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A NEW SPECIES OF *VIOLA* (VIOLACEAE) FROM THE GUADALUPE MOUNTAINS, TRANS-PECOS TEXAS

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ABSTRACT

The only yellow-flowered *Viola* known to exist in the Guadalupe Mountains, Texas, is described as **V. guadalupensis**. The rock-dwelling new species is known from a single, small limestone formation on the East Rim of the mountains, and is an immediate candidate for endangered status. The new species is related to *V. vallicola* and *V. nuttallii* of northern New México and western United States, and is also similar to *V. painteri* of northern México.

RESUMEN

La única *Viola* con flores amarillas en las montañas Guadalupes, Texas, se describe como **V. guadalupensis**. La especie, que vive (existe) entre las piedras, se reconoce de una sola, pequeña formación de piedra caliza en la Orilla al Este de las montañas, y es candidata imediate para estado o posición de peligro. La nueve especie esta relacionada a *V. vallicola* y *V. nuttallii* del norte de nuevo México y el oeste de los Estados Unidos, y es también semejante a *V. painteri* del norte de México.

During the course of photographic studies of plants in Guadalupe Mountains National Park, Ranger Brent Wauer discovered an undescribed yellow-flowered violet growing in one small rock formation along the East Rim of the Guadalupe Mountains. Photographic, ecologic, and other data in addition to those presented below for the new species of *Viola* are included in the extensive photographic collection of plants housed in Guadalupe Mountains National Park headquarters at Pine Springs.

VIOLA **guadalupensis** A.M. Powell and B. Wauer, sp.nov. Fig. 1.

Plantae perennes quasi glabrae usque ad 10 cm altae. *Laminae foliorum ovatae vel ovati-lanceolatae, 1.2 – 2.4 cm longae, 0.7 – 1.2 cm latae, glabrae* vel trichomatibus paucis secus venas paginarum infernorum, *margines integrae vel parce crenatae in dimidio proximali. Corolla flava, petala 7 – 10 mm longae*, petalum infernum venis prominentibus brunneis; styli ca 1.5 mm longi capitati. *Fructus stramineus 3.0 – 4.5 mm longus; semina ovoidea ca 2 mm longa.*

Perennial in small openings of *limestone rock face*, plants to 10 cm tall. Stems glabrous, $1-4$ cm long (those parts collected from rock openings). Leaves caulescent; petioles glabrous, $2-6$ cm long; stipules $3-11$ mm long, $0.5-1.8$ mm wide, lanceolate to ovate- or oblong-lanceolate, or linear, whitish to greenish and thin, sparingly glandular-fimbriate; *blades ovate to triangular-ovate or ovate-lanceolate, $1.2-2.4$ cm long, $0.7-1.3$ cm wide, glabrous* or with a few short hairs especially along veins underneath, the margins entire or with $1-3$ crenations on lower half, apex acute to rounded, the tip rather obscurely callused, the *base broadly cuneate* to rounded or truncate. Flowers borne among or above the upper leaves, pedicels-peduncles $3.5-6$ cm long, glabrous, slender; sepals glabrous, linear to linear-lanceolate, $3.5-5$ mm long, margins scarious, the base truncate or rounded to subauriculate; *corollas yellow, fading reddish brown*, some of the petals smeared reddish-brown outside, inconspicuously brown-veined (middle veins) near base and inside on lateral petals, *prominently brown-veined* (middle and diverging veins) *on lower (spured) petal*, the petals $7-10$ mm long, the two lateral petals bearded inside; spur $1-1.3$ mm long; anthers $1.5-2$ mm long; terminal appendages $1-1.4$ mm long; nectariferous spurs ca 1 mm long; styles ca 1.5 mm long, capitate, with short hairs on 2 margins. Fruit greenish, maturing tan, glabrous, $3-4.5$ mm long; *seeds ovoid, ca 2 mm long, light brown*, with a *well developed caruncle*, off-white to tanish in color, extending back along the seed from nearly one-half to almost the entire length of the seed.

TYPE: TEXAS. CULBERSON CO.: Guadalupe Mountains of Guadalupe Mountains National Park, N side of prominent rock face (no map name), along E Rim, 1.48 km N, 1.0 km E of the summit of Hunter Peak; ca 35 scattered plants on a 7 X 10 m rock face sheltered by vegetation; elev. 2600 m (8000 ft); collected by B. Wauer who found plants growing in "bullet-hole" openings in rock faces where roots could not be collected without damage; 12 May 1988, *A.M. Powell and B. Wauer* 5497 (HOLOTYPE: SRSC; ISOTYPE: TEX).

Known only from the type collection.

Viola guadalupensis is named after the only mountain range in which it is known to occur. In fact, the plants are known only from one northwest-facing dolomitized limestone outcrop (with small ledges), shaded by *Pseudotsuga menziesii* (Douglas Fir), on the East Rim of the Guadalupe Mountains. Associated plant species on the rock outcrop include *Petrophytum caespitosum, Valeriana texana, Pinaropappus parvus, Chaetopappa hersheyi, Stipa lobata*, and *Carex* sp., and at the base of the rock outcrop *Fendlerella utahaensis, Ptelea trifoliata, Cercocarpus montanus*, var. *argenteus, Fendlera rupicola, Amelanchier utahensis, Physocarpus monogynus*, and *Cheilanthes* sp. The second author has carefully examined other seemingly suitable habitats in the Guadalupe Mountains including those along about 8 km (5

FIG. 1. Habit of *Viola guadalupensis*, Guadalupe Mountains, Texas.

mi) of the East Rim from the top of Bear Canyon to Lamar Canyon without locating any additional plants. The entire known population of *V. guadalupensis* comprises about 35 individuals in the one site.

Two other species of *Viola* are known to occur in the Guadalupe Mountains, *V. lovelliana* Brainerd and *V. missouriensis* Greene, both blue-flowered taxa (Correll and Johnston 1970; Russell 1965; Burgess and Northington 1981). *Viola guadalupensis* is the only known yellow-flowered violet in the Guadalupe Mountains, and it appears to be related to *V. vallicola* A. Nels. and *V. nuttallii* Pursh, yellow-flowered species of the western United States with closest distribution in southern Colorado or northern New Mexico (Martin and Hutchins 1984; Fabijan et al. 1987). *Viola guadalupensis* differs from *V. vallicola* and *V. nuttallii* by its rock-dwelling habit, leaf characters (especially the blade shape and pubescence), fruit size, and seed morphology (Table 1). *Viola guadalupensis* also exhibits generally smaller vegetative and floral features than *V. vallicola* and *V. nuttallii*. Morphological traits suggest closest relationship with the diploid *V. vallicola*. A chromosome count of *V. guadalupensis* will be very helpful in clarifying its relationship in the *V. nuttallii* complex (Fabijan et al. 1987, Baker 1957).

