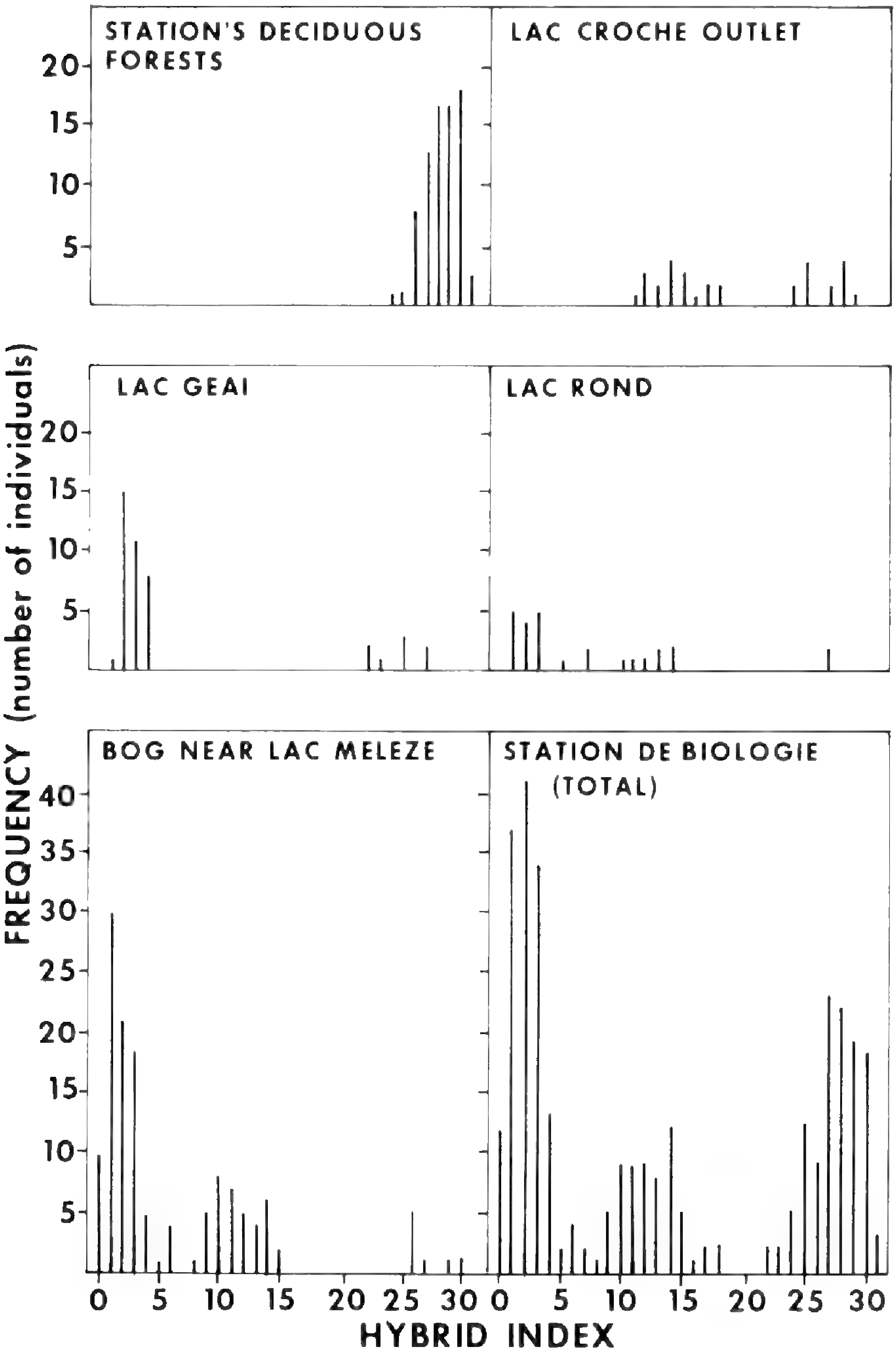

Figure 8. **Frequency of individuals with different hybrid index** (Pike, 1970) in many populations at the Station de Biologie, Université de Montréal, St. Hippolyte, Co. Terrebonne (46° 00'N, 76° 00'W). Index range: *A. nemoralis*: 0–4; *A.* × *blakei*: 8–19; *A. acuminatus*: 25–31. Intermediate scores indicate backcrosses.

Superior area. This is rendered more likely by the existence today of disjunct populations on Caribou Island, in the middle of Lake Superior (Fig. 5), and in the Upper Peninsula (Mich.). The actual western limit may be a function of time and the species could still be expanding its range westward north of Lake Superior (Figure 9).

Migration of *Aster acuminatus* was probably delayed, in comparison to that of *A. nemoralis,* owing to its more southern refugium and its ecological requirements. The Appalachian highlands provided a first axis of migration. Upon reaching Pennsylvania-New Jersey, the spectrum of possible routes (Figure 9) broadened from the mountains to the shelf. At ca. 11,000 yrs. B.P., hardwoods started to replace boreal forest elements in this area and coastal New England (Davis, 1976). The establishment of yellow birch, with which this aster is often associated, could serve to estimate the pace of migration. However, this birch's pollen has not always been differentiated by palynologists and cannot be used extensively as yardstick. We have to use other temperate deciduous forest elements also. By 8,000 yrs. B.P., such elements were increasing in the Maritimes and southeastern Québec. This event may have corresponded with *A. acuminatus* arrival. From Cape Breton Island, it crossed the Cabot Strait to reach Newfoundland. A number of deciduous forest elements may have chosen the same route at roughly the same time, *inter alia* the yellow birch whose northern limit in Newfoundland is just to the north of *A. acuminatus'* northernmost locality on the island (Bouchard, et al., 1978). The Iles-de-la-Madeleine may have been reached also at this period, whether by long-distance dispersal or across a still partly exposed shelf. The Champlain Sea was no more a barrier when this species reached southern Québec. It may therefore have moved into the Laurentian Hills by 6,500 yrs. B.P., and Lac St-Jean area, its northern limit, by 5,000 yrs. B.P. The Gaspé Peninsula may have been colonized by plants coming from Maine and New Brunswick, as for the few *A. nemoralis* colonies (Figure 9).

The absence of westward expansion in eastern Ontario stresses the significance of the already discussed ecological barriers in this area. Certainly, time cannot be a factor here. The isolated Turkey Point (Ont.) population may represent a long-distance dispersal event or, alternatively, a relict from a period of range extension when climates were cooler and/or moister. A similar hypothesis is used by Kapp (1977) to explain disjunct populations of hemlock west of its main range.

DISCUSSION

These two closely related perennial herbs display a close relationship between leaf characteristics and habitat. *Aster acuminatus* inhabits cool, mesic deciduous and mixed forests, and has a low number of wide-limbed leaves. In open, dry situations, the foliage is chlorotic, the blades narrower. The bog dweller, *A. nemoralis*, exhibits a great number of small, ericoid leaves of xerophytic character, an advantage in strongly insolated, nutritionally poor environments. *Aster acuminatus* has a distinctly Appalachian range, although it was successful in reaching the Laurentian Hills. Northern and southern limits correspond to isopleths of climatic parameters such as frost-free period and mean summer temperatures. The western limit is a result of the action of moisture and edaphic factors. On the other hand, *A. nemoralis* is confined to glaciated eastern North America, with the exception of the Pine Barrens of New Jersey. Acidity (or low levels of calcium) and conditions conducive to bog development play a prominent role in shaping its range. Both conditions are met on the acidic bedrock and pond-strewn landscape of the Canadian Shield and New England. Climatic factors (such as temperature) may delimit the southern edge of its range, since seemingly adequate environments exist further south on the Coastal Plain. Growing season and permafrost are likely determinant at the northern limit.

Thus, it appears that in both cases the factors controlling distribution at a local and regional level and those ruling over distribution at the continental level are similar. This phenomenon has been found in other studies (Bouchard & Maycock, 1970; Holland, 1974, 1975; Haber, 1977). In the case of *Viola rotundifolia* (Bouchard & Maycock, *loc. cit.*), an appalachian element, details of distribution are parallel to those of *A. acuminatus*. Examples are the hiatus in central Pennsylvania-Maryland, the southern limits in Georgia and east of the mountains. Discrepancies at the western and northern margins of the ranges underline differences in some of the ecological requirements of these species. However, major controlling factors are moisture and temperature in both cases.

That both regional and "continental" control are affected by the same factors is expected when the nature of adaptation is considered. Interactions of the milieu with a species' genome through selection produces adapted individuals. As this phenomenon operates at a local, populational level, it seems logical to infer that ultimate control over the range of a species will result from these same factors. Although ecotypic differentiation may appear to change ranges' outlines, it represents no more than a readjustment of distribution limits to slightly changed controlling parameters. Ecotypic variation is but a population phenomenon, and not a "cladogenetic" event (Quinn, 1978).

Many people may object to the use of correlations between climatic and/or edaphic parameters and distribution limits as a mean of detecting limiting factors. Their argument is that only an autoecological study is able to do so. Although it is true that ranges of tolerance to different factors can best be determined that way, there remains the problem of determining how these apply in nature, where other elements come into play, such as competition, diseases, etc. This is the classical potential vs. realized niche concept. Thus, biogeographical correlation still remains a valuable tool in this context, insofar as it only states the facts and does not try to infer direct causal relationships. Others would say, rightly, that range limits are not the result of single factors. However, it has repeatedly been noticed that isolated factors may have an overwhelming importance, determining *de facto* the level of reaction to other components (Dansereau, 1951). Jeffree (1955) has even shown that some species distributions can be modeled using a few temperature parameters. Furthermore, the use of different levels in analysis (local, regional, continental) ensures that the proper factors are selected. It thus seems reasonable to use correspondances between isopleths, or other geographically varying characteristics of the environment, and range limits as a first approximation of the nature and intensity of controlling factors. It will be the task of autecologists to determine their exact mode of action, be it direct or indirect. Biogeographical analysis and synthesis is after all a starting point.

In the second part, we tried to reconstruct post-glacial history of *Aster acuminatus* and *A. nemoralis*. As we pointed out earlier, the absence of fossils is handicapping our effort. The assumption that the ecological requirements of a species did not change from glacial time to the Holocene is basic to such reconstitutions and deserves to be mentioned. It has been discussed by many paleoecologists with regard to paleoclimatological reconstructions. There is no way to prove that it is right or wrong.

A further point of concern is the location of the so-called "refugia". Very little information is available on this subject, particularly for eastern deciduous forest elements (Davis, 1976). The presence of macrofossils in deposits whose geographical location contrasts with present distribution stresses the problem of finding past ecogeographic equivalents of modern ranges (e.g. *Schizaea pusilla,* Whitehead, 1972; *Pinus banksiana,* Davis, 1976). The possibility of genetic depauperation, subsequent to population eradication by ice advance, and thus shrinkage of ranges of tolerance, has to be considered. Migration routes or fronts are also a facet of this problem (e.g. *Dryas integrifolia, D. drummondii,* Miller & Thompson, 1979). In our case, the shelf route can be postulated only because we know that fossils of plants and animals indicate their presence there during and after ice age (Flint, 1971; Ogden, 1977).

A careful application of our knowledge of present ecology and distribution of species, coupled with paleoecological reconstructions, are our chief means of historical analysis. A further element that can be used, with caution, is the glacial/post-glacial history of taxa whose fossil record is more complete and whose requirements and ranges overlap with those of the species under study.

Two points have to be taken into consideration: 1) differences in ecological requirements and life-form; 2) differences in dispersal potential. Let us use our utilization of yellow birch, *Betula alleghaniensis,* as a marker of *Aster acuminatus'* progression. Similarities and differences can be summarized as follows: a) the former species is a tree, the latter a perennial herb; b) yellow birch's range is wider to the west, and slightly so to the north; c) however, where they occur together their ecological needs seem to be similar in great part (both benefiting *inter alia* from small disturbances in the canopy for their establishment, etc.); and d) both are anemochorous. A taller individual can disperse propagules to greater mean distances owing to the higher starting point of its fruits. However, the shorter generation time of *A. acuminatus* may compensate for a smaller dispersion radius. The wider range implies that yellow birch is useful as an index only within the area where the whorled *Aster* is

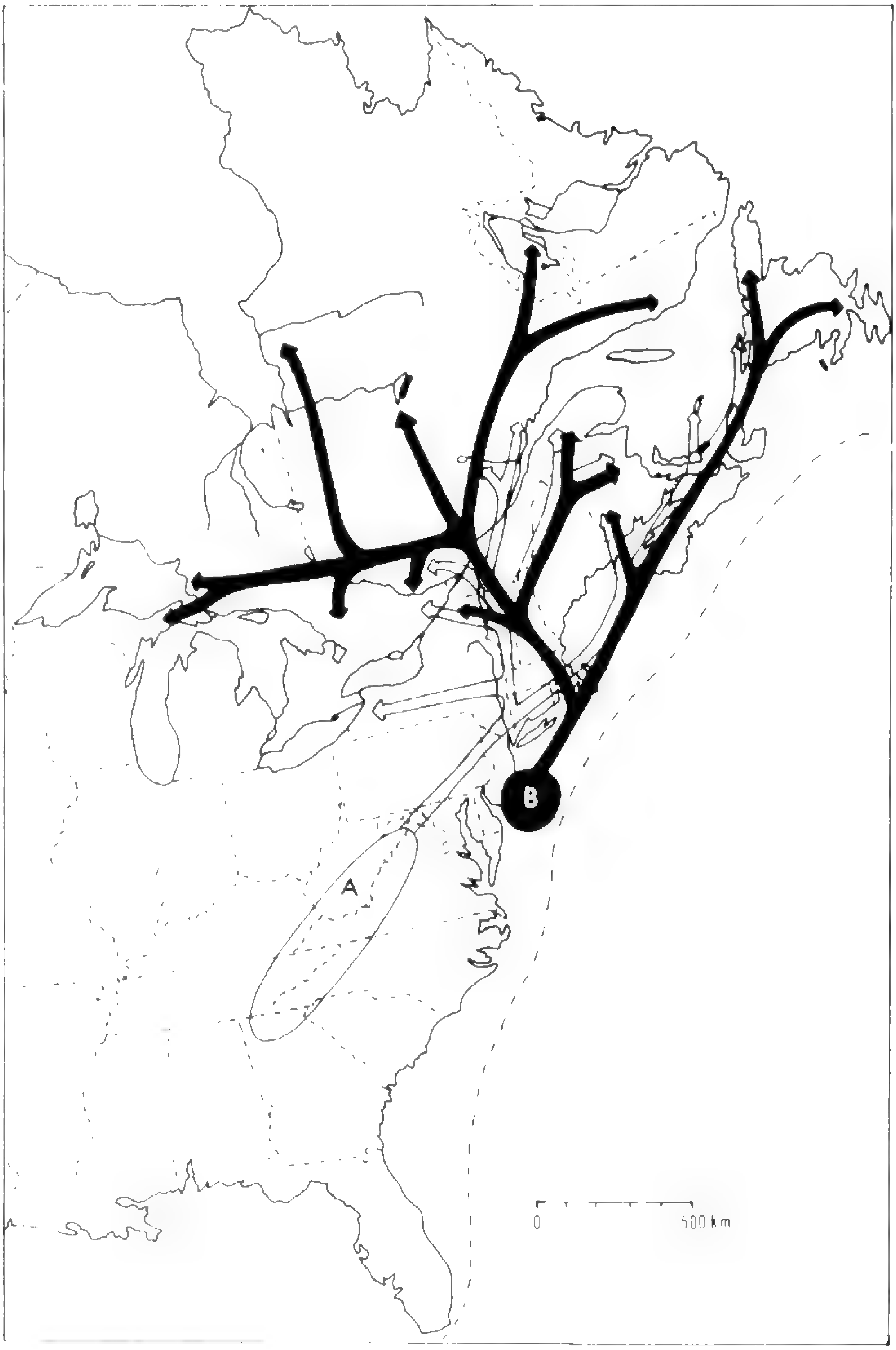

Figure 9. **Probable Areas of Refugium, migration and recolonization routes of** *Aster acuminatus* (A, grey) and *A. nemoralis* (B, black).

present today, i.e. in the eastern part of its range: the rest is irrelevant. Finally, the greater tolerance of the birch to northern conditions means that estimates of the *Aster* migration rate based on its progression will represent an upper limit, a maximum: *Aster acuminatus* may have been present in a given area not earlier than the date of yellow birch arrival. This short-coming could be alleviated by using a number of taxa of similar ecogeographies, which could provide a probability envelope. The same can be said of the use of vegetation units for this purpose, as we did with *A. nemoralis* and closed boreal forest. The application of such criteria is useful mostly in areas where revegetation sequence is parallel to present latitudinal zonation, i.e. where distortion of vegetation in the post-glacial was the least. Richard (1977) showed that this was the case for Québec, a region more remote from the ice front than New England where vegetation units were more intermingled (his "spring effect").

Hill (1976) postulated an introgression of genes from *Aster nemoralis* to *A. acuminatus* that would have occurred during the glaciation, in the Appalachians, to explain the aspect of individuals of *A. acuminatus* living on exposed summits of this region. His argument is based on two observations: 1) individuals of these populations tend to score lower than typical *A. acuminatus* when using Pike's index, due mostly to narrower leaves; 2) these plants show loose meiotic pairings and lower pollen fertility. Wells (1980) criticized Anderson-type indices because they tend to show evidences of hybridization even in cases where it is not occurring, reflecting author's biases in choosing the characters. Hill (*loc. cit.*) never considered the possibility of phenotypic plasticity. It has been observed by us that plants of this species exposed to drier, sunnier conditions have narrower, chlorotic leaves. Another possibility could be ecotypic adaptation. Furthermore, Jones (1976) demonstrates in experimental studies that pollen fertility in *Aster* is linked with the conditions under which a plant is grown: the greater the stress, the lesser the fertility. Loose pairing at metaphase I of meiosis (not an actual failure to pair) could also be ascribed to this phenomenon. Thirdly, there is no real support for the existence of *A. nemoralis* in the mountains. We do not reject, however, the possibility of hybridization on the Piedmont, where fossil bogs have been found. Finally, as we pointed out in the section on *Aster* × *blakei's* distribution, hybridization in this case is definitely a local phenomenon (Figure 8), which does not lead to extensive introgression even in sympatric areas. The selection gradient between bog and mesic forest seems to be strong enough to maintain genetic identity even in front of gene flow (May, et al., 1975). The dry, wind-and-sun-exposed summits mentioned by Hill (*loc. cit.*) are rather far, ecologically, from the ecotones where the hybrid grows. That its genes would be helpful in this context is far from proven!

This study encompasses several of the "integrative levels" of Dansereau (1951). The actual distributions of *Aster acuminatus* and *A. nemoralis* cannot tell us much about their phylogenetic history, since all their relatives (subgenus *Doellingeria)* are today restricted to eastern North America and no fossils are known. The paleobotanical level (level 1) was thus ignored. However, all the other levels (2 to 8) were involved: paleoecological, aerographical, bioclimatological and, in part, autoecological. We also used data from the synecological and phytosociological levels, particularly to determine controlling factors. Finally, the impact of man (land use and conservation) was also considered in due place. Thus, an ecogeographical analysis, based on a synthesis of all known data, certainly constitutes a source of useful information for the other plant scientists (taxonomists, ecologists, physiologists), as well as for the conservationist. There is certainly a need for more study of this type, particularly in relation to rare species' protection.

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THE TAXONOMY OF THE GENUS *EUTHAMIA*[1]

DAVID J. SIEREN

Ever since the name *Euthamia* was first proposed by Nuttall in 1818 as "a subgenus, or rather genus, reciprocally allied to *Solidago* and *Chrysocoma*. . ." the euthamioid goldenrods have been variously treated as a genus, or as a section or subgenus of the genus *Solidago* to which they are most closely allied. Accordingly there has developed over the years an extensive synonomy and there still exists significant confusion about specific limits in the group and the relationships between *Euthamia* and *Solidago*. Recent evidence (Sieren, 1970; Anderson and Creech, 1975) seemingly supports the contention that *Euthamia* should be considered a distinct genus. The purposes of this paper are, therefore, to present a taxonomic treatment of the genus and to give fairly complete accounts of the bibliography and synonomy as a basis for further study.