Viola guadalupensis is also similar to the yellow-flowered *V. painteri* Rose & House, a species of pine-fir woodlands in the Sierra Maderas del Carmen in Coahuila, south to Oaxaca, in Mexico (Rose and House 1905, Henrickson, pers. comm.). *Viola painteri* and *V. barroetana* Schaffner may be the only yellow-flowered violets in northern Mexico (Nesom, pers. comm., Baker 1957). *Viola guadalupensis* is delimited from *V. painteri* by its rock-dwelling habit, glabrous herbage, ovate to ovate-lanceolate leaf blades that are smaller and narrower with margins entire or sparingly crenate on the lower half, apexes acute or rounded, broadly cuneate to rounded or truncate leaf bases, shorter sepals and petals, and smaller fruits and seeds. *Viola painteri* has herbage glabrous to pubescent, leaf blades cordate to reniform, 1 − 3(-5) cm long, 1 − 2(-4) cm wide, apexes acute, bases cordate, margins evenly crenate-serrate, fruit 7 − 9 mm long, and seeds ca 2.5 mm long. Baker (1957) suggests that *V. vallicola* may have arisen from *V. barroetana* although Fabijan et al. (1987) do not discuss this possibility, and we have not compared *V. guadalupensis* with *V. barroetana*.

ACKNOWLEDGMENTS

We are grateful to Guy Nesom who provided the Latin translation, information about the general distribution of yellow-flowered violas in Mexico, and corrections to the manuscript, and to Jim Henrickson who made available the treatment of *Viola* for the Chihuahuan Desert Flora.

TABLE 1. Some distinguishing features of *Viola guadalupensis* and related species.

	V. GUADALUPENSIS	V. VALLICOLA	V. NUTTALLII
Substrate	Rock crevices	Soils	Soils
Leaf blades	Ovate to triangular-ovate or oblong-lanceolate, 1.2 − 2.4 cm long, 0.7 − 1.3 cm wide, the base broadly cuneate to rounded or rarely truncate, glabrous throughout or with a few short hairs along veins underneath, margins entire or 1 − 3-crenate on lower half	Ovate to oblong-ovate, 1.9 − 7 cm long, 0.9 − 3 cm wide, the base truncate to subcordate, sparsely to densely puberulent throughout or glabrous, but often puberlent along veins and margins if glabrous on the surfaces, margins usually ciliate, entire to crenulate	Mostly lanceolate, 2.5 − 7.5 cm long, 0.6 − 3.2 cm wide, the base attenuate, surfaces glabrous to rather sparsely puberulent especially along the veins underneath, margins ciliate, entire to crenulate mostly on lower half
Fruit	3 − 4.5 mm long, glabrous	(5)6 − 8 mm long, glabrous to densely puberulent	7 − 11 mm long, glabrous to puberulent
Seeds	ca 2 mm long 1.2 − 1.4 mm wide, ovoid with an off-white to tanish caruncle well developed (not distally flattened) and extending back along the seed from nearly one-half to almost the entire length of seed	2.2 − 2.7 mm long, 1.2 − 1.5 mm wide, ovoid with a whitish caruncle ca 0.8 mm long and distally flattened	2.8 − 3 mm long, 1.5 − 1.8 mm wide, ovoid, with a whitish caruncle, ca 1 mm long and distally flattened
Chromosome Number	Unknown	$2n = 12$	$2n = 24$

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AN EXPLANATION FOR THE DISCREPANCY IN THE CHROMOSOME COUNT OF THE REDBUD (*CERCIS CANADENSIS*, LEGUMINOSAE)

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ABSTRACT

Varying chromosome counts of *Cercis canadensis* L. have been reported in the literature, i.e., $n = 6$ and $n = 7$. Squash preparations of pollen parent cells from native trees in southwestern Ohio confirm the count of $n = 7$. However, past segmental interchanges between nonhomologues are the assumed cause of occasional structural connections observed between two or more bivalents during meiosis. The viewing of such connected chromosomes, perhaps superficially appearing as a unit structure, might result in an erroneous count, such as $n = 6$.

A plant species with a low number of chromosomes usually does not present special difficulty in the determination of chromosome number unless aneuploidy or dysploidy exists in its populations (cf. *Claytonia virginica*, Lewis 1967). *Cercis canadensis*, a woody legume, is not known to be aneuploid or dysploid, yet different base chromosome numbers have been reported. Senn (1938) reported $n = 6$ and $2n = 12$, based on both meiotic and mitotic counts at the Blandy Experimental Farm, Virginia. These counts had impact in the framework of Senn's pioneering work on legume cytology in relation to phylogeny. However, Taylor (1967) reported $n = 7$ for *Cercis canadensis* from a "shrub of unknown origin in Dominion Arboretum. Ottawa." Curtis (1976) subsequently reported $n = 7$ from a specimen cultivated at the Missouri Botanical Garden, and suggested that the $n = 6$ determination (by Senn) was incorrect. But would a diligent worker such as Senn have made an actual miscount on a species as seemingly simple chromosomally as the redbud? The argument takes on additional significance in light of Goldblatt's (1981) view of *Cercis* as a diploid ($2n = 14$, $n = 7$, $x = 7$) relict in the subfamily Caesalpinioideae, most members of which are presumably tetraploids — often $n = 14$, but some $n = 12$! In *Cercis*, the ancestral diploid condition is considered to be retained, not only in context of the caesalpinioids, but in that of the legumes as a whole. However, does variation in the chromosome number of *Cercis* occur? Is it uniformly $n = 7$ as one would suspect, or do counts of $n = 6$ exist as well?

Over the course of three successive springs (centering around early

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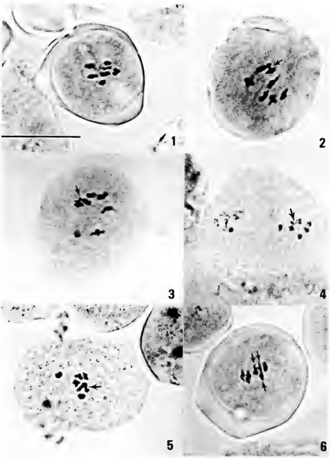
April), I obtained meiotic pollen parent cell (PPC) counts from four trees at different locations among the native populations of redbud in southwestern Ohio (Butler County). These specimens are vouchered in the Herbarium of Miami University (MU). Standard aceto-carmine smear methods were employed in all cases. Prior to staining, flower buds were fixed in modified Carnoy's solution (4 parts chloroform, 3 parts absolute ethanol, and 1 part glacial acetic acid). Buds containing appropriate meiotic stages were collected typically between 7:00 and 7:30 A.M.

I was surprised by finding apparent counts of $n = 7$, $n = 6$, and even lower numbers, in all trees (Figs. $1-6$). However, careful anaylsis by oil-immersion light microscopy, photography, and enlargement of photographic prints revealed that the actual count is $n = 7$ (Fig. 1). This count ($n = 7$) could be documented in the case of each tree. In the squashes, however, associations were rather commonly observed between two or more of the bivalents during at least the first prophase/metaphase of meiosis I. These associations may occur to an extent that chiasma-like structural connections exist for a time between nonhomologues (Figs. $2-3$). These connections may persist, as observed between nonhomologous univalents in telophase of meiosis I (Fig. 4). The fact that some cells in a given smear show only unassociated bivalents, while others show apparently catenated chromosomes, is not altogether surprising because plants with reciprocal translocations can occasionally produce a "normal" complement of bivalents at meiosis (reported, but as rare, in *Collinsia heterophylla* by Garber and Dhillon 1962). Regardless, the associations in *Cercis canadensis* provide some evidence of a past (perhaps long past) segmental interchange (Burnham 1956) between two or more of the chromosome pairs.

Associations between nonhomologous chromosomes are known within another member of the legume family (lines of garden pea, *Pisum sativum*, $n = 7$, cf. Sansome 1932). Although similar to those of the garden pea, the associations in redbud are not as consistently present, nor necessarily as definitive. The chromosomal connections in *Cercis* are nonetheless in some cases striking enough to result in the appearance of a chain of four (or more) chromosomes at diakinesis (Fig. 5). This chain in redbud bears a close resemblance to the often-cited, excellent photographic illustration of a translocation chain or ring of four chromosomes described by Brown (1949) in irradiated tomatoes. That the associated chromosomes in *Cercis* are merely connected at a point (Figs. $2-3$) and appear at most connected as a chain (Fig. 5) and not as an actual ring is probably indicative of the past interchange of only small chromosomal segments (Burnam 1932). Nonetheless, to a cytotaxonomic investigator who had not studied the situation in *Cercis*, a count other than the correct one of $n = 7$ might be made,



FIGS. 1 – 6, PPC's of *Cercis canadensis*: Fig. 1, late prophase of meiosis division I, $n = 7$. Figs. 2 – 3, late prophase of meiosis I; note connections between two bivalents (arrows). Fig. 4, telophase of meiosis I; note persistence of connection between two univalents (arrow). Fig. 5, late prophase of meiosis I; note apparent count of six due to chromosome chain involving two bivalents (arrow). Fig. 6, metaphase of meiosis I; count of four or five is possible due to interconnection of bivalents (arrows). Scale bar, 20 μm; all photographs are at same magnification.

especially if a cell such as that in Figure 5 would be encountered. Even if bivalents are merely "interlocked" (a condition reported as common in diploid species of *Tradescantia*; Sax and Anderson 1933), an opportunity for a miscount would exist. It seems plausible that Senn (1938) encountered either very closely associated, perhaps interlocked, bivalents, or else an actual reciprocal translocation, when he reported his count of $n = 6$ from PPC's. Close spatial association of nonhomologues may give rise to natural reciprocal translocations, (suggested as a possiblility by Sax and Anderson 1933). Such translocations may be observed in somatic tissue as well as cells undergoing meiosis (Burnham 1956). Hence, Senn's $2n$ (somatic) count of 12, made from anther wall tissue, is also understandable in the light of the interpretation(s) presented here. Regardless, the chromosome count of all species of *Cercis*, although perhaps difficult to determine in the case of *C. canadensis*, is apparently $n = 7$, $2n = 14$, as considered by Goldblatt (1981).

Study of the cytology of species of *Cercis* other than *C. canadensis* might prove interesting if only to determine if nonhomologous chromosome associations exist in these as well. Since chromosomal connections due to reciprocal translocations may result in varying levels of reduced fertility (Garber 1948), a study of pollen viability (or an analysis of microspore quartets) might be undertaken as well.

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CRATAEGUS SECRETA (ROSACEAE), A NEW SPECIES OF HAWTHORN FROM THE EDWARDS PLATEAU, TEXAS[1]

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ABSTRACT

A new species of *Crataegus* L. (Rosaceae), C. **secreta** Phipps, is described from west-central Texas in the drier, northwestern parts of the Edwards Plateau. It is now known from at least a five-county area. The new species is compared with candidates in series *Virides* and *Molles* and easily excluded from these series. Its probable affiliation is series *Tenuifoliae*, but this awaits further study.

The Edwards Plateau area of Texas is an important phytogeographical area. Cooler than the Rio Grande Valley to the south and the Gulf Coast Plain to the southeast, considerably more mesic than most of Trans-Pecos Texas to the west and most of the Chihuahan Desert to the south and southwest, it forms a stepping stone between the Cross-Timbers region of eastern Texas and the higher, more mesic parts of the Sierra Madre Oriental in Mexico. Its vegetation is discussed in detail in Amos and Gehlbach (1988). The undulating uplands at around 1500 to 2500 ft. a.s.l. are covered by a mixture of grassland and scrubby dwarf oaks (*Quercus sinuata* var. *breviloba* - Bigelow Oak, *Q. fusiformis* - Texas Live Oak and *Q. texana* - Texas Red Oak) with junipers (especially *J. ashei* and *J. pinchotii*). The valleys, which are often ravine-like, are quite rich in taxa with northern affinities. They are often more mesic, with taller trees. The ranchland ecosystems, however, are not necesarily in anywhere near their ancestral state with the decreased fire regime imposed by modern pastoralism and the introduction of cattle and goats brought about by European settlement. Goats, in particular, may have mediated massive changes in the woody flora. Also to be taken into account are the elimination of the mobile bison and the presumptively large changes in deer population since large predator removal and control of screw-worm larvae.

This interesting area has been explored for hawthorns by the author in recent years with a view to helping to establish the southwesterly limits of American species of *Crataegus* and the northern limits of predominantly

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Mexican species. *Crataegus*, hitherto generally held to be rare in the Edwards Plateau, have recently been demonstrated to be locally common in this region. It is clear that hawthorns are a fairly general feature of the scrub oak woodland (but much less common among junipers) and are not by any means restricted to streams in the Edwards Plateau as formerly believed. Among the species encountered are *C. crus-galli* L., sens. lat. (locally common in the central Edwards Plateau), *C. reverchonii* Sarg. (primarily in the northeastern part of the Edwards Plateau), *C. mollis* (T.&G.) Scheele, sens. lat. (primarily on the eastern margins), *C. tracyi* Ashe ex Egglest. (scattered at higher elevations) and *C. greggiana* Egglest. (extremely rare and seemingly relict). Members of series *Virides* are also found around the southeastern,eastern and northeastern margins of this area.