HISTORY OF THE GENUS

The first description of a *Euthamia* species was by Linnaeus in 1753 in Species Plantarum from a specimen of *Euthamia graminifolia* in Pehr Kalm's collections from Canada. Apparently recognizing the habit similarities between it and species of the genus *Chrysocoma* (i.e., narrow. sessile, entire leaves), Linnaeus named the specimen *Chrysocoma graminifolia,* alluding in the specific epithet to the grass-like leaves. In his Mantissa of 1767, Linnaeus later named the same species *Solidago lanceolata* based on a specimen probably collected by Royen in "America septentrionali" although there was apparently some doubt since in the description there is a question mark after the phrase. The two names were brought into synonomy by Michaux (1803), who recognized both as *Solidago lanceolata.* He extended its known range down the eastern seaboard, and he also recognized two varieties, α *major* with "*foliis rarioribus, latiscule linearibus*" and β *minor,* with "*foliis crebrioribus, anguste linearibus; axillis foliosis: subglutinosa*", α *major* having a habitat "in Canada" and β *minor* "*in pascuis circa Charlstown*", around Charlestown, South Carolina. The distinc-

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[1] Condensed and modified from a thesis submitted in partial fullfillment of the requirements for the degree of Doctor of Philosophy in Botany in the Graduate College of the University of Illinois, 1970.

tions between the two varieties were so obvious that Frederick Pursh in 1814 elevated *β minor* to specific rank with the name *Solidago tenuifolia,* thus recognizing two species, *S. lanceolata* and *S. tenuifolia.* Many herbarium specimens collected in the middle 1800's reflect the widespread usage of the epithet *lanceolata.*

The name *Euthamia* was first proposed in 1818. Nuttall in his *Genera of North American Plants* suggested the name for this group of goldenrods "...in allusion to the crowding of the flowers", as "a subgenus, or rather genus, reciprocally allied to *Solidago* and *Chrysocoma*...", although he maintained the two species in the genus *Solidago.* He also took up the earlier specific epithet *graminifolia* and relegated *S. lanceolata* to synonomy under *S. graminifolia.* The fact that, in his 1841 publication, he referred to the 1818 proposal of *Euthamia* as a "section" of *Solidago* indicates that he did not intend in 1818 to consider the group as a good genus, even though in discussions under the genus *Bachyris* he referred to "*Euthamia tenuifolia*". Stephen Elliott, in 1824, also used the name *Euthamia* in combination with specific epithets, but he too used it only in Nuttall's sense of the group as a subgenus and he retained the species in *Solidago.*

Sixteen years later, in 1841, Nuttall finally used the name *Euthamia* in a truly generic sense. At that time, he retained *E. tenuifolia* and *E. graminifolia,* and named a new and very distinct species from western North America, *Euthamia occidentalis.* Torrey and Gray, in the next year, transferred the three species back to *Solidago,* and added the equally distinct *Euthamia leptocephala* from western Louisiana and Texas.

Of the four species thus recognized 100 years after Species Plantarum, *Euthamia graminifolia* was the most inclusive, wide-ranging, and variable, and everything not included in the other three species was placed in it. It wasn't until 50 years later, when E. L. Greene (1902) published his "A Study of *Euthamia*", that the genus was closely examined. After reinstating the genus in 1894, he proceeded to name 14 new species in 1902, one in 1906, and another in 1911. Several of his new species were based on single specimens sent to him by other collectors. In 1894, Greene also had inaugurated the debate over the status of Linnaeus' *Erigeron carolinianus* by proposing *Euthamia caroliniana* as the earlier valid name for *Solidago tenuifolia.* Following Greene's efforts, M. L. Fernald (1908) returned the previously and newly named species to

Solidago and between then and 1944 proposed 17 new names, although most were not new species, but rather the result of the transfer of Greene's species from *Euthamia* to *Solidago.* He also considered Greene's species concept to be too narrow.

The next important study was by R. C. Friesner in 1933. In his investigation of the northeastern American Solidagos, he maintained 13 of the previously described species and one variety, and added one new species of this own and 3 new binomial combinations. His species concept tended to be nearer Greene's and he recognized several of Fernald's varieties as species. In 1943, Stuart K. Harris made a study of *Solidago,* section *Euthamia.* He added 4 new names, and Fernald, in the 8th edition of Gray's Manual, followed Harris' treatment of the group, as have authors of other floras.

MORPHOLOGY

Stems

All species of *Euthamia* are fibrous-rooted, rhizomatous perennials. New shoots arise from the underground stems in successive growing seasons, and often form extensive, relatively dense colonies. In *E. gymnospermoides,* and probably *Euthamia* generally, the rhizomes between shoots tend to die off, so that in any given colony the shoots are not all interconnected. Except perhaps in *E. occidentalis,* where Harris (1943a) has reported "tuberous enlargements" on the rhizomes of some specimens, the underground portions of the stems are not diagnostically important.

The erect stems are usually nearly terete near the base with only slight vertical ridges and become strongly striate-angled toward the apex, especially in the inflorescence where the diameters are less. They often tend toward woodiness at the base, although this is variable with some of the *Euthamia* species, such as *E. pulverulenta* and *E. hirtipes,* being often very woody even in the inflorescence.

Biseriate, glandular trichomes (colleters) secrete a viscid substance which often gives the stems of *Euthamia* species a varnished appearance, especially in the inflorescence. This appears to be somewhat correlated with the habitat, species growing in more severe sites producing more varnish. In a population of *E. gymnospermoides* near Urbana, Illinois, the plants had little varnish when young, were very sticky in early August at the bud stage, and although still shiny, were relatively dry again when flowering had been completed in September and October. This can be a useful distinguishing character for those species such as *E. gymnospermoides* and *E. tenuifolia* which are characteristically glutinous. Other useful stem characters for separating species are the presence or absence and amount of pubescence, the glaucous condition which often characterizes *E. occidentalis,* height of the plants, and the relative length of the inflorescence. Most of the species have at least a few short hairs on the stem, especially on the uppermost branchlets, but only one variety, *E. graminifolia* var. *nuttallii,* is typically pubescent on the stem below the inflorescence. The amount of pubescence in all species of *Euthamia* increases toward the plant apex. Little work has been done on the anatomy of the genus.

Leaves

Euthamia leaves, except in shape and degree of pubescence, are extremely non-variable, and even those characters vary within relatively narrow limits.

The leaves of all of the species are sessile, glandular-punctate, and have entire and more or less scabrous margins. Small internal cavities which can be seen by transmitted light are present in all of the species and vary only as to size and abundance. The nature of these cavities was indicated by Anderson (1963) for *Euthamia leptocephala,* in which they are very large. The stomates are, in some species, often very conspicuous, appearing as little white shimmering dots.

Whittaker (1918) pointed out that the leaves are essentially 3-veined, but that a multiplication of nerves can occur which seems to be especially correlated with an increase in leaf size; as a result, when distinguishing taxa in *Euthamia,* the character of vein number is not a good one to use except secondarily. Because the species are so similar morphologically, the significance of this particular character has been overemphasized. Since the leaves are all essentially linear, the major veins run more or less parallel to the midrib from the base outward.

Euthamia leaf pubescence is very uniform, and varies only as to amount. Three kinds of trichomes are present, all of which are present in all of the species.

The most conspicuous type is a simple, uniseriate hair which is found on the margins, and, in pubescent forms, the veins and laminar surfaces. The number of cells comprising the trichomes ranges from 2 to 4, and even glabrous species have at least a few of these hairs in the axils of the leaves or on the veins.

The second type is composed of a uniseriate pedestal of a few to several cells supporting an elongated, whip-like cell. These are most easily seen on the phyllaries, but are also present on the leaves.

The punctae which characterize *Euthamia* are caused by biseriate, glandular trichomes (colleters) which are depressed below the surface and secrete a viscid, varnish-like substance. In those species, such as *E. gymnospermoides,* in which the punctae are most easily seen, there also is an increased production of varnish. The colleters are usually 4 cells in height and, from a side view, appear to have a flattish top.

On the epidermal surfaces, the arrangement of the stomatal subsidiary cells is anomocytic (ranunculaceous) and the cuticle is usually developed into random, very narrow, parallel striations which seem to have no particular orientation with respect to the stomates.

The lower cauline leaves of Euthamias are early deciduous, so that by flowering time the stems below the inflorescences are often devoid of leaves.

Inflorescences

The inflorescences are mostly corymbiform or somewhat paniculate (*Euthamia occidentalis*) with the heads variously stalked or sessile in terminal glomerulate clusters. Useful diagnostic characters include the pubescence or lack of it, the relative size and shape of the inflorescence, the tendency of some species to form an irregular, interrupted, or storied inflorescence, whether or not the heads are pedunculate, and the relative flatness of the top of the inflorescence.

Heads

The heads are characteristically small, less than 1 cm. in length, and numerous. As mentioned previously, they are variously glomerate or pedunculate and most species have at least some heads of both conditions although there often is a tendency in one direction or the other. The receptacles in all species of *Euthamia,* in addition to being deeply alveolate, are to a greater or lesser degree also fimbrillate, in some species only slightly so, but usually very conspicuously. The phyllaries are characterized by the presence of colleters (and are thereby often glutinous) and by the *Euthamia* type of the whip-trichomes previously discussed. The colleters are generally restricted to the upper 1/3 of the phyllaries, but in *E. tenuifolia* they most often extend the entire length. Whereas on the leaves they sit in tiny depressions, the colleters on the phyllaries can often be seen as small, granular, whitish bumps. The whip-trichomes are conspicuously located on the margins at the tips of the phyllaries. Variously shaped, simple, unseriate trichomes similar to those found on the leaves are also often interspersed with the whip hairs. As pointed out by Kapoor and Beaudry (1966), the stamen filaments in *Euthamia* join the inside of the corolla at the junction of the tube and the limb.

SYSTEMATIC TREATMENT

Generic Synonomy and Description

Euthamia (Nuttall) Nuttall, Trans. Amer. Phil. Soc. n.s. Vol. 7. 1841.

Basionym: *Solidago,* subgenus *Euthamia.* Nuttall, 1818. TYPE SPECIES: *Euthamia tenuifolia* (Pursh) Nuttall. Nuttall (1818) 162; Elliott (1824) 391; Britton (1901) 942; Greene (1902) 72; Small (1903) 1189, (1933) 1360; Rydberg (1906) 349, (1917) 872; Britton & Brown (1913) 398; Wooton & Standley (1915) 667; Bush (1918) 158; Friesner (1933) 57; Harris (1943) 413; Shinners (1951) 137.

Aster Linnaeus, Sp. Pl. 872 (1753) in part.
Chrysocoma Linnaeus, Sp. pl. 840 (1753) in part.
Solidago Linnaeus, Sp. Pl. 878 (1753) in part.

Erect perennial herbs spreading by means of fibrous-rooted rhizomes, the above-ground stems often woody at the base. Plants glandular, often viscid, aromatic when crushed, the glandular trichomes biseriate, sessile. Sap watery. Leaves very uniform, alternate, sessile, entire, glandular-punctate, mostly linear to linear-lanceolate, glabrous or pubescent. Stems and branches nearly terete, striate-angled, glabrous or pubescent. Entomophilous; the heads with both ligulate and tubular florets, borne corymbosely either sessile, subsessile, or pedunculate in small glomerules at the tips of stems and branches; phyllaries imbricate in 3 to 5 series, the inner narrower and longer than the outer, green-tipped or the pigment absent, one-nerved, the tips obtuse, acute, or acuminate. Receptacle alveolate, variously fimbrillate. Ray florets pistillate, fertile, usually more numerous than the disc florets; corolla yellow, variously lobed and veined, divided into a terminal limb and a basal tube; style branches 2, the stigmatic papillae marginal with blunt tips; pappus of nearly equal capillary bristles, nearly as long as the corolla. Disc florets perfect, fertile; corolla yellow, 5-lobed, with comissural veins, the terminal limb often constricted conspicuously into the lower tube; stamens 5, the filaments epipetalous at the junction of the tube and limb, not connate; anthers connivent, without long tails, the terminal appendage deltoid; style branches 2, linear, obtuse, spreading at maturity, the collecting hairs terminal and median on the outer surface, extending down between the marginal, blunt, stigmatic papillae; pappus of nearly equal capillary bristles, nearly as long as the corolla. Mature ovaries pubescent, variously veined, sometimes extended into a basal tubercle, nearly terete, widest at or above the middle. Pollen spheroidal, echinate, the spines short, 3-pored.

Basic chromosome number, $x = 9$, the majority of the species are diploids ($n = 9$), although $n = 18$ and $n = 27$ are known.

Entirely North American, including mostly non-weedy species of dry to wet habitats.

The name *Euthamia* was derived from the Greek (*eu-*, well, and -*thamees,* crowded) by Nuttall "...in allusion to the crowding of the flowers."

KEY TO THE SPECIES OF *EUTHAMIA*

1. Heads 10–20 flowered, some or more often all of them pedunculate; involucres turbinate or campanulate, if campanulate then the leaves less than 4 mm wide and with numerous axillary fascicles, 3–6 mm high; leaves 1–5 nerved, firm or lax, deflexed, diverging or ascending. .... 2.
  2. Leaves usually less than 3 mm wide, 1–3 nerved, lax, either deflexed or ascending, conspicuously punctate and often viscid, never pustulate; axillary fascicles numerous or absent; involucres turbinate or campanulate; coastal plain species. .... 3.
    3. Axillary fascicles numerous; cauline leaves usually very lax and conspicuously deflexed; involucres 3–5 mm high;

inflorescence often storied and dome-like, usually less than 1/3 of the height of the plant; wide distribution. .... *E. tenuifolia*

3. Axillary fascicles absent; cauline leaves not conspicuously deflexed; involucres 5–6 mm high; inflorescence irregular to nearly flat-topped, not uniformly dome-shaped, usually nearly 1/2 the height of the plant with several, very strict, woody branches; Texas. .... *E. pulverulenta*

2. Leaves usually more than 3 mm wide, 3–5 nerved, firm, diverging or ascending, either conspicuously punctate and viscid or pustulate; axillary fascicles essentially absent; involucres turbinate; species of the coastal plain and midwestern interior. .... 4.

4. Involucres 3–5 mm high; leaves usually conspicuously darkly glandular-punctate and occasionally pustulate, if pustulate then also pubescent in the axils and on the veins; eastern coastal plain species. .... *E. hirtipes*

4. Involucres 4–6 mm high; leaves either epustulate and strongly punctate or conspicuously pustulate and appearing to lack punctae, if pustulate then very glabrous; southern coastal plain and midwestern species. ..... 5.

5. Leaves pustulate, appearing translucently punctate, not viscid, thin, very smooth, lanceolate; lower Mississippi valley and southeastern Texas. ..... *E. leptocephala*

5. Leaves densely and darkly glandular-punctate, not pustulate or conspicuously translucent-punctate, usually viscid, thick, often pubescent in the axils or on the veins, lance-linear; midwestern prairies and plains. .. .. *E. gymnospermoides*

1. Heads 20–50 flowered, mostly sessile but occasionally pedunculate; involucres campanulate, 3–5 mm high; leaves 3–7 nerved, firm, diverging or ascending. .... 6.

6. Innermost phyllaries obtuse or merely acute, not conspicuously acuminate; inflorescence corymbiform, essentially flat-topped; plants glabrous or pubescent, never glaucous; northern and eastern species. .... 7.

7. Disc flowers usually less than 12, always less than the number of rays; heads narrowly campanulate; plants glabrous to pubescent, usually not viscid, to 15 dm in height; stem simple to near summit or well-branched;

widely distributed. .... *E. graminifolia*

7. Disc flowers usually more than 12, often more than the number of rays; heads broadly campanulate; plants very glabrous, often viscid, to 8 dm in height; stem simple to near the summit with a small inflorescence; Nova Scotia. .... *E. galetorum*

6. Innermost phyllaries acuminate; inflorescence paniculate, interrupted; plants glabrous and often glaucous; western species. .... *E. occidentalis*

TAXONOMIC TREATMENT OF SPECIES

1. **Euthamia galetorum** Greene. Leafl. Bot. Obs. and Crit. **2**: 152. 1911. Type: margin of Lake Pleasant, near Springfield, Nova Scotia, *E. L. Greene, August 8, 1910.* (ND-G 59!).

Solidago tenuifolia (Pursh) Nuttall var. *pycnocephala* Fernald. Rhodora **23**: 293. 1922. Type: Wet lower peaty and cobbly beach of Salmon (Greenville) Lake, Yarmouth County, Nova Scotia, *M. L. Fernald, C. H. Bissell, C. B. Graves, R. Long, and D. H. Linden 22743,* August 13, 1920. (GH!).

Solidago graminifolia (L.) Salisb. var. *galetora* (Greene) House, Bull. N. Y. State Museum 243–244: 45. 1923.

Solidago galetorum (Greene) Friesner, Butler Univ. Bot. Studies **3**, no. 1: 58. 1933.

Euthamia graminifolia (L.) Nutt. *galetorum* (Greene) Friesner, Butler Univ. Bot. Studies **3**, no. 1: 58. 1933.

Erect perennial from branched creeping rhizomes, to 8 dm in height. Stem glabrous, terete or nearly so, striate-angled, branched near the summit. Cauline leaves alternate, sessile, entire, linear, tips obtuse to short acute, to 6 cm long and 5 mm wide, 3–5 nerved, glabrous, margins scabrous, axillary fascicles absent or if present not numerous, punctae often conspicuous. Inflorescence small, compact, terminal, usually less than 10 cm broad, branches glabrous. Heads glomerulate. Involucre campanulate, 3–4 mm high. Phyllaries wide, one-nerved, the outer broadly ovate, obtuse, green-tipped, the inner linear, obtuse to acute, with or without green tips. Flowers 20–50, the discs usually equal to or a few more than the rays. Achenes about 1 mm long, pubescent. Receptacle alveolate, only slightly fimbrillate.

FLOWERING: July to October.

CHROMOSOME NUMBER: Unknown.

DISTRIBUTION: Lake shores of southern Nova Scotia.

Euthamia galetorum appears to be most closely allied to *E. graminifolia*, although it has frequently been treated as a variety of *E. tenuifolia* (Fernald, 1950). It is readily separated from the latter species by its large numbers of flowers, especially disc, its wider, ascending leaves, and the absence of axillary fascicles. In its gross morphology *E. galetorum* most closely approaches the wide, bluntish-leaved variety of *E. graminifolia*, variety *major*. Collections of this variety from open sites such as lake shores, which is where most of the *E. galetorum* collections have been made, bear a striking resemblance to the latter species. *Euthamia galetorum* appears to be restricted to Nova Scotia and its consistently large number of disc flowers correlated with very broad heads, often viscid leaves, and the strict habit, seems to separate *E. galetorum* from the Nova Scotian representatives of *E. graminifolia*.

This is a pretty species, often with shining leaves, the type specimens found by Greene "growing among sundews and bog violets, bordering thickets of sweet gale." It is seemingly restricted to Nova Scotia and most of the specimens have been collected along the cobbly and boggy shores and beaches of lakes in the southern half.

2. **Euthamia graminifolia** (L.) Nuttall, Trans. Amer. Phil. Soc. **II**, 7: 326. 1840.

Erect perennial from branched creeping rhizomes, up to 1.5 meters in height. Stem nearly glabrous to densely hirtellous, terete or nearly so, striate-angled, branched in the upper fourth. Cauline leaves alternate, to 13 cm long and 12 mm wide, 3–5 nerved depending on width, with merely scabrous to scabrous-ciliolate margins, nearly glabrous with only a few scattered hairs on the upper midrib in the axils to densely spreading hirtellous on both surfaces, axillary fascicles absent, or if present not numerous, punctae inconspicuous, the plants usually not strongly glutinous. Inflorescence short, flat-topped or slightly rounded, nearly as long as broad, the branches nearly glabrous to densely pubescent, and, except in reduced forms, not all reaching the summit thus giving the inflorescence an irregular, interrupted appearance. Heads mostly densely glomerate. Involucre campanulate, 3–5 mm high. Phyllaries yellowish, 1-nerved, the outer ovate, obtuse, usually green-tipped, the inner oblong, obtuse to broadly acute, with or without green tips. Ray flowers 11–35, usually 17–22. Disc flowers 4–13, usually 5–7. Achenes about 1 mm long, pubescent. Receptacle alveolate, weakly to moderately fimbrillate.

COMMON NAMES: Creeping Yellow Weed, Nuttall's Goldenrod, Lance-leaved Goldenrod, Bushy Goldenrod, Flat-topped Goldenrod, Fragrant Goldenrod, Lance-leaf Euthamia, Grass-leaved Goldenrod, Flat-topped Hairy Goldenrod, Narrow-leaved Goldenrod.

FLOWERING: July to October.

CHROMOSOME NUMBER: $2n = 9$, Beaudry and Chabot (1959), Solbrig, et al. (1964), Sieren (1971); $2n = 18$, Beaudry and Chabot (1959), Beaudry (1963), Kapoor and Beaudry (1966).

DISTRIBUTION: Common in moist places from Newfoundland across Canada to southern British Columbia, south in the Rocky Mountains possibly to New Mexico; south in the eastern United States to Virginia, west to Illinois and the Black Hills of South Dakota.

Euthamia graminifolia is the most variable species in the genus. Although many more segregates have been proposed in the past, only 3 stand out with any distinctness.

Euthamia graminifolia var. *graminifolia* is the acute to attenuate, narrow-leaved, nearly glabrous form which extends in a wide band through the middle of the range from the Dakotas to Nova Scotia. It intergrades on its southern side with the pubescent extreme of the species, variety *nuttallii*, and on its northern and western sides with the wider, bluntish-leaved variety *major*. The varieties are most difficult to sort out in the east where they seem to blend almost imperceptibly. In the west, they are more distinct. Variety *major* overarches variety *graminifolia* and extends into western Canada and the Dakotas and down the length of the Rocky Mountains possibly to New Mexico, although I have seen specimens only from as far south as east-central Utah. Variety *nuttallii* does not extend as far west as variety *graminifolia*, but is the only representative of the species in Illinois and Indiana, except in the far northern countries and around Lake Michigan.

As previously mentioned, the varieties, especially *graminifolia* and *nuttallii*, are nicely intergraded in the east, and often grow in the same areas with all intermediates. Because of these intermediates, it is often difficult to apply the formal varietal names. When Greene (1902) named *Euthamia nuttallii,* he had in mind robust, hispidly-hirtellous plants like those from the District of Columbia, the type locality. This concept has since been gradually broadened to include smaller, narrower-leaved plants if they appear at all pubescent, and only the most glabrous specimens are set aside to be included in variety *graminifolia.* Pubescence, and also the presence or absence of chlorophyll at the phyllary tips, have been overemphasized in the species as useful characters for distinguishing segregates. Every specimen of *E. graminifolia* I have seen has at least a few hairs, and the amount of pubescence varies not only from plant to plant, but also from one part of the plant to another, usually increasing from the base to the apex. These characters can be useful, however, in characterizing the species in relation to other closely related taxa.

The species varies considerably in habit. Variety *nuttallii, sensu* Green, is usually very tall (sometimes to 5 feet), and fully branched, although the inflorescence is usually less than one-third the height of the plant. Varieties *graminifolia* and *major* vary with the habitat. Those plants growing in open sites such as lake shores and roadside ditches are usually of a stricter habit with a smaller inflorescence than are those found in more closed sites. Several specimens of variety *major* bear a striking resemblance to the blunt-leaved *E. galetorum,* a species collected most often from lake shores in Nova Scotia. The relationships between these two species warrant further study.

Euthamia graminifolia is characterized by 20- to 50-flowered heads, but even on one plant the number is often very erratic. In variety *nuttallii,* the number of flowers decreases slightly moving from the eastern part of the range to the western and there are indications that this is true of the other two varieties also.

The species as a whole is not conspicuously punctate, although this too is variable, and it is often difficult to see the punctae at all.

Both variety *graminifolia* and variety *nuttallii* have a haploid chromosome number of 9. It is unknown for variety *major.*

The nearly glabrous forms of *Euthamia graminifolia* bear a close resemblance to *E. gymnospermoides,* especially when they are fully branched. The two taxa are distinct, however, and the differences are discussed under the latter species.

Euthamia graminifolia, more so than any of the other species in the genus, is moisture-loving; so much so that it was included by

Fassett (1957) in his *Manual of Aquatic Plants* as occurring commonly on wet shores of lakes and streams and occasionally in shallow water.

2a. **Euthamia graminifolia** var. **graminifolia**

Chrysocoma graminifolia Linnaeus, Sp. Pl. 841. 1753. TYPE: "Habitat in Canada. Kalm." (S; photocopy WNC!)

Solidago lanceolata Linnaeus, Mantissa 114. 1767. TYPE: "Habitat in America septentrionali. Royen 80." (LINN; photo GH!).

Solidago graminifolia (Linnaeus) Salisbury, Prodomus 109. 1796.

Aster graminifolius (L.) Kuntze, Revisio Generum Plantarum **1**: 316. 1891.

Solidago graminifolia (L.) Salisb. var. *typica* Rosendahl & Cronquist, Amer. Midl. Nat. **33**: 253. 1945.

Solidago graminifolia (L.) Salisb. var *graminifolia* forma *bulbipara* LePage, Nat. Canad. **88**:52. 1961. A form with bulbils in the axils of the leaves. TYPE: Ontario, on the Kenogami River, 14 miles above Mammamatawa, *Dutilly and LePage 38343*, August 3, 1960. (CAN!)

2b. **Euthamia graminifolia** var. **major** (Michaux) Moldenke, Phytologia **12**: 478. 1966.

Solidago lanceolata Linnaeus α *major* Michaux, Fl. Bor. Am. **2**: 116. 1803. TYPE: "in Canada." Type specimen not designated.

Euthamia camporum Greene var. *tricostata* Lunell, Amer. Midl. Nat. **2**: 59-60. 1911. TYPE: North Dakota, Leeds, Benson Co., *Lunell, August 23, 1898.* (MIN!).

Solidago graminifolia (L.) Salisb. var. *septentrionalis* Fernald, Rhodora **17**: 12. 1915. TYPE: "--Newfoundland; . . .Quebec. . ." Type specimen not designated.

Euthamia bracteata Bush, Amer. Midl. Nat. **5**: 172. 1918. TYPE: Colorado, Canon City, *T. S. Brandegee B532, 3072.* 1872. (Probably MO)

Solidago bracteata Bush, Amer. Midl. Nat. **5**: 173. 1918.

Solidago camporum (Greene) Fedde var. *tricostata* (Lunell) Fedde, Justs. Bot. Jahresb. **41**. Abt. 2: 144. 1918.

Solidago graminifolia (L.) Salisb. var. *Grahami* Rousseau, Nat. Canad. **69**: 107. 1942. TYPE: Quebec: Ile d'Anticosti, sur la berge du ruisseau McGilvray (entre la rivière á La Loutre et la rivière Jupiter) avec *Solidago anticostensis.* 27 août 1940. *Rousseau 51456A.* (MTJB, not seen)

Solidago graminifolia (L.) Salisb. var. *tricostata* (Lunell) Harris, Rhodora **45**: 413. 1943.

Solidago graminifolia (L.) Salisb. var. *major* (Michaux) Fernald, Rhodora **46**: 330. 1944.

Solidago graminifolia (L.) Salisb. var. *major* (Michaux) Fernald forma *gemmans* LePage, Nat. Canad. **81**: 260. 1954. A form which produces bulbils in the axils of the leaves. Suggested by LePage to be a result of less than adequate light necessary to produce mature fruits and as a means of insuring perpetuation by vegetative means. TYPE: along the Albany River, *Dutilly and LePage 30387,* August 12, 1952. (CAN!)

Extending across the northern portion of the range of *E. graminifolia*, this variety differs from the typical variety in having wider and blunter leaves. In the western parts of its range, where it is most distinct, in the Dakotas, western Canada, and in the Rockies, the leaves become quite short in relation to their width. The other morphological characters are not significantly different from those of variety *graminifolia.*

2c. **Euthamia graminifolia** var. **nuttallii** (Greene) W. Stone, Pl. So. New Jersey 752. 1912.

Euthamia nuttallii Greene, Pittonia, **5**: 73. 1902. TYPE: District of Columbia, near Chevy Chase, *E. L. Greene, September 15, 1902.* Lectotype designated by L. H. Shinners in 1946. (ND-G 53!).

Euthamia floribunda Greene, Pittonia **5**:74. 1902. TYPE: "marshes of Delaware Bay at Port Norris in southern New Jersey, in 1890, by J. H. Holmes." (US!).

Euthamia hirtella Greene, Leafl. Bot. Obs. and Crit. 1: 180 181. 1906. Bush (1918). 160. TYPE: Indiana, Lakeville, *E. L. Greene, September 29, 1903.* Lectotype designated by L. H. Shinners in 1946. (ND-G 50!).

Solidago graminifolia (L.) Salisb. var. *nuttallii* (Greene) Fernald, Rhodora **10**: 92. 1908.

Solidago polycephala Fernald, Rhodora **10**: 93. 1908. TYPE: *Euthamia floribunda* Greene, non *S. floribunda* Phil., Anal. Univ. Chile **87**: 430. 1894.

Solidago graminifolia (L.). Salisb. var *polycephala* (Fernald) Fernald, Rhodora **17**: 12. 1915.

Solidago hirtella (Greene) Bush, Amer. Midl. Nat. **5**: 160. 1918.

Euthamia fastigiata Bush, Amer. Midl. Nat. **5**: 164. 1918. TYPE: Biltmore, North Carolina, sandy bottoms along the French Broad River, Biltmore Herbarium 993b, August 23rd, 1897. (NY 75054! isotypes, ILL! ND-G!; paratypes, ND! GH!).

Solidago floribunda (Greene) Bush, Amer. Midl. Nat. **5**: 167. 1918, non *S. floribunda* Phil., Anal. Univ. Chile **87**: 430. 1894.

Solidago fastigiata Bush, Amer. Midl. Nat. **5**: 164. 1918.

Solidago nuttallii (Greene) Bush, Amer. Midl. Nat. **5**: 168. 1918.

This variety can usually be distinguished from variety *graminifolia* by its hispidly-hirtellous leaves and branches with the most typical specimens observed from Illinois, Indiana, Ohio, and the District of Columbia. In addition, the plants of variety *nuttallii* often are more robust and have larger leaves than variety *graminifolia.*

3. **Euthamia gymnospermoides** Greene, Pittonia **5**: 75. 1902. TYPE: Sapulpa, Indian Territory, *B. F. Bush 252,* October 6, 1894. (ND-G 48!; isotype, GH!).

Euthamia media Greene, Pittonia **5**: 74. 1902. TYPE: Banks of the Mississippi at Oquawka, Illinois, *Harry N. Patterson, 1876.* (ND-G 58!)

Euthamia camporum Greene, Pittonia **5**: 74. 1902. TYPE: Banks of the Platte, at Sterling, Colorado, *Edw. L. Greene, 1896.* (ND-G 57!).

Euthamia chrysothamnoides Greene, Pittonia **5**: 76. 1902. TYPE: Prescott, Arkansas, *25 Aug., 1882, G. W. Letterman.* (US!).

Euthamia remota Greene, Pittonia **5**: 78. 1902. TYPE: "rolling prairie country about Lake Michigan, not rare from northern Indiana to southern Wisconsin,". Type specimen not designated.

Solidago moseleyi Fernald, Rhodora **10**: 93. 1908. TYPE: Ohio, Oxford Prarie, Erie Co., *September 5, 1898, E. L. Moseley.* (Location not known).

Solidago gymnospermoides (Greene) Fernald, Rhodora **10**: 93. 1908.

Solidago camporum (Greene) A. Nelson, Coult. & Nels. Man. Bot. Rocky Mts. 507. 1909.

Solidago graminifolia (L.) Salisb. var. *camporum* (Greene) Fernald, Rhodora **17**: 12. 1915.

Solidago media (Greene) Bush, Amer. Midl. Nat. **5**: 167. 1918.

Solidago chrysothamnoides (Greene) Bush, Amer. Midl. Nat. **5**: 172. 1918.

Euthamia glutinosa Rydberg. Brittonia **1**: 102. 1931. TYPE: Kansas, Belvidere, *September 15, 1897, L. F. Ward* (NY!)

Solidago perglabra Friesner, Butler Univ. Bot. Studies **3**, no. 1: 61. 1933. TYPE: dry bank at east end of Mink Lake, four miles north of Valparaiso, Porter Co., Indiana, *R. C. Friesner 3542,* September 5, 1931. (BUT; photo, GH!).

Solidago graminifolia (L.) Salisb. var. *media* (Greene) S. K. Harris, Rhodora **45**: 413. 1943.

Solidago graminifolia (L.) Salisb. var *remota* (Greene) S. K. Harris, Rhodora **45**: 413. 1943.

Erect perennial from branched creeping rhizomes, up to 1 meter in height. Stem glabrous or with scabrous lines, terete or nearly so, striate-angled, branched one-third to one-half way down. Cauline leaves alternate, sessile, entire, narrowly linear-lanceolate, short to long-attenuate, to 12 cm long and 8 mm wide, 3–5 nerved, margins scabrous, nearly glabrous, often with scattered short hairs on the veins or in the axils, axillary fascicles absent or, if present, not numerous, punctae generally easily seen and quite often very conspicuous, plants often strongly glutinous. Inflorescence V-shaped, flat-topped to slightly rounded, branches glabrous or with scabrous lines. Heads numerous, glomerate or more often partly or wholly pedunculate. Involucre turbinate, often strongly glutinous, 4–6 mm high. Phyllaries straw-colored, one-nerved, often green-tipped, the outer ovate, obtuse to acute, the inner linear-oblong, obtuse to acute. Ray flowers 9–13. Disc flowers 3–9, 3.0–5.0 mm long. Achenes about 1 mm long, pubescent. Receptacle alveolate, moderately to very strongly fimbrillate.

COMMON NAME: Viscid Euthamia.

FLOWERING: August to October.

CHROMOSOME NUMBER: $n = 18$, Sieren (1971).

DISTRIBUTION: Plants of high plains and moist roadside priaries from the Texas Panhandle and Oklahoma to Colorado, north and east to southern Michigan, Ohio, Indiana, Illinois, and Missouri.

Euthamia gymnospermoides, E. media, E. camporum, and *E. remota* were all described by E. L. Greene in 1902; *E. camporum* from northeastern Colorado, *E. media* from western Illinois, *E. gymnospermoides* from what is now Sapulpa, Oklahoma, and *E. remota* from around the southern end of Lake Michigan. Most recently, *E. camporum* has been included in *E. graminifolia* as a variety (Harrington, 1954; Fernald, 1950) as has *E. media;* in addition, *E. media* has been treated as a separate species (Deam, 1940; Jones, 1963) and *E. remota* was placed in synonomy with *E. media* (Jones, 1963). *Euthamia gymnospermoides* is the name most often recognized as the correct one for the common species of the prairies from Texas and Oklahoma to Wisconsin and South Dakota (Fernald, 1950; Gleason, 1952), although Shinners (1951) suggested that what has been called *E. gymnospermoides* is really *E. camporum,* and *E. gymnospermoides* might be a restricted endemic of central Oklahoma.

In an attempt to clarify the situation, specimens from the 12 state area involved were sampled for 23 character states, using especially those that had been traditionally used to distinguish the species, and, in addition, searching for new ones which might show some positive correlation. Some of these, after a time, were determined to be more or less non-variable (for example, achene length) or extremely variable even in a single head (such as ray floret length) and the measuring of these was to a large extent discontinued. The examinations failed to produce any characters that could be used to separate the taxa specifically, but rather indicate that *E. camporum, E. media, E. gymnospermoides* and *E. remota* are at this time best treated as con-specific.

They did, however, point out several morphological trends which occur over the range of the species.

Moving west and southwest from Illinois and Wisconsin, the leaves tend to become somewhat thicker, a little narrower, and more glutinous, and the punctae more distinct, possibly in response to the decreasing rainfall.

The height of the receptacle fimbrillae is more or less sporadic throughout the range, although it too tends to increase moving toward the southwest, and the most strongly fimbrillate receptacles were observed on specimens from Oklahoma.

Involucre height, one of the characters often used to distinguish the taxa *media* and *gymnospermoides*, also to a certain extent was sporadic, but in general the shorter involucres were found in the east and they increased in height toward the western part of the range.

In general, the length of the flowers, both ray and disc, varied with the height of the involucre, the shorter involucres surrounding shorter flowers, although even within a single head the lengths of the ray flowers were extremely variable.

Although most of the achenes examined were immature, length and pubescence did not seem to be significantly variable.

There also is no significant trend in flower number, with most counts falling between 15 and 20 per head, this narrow range not allowing for much of a trend in any event.

It was interesting to note that as flower length increased moving west, the tubes of the disc corollas remained relatively constant, and it was the limbs that varied in length.

Euthamia gymnospermoides closely resembles the glabrous form of *E. graminifolia* and the two species are often difficult to distinguish in those areas where they are in contact, in particular southern Minnesota, Wisconsin, and Michigan. As part of the sampling studies involving *E. gymnospermoides* special attention was paid to specimens of *E. graminifolia* and *E. gymnospermoides* north and south of the Tension Zone in Minnesota and Wisconsin. The Tension Zone as it extends from northwest to southeast through these states is that region which contains the northernmost localities for many species which are a part of the Prairie element, and the southernmost localities for many species which are a part of the Boreal element (Curtis, 1959). The Tension Zone thus includes species from both elements.

That differences exist in the Euthamias north and south of the Tension Zone has long been recognized. In most instances, the glabrous plants in Illinois and Indiana have been treated as either *E. graminifolia* var. *media* (Fernald, 1950), or *E. media* (Jones, 1963),

Table 1. **Comparison of E. graminifolia north of the Tension Zone in Wisconsin and E. gymnospermoides.**

E. graminifolia	*E. gymnospermoides*
1. Haploid chromosome number 9.	1. Haploid chromosome number 18.
2. Number of flowers per head usually more than 20.	2. Number of flowers per head usually less than 20.
3. Stem branched in the upper one fourth.	3. Stem branched in the upper one half to one third.
4. Inflorescence wider and shorter, the width/height ratio averaging 0.87.	4. Inflorescence narrower and longer, the width/height ratio averaging 0.71.
5. Leaf punctae inconspicuous and the plants not obviously glutinous.	5. Leaf punctae conspicuous and the plants often obviously glutinous.
6. Receptacle moderately fimbrillate.	6. Receptacle moderately to strongly fimbrillate.
7. Involucre height 3.0–5.0 mm, averaging about 4.0 mm.	7. Involucre height 4.0–6.0 mm, averaging about 4.5 mm.
8. Heads densely glomerate, pedunculate only when associated heads abort.	8. Heads occasionally glomerate.
9. Disc florets 2.5–3.5 mm long, averaging about 3.0 mm.	9. Disc florets 3.0–5.0 mm long, averaging about 4.0 mm.

intermediate between the more westerly *E. gymnospermoides* and the northern *E. graminifolia* var. *graminifolia*. Rosendahl and Cronquist (1945) chose to consider *E. graminifolia* and *E. gymnospermoides* as intergrading to some extent in the area of the Tension Zone and did not recognize the plants south of that area as a separate taxon. I am in agreement with the latter interpretation.

The significant differences between *E. gymnospermoides* and *E. graminifolia* as indicated by the Wisconsin studies and including the sampling of *E. gymnospermoides* over the 12 state area are given in table 1. Where the two species come in contact in Minnesota, Wisconsin, Michigan and Ohio, the differences are subtle, and often do not hold consistently, but in most cases, the combination of the characters that do hold is enough to allow proper application of the names.

Besides the narrower heads in *E. gymnospermoides*, reflecting the reduced number of flowers, the leaves of that species are narrower, more numerous, and often more strongly ascending. The inflorescence is longer and usually viscid, and is more nearly flat-topped. The inflorescence of *E. graminifolia* is usually somewhat interrupted with not all of the branches reaching the same level at the summit.