In view of the generally good state of botanical knowledge of this region it was, therefore, a considerable surprise to encounter a distinctive and apparently unknown species of *Crataegus* in the Edwards Plateau. The new species has been carefully compared with the regional endemics *C. uvaldensis* Sarg. (series *Molles* - close to or conspecific with *C. greggiana*) and *C. desertorum* Sarg. (a xeromorphic form of series *Virides* also described originally from Uvalde) but these are quite different. *Crataegus sutherlandensis*, a Texas endemic from just outside the Edwards Plateau, east of San Antonio, was also considered, and also rejected as being a typical member of series *Virides*. Considering the somewhat isolated nature of the Edwards Plateau, attention was therefore given to regions further afield as possibly having disjunct conspecifics. However,to the immediate west (Trans-Pecos) only *C. tracyi* is known from the Davis Mountains (this species also occurs in the Edwards Plateau). To the south, no Mexican species is a match (Phipps, in preparation). To the north and northeast, therefore, it seemed prudent to consider species described from Oklahama, southwest Arkansas, and eastern Texas.

The new species is nevertheless in many ways closest to *C. greggiana* in general facies. The fine straight thorns, scrubby plant habit and small, some what lobed leaves are all suggestive, as is the red fruit. But the slightly pubescent, or nearly glabrate, plant parts — foliage, young shoots, inflorescence, and fruit — of the new species, are all dissimilar from *C. greggiana* as is the stamen number. *Crataegus brachyphylla* Sarg., from southwest Arkansas, is also an obvious candidate species for comparison but it is also more typically *Molles* in its pubescence. Moreover, in spite of its name, it has substantially larger foliage than the new species. All other members of series *Molles* in the region mentioned may be excluded by their much larger foliage and dense indumentum. Species of series *Crus-galli* are too generally different to warrant even cursory attention. *Crataegus secreta* may be differentiated from the most similar *Crataegus* species discussed by the characters given in Table 1. It will be seen that one of the most similar of those considered is *C. desertorum*. However, Sargent's (1922b) assignment of this taxon to series *Virides* is undoubtedly correct. The other species mentioned in the table are all unquestionably series *Molles*. One is, therefore, left with the conclusion that a distinctive new species of *Crataegus* (even though a statistically unlikely phenomenon, given the number of taxa described already in North America) has been discovered.

The first collection of *C. secreta* may have been Palmer's in 1917 from Menard, Menard Co.; however, this specimen is sterile. The species remained uncollected until 1933 − 35 when a number of specimens from Sutton and Val Verde counties were collected by Cory and by Parks and Cory. McVaugh then collected it in Menard Co. in 1947. The next collection appears to be by Marshall Enquist from Scalp Creek, Menard Co., in April 1986, a specimen of which was donated, along with a collection of other unidentified *Crataegus*, to the author. The recognition that the Scalp Creek hawthorn might be a new species has spurred a minor craze in *Crataegus* collecting in this *Crataegus*-poor region of Texas so that now at least 20 numbers of the new taxon exist in herbaria. Due to the ability of this species to resist scientific detection for so long, I am naming it *Crataegus secreta*. 1930's collections are also reported from Scalp Creek by R. O'Kennon from the University of Texas herbarium but these have not been located by the author.

CRATAEGUS **secreta** Phipps, sp. nov. Fig. 1.

Frutex vel arbor parva, 3 − 6 m alta, spinosa; spinae rectae, ± tenues, ± nigrae, usque ad 4 cm longis; cortex platata. Foliae brachyblastorum ovatae, parvae, brevipetiolatae, 2 − 3 cm longae, distincte lobatae, 3 − 4 paribus venarum secondarium, serratae, in apice acutae, ± truncatae proximale, laeviter pubescentes (praecipue supra) ubi juvenes, glabrescentes, petiolis brevibus; foliae surculorum elongationum magniores, magis profunde lobatae, carentes venas in sinibus. Anthesis vernalis (in Aprilem); inflorescentia panicula subconvexa, ferens ca 4 − 10 flores albas, ramuloris pedicellisque sparsim pubescentibus; lobi calycis 2 − 3 mm longi, triangulati, pubescens adaxiale, marginibus ± integris (glandulis stipitatis); petala orbiculares, ca 5 mm longa; stamina ca 15, antheribus purpureis; stigmata, styli et carpella (4-) 5; fructus pomum rubrum, parum oblatus, ca 1 cm diametro, carine farinosi, pyrenibus 5, dorsale sulcatibus.

Bush to small tree 3 − 6 m tall, thorny; thorns straight, ± fine, blackish, to 4 cm long; bark plated. Leaves of short shoots ovate, small, short-petiolate, 2 − 3 cm long, distinctly lobed, with 3 − 4 lateral nerves, serrate, acute at the apex, ± truncate below, slightly pubescent (especially above when young, glabrescent; leaves of shoots of elongation larger, more deeply lobed, lacking veins to the sinus. Flowering in spring (April), in-

TABLE 1. Comparison of *Crataegus secreta* Phipps with selected congeners.

	C. SECRETA	C. GREGGIANA Egglest. (1909)	C. BRACHYPHYLLA Sarg. (1922a)	C. UVALDENSIS Sarg. (ex litt.) (1922b)	C. DESERTORUM Sarg. (1922b)
Series	? Tenuifoliae	Molles	Molles	Molles	Virides
Distribution	Tx: Menard, Mason, Schleicher, Sutton, Val Verde cos.; ? Jeff Davis Co.	Tx: Edwards Plateau (rare); Mexico: Sierra Madre Oriental	Ark: Hempstead Co.	Tx: Uvalde Co.	Tx: Uvalde Co.
Leaf:					
length	2 cm	2 cm	$5-7$ cm	$4-5$ cm	cm $1.5-2$ cm
shape	± ovate	ovate	broad-ovate	ovate	ovate to obovate
pubescence (young)	subglabrous	densely pubescent	densely pubescent	pubescent	pubescent
Hypanthial pubescence	glabrous	densely pubescent	densely pubescent	densely pubescent	glabrous
Calyx lobe margin	± entire, with stipitate glands to glandular-serrate	irregularly glandular-serrate	laciniately glandular-serrate	irregularly glandular-serrate	obscurely serrate
Stamen no.	ca 15	10	20	$5-10$	20
Anther					
colour	purple	pink	deep rose	?	pale yellow
Style no.	(4-) 5	5	3	$3-5$	$4-5$
Fruit:					
diameter	10 mm	10 mm	$10-12$ mm	$10-14$ mm	$4-5$ mm
colour	red	deep red	dull dark red	bright red	orange-red

florescence a flattish, convex panicle, bearing about $4-10$ white flowers, branches and pedicels sparsely pubescent; calyx lobes $2-3$ mm long, triangular, adaxially strigose-pubescent, margins ± entire to glandular-serrate, or entire with some stipitate glands; petals ± circular, about 5 mm long; stamens ca 15, anthers purple; stigmas, styles and carpels (4-) 5; fruit a red pome, slightly oblate, ca 1 cm diameter, flesh mealy; pyrenes 5, dorsally ribbed.