It appears that the discernible line of contact between the two species in Wisconsin lies just slightly south—perhaps 50 miles—of the Tension Zone as indicated in the maps of Wisconsin in the paper by Salamun (1965). This may be related to a greater adaptability of *Euthamia graminifolia* which is found in a wider variety of habitats than is *E. gymnospermoides.*

4. **Euthamia hirtipes** (Fernald) Sieren, Phytologia **23**: 304. 1972.

× *Solidago hirtipes* Fernald, Rhodora **48**: 65. 1946. TYPE: Sussex Co., Virginia: roadside thicket about 1½ miles north of Waverly, September 13, 1945, *Fernald & Long 15015* (GH!); isotype (PH).

Erect perennial from branched creeping rhizomes, up to 1.5 meters in height. Stem glabrous to hirtellous, terete or nearly so, striate-angled, branched at or above the middle. Cauline leaves alternate, sessile, entire, linear-lanceolate, acute to acuminate, to 8 cm long and 5 mm wide, 3–5 nerved, margins scabrous, nearly glabrous to sparsely hirtellous, especially on the veins, axillary fascicles absent or if present not numerous, punctae usually conspicuous, the surfaces sometimes slightly pustulate. Inflorescence v-shaped with few to several strongly ascending branches, essentially flat-topped, occasionally somewhat storied, usually longer than broad, branches glabrous to pubescent. Heads numerous, mostly pedunculate. Involucres turbinate, glutinous, 3–5 mm high. Phyllaries straw-colored, 1-nerved, the outer ovate, obtuse, usually green-tipped; the inner oblong, obtuse to broadly acute, with or without green tips. Ray flowers usually 7–12. Disc flowers usually 3–5. Achenes about 1 mm long, pubescent. Receptacle alveolate, moderately to strongly fimbrillate.

FLOWERING: October

CHROMOSOME NUMBER: $2n = 54$, Sieren and Merritt (1980).

DISTRIBUTION: On the coastal plain from southeastern Virginia to southeastern South Carolina.

Euthamia hirtipes was first proposed by Fernald to be the result of hybridization between *E. graminifolia* and *E. microcephala* (part of *E. tenuifolia* as here understood) inasmuch as it is morphologically intermediate between the two and the ranges of the proposed parents would allow it. Fernald suggested at that time that it might eventually be recognized as a fully established species with a greater range than that of the type population. Several specimens have been since collected from the Carolinas which bear strong resemblance to the type. Most of the specimens have been referred to either *E. tenuifolia* or *E. leptocephala* and were most probably the basis of the extension of the range of *E. leptocephala* from the lower Mississippi valley east to the Carolinas. *Euthamia tenuifolia* and *E. microcephala* were often distinguished on the basis of leaf width, *E. tenuifolia* having slightly wider leaves, which probably accounts for most of the specimens being named *E. tenuifolia.*

Specimens of *Euthamia hirtipes* from further south in the range differ from the type in that they tend to be less pubescent and to have the leaves more strongly ascending. It may be that further studies will provide evidence for segregating the type population and the more southerly individuals as distinct species; for the present, however, their similarities seem to justify maintaining them as one.

Pollen goodness tests and mature achenes indicate a high degree of fertility in the species. In addition, there seems to be no conspicuous intergradation between it and either *Euthamia graminolia* or *E. tenuifolia;* thus the species seems clearly defined.

The question of the range extension of *Euthamia leptocephala* and its relation to *E. hirtipes* is further discussed with the treatment of the former species.

5. **Euthamia leptocephala** (Torrey & Gray) Greene, Mem. Torrey Bot. Club **5**: 321. 1894.

Solidago leptocephala Torrey & Gray, Fl. N. Am. 2: 226. 1842. TYPE: "Western Louisiana, *Dr. Leavenworth! Dr. Hale!* Texas, *Drummond;*" The collection from Louisiana by Leavenworth has been designated as the lectotype. (Lectotype, GH!; syntype, GH!).

Erect perennial from branched creeping rhizomes, up to 1 meter in height. Stem glabrous, terete or nearly so, striate-angled, branched near the top. Cauline leaves alternate, sessile, entire, lanceolate, short-cuspidate to acute, to 8 cm long although usually shorter, and to 7 mm wide, 3–5 nerved, with scabrous margins, very glabrous, often yellowish-green with a conspicuous midrib, punctae obscure, the surface often pustulate. Inflorescence short, compact, cuneate-rounded, branches glabrous. Heads glomerate or pedunculate in small terminal clusters. Involucres turbinate, 4–6 mm high. Phyllaries whitish-yellow, somewhat viscid, often with green tips, the outer ovate-linear, bluntish, the inner linear, obtuse to sometimes acute. Ray flowers usually 7–14. Disc flowers usually 3–5. Achenes about 1 mm long, pubescent. Receptacle alveolate, moderately to strongly fimbrillate.

COMMON NAME: Western Bushy Goldenrod.

FLOWERING: September to November.

CHROMOSOME NUMBER: Counts made by Beaudry (1963) and Kapoor and Beaudry (1966) indicate that this species has a diploid chromosome number of 54. The counts were made from specimens collected in Florida and South Carolina, out of the range of the species as here understood.

DISTRIBUTION: A species of the lower Mississippi valley, ranging from southeastern Texas to Arkansas, southeastern Missouri, extreme southern Illinois, western Tennessee and Kentucky, Mississippi and Louisiana in wet flats, low wet fields, glades, edges of woods and other moist places.

Euthamia leptocephala is most easily recognized by its very smooth, often pustulate leaves. It most closely resembles *E. hirtipes* of the east coast which differs from *E. leptocephala* in being conspicuously punctate and more pubescent, usually having at least a row of hairs on the upper midrib. The leaves of *E. hirtipes* may be slightly pustulate, which probably accounts for some of the confusion regarding the two species. Fernald (1950) extended the range of *E. leptocephala* to the Carolinas, probably basing his decision on Gray Herbarium specimens of *E. hirtipes* which were collected in North Carolina. As here understood, the ranges of the two are distinct. They are, however, very similar morphologically and if additional material presents a continuous range correlated with normal range variation in the distinguishing leaf differences, the two species might, with some justification, be united. The relationships between the two species and, for that matter, the entire southeast complex, warrant further study and until this can be done, it seems preferable to treat the species as separate taxa.

E. leptocephala is typically found growing at low elevations, and according to Palmer and Steyermark (1935), the species, at least in Missouri where it is restricted to the southeastern lowlands, has a decided preference for acid soils.

6. **Euthamia occidentalis** Nuttall, Trans. Am. Phil. Soc. II. 7: 326. 1841. TYPE: "Hab. Banks of the Oregon and Wahlamet, and Lewis' River, in the Rocky Mountains; chiefly on sand and gravel bars, as well as islands." No specimens were cited in Nuttall's original description, but a specimen in the Gray Herbarium collected by Nuttall along the Wahlamet and very probably a part of the original material has been designated as the lectotype. (GH!).

Solidago occidentalis (Nutt.) Torrey & Gray, Fl. N. Am. **2**: 226. 1842.

Aster baccharodes Kuntze, Rev. Gen. Pl. **1**: 316. 1891. TYPE: a new name, the type that of *Euthamia occidentalis* Nuttall.

Euthamia californica Gandoger, Bull. Soc. Bot. Fr. **65**: 41. 1918. TYPE: California, Santa Clara county, Palo Alto, abundant in places on and near the marshes. 2–5 feet. *C. F. Baker 1517*, September 1, 1902. (Isotype, GH!).

Euthamia linarifolia Gandoger, Bull. Soc. Bot. Fr. **65**: 41. 1918. TYPE: Washington, Klickatat county, auf der Niederung Bingen, *William N. Suksdorf 6108*, August 7, 1907. (Isotype, WTU; photo, GH!).

Erect stout perennial from branched creeping rhizomes, up to 2 meters in height. Stem glabrous, terete or nearly so, striate-angled, branched at or above the middle. Cauline leaves alternate, sessile, entire, linear, cuspidate to attenuate, to 10 cm long and 9 mm wide, 3–5 nerved, margins scabrous, often sparsely pubescent on the upper surface in the axils, often with axillary fascicles, punctae not conspicuous. Inflorescence ample, virgate-rounded, narrow, elongate, often interrupted, branches glabrous, leafy-bracted. Heads not densely glomerate, mostly all pedunculate in small cymose clusters. Involucres campanulate, 4 mm high. Phyllaries firm, scarious, prominently 1-nerved, straw-colored, the outer lance-linear, acute, sometimes green-tipped, the inner linear, decidely acute to acuminate. Ray flowers 15–28, usually 17–22, 1.5 to 2.5 mm long. Disc flowers 7–18, usually 9–11. Achenes about 1 mm long, pubescent. Receptacle alveolate, moderately fimbrillate.

COMMON NAME: Western Goldenrod.

FLOWERING: July to November.

CHROMOSOME NUMBER: $2n = 18$, Raven (1960), Beaudry (1963), Kapoor & Beaudry (1966).

DISTRIBUTION: A widely distributed species in marshes, stream beds, river bottoms, lake shores, and other moist ground from southern California north to British Columbia and Alberta, south to Nebraska, New Mexico, and Arizona. Ranging in altitude from the shores of the Pacific to 7500 feet in the southern Rockies. Although several manuals mention Texas, Shinners (1950, in his notes on the Texas Euthamias gave no indication it is found there; until some specimens are forthcoming, Texas should be excluded from its range. Harris (1943) noted that he had seen two collections from just south of the California border.

Euthamia occidentalis is one of the most distinctive species in the genus, and is the only representative of the group in the far west. It is quickly identified by its large size, its paniculate inflorescence, and its very acute to acuminate innermost phyllaries. Its leaves and stems are extremely glabrous and often have a whitish cast.

7. **Euthamia pulverulenta** Greene, Pittonia 5: 75. 1902. TYPE: "from the vicinity of Hockley, southeastern Texas", *F. W. Thurow in 1890.* (US).

Solidago texensis Friesner, Butler Univ. Bot. Studies **4**: 196. 1940. A new name proposed by Friesner because of earlier homonym, *Solidago pulverulenta* Nutt.

Solidago gymnospermoides (Greene) Fernald var. *callosa* Harris, Rhodora **45**: 413. 1943. A new name, the type that of *Euthamia pulverulenta* Greene.

Erect perennial from branched creeping rhizomes, up to 1.5 meters in height. Stem glabrous, terete or nearly so, striate-angled, branched near the middle. Cauline leaves alternate, sessile, entire, narrowly linear, acute, to 7 cm long and 3 mm wide, usually narrower, 1–3 nerved, margins scabrous, glabrous, viscid, axillary fascicles usually absent, strongly punctate. Inflorescence large, usually with several very strict woody, glabrous branches. Heads sometimes sessile, but usually individually stalked. Involucres turbinate, 5–6 mm high. Phyllaries straw-colored, one-nerved, usually green-tipped, the outer ovate, acute or obtuse, the inner linear-oblong, acute or obtuse. Ray flowers 10–11. Disc flowers 5–7. Achenes about 1 mm long, pubescent. Receptacle moderately to strongly fimbrillate.

FLOWERING: October and November
CHROMOSOME NUMBER: Unknown
DISTRIBUTION: Southeastern Texas.

L. H. Shinners in 1951 examined the type of *Euthamia pulverulenta* and pointed out that the species had long been overlooked since its original description. Several specimens have been seen from the general area of the type, and, although they are probably closely related to *E. gymnospermoides,* their narrow leaves and strict woody branches make them distinct enough. The pulverulence after which the species is named is most likely the colleters common on the phyllaries of all of the species of the genus, but which are often obscured by the varnish. Greene (1902) mentioned the number of ray flowers was less than the number of discs in the type specimen, and, although this is apparently the exception rather than the rule, one specimen (Willacy Co., Texas, *B. C. Tharp in 1941,* GH) was seen in which this is the case.

8. **Euthamia tenuifolia** (Pursh) Nuttall, Genera **2**: 162. 1818. TYPE: A specimen (*Pursh,* pine barrens near Dismal Swamp) collected by Pursh on his southern expedition of 1806 has been designated as the lectotype. (PA!).

Solidago lanceolata L. *α minor* Michaux, Fl. Bor. Am. **2**: 116. 1803. TYPE: "foliis crebrioribus, anguste linearibus; axillis foliosis; subglutinosa. Hab. *α*. in pascuis circa Charlstown."

Solidago tenuifolia Pursh, Fl. Amer. **II**: 540. 1814.

Euthamia tenuifolia (Pursh) Nuttall *γ glutinosa* Nuttall, Trans. Am. Phil. Soc. 7: 326. 1841. Said by Nuttall to be distinguished by its very glutinous heads. Type specimen not designated.

Euthamia tenuifolia (Pursh) Nuttall *β microcephala* Nuttall, Trans. Am. Phil. Soc. 7: 326. 1841. Described by Nuttall as having smaller than usual heads. Type specimen not designated.

Solidago caroliniana (L.) B. S. P., Prelim. Cat. N. Y. Pl. 26. 1888. TYPE: Not *Erigeron carolinianum* L., basionym.

Euthamia caroliniana (L.) Greene, Mem. Torrey Bot. Club **5**: 321. 1894. TYPE: Not *Erigeron carolinianum* L., basionym.

Euthamia microcephala Greene, Pittonia **5**: 79. 1902. TYPE: dry field, Leslie, Sumpter Co., Georgia, *Roland M. Harper 594*, September 6, 1900, (US; photo, GH!).

Euthamia microphylla Greene, Pittonia **5**: 79. 1902. TYPE: Ocean Springs, Mississippi, *S. M. Tracy 4751*, October 9, 1898; Apalachicola, Florida, *Dr. Chapman*. Five specimens of *Tracy 4751* have been seen, but none with the date given by Greene for the type. The specimen in the Notre Dame Green Herbarium, however, has "type" written on the label in what appears to be Greene's handwriting and this specimen has been designated as the lectotype. (ND-G 51!; other specimens of *Tracy 4751*: ND-G 52, US, OS!; Chapman GH!).

Euthamia minor Greene, Pittonia **5**: 78. 1902. TYPE: Based on *Solidago lanceolata* L. *α* minor Michaux.

Solidago minor (Greene) Fernald, Rhodora **10**: 13. 1908.

Solidago microphylla (Greene) Bush, Amer. Midl. Nat. **5**: 177. 1918.

Solidago microcephala (Greene) Bush, Amer. Midl. Nat. **5**: 176. 1918.

Solidago michauxii House, Bull. N. Y. State Mus. **254**: 695. 1924. *S. minor* (Greene) Fernald, 1908, *non S. minor* Mill., 1768.

Erect perennial from branched creeping rhizomes, up to 1 meter in height. Stem glabrous, terete or nearly so, striate-angled, branched above the middle. Cauline leaves alternate, sessile, entire, often very narrow, linear, acute, up to 7 cm long and 4 mm wide, 1–3 nerved, with scabrous margins, glabrous or more often hirtellous in the axils or on the veins, axillary fascicles numerous especially in the inflorescence, strongly punctate. Inflorescence flat-topped or rounded with the heads then somewhat storied, branches nearly glabrous or the uppermost hirtellous. Heads sessile or more often pedunculate. Involucres campanulate to turbinate, 3–5 mm high. Phyllaries pale straw-colored, one-nerved, usually more or less green-tipped, the outer ovate, acute to obtuse, the inner oblong-linear, acute or obtuse. Ray flowers 7–15. Disc flowers 3–9. Achenes about 1 mm long, pubescent. Receptacle moderately to strongly fimbrillate.

COMMON NAMES: Slender Goldenrod, Narrow-leaved Bushy Goldenrod, Slender Fragrant Goldenrod, Quobsque Weed, Narrow-leaf Euthamia.

FLOWERING: August to December

CHROMOSOME NUMBER: $2n = 18$, Beaudry and Chabot (1959), Beaudry (1963), Kapoor and Beaudry (1966), Sieren and Merritt (1980).

DISTRIBUTION: Found in moist or dry sandy soil on the coastal plain from southeastern Maine south to Florida and west to

Louisiana. The species is best developed in the Carolinas, Georgia, and Florida.

Euthamia tenuifolia is readily distinguished from the other species in the genus by its very narrow, usually reflexed leaves, its numerous axillary fascicles, and its small numbers of flowers. In the northern portion of its range, there is a slight increase in flower number correlated with slightly wider leaves and, at the northern extreme, a stricter habit with a smaller inflorescence. This creates an occasional problem in identification as they are then similar to some specimens of *E. graminifolia* from the same area, but the difficulty is minor, and the two species are very distinct. It was these northernmost specimens which are somewhat intermediate between typical *E. tenuifolia* and *E. galetorum* that previous authors (Harris, 1943; Fernald, 1950) used as the basis for combining the two species. *E. galetorum* has wider, firmer leaves which are never reflexed and many more flowers per head.

In addition to *E. microcephala*, Greene (1902) split off several other segregates from the southeastern portion of the range which do not seem to differ significantly enough to deserve specific rank.

The plants are very often divested of the cauline leaves below the inflorescence by flowering time, leaving only the very narrow rameal leaves with their numerous axillary fascicles subtending narrow, viscid heads. One of the more attractive species in the genus, *E. tenuifolia* has been reported on several herbarium labels to be strongly and pleasantly odoriferous.

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THE *PHYSOSTEGIA PURPUREA-LEPTOPHYLLA-DENTICULATA* PROBLEM: TAXONOMIC AND NOMENCLATURAL CLARIFICATION

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There is much disagreement among floristic works about the taxonomic status of the obtusely-toothed to entire-leaved species of *Physostegia* that occur on the Atlantic and eastern Gulf Coastal Plain from southeastern Virginia to Florida (Figure 1). Ahles (1964) treated the complex as a single species (incorrectly placed in the genus *Dracocephalum*, a name that has been conserved for a different genus), but earlier authors (Elliott, 1816–1824; Small, 1913, 1933; Fernald, 1950) recognized two to three species. The confusion has been compounded by nomenclatural disagreements, at least eight epithets having been applied to members of this complex in major floristic works.

My own studies of the group, undertaken in connection with a systematic study of the genus as a whole, indicate that the complex consists of three species. One of them, *Physostegia godfreyi* Cantino, is easily distinguished and has been discussed elsewhere (Cantino, 1979); it will not be considered here. The other two species, *P. purpurea* (Walter) Blake and *P. leptophylla* Small, overlap somewhat morphologically but differ in habitat requirements and chromosome number. They are nearly to completely reproductively isolated from each other. In the following discussion, systematic and nomenclatural aspects of the problem will be discussed separately.

SYSTEMATICS

Physostegia purpurea and *P. leptophylla* differ in six morphological characters, but in each of these characters the ranges of character states found in the two species overlap. The four most discriminating characters have been plotted on a scatter diagram (Figure 2). Two characters, corolla color and shape of the leaf apex, have been omitted from the diagram.The corollas of *P. purpurea* tend to be a paler pink than those of *P. leptophylla,* but the difference is difficult to quantify, and the interspecific overlap is at

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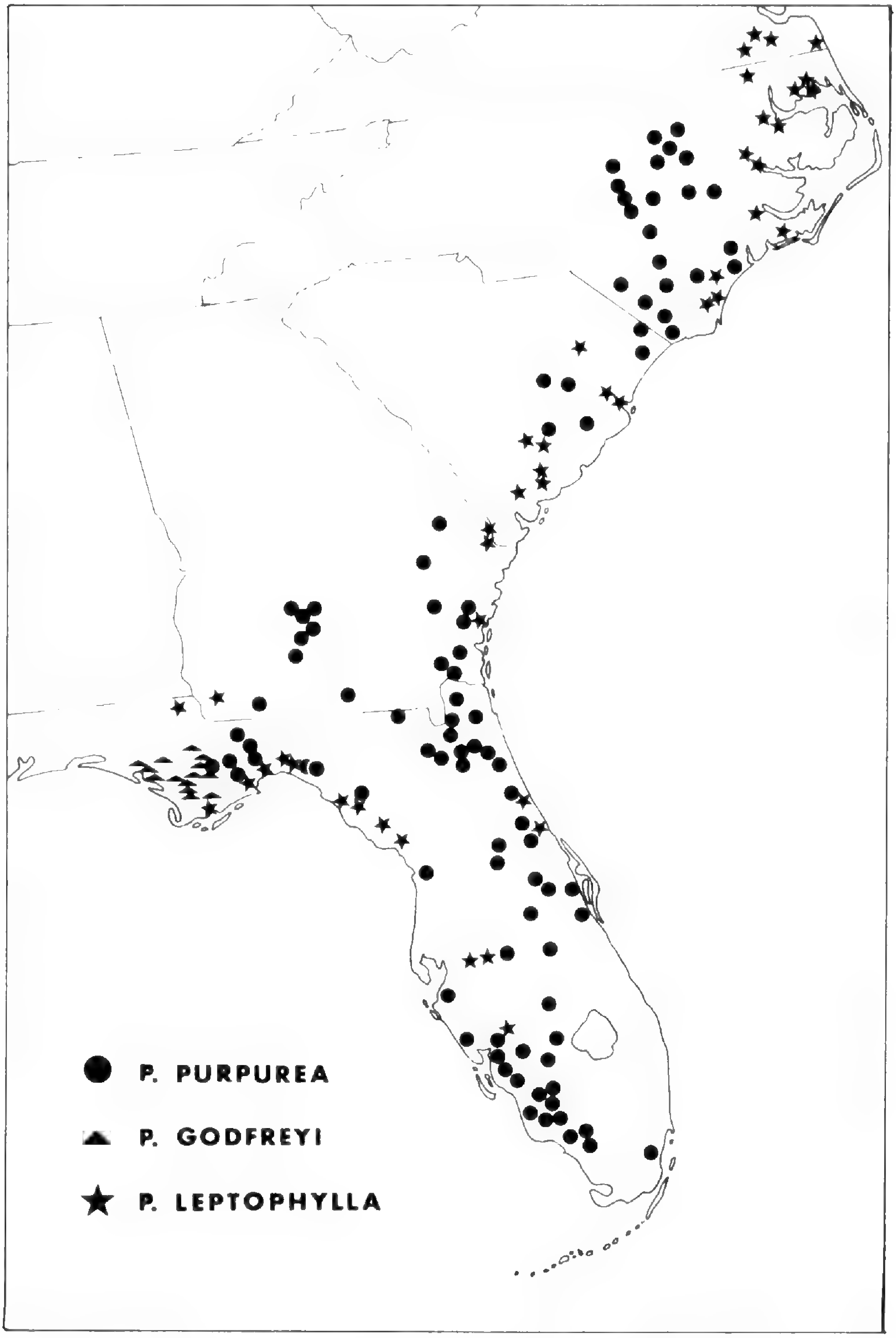

Figure 1. **Distribution of Physostegia purpurea, P. leptophylla, and P. godfreyi.**

least as great as in any of the characters included in Figure 2. The leaf apex, which tends to be obtuse in *P. purpurea* and acute to attenuate in *P. leptophylla,* is a fairly reliable diagnostic character in the northern part of the range of the two species but is of little use in Florida, where the leaves of *P. purpurea* are frequently so narrow that the genes responsible for an obtuse apex cannot be expressed—the leaf apices are automatically acute.

Of the characters included in Figure 2, by far the most discriminating is the degree of reduction of the upper stem leaves (vertical axis), expressed as a ratio of the length of the leaves of the second pair below the terminal receme to the length of the internode directly above them. There is considerably more overlap in the number of lower nodes bearing petiolate leaves (horizontal axis), the form of the rhizome (shading of the circles), and the shape of the leaves (projections from circles). The degree of overlap in the lattermost character is not immediately obvious from the diagram. In 82% of the specimens of *Physostegia purpurea* there is at least one leaf widest above the middle of the blade, versus 13% of the specimens of *P. leptophylla.* In contrast, 62% of the specimens of *P. leptophylla* have at least one leaf widest below the middle of the blade, versus 8% in *P. purpurea.* In spite of the fact that there is interspecific overlap in every character, the data points form two obvious clusters, particularly if the three specimens represented by the points labeled "A" and "B" in Figure 2 are excluded. These three specimens could not be placed in either species on the basis of morphology alone; their identification is discussed below.

The sample of herbarium specimens upon which the scatter diagram was based was not entirely random. The sample of *Physostegia leptophylla* was unbiased (at least to the extent that herbarium specimens ever provide an unbiased sample), in that all of the specimens at my disposal that included the necessary structures were used. However, the sampling of *P. purpurea,* of which a much greater number of specimens was available, was biased towards the inclusion of the widest possible range of variation in the characters of interest. Thus the degree of morphological overlap is exaggerated in Figure 2; the relative frequency of specimens of *P. purpurea* exhibiting one or more character states that can also be found in *P. leptophylla* is somewhat higher than if the sample had been random.

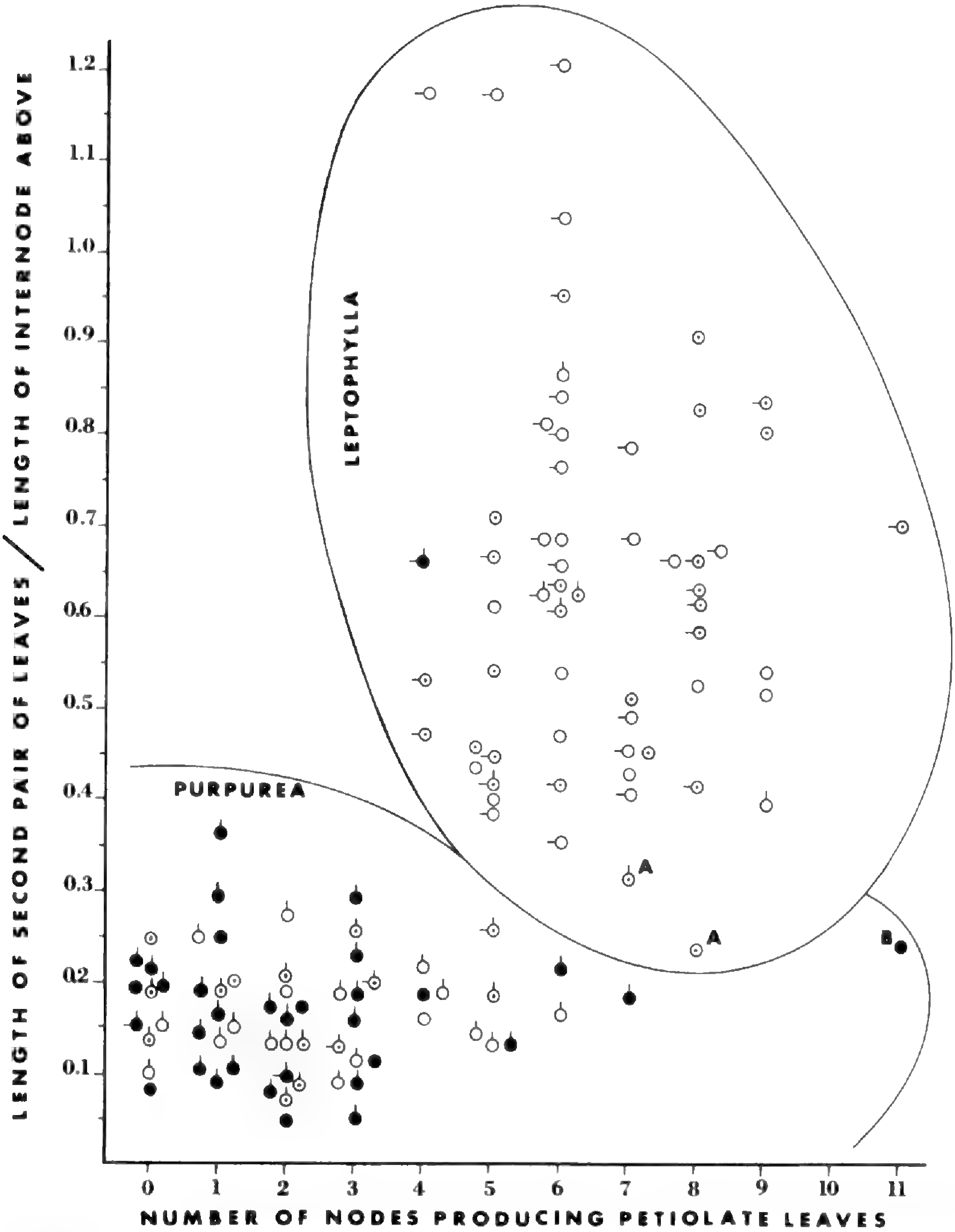

Figure 2. **Morphological overlap between Physostegia purpurea and P. leptophylla.**

Each point represents a single herbarium specimen. Shading of circles: clear circle, horizontal rhizomes present on specimen; blackened circle, no horizontal rhizomes produced by the plant; circle with dot in center, underground parts missing from specimen (rhizome unknown). Projections from circles: upwards if at least one leaf on specimen widest above middle of blade; to the side if at least one leaf on specimen widest below middle of blade; both upwards and to the side if specimen includes leaves widest above middle of blade and leaves widest below middle; no projections if all leaves widest near middle of blade. A, B: see text.

Table 1. **Chromosome Numbers of Physostegia purpurea and P. leptophylla**

Physostegia purpurea

Chromosome Number (2*n*)	Location of Population	Voucher (GH)
38	North Carolina: Nash Co., 1 mi E of Middlesex	*Cantino 935*
38	North Carolina: Harnett Co., 3 mi SE of Bunnlevel	*Cantino 939*
38	Georgia: Turner Co., ca 8 mi W of Irwinville	*Cantino 1034*
38	Florida: Collier Co., E of Ochopee	*Cantino 1142*
38	Florida: Wakulla Co., 8.4 mi WNW of Sopchoppy	*Cantino 1143*

Physostegia leptophylla

Chromosome Number (2*n*)	Location of Population	Voucher (GH)
76	Virginia: Southampton Co., Zuni	*Cantino 970*
76	North Carolina: Pitt Co., ca 6 mi WNW of Washington	*Cantino 973*
76	South Carolina: Georgetown Co., Sampit	*Cantino 982*
76	Florida: Taylor Co., 2.8 mi S of Tennile	*Cantino 1140*
76	Florida: Wakulla Co., 2 mi SW of Wakulla	*Cantino 1141*

The chromosome numbers of *Physostegia purpurea* and *P. leptophylla* have never before been reported. Root tips, obtained from greenhouse plants which had been raised from rhizomes collected previously in natural populations, were used to determine the mitotic numbers of these species. The root tips were pretreated in 8-hydroxyquinoline and then dissected in aceto-orcein, according to the procedure outlined by B. W. Smith (1974; pp. 251–252), originally adapted from Tijo & Levan (1950). The results (Table 1) indicate that *P. purpurea* has 38 chromosomes, the number found in most species of *Physostegia* (Cantino, in press), whereas *P. leptophylla* is a tetraploid with 76 chromosomes.

Physostegia leptophylla and *P. purpurea* are reproductively isolated by means of several partially effective mechanisms which are superimposed on one another like a set of sieves with progressively finer meshes. The first level of isolation is ecological. In spite of their extensive sympatry (Figure 1), I know of no instance of the two species occurring at the same site. They have markedly different habitat requirements. *Physostegia leptophylla* is found in wooded river swamps and in fresh and brackish marshes. It frequently grows in shallow water and can tolerate deep shade. *Physostegia purpurea* is a species of open pinelands, where it is generally found in moist sites but usually not in standing water. It rarely grows in the shade and never in deep shade.

Ecological isolation is undoubtedly very effective in restricting the opportunities for hybridization between the two species, but the habitats to which they are confined can be found adjacent to one another, a situation that might permit occasional insect-mediated pollen transfer. If this were to occur, two postzygotic barriers to gene flow would come into operation—seed-incompatibility and hybrid sterility.

Experimental crosses between *Physostegia purpurea* and *P. leptophylla* failed to yield any mature seed, although intraspecific crosses involving each species were sucessful (Table 2). Eight geographically scattered populations of *P. purpurea* and seven of *P. leptophylla* were represented among the parent plants in the interspecific crosses. Percentage figures in Table 2 are based on a maximum yield of four nutlets per flower pollinated. Nutlet initiation was scored a few days after the pollinations were carried out by counting the number of ovary lobes that had begun to enlarge; each ovary lobe can potentially develop into a single-seeded nutlet. Further details of the study are presented elsewhere (Cantino, in press).

In the interspecific crosses, nutlets were initiated but they aborted before reaching maturity, a result that indicates that the breeding barrier is postzygotic. It is not known whether this isolating mechanism is as effective under natural conditions as it is in the experimental garden. In the event that an occasional hybrid seed were to be produced in nature, in spite of the ecological isolation of

Table 2. **Results of controlled pollination experiments involving Physostegia purpurea and P. leptophylla**

	Number of Trials (Pairs of Plants)	**Total Number of Flowers Pollinated**	**Percent Nutlet Initiation**	**Percent Nutlet Maturation**
Purpurea × Purpurea	5	60	60.4%	41.3%
Leptophylla × Leptophylla	5	93	73.9%	54.8%
Leptophylla (♂) × Purpurea (♀)	6	77	68.2%	0.0%
Purpurea (♂) × Leptophylla (♀)	5	57	81.6%	0.0%

the two species and the likelihood of seed abortion, the resulting plant would be triploid and therefore mostly sterile. Although none of the three isolating mechanisms, by itself, is completely effective, with the possible exception of the seed abortion observed in the garden, the combination of the three mechanisms could be expected to result in virtually total reproductive isolation.

I have seen no clear evidence of natural hybridization between *Physostegia purpurea* and *P. leptophylla.* A few specimens from Florida exhibit an intermediate morphology, but there is little evidence to suggest that they are hybrids rather than extremes in a pattern of overlapping interspecific variation. One of them (represented by point "B" in Figure 2) was collected from a population in Collier County, Florida (voucher: *Cantino 1025*), the other members of which had the characteristic morphology of *P. purpurea.* One member of the population (but not the intermediate specimen itself) was found to have 19 pairs of chromosomes, in agreement with other counts for *P. purpurea.* Because the nearest known occurrence of *P. leptophylla* is about 100 miles to the north, it is unlikely that the population is a hybrid swarm. It is far more plausible that the specimen represented by point "B" is simply a somewhat aberrant individual of *P. purpurea.*

A second instance of intermediacy between *Physostegia leptophylla* and *P. purpurea* was found in Taylor County, Florida (voucher: *Cantino 1026*). The plants were growing in a rocky stream bed, not a characteristic habitat for either species, and the morphology of various members of the population ranged from that which is usual in *P. leptophylla* to forms intermediate between *P. leptophylla* and *P. purpurea*. The most intermediate specimens are represented by the two data points labeled "A" in Figure 2. The single member of the population for which a chromosome count was obtained (not one of the most intermediate specimens) had 38 pairs, the number found in *P. leptophylla*. Lacking chromosome counts for the intermediate specimens, one cannot rule out the possibility that they are hybrids. However, I saw no *P. purpurea* growing in the vicinity, leading me to suspect that they are just aberrant individuals of *P. leptophylla*.

NOMENCLATURE

Of the specific epithets that have been applied to either *Physostegia purpurea* or *P. leptophylla*, three (*purpurea, incarnata,* and *denticulata*) are particularly problematical. These will be discussed in chronological order.

In his *Flora Caroliniana* (1788), Thomas Walter described three new species of what he thought to be *Prasium*. His uncertainty about their true affinities was evidenced by his placement of a question mark after the generic name, so that it appeared as "*Prasium?*". Soon after the publication of *Flora Caroliniana,* several botanists realized that Walter's *Prasium? purpureum* and *Prasium? incarnatum* were representatives of *Physostegia,* then known as *Dracocephalum*. Ventenat (1801) listed *Prasium incarnatum* in synonymy with his *Dracocephalum variegatum,* and Elliott (1816–1824) synonymized *Prasium purpureum* under *Dracocephalum denticulatum.* A century later, Blake (1915) examined the two specimens labeled as *Prasium* in the Thomas Walter Herbarium at the British Museum (Natural History) and verified that they were indeed *Physostegia.*

The typification of new names in Walter's *Flora Caroliniana* presents a problem in that there is no evidence that Walter actually based his descriptions on, or even saw, the collection of fragmentary material that is now regarded as the Walter Herbarium. Ward

(1977) discussed the situation in considerable detail. The relevant facts are as follows: John Fraser, who collected extensively in the southeastern United States in the late 1700's, returned to England in 1788, carrying with him the manuscript of Walter's *Flora Caroliniana*. Fraser also brought to England a collection of plant material which he claimed included specimens of the species in Walter's *Flora Caroliniana*, but he never claimed to be carrying Walter's herbarium. The origin of the folio of specimens in the British Museum that has generally been regarded as the Walter Herbarium is uncertain. Ward (1977) believes it likely that "A large but inferior collection of plants was gathered by Fraser during his travels, part or all of which may have been shown to Walter, and from which at a later date some other person, perhaps Fraser's son, selected specimens he believed representative of those species treated in *Flora Caroliniana*. This selection now constitutes the British Museum's 'Walter Herbarium.'" No other remnant of Walter's collections is known to exist. The Walter Herbarium does not circulate, but the entire collection was photographed by Bernice G. Schubert in 1946 and 1947, and the resulting album is available for study in the library of the Harvard University Herbaria.

Walter's short descriptions shed little light on the identity of the specimens upon which he based the names *Prasium? purpureum* and *Prasium? incarnatum*. There are two species of *Physostegia* that occur commonly in coastal South Carolina where Walter lived and collected, and both are variable enough in the characters used by Walter to distinguish *Prasium? purpureum* and *P. incarnatum* to preclude definitive association of either of Walter's names with either species on the basis of the descriptions alone.

Of the two specimens labeled as *Prasium* in the Walter Herbarium, Blake (1915) states that "The right-hand specimen, with sharply mucronate-serrate lanceolate leaves, which agrees with Walter's description of his *Prasium? incarnatum*, is *Physostegia virginiana* (L.) Benth., while the other, with linear-lanceolate crenate-dentate leaves, typifies *Prasium? purpureum* Walt. and is the same as *Physostegia denticulata* (Ait.) Britton." Blake accordingly labeled the two specimens in the Walter Herbarium as *Prasium? purpureum* and *P. incarnatum*. This constitues a lectotypification even though it is not known whether Walter actually saw the specimens in the "Walter Herbarium." Blake was apparently not aware of this complicating factor, and it is clear from the introductory notes in his 1915 paper that it was his intention to link Walter's names with specimens in what he considered to be Walter's herbarium.

As will be shown later, Blake was probably incorrect in surmising that Aiton's *Dracocephalum denticulatum,* the basionym of *Physostegia denticulata,* was based on a type that is conspecific with the specimen labeled by Blake as *Prasium? purpureum* in the Walter Herbarium. But more importantly, he was clearly incorrect in stating that the right-hand specimen in the Walter Herbarium (which is indeed *Physostegia virginiana*) agrees with Walter's description of *Prasium? incarnatum.* Walter described *P. incarnatum* as having subamplexicaulous leaves and even italicized the word, presumably to emphasize its importance as a distinguishing character. The specimen that Blake labeled as *Prasium? incarnatum* in the Walter Herbarium has only two leaves, both of which are sessile but not amplexicaulous. Moreover, *Physostegia virginiana,* the species to which the specimen clearly belongs, practically never has anything approaching subamplexicaulous leaves. Blake's typification should, therefore, be rejected, leaving the name *Prasium? incarnatum* without a type. Inasmuch as it is impossible to determine from the description alone to which of two species (*Physostegia purpurea* or *P. leptophylla*) the name should refer, *Prasium? incarnatum* should be left as a *nomen dubium.*

It can perhaps be argued that both of Walter's names should be rejected as *nomina dubia* and more recent names applied to the two species of *Physostegia.* However, in view of the widespread and unambiguous use of the epithet *purpurea* in this genus, and the fact that the specimen in the Walter Herbarium that Blake labeled as *Prasium? purpureum* agrees with Walter's description, I believe it preferable to accept Blake's typification of *Prasium? purpureum,* thus retaining a long-standing name and avoiding confusion that would otherwise result.