TYPE: TEXAS.: **Menard Co.**: creekside ca 5 mi E of Menard, 2000 ft, 15 Apr 1988, *J.B. Phipps, M. Enquist and R. O'Kennon 6123* (HOLOTYPE: UWO; ISOTYPES: to be distributed); the same tree collected in fruit is *J.B. Phipps* and *R. O'Kennon 6233*, 13 Oct 1988 (UWO). Five other specimens have been collected at the above site. *M. Enquist s.n.*, Apr 1987 (UWO), and 9 Apr 1986 (TEX) represent earlier collections of this taxon from the same location.

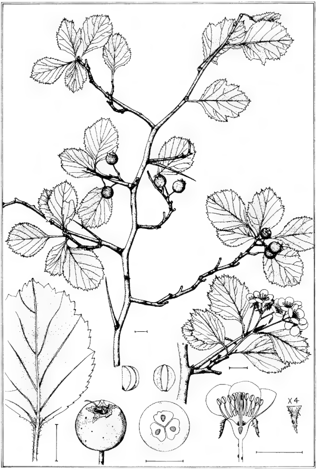

FIG. 1. Line drawing of *Crataegus secreta* Phipps, sp. nov. Fruiting branch, fruit and pyrenes from *J.B. Phipps 6233*; flowering shoot and flower parts from *J.B. Phipps 6121*; leaf from *J.B. Phipps 6121*. Scale bars 1 cm. Susan Laurie-Bourque del.

Other specimens examined: TEXAS: **Mason Co**: 1 km N of Katemcy, 1880 ft, scrub along creek bed, 15 Apr 1988, *Phipps and O'Kennon 6127* (UWO); 14 Oct 1988, *Phipps and O'Kennon 6243* (same location) (UWO); 1.6 mi S of jct. 1851 and 1222, west side of road, along Sandy Creek, A. W. Edmiston property, 27 Apr 1989, *Enquist 1076* (TEX-LL, UWO). **Menard Co.**: Route 83, 1 mi S of jct. with Tx 29, 2000 ft, *Phipps, Enquist and O'Kennon 6121*, 15 Apr 1988 (UWO); *Phipps and O'Kennon 6239* represents the same plant in fruit, 1 Oct 1988 (UWO); on bluffs of San Saba River near Ft. McKavett, 4 Apr 1989, collected in bud and forced, *Phipps, Enquist and O'Kennon 6318* (UWO); wooded bottom of San Saba R., near crossing of Ft. McKavett Rd., 17 mi S of west of Menard, scarce, 12 May 1947 *R. McVaugh 8787* (SMU). **Schleicher Co.**: W of Fort McKavett, 3.2 mi W of jct. with hwy. 864, first crossing of Middle Valley Prong of San Saba River, 19 Apr 1989, *Enquist 996* (TEX-LL, UWO). **Sutton Co.**: 30 mi SW of Sonora, 4 Apr 1933, *V. L. Cory 5505* (TAES); Aldwell Bros. (? ranch), 21 Apr 1934, *H.B. Parks and V.L. Cory 8433 and 8434* (TAES); south-west quadrant ... near Dry Devil's River, 19 Apr 1989, *Enquist 717,732* (TEX-LL, UWO); SW quadrant, by Granger Draw Road near crossing of Dry Devil's River, 19 Apr 1989, *Enquist 720* (TEX-LL, UWO). **Val Verde Co.**: NE quadrant, on the floodplain of the Devil's River, 19 Apr 1989, *Enquist 710* (TEX-LL, UWO); 11 mi NE of Juno, 4 Jun 1939, *H.B. Parks and V.L. Cory 31678* (TAES) -doubtful ID, specimen badly damaged by herbarium beetle. It appears that *E. J. Palmer 11889* (A) from "low woods on the San Saba River, Menard, Menard Co., May 12, 1917 "may also be *C. secreta*. Since this specimen is sterile, it is not easily rejected from *C. uvaldensis*. However, it is within the area of distribution for *C. secreta*. *Enquist 1144* (UWO) from Musquiz Canyon, Jeff Davis County may represent the same species but confirmatory material is required.

I would like to propose the vernacular name 'Plateau Hawthorn' for *Crataegus secreta*.

Crataegus secreta has now been found at several sites in Menard, Mason, Schleicher, Sutton and Val Verde counties. It occurs near creek beds and in the shade of oak trees, always,so far as is understood, in rangeland. *Crataegus secreta*, although hardly common, is not believed to be under threat, due to a compatable type of land-use in its natural habitat. It should be searched for in adjacent counties.

The serial affiliation of *C. secreta* is not clear. On *prima facie* grounds assignment to series *Tenuifoliae* seems obvious. These are very 'median' American hawthorns with ± ovate, relatively small, shallowly lobed leaves, a modest amount of pubescence, quite thorny, with thorns of median length, flowering early-midseason, with smallish flowers, fruit red of medium size, spherical, with unpitted pyrenes. These characteristics all apply to *C.secreta*. However, if *C. secreta* were to be assigned to *Tenuifoliae* then its somewhat xeromorphic characteristics, particularly short-petiolate leaf, and fine, straight thorns, as well as the precise leaf shape with its unusual lobing would make it the most distinctive members of the series. Furthermore, *Tenuifoliae* are not primarily either a southern or a xeromorphic series. Affiliation with series *Virides* is however, easily rejected where the central tendencies of *Virides* are concerned: the leaves (though usually small) are usually evenly lobed (or sometimes unlobed) and the plants are

± glabrate, not usually very thorny, calyx lobes ± entire, with twenty stamens and ivory anthers, and small, ± shiny, orange-red fruit. However, Texas *Virides* can be found with blood-red fruit (a deeper color than *C. secreta*) but these are more succulent and shiny than *C. secreta*. Also the sometimes lobed leaf shape in forms assigned to *C. desertorum* and *C. sutherlandensis* together with a greater thorniness than typical *Virides*, may resemble *C. secreta*, but then the fruit and calyx are quite wrong. The aforementioned taxa in the series *Virides* (together with other members of series *Virides*) occur around the southern and eastern margins of the plateau. *Crataegus secreta* also has some striking resemblances to the small-leaved *Molles* species *C.greggiana* Egglest. particularly in leaf size, thorniness (a very close match) and fruit characteristics (bright red when ripe, though slightly smaller than in *C. greggiana*), with mealy, not succulent flesh. But then the leaf shape is different and also *C. secreta* lacks the dense pubescence of all parts that (especially while young) so thoroughly characterize the *Molles* series. *C. greggiana*, of course, occupies the most generally xeric habitats of all North American *Crataegus* and occurs, although scarcely, on the Edwards Plateau. The stamen number (15) of *C. secreta* is midway between that of *C. greggiana* (10) and series *Virides* (20). It is not unreasonable, therefore, to suppose that *C. secreta* is of *Molles* × *Virides* hybrid origin for its characters fall midway between these two series, but this hypothesis must await detailed biosystematic and morphometric analysis. If this hybrid hypothesis is true, then resemblances to series *Tenuifoliae* are coincidental. However, even if of hybrid origin, *C. secreta* has the marks of a good species, being rather uniform over a five (or six, if Jeff Davis be included) county area of distribution and not merging into any other Texan species. Therefore, for the time being, it seems wise to leave *C. secreta* unassigned.