In 1789, only a year after the publication of Walter's *Flora Caroliniana,* the name *Dracocephalum denticulatum* Aiton was published in *Hortus Kewensis,* based on a garden plant grown in England from material brought there from "Carolina" two years earlier. The type specimen, a photograph of which has been supplied to me by the British Museum, has proved to be perplexing. It resembles certain specimens of *Physostegia virginiana* from Pennsylvania and West Virginia, but its leaf serrations are unlike those of the forms of *P. virginiana* that occur in the Carolinas. It is of course possible that the seed or rhizome from which the English garden plant was grown was sent from the Carolinas but collected elsewhere. A second, less likely possibility is that the specimen represents a somewhat aberrant individual of *P. purpurea.* The type specimen of *D. denticulatum* has much less reduced upper leaves than does *P. purpurea,* and it differs from the forms of *P. purpurea* that occur in the Carolinas in having acute, rather than obtuse, leaf tips. The former of these differences is of particular importance, because the striking reduction of the upper leaves in *P. purpurea* is its most distinctive trait.

One bit of evidence that suggests that the affinities of the type of *Dracocephalum denticulatum* lie with *Physostegia virginiana* rather than with *P. purpurea* is its blooming period. In the protologue of *D. denticulatum,* it is recorded that the plant blooms in August. In the Carolinas and neighboring states, *P. virginiana* blooms from mid-June through mid-October, with the majority of the plants blooming in July and August. *Physostegia purpurea* blooms in the Carolinas from late May through (rarely) the first few days of August, with the majority of the plants blooming in June.

Yet another bit of evidence suggesting affinity with *Physostegia virginiana* rather than *P. purpurea* comes from Curtis' *Botanical Magazine* (6: *tab. 214.* 1793), where a picture of *Dracocephalum denticulatum* was published only four years after the original publication of the name. The illustration is accompanied by the description drawn from *Hortus Kewensis* and by some additional notes, among which is a statement that the illustration is based on a plant grown from seeds collected in the vicinity of Philadelphia and is of the same species as the plant obtained by a Mr. Watson, an English nurseryman, from Carolina. The latter was apparently the garden plant upon which the original description in *Hortus Kewensis* was based. William Curtis and William Aiton were contemporaries in the London botanical community, so it is quite possible that Curtis actually saw living specimens of the plants Aiton described as *D. denticulatum.* Thus Curtis' statement that the plant illustrated in his magazine, which is clearly a representative of *Physostegia virginiana,* is of the same species as the one obtained from Carolina lends support to the premise that the Carolina plant, too, was a form of *P. virginiana*.

On the basis of the evidence discussed above, I consider *Dracocephalum denticulatum* to be a synonym of *Physostegia virginiana*. The epithet *denticulatum* has, however, been applied to both *P. purpurea* and *P. leptophylla* (Small, 1913; Fernald, 1950), as well as to *P. virginiana* (Elliott, 1816 1824). The name should thus probably be rejected as ambiguous. Even if I am incorrect in my judgment about the affinities of the type specimen of *D. denticulatum*, and it actually represents an unusual form of *P. purpurea*, the name is still a later synonym and thus should not be applied to that species.

Fernald's use of the name *Physostegia denticulata* (Ait.) Britt. to represent *P. leptophylla* in Gray's Manual (1950) was based (Fernald, 1943) on his judgment that Aiton's brief diagnosis of *Dracocephalum denticulatum* corresponded well to plants Fernald had collected in Virginia (which fall within *P. leptophylla* as delimited here), together with the fact that the garden plants upon which the name was based were stated in the protologue to have come from "Carolina," where plants similar to Fernald's Virginia specimens abound. He apparently overlooked the fact that Aiton's diagnosis is equally descriptive of a number of other species of *Physostegia*. He makes no mention of having seen Aiton's type specimen, which is clearly not a representative of *P. leptophylla*.

Adding to the confusion, Chapman described in 1860 a var. *denticulata* of *Physostegia virginiana* without any reference to any earlier use of the epithet. The type specimen is unknown and the description is insufficient to determine whether the name was based on a specimen of *P. leptophylla, P. purpurea,* or *P. godfreyi*. Because there is no earlier use of the epithet at the varietal level, the name is legitimate, but unless a type specimen emerges, it is best left as a *nomen dubium*.

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KARYOTYPE RELATIONSHIPS OF NATIVE NEW WORLD *VICIA* SPECIES (LEGUMINOSAE)[1]

SUDARATANA VEERASETHAKUL AND J. STUART LASSETTER

Vicia (Leguminosae: Paplionoideae) with an estimated 140 to over 170 species (Plitmann, 1967; Gunn & Kluve, 1976; Kupicha, 1976) is a world wide temperate zone genus of tendril-bearing vines. This genus exhibits great karyotypic diversity that is significant at the species level (Sveshnikova, 1927; Heitz, 1931; Shrivistava, 1963; Mettin & Hanelt, 1968; Stankevich, 1970; Yamamoto, 1973; Lassetter, 1975; and many others, list not inclusive). Except for a few reports (Rousi, 1961; Mettin and Hanelt, 1968; Lassetter, 1972, 1975; Veerasethakul, 1978; Veerasethakul & Lassetter, 1979; Lassetter & Gunn, 1979), the karotype work has been restricted to species native to the Old World.

A mixture of native and naturalized vetches occurs in the New World. In North America only about 15 or 16 of the 35 species are native (Hermann, 1960; Gunn, 1971; also see Rousi, 1961, and Veerasethakul & Lassetter, 1979, concerning native status of *Vicia cracca*). In Central America (including Mexico), 6 to 10 species are native New World taxa (Gunn, 1979). No comprehensive treatment of South American vetches exists, and the status of several species there is questionable (see Lassetter & Gunn, 1979, for taxonomy of *V. nigricans*). Probably about 20 "good" species occur in South America.

Native North American species listed in Hermann (1960) for which we had no seed material are *Vicia reverchonii* (probably now extinct) and *V. hugeri* (rare piedmont taxon in the southeastern U.S.). The species status is questionable for both taxa. We also had no seeds of *V. pulchella* or *V. leucophaea*. From Central America and Mexico, we studied four of the six native species. Our South American seeds were very limited, and we could include only *V. nigricans* and *V. graminea*. The species for which we do present karyotypes represent about 35% of the native New World vetches, and all belong to the subgenus *Vicilla* sensu Kupicha (1976).

This report presents karyotypes of native New World *Vicia*

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[1] The information presented here represents a Master's thesis submitted by the senior author to Eastern Kentucky University, 1978, as well as additional contributions by the junior author.

species, and groups of species based on karyotypes are compared with Kupicha's subgeneric groupings. Kupicha (1976) has presented the most recent major taxonomic treatment of the genus, but she did not use karyotypes as taxonomic characters in delimiting subgeneric taxa.

MATERIALS AND METHODS

Where possible, seed samples were obtained from several portions of the ranges of the species. Specific sources and identifications, collection sites, and location of population vouchers from which seeds were taken are given in the figure captions. In those captions, BARC indicated the seeds were obtained from the seed collection of the Agricultural Research Center, Beltsville, Maryland. Samples with DAO were provided by the Biosystematics Research Institute, Ottawa, Canada. Herbarium acronyms used here and elsewhere follow Holmgren and Keuken (1974). Seeds identified with C. R. Gunn's collection numbers were provided by Gunn from his personal collection, but population vouchers are in NA. Lassetter's collection numbers are represented by vouchers in ISC and EKU (Eastern Kentucky University). Other seeds were taken from the indicated herbarium sheets at the respective herbaria.

Seed coats were nicked with a razor blade, seeds germinated in rolled wet paper, and seedlings were transferred to pots of perlite and fertilized until root tips were removed for squashes. Adequate dividing cells were found from 1 to several hours after seedlings received morning sunlight. After root tips were removed, seedlings were transplanted to a mixture of one part peat, one part perlite, and three parts potting soil, and were grown as chromosome vouchers. Most of these vouchers are in EKU but a few are in ISC.

The root tips were pretreated with 0.002M 8-hydroxyquinoline for 4 hours in a 13° C water bath. The tips were fixed in 3:1 (V/V) absolute ethanol:glacial acetic acid for 15 minutes at 60° C, and hydrolyzed for 10 minutes in 1N HCl at 60° C. They were then Feulgen stained with Schiff's reagent for 1 hour. The tips were squashed in 45% acetic acid. All slides were made permanent by the CO_2 freezing method (Bowen, 1956) using Euparal as a mounting medium.

Most squash preparations were examined on a Bausch and Lomb stereozoom compound microscope with a 100× oil immersion

Plate 1. Figures **1–3**. *V. gigantea* Hook. 1. USDA *Barclay 1664* Clallam Co., Washington, USA BARC 2. USDA *Terrell s.n.* Lincoln Co., Oregon, USA BARC 3. C. R. *Gunn 3670* Clallam Co., Washington, USA NA. Figures **4–7**. *V. nigricans* Hooker & Arnott 4. USDA *PI 349242* Nahuel Huapi, Argentina BARC 5. USDA *PI 349244* Lawin, Argentina BARC 6. USDA *PI 349244* Pts. Mawzawo, Argentina BARC 7. USDA *PI 349243* Near Puerto, Argentina BARC

objective, and drawings of karyotypes were made from permanently mounted slides using a Zeiss camera lucida. Other slides were examined on a Leitz Laborlux microscope with a 90× apochromatic oil immersion objective, and drawn using a Leitz drawing apparatus.

RESULTS AND DISCUSSION

The species of this study have been categorized into three groups based on karyotype appearance.

Species in group one (Plate 1) contained the largest chromosomes of the species studied. These two species and *Vicia menziesii* of Hawaii form a trio of vetches which share several unusual *Vicia* traits (Lassetter & Gunn, 1979). These three species belong to Kupicha's Section *Cassubicae*, although she did not list *V. gigantea* (indicating her unproposed taxonomic position that *V. gigantea* and *V. nigricans* are conspecific) or *V. menziesii* (previously believed extinct).

Group two (Plate 2) contains species with distinctive karyotypes containing chromosomes with secondary constrictions near the centromere and no satellited chromosomes. The chromosomes of these species are all about the same size except for those of *Vicia graminea*, which are slightly smaller. Kupicha (1976) placed *V. americana* in the monotypic section *Americanae*, but she did not include *V. hassei* (Lassetter, 1975) — with two chromosome pairs with secondary constrictions near the centromere, or *V. humilis* in her study. These two species are listed by Gunn (1979) as members of section *Cracca*. *Vicia graminea* was placed in Section *Australes* by Kupicha, who was able to study more South American species than we. The karyotype of *V. graminea* does resemble karotypes of the other members of group two, but it should be compared with karyotypes of other South American species. The karyotype of *V. graminea* compares favorably with the one presented by Mettin and Hanelt (1968).

This group of species, while sharing karyotype similarities, is diverse in other characteristics, and contains representatives of three different sections sensu kupicha (1976).

Group three (Plates 3, 4, 5, & 6) has smaller chromosomes with satellites and no secondary constrictions near the centromere. All the taxa of this group are placed in Section *Cracca* by Kupicha (1976). Our samples of *Vicia cracca* (Plate 3) were tetraploid, but the basic diploid set is like the diploid species of this group. Rousi (1961) and Veerasethakul and Lassetter (1979) have discussed geographical distribution and ploidy in *V. cracca*.

The Vicia ludoviciana complex (Plate 4), including *V. ludoviciana, V. leavenworthii, V. exigua,* and their varieties, was the subject of

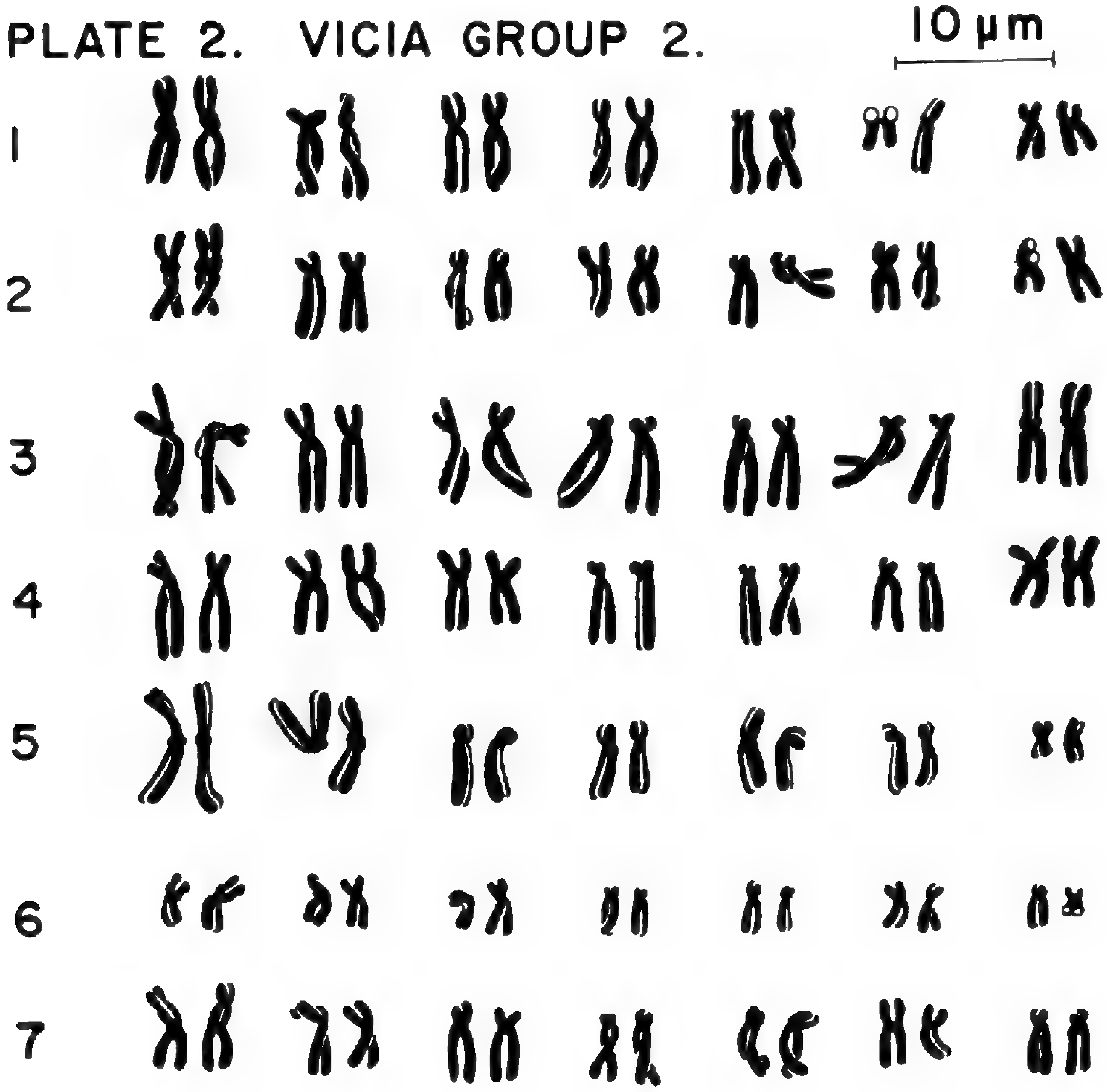

Plate 2. Figure **1 & 2.** *V. americana* Muhl. 1. *C. R. Gunn 2631* Riverside Co., California, USA NA 2. *C. R. Gunn 2566* Story Co., Iowa, USA ISC Figures **3 & 4.** *V. humilis* HBK. 3. USDA *J. Rzedowski 24058* Coatlinchan, Mexico BARC 4. USDA *PI 343008* Morelos, Mexico BARC Figure **5.** *V. hassei* S. Wats. 5. *Wiggins and Ernst 123* Guadalupe Island, Baja California, Mexico DS Figure **6 & 7.** *V. graminea* Sm. 6. USDA *L. G. Labouriau s.n.* Sao Paulo, Brazil BARC 7. USDA *DEIP 20.258* Buenos Aires, Argentina BARC

biosystematic study (Lassetter, 1972, 1975, 1978 a&b, and in press). The complex was reevaluated as one wide ranging species, *V. ludoviciana,* with one subspecies of five geographical races and a second subspecies of two races. The kind of infraspecific karyotype variation exhibited by these taxa is similar to that shown by Rousi (1961) to exist in *V. tenuifolia.* Kupicha (1976) viewed *V. ludoviciana,, V. leavenworthii,* and *V. exigua* as separate species, but was not aware of the recent work on the complex.

PLATE 3. VICIA GROUP 3.

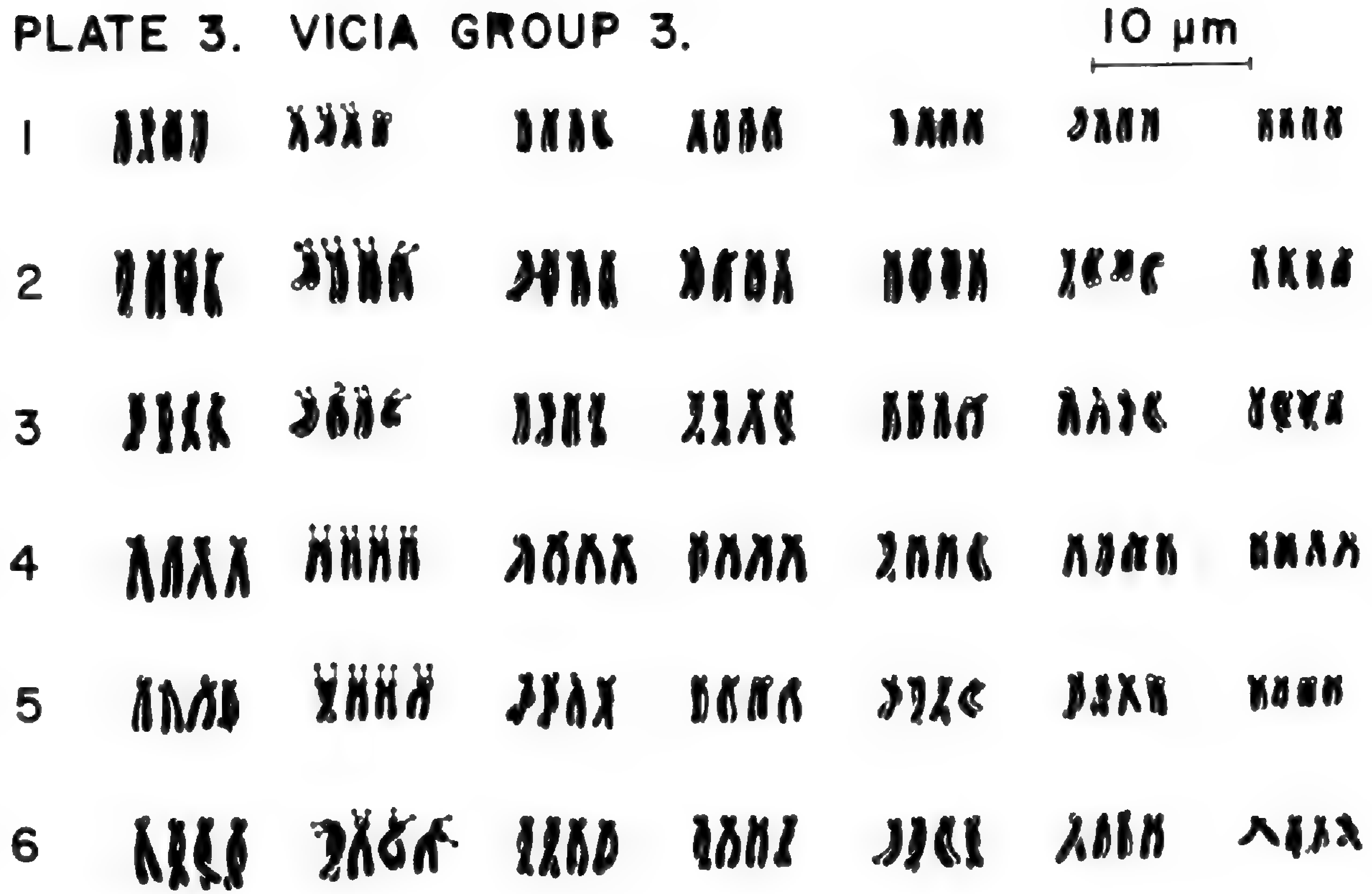

Plate 3. Figures **1–6**. *V. cracca* L. 1. DAO *W. E. Kemp & T. F. Adams s.n.* Ontario, Canada DAO 2. *C. R. Gunn 3768* Meductic, New Brunswick, Canada NA 3. USDA *NJ-64-68* Cape May Co., New Jersey, USA BARC 4. *C. R. Gunn 3770* Quebec, Canada NA 5. USDA *PI 234266* Ontario Co., New York, USA BARC 6. *C. R. Gunn 3759* Cumberland Co., Nova Scotia, Canada NA