ACKNOWLEDGMENTS

Thanks to Wm. F. Mahler (SMU) for information on Edwards Plateau ecology and for wide ranging searches by Marshall Enquist during the rediscovery phase. I would also like to thank Bob O'Kennon and Marshall Enquist for their comments on the first draft of this paper, January 1989.

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THE ALPINE-SUBALPINE FLORA OF NORTHEASTERN MÉXICO

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ABSTRACT

A floristic list of angiosperms found above or in association with timberline vegetation in northeastern México is presented. The flora doubles the number of alpine-subalpine species previously reported for the region, and extends the known distribution of this vegetation type. Included are 170 species, representing 119 genera and 46 families.

RESUMEN

Se presenta un listado floristico de angiospermas que existen en los límites arboreos de zonas altas en el nordeste de México. Se reconoce el doble del numero de elementos alpino-subalpinos reportados para la region en trabajos anteriores, y se extiende la distribucion conocida de este tipo de vegetacion. Se reconocen 170 especies, 119 generos y 46 familias.

The isolated presence of timberline vegetation in northeastern México was recognized by Muller (1939), and has since been subjected to few studies. Beaman & Andresen (1966) characterized in detail the ecological and floristic aspects of Cerro Potosí, Nuevo Leon, one of several prominent peaks in the region. Alpine meadow dominated by chamaephytes and hemicryptophytes is encountered on Cerro Potosí from 3620 − 3700 m, and subalpine meadow composed primarily of erect forbs and cespitose grasses is found as low as 3460 m. A unique form of subalpine vegetation dominated by dense, shrubby stands of *Pinus culminicola* Andresen & Beaman often intercedes the *Pinus hartwegii* Benth. forests and alpine meadow as low as 3450 m. Based on the above characterizations of alpine and subalpine zones, and their associated elevational limits, one would suspect these vegetation types to be more widespread, as the region includes several ranges that reach from 3450 − 3700 m. Contrary to suggestions that Cerro Potosí is the sole center for alpine-subalpine vegetation in northeastern México (Beaman & Andresen, 1966), recent explorations of high elevational ranges revealed a more complex and widespread timberline flora.

The timberline vegetation of northeastern México includes three discreet centers (Fig. 1). The northern center begins 36 km east of Saltillo in the northernmost extensions of the Sierra Madre Oriental. The closely spaced Sierra Coahuilon, Sierra La Marta and Sierra La Viga provide refugia for alpine or subalpine elements along their ridges and upper, southern ex-

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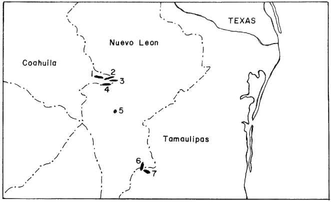

	LAT. N.	LONG. W	ALTITUDE
[1]SIERRA LA VIGA	25 21'	100 33'	3700 m
[2]SIERRA POTRERO DE ABREGO	25 19'	100 22'	3460 m
[3]SIERRA COAHUILON	25 14'	100 20'	3500 m
[4]SIERRA LA MARTA	25 12'	100 22'	3700 m
[5]CERRO POTOSI	24 53'	100 15'	3700 m
[6]SIERRA PENA NEVADA	23 48'	99 51'	3640 m
[7]SIERRA BORRADO	23 47'	99 51'	3460 m

FIG. 1. Distribution of alpine-subalpine sites explored in northeastern México, including their altitudes, latitudes and longitudes. Underlined localities included in floristic list.

posures from 3400 – 3700 m. The second center for timberline vegetation, Cerro Potosí, occurs as a singular peak 38 km to the south of Sierra La Marta. Present day maps (DETENAL, Joint Operations Graphic maps, Department of Commerce Operational Navigation Charts) generally place Cerro Potosí at 3700 m, about equal in elevation to Sierra La Marta, the closest point of alpine-subalpine contact to the north. The third and southern center for timberline vegetation is located 125 km south of Cerro Potosí, including Sierra Borrado and Sierra Peña Nevada (Fig. 1). The latter peaks are generally reported to reach 3400 and 3650 m, respectively. As predicted by Muller (1939), Sierra Peña Nevada also provides satisfactory habitat for shade intolerant, timberline species, which are distributed sporadically with stunted individuals of *Pinus hartwegii* along the ridges and uppermost southeast and southwest exposures of the range. Sierra Borrado, though excluded in the floristic list due to its lack of an established subalpine vegetation, deserves mention since many subalpine species are encountered on its upper and relatively open, eastern exposures.

Fieldwork was undertaken during summer months from 1984 – 86. All sites were visited at least once at the beginning of the flowering season (June), during the peak of the flowering season (July – August), and during the fruiting months (September – October). In addition to the author's collections, complementary material was studied at TEX, where a significant collection of the Northeast Mexican flora has been accumulated in recent years. Near complete sets of the author's collections are deposited at MEXU and TEX, and incomplete sets are at UAT, WIS and XAL.

While Beaman & Andresen (1966) reported 81 species for Cerro Potosí, the updated list includes 170 species for the alpine-subalpine vegetation of northeastern México. A few additional species are added to the list for Cerro Potosí, and most species previously listed as endemic to the peak are present and often prevalent in the other timberline refugia. A forthcoming study will analyze in more depth, based in part on the distributional data presented here, the phytogeographic relationships among various alpine-subalpine peaks of northern México (McDonald, in press).

Floristic List

	PN	PO	MA	CO	VI
AGAVACEAE					
Agave macroculmis Tod.	X	X			
BORAGINACEAE					
Hackelia leonotis I. M. Johnston		X			X
Lithospermum sordidum Brand.	X	X			
Onosmodium dodrantale I.M. Johnston	X	X	X		
CAMPANULACEAE					
Campanula rotundifolia L.	X	X	X	X	X
CAPRIFOLIACEAE					
Symphoriocarpus microphyllus H.B.K.	X	X	X	X	X
CARYOPHYLLACEAE					
Arenaria lanuginosa Rohrb.	X	X	X	X	X
Arenaria cf. *lycopodioides* Willd. ex Schlecht.	X				X
Arenaria cf. *oresbia* Greenm.	X	X	X	X	X
Cerastium brachypodum (Engel. ex A. Gray) Robins.	X	X	X	X	

PN = Pena Nevada, PO = Cerro Potosí, MA = Sierra La Marta, CO = Sierra Coahuilon, VI = Sierra La Viga

(Floristic List continued)	PN	PO	MA	CO	VI
Stellaria cuspidata Willd.	X	X		X	X
Silene laciniata Cav.	X		X	X	X
CELASTRACEAE					
Paxistima myrsinites Raf.	X		X	X	X
COMMELINACEAE					
Commelina tuberosa L.	X				
COMPOSITAE					
Achillea millefolium L.		X	X	X	X
Ageratina oreithales (B.L. Rob.) B. Turner	X	X	X		X
Ageratina campylocladia (B.L. Rob.) B. Turner				X	
Antennaria parvifolia Nutt.		X			
Astranthium beamanii De Jong		X			
Bidens triplinervia H.B.K.	X		X	X	X
Brickellia nesomii B. Turner	X	X		X	
Brickellia coahuilensis (A. Gray) Harcombe & Beaman	X		X	X	X
Brickellia hintoniorum B. Turner			X	X	X
Chaetopappa parryi A. Gray	X				X
Cirsium novoleonense G. Nesom (in prep)	X	X	X	X	X
Dugaldia pinetorum (Standl.) Bierner		X			
Erigeron hintoniorum Nesom (in prep)		X	X	X	
Erigeron onofrensis Nesom (in prep)	X				
Erigeron potosinus Standl.		X			X
Erigeron pubescens H.B.K.		X	X		X
Erigeron wellsii Nesom	X				
Gnaphalium hintoniorum B. Turner (in prep)	X	X	X	X	X
Grindelia inuloides Willd.	X	X		X	X
Helianthella quinquenervis (Hook.) Gray		X		X	
Heterotheca mucronata Harms ex Turner			X		
Hieracium dysonymum Blake	X	X	X	X	
Hymenoxys ursina Standl.		X			X
Hymenopappus hintoniorum B. Turner				X	
Machaeranthera odysseus Nesom	X				
Senecio bellidifolius H.B.K.	X				
Senecio carnerensis Greenm.	X	X	X	X	X
Senecio coahuilensis Greenm.	X	X	X	X	X
Senecio hintoniorum B. Turner		X			
Senecio loratifolius Greenm.	X	X	X	X	X
Senecio madrensis A. Gray	X	X	X	X	X
Stevia pilosa Lag.	X				
Tagetes lucida Cav.	X				
Taraxacum officinale Weber in Wigg.			X	X	X
Thelesperma graminiformis (Sherff) Melchert (in prep)	X				

(Floristic List continued)	PN	PO	MA	CO	VI
Thelesperma mullerii (Sherff) Melchert (in prep)		X			
Zaluzania megacephala Sch.-Bip.	X				
CRASSULACEAE					
Sedum chrysicaulum McDonald (in prep)	X	X	X	X	X
Sedum papillicaulum Nesom (in prep)	X				
Sedum clausenii Nesom (in prep)			X	X	X
Villadia cuculata Rose	X	X		X	X
Villadia misera (Lindl.) R. Clausen			X	X	
Echeveria cf. *simulans* Rose			X	X	
CRUCIFERAE					
Draba helleriana Greene	X	X	X	X	X
Erysimum capitatum Greene	X	X	X	X	X
Pennelia longifolia (Benth.) Rollins	X		X	X	
Thlaspi mexicanum Standl.	X	X			
CUPRESSACEAE					
Juniperus monticola Martinez	X	X	X		
CYPERACEAE					
Carex bella Bailey		X	X		
Carex orizabae Liebm.		X			
Carex schiedeana Kunze	X				
ERICACEAE					
Arctostaphylos pungens H.B.K.	X				
EUPHORBIACEAE					
Euphorbia beamanii M.C. Johnston	X	X	X	X	X
FAGACEAE					
Quercus greggii (A. DC.) Trel.	X		X		
Quercus spp.	X				
FUMARIACEAE					
Corydalis pseudomicrantha Fedde		X	X	X	
GARRYACEAE					
Garrya ovata Benth. var. *ovata*		X	X	X	X
GENTIANACEAE					
Gentianella amarella (L.) Borner		X			
Frasera speciosa Dougl.			X	X	X
Halenia alleniana Standl. ex Wilbur	X				
GERANIACEAE					
Geranium seemanii Peyr.	X	X	X	X	X
Geranium crenatifolium H.E. Moore	X	X			X
GRAMINEAE					
Blepharoneuron tricholepis (Torr.) Nash	X	X			
Brachypodium pringlei Scribn. ex Beal.	X		X	X	X
Bromus anomalus Rupr. ex Fourn.	X	X	X	X	X
Calamagrostis purpurascens R. Br.		X	X		
Deschampsia flexuosa (L.) Trin.		X			
Elymus trachycaulus (Link.) Gould ex Shinners		X	X	X	X

(Floristic List continued)	PN	PO	MA	CO	VI
Festuca amplissima Rupr.			X		
Festuca hephaestophila Nees ex Steud.	X	X		X	X
Festuca pringlei St.-Yves		X			
Festuca rosei Piper	X		X		
Festuca rubra L.	X		X	X	X
Festuca thurberi Vasey			X		X
Festuca hintoniana E. Alexeev		X	X		
Kohleria pyramidata Beauv.	X			X	
Muhlenbergia rigens (Benth.) Hitch.	X				
Muhlenbergia virescens Trin.	X		X		X
Muhlenbergia wolfii (Vasey) Rydb.	X				
Phleum alpinum L.		X			
Piptochaetium virescens (H.B.K.) Parodi	X				
Poa mulleri Swallen		X			
Poa pratensis L.				X	X
Poa strictiramea A. Hitch.			X		X
Trisetum spicatum (L.) Richter	X	X	X	X	X
HYDROPHYLLACEAE					
Nama whalenii Bacon (in prep)				X	
Nama dichotoma (R. & P.) Choisy	X				
Phacelia heterophylla Pursh	X	X	X	X	X
Phacelia platycarpa Spreng.	X	X	X		
IRIDACEAE					
Sisyrinchium schaffneri Wats.	X	X			
Sisyrinchium sp. nov.	X				
LABIATAE					
Agastache palmeri (B.L. Rob.) Standl. var. *leonensis* R. Sanders			X	X	X
Hedeoma costatum A. Gray	X				
Salvia macellaria Epl.	X	X	X	X	X
Salvia unicostata Fern.	X				
Salvia sp. nov. McDonald (in prep)				X	
Scutellaria potosina Brandeg.	X				
Stachys kerrlii Benth.	X	X		X	
LEGUMINOSAE					
Astragalus purpusii M.E. Jones	X	X	X	X	X
Trifolium schneideri Standl.	X	X			
Vicia humilis H.B.K.		X			
Vicia ludoviciana Nutt.	X	X			X
Lupinus cacuminis Standl.	X	X	X	X	X
LILIACEAE					
Calochortus marcellae Nesom	X				
Schoenocaulon sp. nov. Frame (in prep)	X				
Maianthemum stellatum (L.) Link		X	X	X	
Zigadenus virescens (H.B.K.) MacBride	X	X	X	X	X
LINACEAE					
Linum lewisii Pursh	X	X	X	X	X