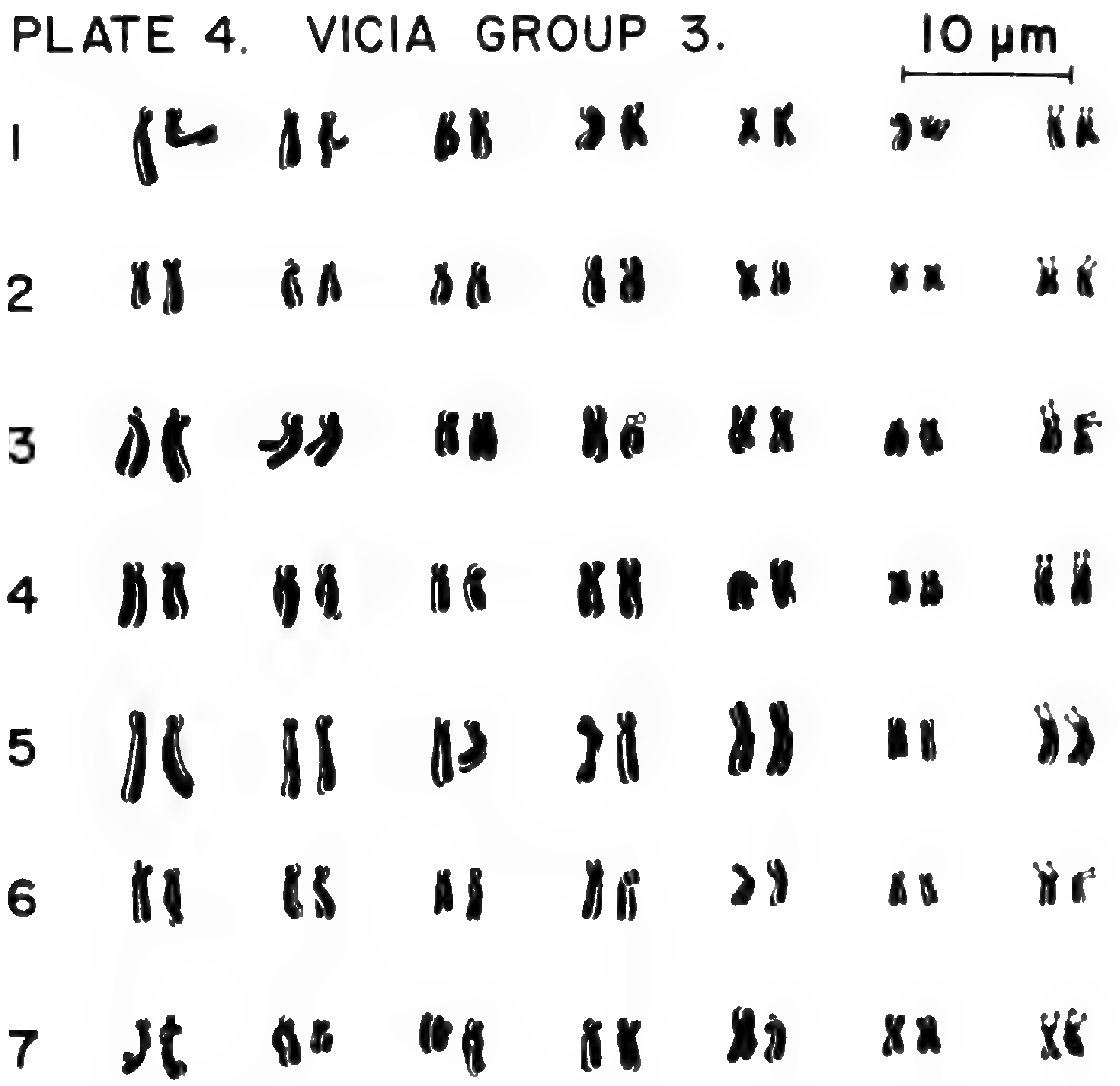

Plate 4. Figure 1. *V. ludoviciana* Nutt. subspecies *ludoviciana* race 1 *Lassetter 1753* Fayette Co., Texas, USA ISC Figure 2. *V. ludoviciana* Nutt. subspecies *ludoviciana* race 5 *Lang 4665* Menard Co., Texas, USA ISC Figure 3. *V. ludoviciana* Nutt. subspecies *ludoviciana* race 2 *Lassetter 1773* Aransas Co., Texas, USA ISC Figure 4. *V. leavenworthii* Nutt. subspecies *ludoviciana* race 7 *Goodman and Lawson 8171* McCurtain Co., Oklahoma, USA OKL Figure 5. *V. ludoviciana* Nutt. subspecies *leavenworthii* race 6 *Lassetter 1833* Dallas Co., Texas, USA ISC Figure 6. *V. ludoviciana* Nutt. subspecies *ludoviciana* race 4 *Lassetter 1731* Culberson Co., Texas, USA ISC Figure 7. *V. ludoviciana* Nutt. subspecies *ludoviciana* race 3 *I. Marin, s.n.* Riverside Co., California, USA ISC

Vicia caroliniana and *V. minutiflora* (Plate 5) have karyotypes similar to those of the *V. ludoviciana* complex, but satellites are located on different chromosomes and centromere placement is different. The size range is comparable.

The three species of Plate 6 are a related trio, and *Vicia acutifolia* and *V. floridana* have been recognized as valid species since their naming in the 1800's. *Vicia ocalensis,* endemic to Florida and not

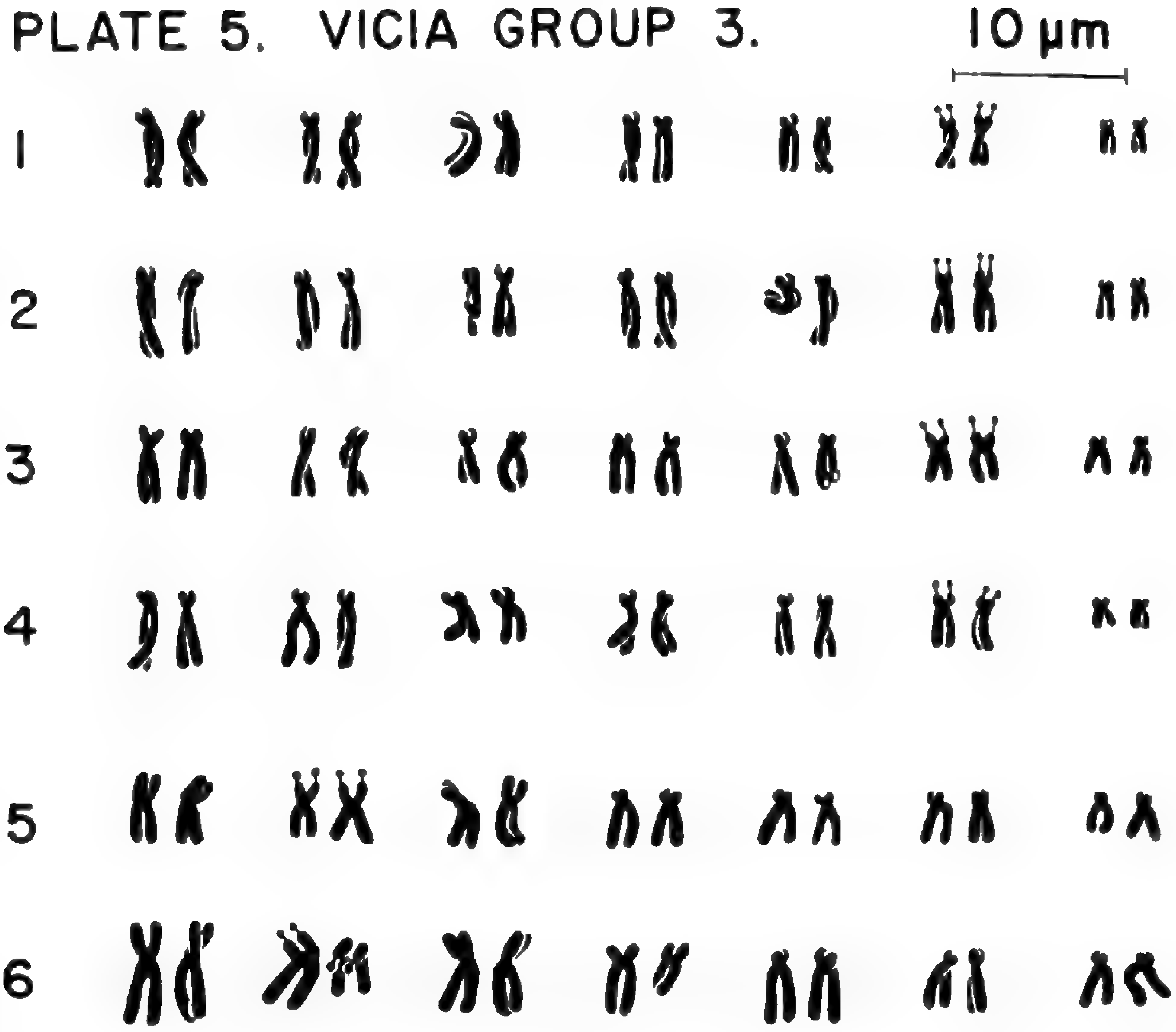

Plate 5. Figures 1 4. *V. caroliniana* Walt. 1. USDA *K. E. Rogers & G. Morton s.n.* Blount Co., Tennessee, USA BARC 2. USDA *Bartholomew s.n.* Wirt Co., West Virginia, USA BARC 3. *Lasseter 2523* Garrard Co., Kentucky, USA BARC 4. *C. R. Gunn 3634* Macon Co., North Carolina, USA NA 5 6. *V. minutiflora* Dietr. 5. *L. H. Shinners 10899* Henderson Co., Texas, USA SMU 6. USDA *C. E. Smith, Jr. 5039* Hale Co., Alabama, USA BARC

studied by Kupicha, was named as a new species by Godfrey and Kral (1958). On morphological characteristics, Godfrey and Kral as well as Hermann (1960) showed that *V. ocalensis* resembles *V. acutifolia* more than *V. floridana.* Our karyotype data also support this relationship.

All these section *Cracca* species of group three share a basically similar karyotype. The chromosomes are about the same size from species to species, and each species has one satellited pair, except for *Vicia ocalensis* which has two satellited pairs.

Section *Cracca* is the largest one in Kupich's treatment and she stated it probably could be subdivided. We, on the basis of karyotype data alone, do not suggest a division, but if *Vicia hassei* and *V. humilis* are valid members of section *Cracca,* other

PLATE 6. VICIA GROUP 3.

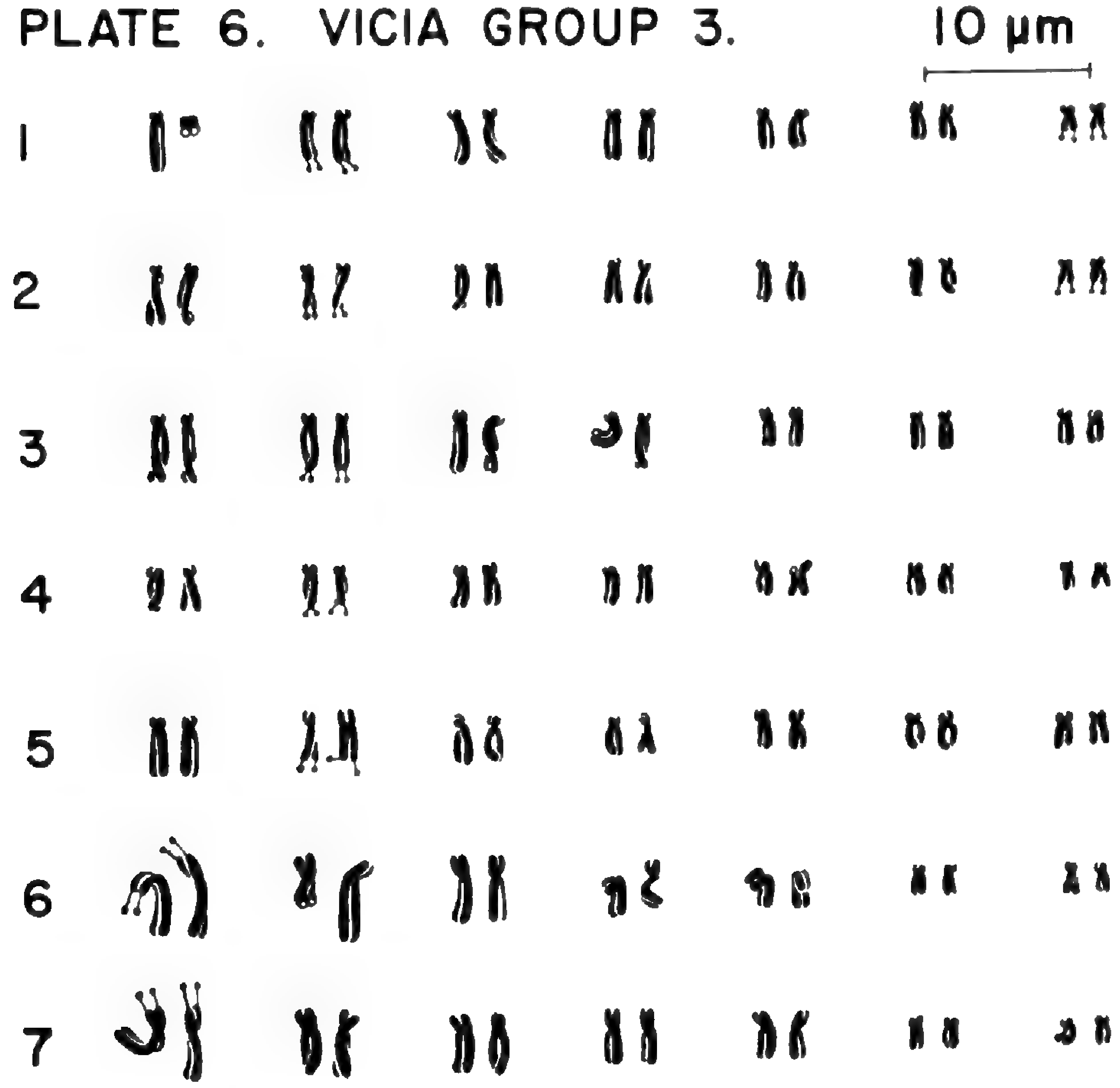

Plate 6 Figures **1–2.** *V. ocalensis* Godfrey & Kral 1. USDA *PI 316685* Marion Co., Florida, USA BARC 2. USDA *PI 316685* Marion Co., Florida, USA BARC Figures **3–5** *V. acutifolia* Ell. 3. *Lassetter 2105* Glenn Co., Georgia, USA EKU 4. USDA *PI 316683* Lake Co., Florida, USA BARC 5. *Lassetter 2138* St. Johns Co., Florida, USA EKU Figures **6 & 7.** *V. floridana* S. Wats. 6. USDA *PI 316684* Levy Co., Florida, USA BARC 7. *C. R. Gunn 3348* Levy Co., Florida, USA NA

taxonomic characters in combination with their karyotypes might justify a sub-section distinction. These two species have very different karyotypes from the species in our group three, and as stated before share karyotype characters with *V. americana* and *V. graminea.* Further work is needed to resolve this problem.

As far as we have determined from the literature, our reported number of $2n = 14$ is the first reported count for the following species: *V. acutifolia, V. caroliniana, V. floridana, V. humilis, V. minutiflora, V. nigricans* (sensu stricto), and *V. ocalensis.*

Cortazar (1948) presented a karyotype ($2n = 14$) of *Vicia macraei* (now a synonym of *V. nigricans,* Lassetter & Gunn, 1979). For *V. americana,* $n = 7$ (Löve, 1973; Moore, 1973; Moore, 1977) and $2n = 14, 28$ (Fedorov, 1969) have been reported. Numbers of $2n = 12, 14, 28$ have been reported for *V. cracca* by Darlington and Wylie (1955), Fedorov (1969), Löve, (1973, 1975), and Moore (1973, 1977); and in addition, Fedorov (1969) reported $2n = 21, 24$. A count of $n = 7$ for *V. gigantea* (now a subspecies of *V. nigricans,* Lassetter & Gunn, 1980) was reported by Moore (1973) who also reported $2n = 14$ for *V. graminea.*

Three counts of taxa of the *Vicia ludoviciana* complex are given by Turner (1956): *V. ludoviciana* var. *typica* (race 1), $n = 7$; *V. leavenworthii* var. *typica* (race 4), $2n = 14$; and *V. leavenworthii* var. *occidentalis* (race 6), $n = 7$.

CONCLUSIONS

The karyotype groupings one and three of native New World *Vicia* presented here support Kupicha's sectional division of the subgenus *Vicilla.* The species of our group two, although similar in karyotypes, are diverse in sectional membership. Additional karyotype data, especially from South American taxa, would greatly aid in understanding the subgeneric relationships of New World vetches.

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BORMANN, F. HERBERT AND GENE E. LIKENS. *Pattern and Process in a Forested Ecosystem.* 253 pp. 1979. Springer-Verlag, N. Y. (Price $19.80).

The authors describe the "structure, function, and development of the hardwood ecosystem in northern New England." The book is a summary of the results of many years of ecological research and quantitative data gathering by many scientists at Hubbard Brook Experimental Forest, Plymouth, NH. It is hoped that this detailed knowledge will help in developing sound land management plans for New England hardwood forests.

TRANQUILLINI, WALTER. *Physiological Ecology of the Alpine Timberline.* 137 pp. 1979. Springer-Verlag, N.Y. (Price $29.70).

This well-organized book summarizes the results of 30 years of studies on the causes of timberline on mountains. Most of the detailed ecological-physiological experiments were done at high-altitude research stations in Europe, but pertinent American studies are included. Anyone interested in the ecology of the Presidential Range in New Hampshire will find this book enlightening.

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INDEX TO VOLUME 83

New scientific names are printed in **bold face**

Acer (Aceraceae). The pollen morphology of the native New England species of the genus, 237-258

Adams, Ralph M. *see* Sauleda, Ruben P.

Alabama and middle Tennessee. Further additions to some notes on the flora of the southern states, particularly, 301-315

Alsophila aminta, *nom. nov.* 149

Angelo, Ray. Pyrus sieboldii (Rosaceae) naturalizing in Massachusetts 161-162

Another station for Conopholis americana (Orobanchaceae) in New Hampshire 158

Argentina. Taxonomic and nomenclatural notes on the flora of Isla de los Estados (Staten Island), Tierra del Fuego, 477

Armeria maritima subsp. **andina** var. **goodalliana,** *var. nov.* 488

Aster 521-550. A acuminatus 524, Map 526; X blakei 533, Map 537; nemoralis 529, Map 532; Ecology 522; Habitat & distribution 524; Post-glacial history 533

Aster acuminatus Michaux and A. nemoralis Aiton (Asteraceae:Astereae). An ecogeographical analysis of the distribution of, 521-550

Astragalus equisolensis, *sp. nov.* 457

Astragalus section Desperati (Leguminosae) and a new species from the Uinta basin of Utah 455-460

Autecological aspects of Diapensia lapponica L. in Newfoundland 101-109

Bahama archipelago. The genus Oncidium Sw. (Orchidaceae) in the, 87-100

Belize. A list of the Dicotyledonae of, 161-236

Bogle, A. Linn *see* Philbrick, C. Thomas

Book review: An illustrated synoptical flora of Baja California 151-153

Books received and literature for New England botanists, 474

Boufford, David E. Another station for Conopholis americana (Orobanchaceae) in New Hampshire 158

Britton, Donald M. *see* Sarvela, Jaakko

Brouillet, Luc & Jean-Pierre Simon. An ecogeographical analysis of the distribution of Aster acuminatus Michaux and A. nemoralis Aiton (Asteraceae: Astereae) 521-550

Bryological relicts in western Massachusetts. Late Pleistocene, 441-448

Caltha × **goodalliana,** *hybrida nova* 490; see Table 1, Distinguishing Caltha dionaeifolia, C. appendiculata, and C. × goodalliana, 493

Cantino, Philip D. Change of status for Physostegia virginiana var. ledinghamii (Labiatae) and evidence for a hybrid origin, 111-118

Cantino, Philip D. The Physostegia purpurea - leptophylla - denticulata problem: taxonomic and nomenclatural clarification 581-593

Carex in Minnesota. New records of, 119-124

Carices. Chromosome numbers of some northern New Jersey, 461-464

Centratherum and Phyllocephalum (Compositae:Vernonieae). Taxonomic revision of, 1-24

Centratherum and Phyllocephalum 1-24. Centratherum 14, Key 15;

C. confertum, *nom. nov.* 21; **C. punctatum** Cass. ssp. **australianum,** *ssp. nov.* 21; **C. punctatum** Cass. ssp. **fruticosum,** *ssp. nov.* 20; Chromosome numbers 4, fig. 6, 7; Distributions—Centratherum 16, Phyllocephalum 11; Doubtful and excluded species, 23; Phyllocephalum 9, Key 10; **P. indicum,** *comb. nov.* 12; **P. scabridum,** *comb. nov.* 10; Pollen 2, fig. 5; Pollen stainability 4; Summary of generic character differences 9; Trichomes 2, fig. 3

Change of status for Physostegia virginiana var. ledinghamii (Labiatae) and evidence for a hybrid origin 111 118

Cheilanthes 133. **C. arequipensis,** *comb. nov.;* **C. concolor,** *comb. nov.;* **C. decora,** *comb. nov.;* **C. geraniifolia,** *comb. nov.;* **C. lonchophylla,** *comb. nov.;* **C. Lozanii,** *comb. nov.;* **C. skinneri,** *comb. nov.;* **C. venusta,** *comb. nov.*

Chromosome numbers of some northern New Jersey Carices 461 464

Chrysopsis 323-384. C. floridana 360; godfreyi 363, f. godfreyi 365, f. viridis 365; gossypina 372, ssp. cruiseana 373, ssp. hyssopifolia 375, ssp. gossypina 377 (f. decumbens 381, f. gossypina 379, f. trichophylla 380); Historical review 325; Key to taxa 347; lanuginosa 362; latisquamea 365; mariana 349; pilosa 353; Relationships within, 337; scabrella 357; subulata 370; Systematic treatment 343

Chrysopsis (Nutt.) Ell. nom. cons. (Compositae:Astereae). A revision of the goldenaster genus, 323 384

Church, George L. *see* Crow, Garrett E.

Conant, David S. A new name for a Puerto Rican tree fern 149

Connecticut. Sarracenia purpurea L. forma heterophylla (Eaton) Fernald: new to, 159-160

Conopholis americana (Orobanchaceae) in New Hampshire. Another station for, 158

Countryman, William D. *see* Crow, Garrett E.

Cranfill, Raymond, & Max E. Medley. Notes on the flora of Kentucky: New and interesting plants in Kentucky 125-131

Crow, Garrett E., William D. Countryman, George L. Church, Leslie M. Eastman, C. Barre Hellquist, Leslie L. Mehrhoff, & Irene M. Storks. Rare and endangered vascular plant species in New England 259-299

Cuttyhunk Island, Massachusetts: with an analysis of vegetational changes over the past half century. The flora of, 25-58

Cyrtomium dubium, *comb. nov.* 134

Day, Robin T., & Peter J. Scott. Autecological aspects of Diapensia lapponica L. in Newfoundland 101-109

Diapensia lapponica L. in Newfoundland. Autecological aspects of, 101-109

Distribution and abundance of Eupatorium leucolepis var. novae-angliae 449 454

Drosera anglica Huds., new to New England 163-165

Dudley, T. R. Taxonomic and nomenclatural notes on the flora of Isla de los Estados (Staten Island), Tierra del Fuego, Argentina 477 519

Dwyer, John D., & David L. Spellman. A list of the Dicotyledonae of Belize 161-236

Eastman, Leslie M. *see* Crow, Garrett E.

Eastman, L. M. Drosera anglica Huds., new to New England 163-165

Ecogeographical analysis of the distribution of Aster acuminatus Michaux and A. nemoralis Aiton (Asteraceae: Asterace). An, 521-550

Eupatorium leucolepis var. novae-angliae. Distribution and abundance of, 449–454

Euthamia 551–579. E. galetorum 559; graminifolia 560, var. graminifolia 563, var. major 563, var. nutallii 564; gymnospermoides 564; hirtipes 569; History 551; Key to the species of, 557; leptocephala 570; Morphology 553; occidentalis 572; pulverulenta 573; Systematic treatment 556; Table 1, Comparison of E. graminifolia north of the Tension Zone in Wisconsin and E. gymnospermoides 568; tenuifolia 574

Euthamia. The taxonomy of the genus, 551–579

Ferns of the Shawnee National Forest (Illinois) 433–440

Ferns. Taxonomic and nomenclatural notes on, 133–137

Field trip announcement. Inside back cover, April

Field trip announcement: Mt. Washington, N.H. Inside back cover, July

Flora of Cuttyhunk Island, Massachusetts; with an analysis of vegetational changes over the past half century 25–58

Forestiera (Oleaceae). The typification of the genus, 465–470

Further additions to some notes on the flora of the southern states, particularly Alabama and middle Tennessee 301–315

Galactia smallii: a new name for G. prostrata Small 471–472

Galactia smallii, *nom. nov.* 471

Gamochaeta malvinensis, *comb. nov.* 478

Genus Oncidium Sw. (Orchidaceae) in the Bahama archipelago. The, 87–100

Glime, Janice M., & Roanna Holcomb. Tetraphis geniculata: a new location for a rare moss in New England 156–157

Grammitis magellanica f. **nana,** *comb. nov.* 483

Gymnocarpium robertianum complex in North America. Studies on the, 421–431

Hellquist, C. Barre. *see* Crow, Garrett E.

Hellquist, C. Barre. The rediscovery of Juncus stygius in Maine 321–322

Herndon, Alan. Galactia smallii: a new name for G. prostrata Small 471–472

Holcomb, Roanna. *see* Glime, Janice M.

Hydrocharis morsus-ranae (Hydrocharitaceae): new to the United States 147–148

Hymenophyllum 134. **H.** subg. **Hymenoglossum,** *stat. nov.;* **H.** subg. **Rosenstockia,** *stat. nov.*

Illinois. Ferns of the Shawnee National Forest, 433–440

Instructions to contributors to Rhodora. Inside back cover, Jan.

Isla de los Estados (Staten Island), Tierra del Fuego, Argentina. Taxonomic and nomenclatural notes on the flora of, 477–519

Jones, Samuel B., Jr. Synoptic classification and pollen morpology of Vernonia (Compositae:Vernoniae) in the Old World 59–75

Juncus stygius in Maine. The rediscovery of, 321–322

Karyotype relationships of native New World Vicia species (Leguminosae) 595–606

Kentucky: new and interesting plants in Kentucky. Notes on the flora of, 125–131

Kirkman, L. Katherine. Taxonomic revision of Centratherum and Phyllocephalum (Compositae: Vernoniae) 1–24
Kral, Robert. Further additions to some notes on the flora of the southern states, particularly Alabama and middle Tennessee 301–315

Lagenifera hariotii, *comb. nov.* 481
Lagenifera nudicaulis, *comb. nov.* 482
Lassetter, J. Stuart. *see* Veerasethakul, Sudarantana
Late Pleistocene bryological relicts in western Massachusetts 441–448
Lemon-scented Pycnanthemum (Lamiaceae). A, 145–146
List of the Dicotyledonae of Belize. A, 161–236
Literature for New England botanists 607
Littlefield, Edward W. More on Pinus Banksiana in New York 317–318

Maine. The rediscovery of Juncus stygius in, 321–322
Massachusetts. Late Pleistocene bryological relicts in western, 441–448
Massachusetts. Pyrus sieboldii (Rosaceae) naturalizing in, 161–162
Massachusetts: with an analysis of vegetational changes over the last half century. The flora of Cuttyhunk Island, 25–58
Matekaitis, Penny. *see* Sørensen, Paul D.
Medley, Max E. *see* Cranfill, Raymond
Mehrhoff, Leslie L. *see* Crow, Garrett E.
Microlepis concinna, *nom. nov.* 135
Minnesota. New records of Carex in, 119–124
Mitchell, Richard S. *see* Roberts, Marvin L.
Mohlenbrock, Robert H. Ferns of the Shawnee National Forest (Illinois) 433–440
More on Pinus Banksiana in New York 317–318
Muir, M. A. *see* Stutts, John G.

NEBC Field trip: New Haven, Connecticut 475–476
Neese, Elizabeth, & Stanley L. Welsh. Astragalus section Desperati (Leguminosae) and a new species from the Uinta Basin of Utah 455–460
New and interesting additions to the flora of Nova Scotia 139–140
New England. Tetraphis geniculata: a new location for a rare moss in, 156–157
New England. Drosera anglica Huds., new to, 163–165
New England Notes:
  Another station for Conopholis americana (Orobanchaceae) in New Hampshire 158
  Drosera anglica Huds., new to New England 163–165
  Pyrus sieboldii naturalizing in Massachusetts 161–162
  Sarracenia purpurea L. forma heterophylla (Eaton) Fernald: new to Connecticut 159–160
  Tetraphis geniculata: a new location for a rare moss in New England 156–157
New England. Rare and endangered vascular plant species in, 259–299
New England species of the genus Acer (Aceraceae). The pollen morphology of the native, 237–258
Newfoundland. Autecological aspects of Diapensia lapponica L. in, 101–109
New Hampshire. Another station for Conopholis americana in, 158
New Hampshire population of Podostemum ceratophyllum Michx. (Podostemaceae). Some notes regarding pollination in a, 319–321
New name for a Puerto Rican tree fern. A, 149

New Jersey Carices. Chromosome numbers of some northern, 461–464
New records of Carex in Minnesota 119–124
New records of tree ferns from Venezuela 141–143
New World Vicia species (Leguminosae). Karyotype relationships of native, 595–606
New York. More on Pinus Banksiana in, 317–318
North America. Studies on the Gymnocarpium robertianum complex in, 421–431
Notes on the flora of Kentucky: New and interesting plants in Kentucky 125–131
Notices of publication:
  CBE Style Manual, 4th edition 473
  Scientific Writing for Graduate Students 473
  Vascular Plants of Continental Northwest Territories, Canada 155
Nova Scotia. New and interesting additions to the flora of, 139–140

Odontosoria 135. **O. Killipii,** *comb. nov.;* **O. spathulata,** *comb. nov.*
Old World. Synoptic classification and pollen morphology of Vernonia (Compositae:Vernonieae) in the, 59–75
Oncidium Sw. (Orchidaceae) in the Bahama Archipelago. The genus, 87–100
O'Neill, Sharman D. The flora of Cuttyhunk Island, Massachusetts: with an analysis of vegetational changes over the past half century 25–58
Ortega, Francisco, *see* Steyermark, Julian A.

Pellaea section **Ormopteris,** *stat. nov.* 135
Philbrick, C. Thomas. Some notes regarding pollination in a New Hampshire population of Podostemum ceratophyllum Michx. (Podostemaceae) 319–321
Philbrick, C. Thomas, & A. Linn Bogle. The pollen morphology of the native New England species of Acer (Aceraceae) 237–258
Phyllocephalum (Compositae:Vernonieae). Taxonomic revision of Centratherum and, 1–24. (*see* Centratherum)
Physostegia ledinghamii (Boivin) Cantino, *comb. et stat. nov.* 111
Physostegia purpurea-leptophylla-denticulata problem: taxonomic and nomenclatural clarification. The, 581–593
Physostegia virginiana var. ledinghamii (Labiatae) and evidence for a hybrid origin. Change in status for, 111–118
Pinus Banksiana in New York. More on, 317–318
Piptocoma Cass. Taxonomic revision of, 77–86
Piptocoma 77–86. Chromatograms 84; distribution 79; key 81; leaf flavonoids (tables) 80, 81, 83
Pleistocene bryological relicts in western Massachusetts. Late, 441–448
Podostemum ceratophyllum Michx. (Podostemaceae). Some notes regarding pollination in a New Hampshire population of, 319–321
Pollalesta H.B.K. (Compositae:Vernonieae). Taxonomic revision of, 385–419
Pollalesta 385–419. P. acuminata 405; areolata 406; barinensis 405; discolor 400; distribution maps 404, 409, 414; excluded names 416; flavonoid chemistry 389 (chromatograph 389, tables 390, 392, 396); **faustiana,** *sp. nov.* 414; hypochlora 402; key to the subgenera and species 398; macrophylla 410; milleri 415; morphology 395; **neglecta,** *sp. nov.* 412; niceforoi 411; palynology 387; **rarissima,** *sp. nov.* 412; roraimensis 409; schomburgkii 413; spruceana 407; subg. Dialesta 400; subg. Odontoloma 402; subg. Pollalesta 406;

taxonomic history 385; trujillensis 403; vernonioides 409
Pollen morphology of the native New England species of the genus Acer (Aceraceae). The, 237–258
Pollen morphology of Vernonia (Compositae:Vernonieae) in the Old World. Synoptic classification and, 59–75
Pollination in a New Hampshire population of Podostemum ceratophyllum Michx. (Podostemaceae). Some notes on, 319–321
Polystichum speciosissimum, *comb. nov.* 136
Pleistocene bryological relicts in western Massachusetts. Late, 441–448
Prange, Robert K., Christene L. Rafuse, & Albert E. Roland. New and interesting additions to the flora of Nova Scotia 139–140
Pryer, Kathleen. *see* Sarvela, Jaakko
Pteridaceae tribe **Platyzomataceae,** *stat. nov.* 135
Puerto Rican tree fern. A new name for a, 149
Pycnanthemum (Lamiaceae). A lemon-scented, 145–146
Pycnanthemum virginianum f. **citriodora,** *f. nov.* 145
Pyrus sieboldii (Rosaceae) naturalizing in Massachusetts 161–162

Rafuse, Christene L. *see* Prange, Robert
Rare and endangered vascular plant species in New England 259–299
Rediscovery of Juncus stygius in Maine, The, 321–322
Revision of the goldenaster genus Chrysopsis (Nutt.) Ell. nom. cons. (Compositae:Astereae). A, 323–384
Roberts, Marvin L., Ronald L. Stuckey, Richard S. Mitchell. Hydrocharis morsus-ranae (Hydrocharitaceae): new to the United States 147–148
Robinson, James T. Sarracenia purpurea L. forma heterophylla (Eaton) Fernald: New to Connecticut 159–160
Roland, Albert E. *see* Prange, Robert K.

Sarracenia purpurea L. forma heterophylla (Eaton) Fernald: New to Connecticut 159–160
Sarvela, Jaakko, Donald M. Britton, & Kathleen Pryer. Studies on the Gymnocarpium robertianum complex in North America 421–431
Sauleda, Ruben P., & Ralph M. Adams. The genus Oncidium Sw. (Orchidaceae) in the Bahama Archipelago 87–100
Schuster, R. M. Late Pleistocene bryological relicts in western Massachusetts 441–448
Scott, Peter J. *see* Day, Robin T.
Semple, John C. A revision of the goldenaster genus Chrysopsis (Nutt.) Ell. nom. cons. 323–384
Shawnee National Forest (Illinois). Ferns of the, 433–440
Sieren, David J. The taxonomy of the genus Euthamia 551–579
Simon, Jean-Pierre. *see* Brouillet, Luc
Some notes regarding pollination in a New Hampshire population of Podostemum ceratophyllum Michx. (Podostemaceae) 319–321
Sørensen, Paul D., & Penny Matekaitis. A lemon-scented Pycnanthemum (Lamiaceae) 145–146
Sorrie, Bruce A. Distribution and abundance of Eupatorium leucolepis var. novae-angliae 449–454
Spellman, David L. *see* Dwyer, John D.
Steyermark, Julian A., & Francisco Ortega. New records of tree ferns from Venezuela 141–143
Stigmatopteris paludosa, *comb. nov.* 136
Storks, Irene M. *see* Crow, Garrett E.

Stuckey, Ronald L. *see* Roberts, Marvin L.

Studies on the Gymnocarpium robertianum complex in North America 421–431

Stutts, John G. Taxonomic revision of Pollalesta H.B.K. (Compositae:Vernonieae) 385–419

Stutts, John G., & M. A. Muir. Taxonomic revision of Piptocoma Cass. (Cosmpositae:Vernonieae) 77–86

Synoptic classification and pollen morphology of Vernonia (Compositae: Vernonieae) in the Old World 59–75

Taxonomic and nomenclatural notes on ferns 133–137

Taxonomic and nomenclatural notes on the flora of Isla de los Estados (Staten Island), Tierra del Fuego, Argentina 477–519

Taxonomic revision of Pollalesta H.B.K. (Compositae:Vernonieae) 385–419

Taxonomy of the genus Euthamia. The, 551–579

Taxonomic revision of Centratherum and Phyllocephalum (Compositae: Vernonieae) 1–24

Tectaria 136. **T. Amphiblestra,** *nom. nov.;* **T. panamanensis,** *comb. nov.;* **T. pedata,** *comb. nov.;* **T. pinnata,** *comb. nov.;* **T. prolifera,** *comb. nov.*

Tennessee. Further additions to some notes on the flora of the southern states, particularly Alabama and middle, 301–315

Tetraphis geniculata: a new location for a rare moss in New England 156–157

Tierra del Fuego, Argentina. Taxonomic and nomenclatural notes on the flora of Isla de los Estados (Staten Island), 477–519

Trachypteris induta, *comb. nov.* 137

Tryon, Alice. *see* Tryon, Rolla

Tryon, Rolla, & Alice Tryon. Taxonomic and nomenclatural notes on ferns 133–137

Typification of the genus Forestiera (Oleaceae). The, 465–470

Uinta Basin of Utah. Astragalus section Desperati (Leguminosae) and a new species from the, 455–460

United States. Hydrocharis morsus-ranae (Hydrocharitaceae): new to the, 147–148

Utah. Astragalus section Desperati (Leguminosae) and a new species from the Uinta Basin of, 455–460

Veerasethakul, Sudaratana, & J. Stuart Lassetter. Karyotype relationships of native New World Vicia species (Leguminosae) 595–606

Venezuela. New records of tree ferns from, 141–143

Vernonia (Compositae:Vernonieae) in the Old World. Synoptic classification and pollen morphology of, 59–75

Vicia species (Leguminosae). Karyotype relationships of native New World, 595–606

Welsh, Stanley L. *see* Neese, Elizabeth

Wheeler, Gerald A. New records of Carex in Minnesota 119–124

Whitkus, Richard. Chromosome numbers of some northern New Jersey Carices 461–464

Wilbur, Robert L. The typification of the genus Forestiera (Oleaceae) 465–470

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CONTENTS

Taxonomic and nomenclatural notes ont he flora of Isla de los Estados (Staten Island), Tierra del Fuego, Argentina
T. R.Dudley 477

An ecogeographical analysis of the distribution of Aster acuminatus Michaux and A. nemoralis Aiton (Asteraceae:Astereae)
Luc Brouillet and *Jean-Pierre Simon* 521

The taxonomy of the genus Euthamia
David J. Sieren 551

The Physostegia purpurea-leptophylla-denticulata problem: taxonomic and nomenclatural clarification
Philip D. Cantino 581

Karyotype relationships of native New World Vicia species (Leguminosae)
Sudaratana Veerasethakul and *J. Stuart Lassetter* 595

Literature for New England botanists 607

Index 609