(Floristic List continued)	PN	PO	MA	CO	VI
ONAGRACEAE					
Epilobium angustifolium L.			X	X	
ssp. *circumvagum* Mosquin					
Oenothera priminervis A. Gray	X				
Oenothera tetraptera Cav.				X	
PAPAVERACEAE					
Argemone subalpina McDonald (in prep)	X				
LORANTHACEAE					
Arceuthobium vaginatum (Willd.) Prest.	X			X	X
ssp. *vaginatum*					
PINACEAE					
Pinus culminicola Andresen & Beaman		X	X		X
Pinus hartwegii Benth.	X	X	X	X	
Picea mexicana M. Martinez			X		
POLEMONIACEAE					
Polemonium pauciflorum Wats.	X	X	X	X	X
POLOGONACEAE					
Eriogonum jamesii Benth.	X	X	X	X	X
var. *undulata* S.G. Stokes					
PRIMULACEAE					
Androsace septentrionalis L.	X	X	X	X	
var. *puberulenta* (Rydb.) Kunth					
RANUNCULACEAE					
Aquilegia elegantula Greene	X		X		
Delphinium valens Standl.	X	X	X	X	X
Ranunculus praemorsus H.B.K. ex DC.	X	X	X	X	X
RHAMNACEAE					
Ceanothus buxifolius Willd. ex Schult.	X		X	X	X
Ceanothus greggii Gray			X		
ROSACEAE					
Alchemilla procumbens Rose	X				
Fragaria californica Newberry	X	X			
Holodiscus dumosus (Nutt.) Heller	X	X	X	X	
Potentilla leonina Standl.		X		X	
Potentilla propinqua Rydb.				X	
Potentilla sp. nov. Nesom (in prep)	X				
Rubus idaeus L.		X	X	X	
RUBIACEAE					
Galium uncinulatum DC.	X	X			
Hedyotis wrightii (A. Gray) Fosberg	X				
SALICACEAE					
Populus tremuloides Michx.				X	X
SAXIFRAGACEAE					
Heuchera mexicana Schaffner	X	X			
Heuchera sanguinea Engelm.	X	X	X		
Philadelphus maculatus (Hitch.) Hu			X		
Ribes neglectum Rose		X	X	X	
Ribes microphyllus H.B.K.			X	X	X

(Floristic List continued)	PN	PO	MA	CO	VI
SCROPHULARIACEAE					
Castilleja bella Standl.	X	X			
Castilleja scorzonerifolia H.B.K.	X	X	X	X	X
Penstemon barbatus Roth	X	X	X	X	X
Penstemon leonensis Straw	X	X	X	X	X
SOLANACEAE					
Solanum verrucosum Schlecht.	X	X		X	
Solanum macropilosum Correll	X				
Physalis orizabae Dun.	X	X			
UMBELLIFERAE					
Arracacia schneideri Mathias & Constance		X	X	X	
Arracacia ternata Mathias & Constance	X				
Arracacia tolucensis Hemsl.			X	X	
Eryngium sp.	X				
Tauschia hintoniorum Constance & Affolter	X		X	X	X
Tauschia madrensis Coult. & Rose		X	X	X	X
URTICACEAE					
Urtica cf. spirealis Blume		X		X	
VALERIANACEAE					
Valeriana sorbifolia H.B.K. var. *sorbifolia*	X				
VERBENACEAE					
Verbena elegans H.B.K.	X	X		X	
VIOLACEAE					
Viola galeanaensis M.S. Baker	X				

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IDENTIFICATION OF THE PLANTS ILLUSTRATED AND DESCRIBED IN CATESBY'S NATURAL HISTORY OF THE CAROLINAS, FLORIDA AND THE BAHAMAS

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Perhaps it will surprise some that after nearly 250 years botanists are still unable to identify several of the plants described and illustrated by Catesby (1730 − 1747) concerning a flora that surely must rank among the best known in this hemisphere. In addition a considerable number of Catesby's plants can be identified only approximately or that, at the very least, legitimate cause exists for debate over their identities. I believe that the explanation of this unsatisfactory state is that Catesby's illustrations are very much lacking in those features that botanists depend upon in order to identify plants and that Catesby's abilities verbally to describe the plants were if anything even less developed than his talents as a biological draftsman. Each group of biologists, after noting the unsatisfactory rendition of the organisms in groups in which they are most expert, usually then indicates that Catesby's greatest talents were in a group other than that which the investigator was most familiar. My conclusion is that the overall evaluation of Catesby's biological depiction is not high as the details and even major features are often either not shown or are poorly depicted. The lack of detail and crudity in representation is indeed unfortunate since for many plants and animals Catesby was either the only one or a prime reference in those Linnaean publications that became the starting points in biological nomenclature. Ewan (1976, p. 89) noted that Linnaeus cited Catesby's work ninety-five times in *Species plantarum* (1753), the starting point for most botanical nomenclature, and Linnaeus in later works or other authors later added to this number in the publication of additional new species based on Catesby's Natural History. Howard and Staples (1983, p. 511) in their paper dealing only with plants concluded that "Catesby's plates appear to be the types of twenty-five recognized taxa, of which twenty-one were described by Linnaeus and four by subsequent authors." These plates were also found by them to be "the types of an additional twelve synonymous names." Clearly then the significance of Catesby's work, artistically crude and almost completely devoid of significant botanical detail though

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the plates may be, is undeniably great since these plates are in some cases considered to be the types upon which a given binomial rests.

More than three decades ago I began this study of the identities of the plants included in Catesby's Natural History of the Carolinas. I soon encountered obstacles that prevented me from completing the investigation in a timely manner. As might be expected some of the obstacles have in time been either directly solved by the publications of others or their work has enabled me to make progress when before I could not. Some of the obstacles that could not then be overcome by me have been solved by my increasing experience that time and greater familiarity with the plants in the field and the literature about them provides. To my chagrin Howard and Staples (1983) published a commentary on Catesby's *Natural History* that largely fulfilled what I had only partly completed two decades before. They pointed out a prior and similar study to their own published by Ewan (1976) of which I was completely unaware. Since some of my conclusions differed significantly from either one or both of these two most recent studies, it seemed worthwhile to place on record my conclusions along with the reasons for my differences. The nature of such a study makes it certain that we can only hope to approach perfection incrementally. Hopefully the future will judge that some progress in interpreting the identities of Catesby's plants was made in this account. I would be remiss not to acknowledge the assistance and stimulation I obviously received from both Ewan's and Howard and Staples' earlier commentaries.

For those interested in learning about the life and accomplishments of Mark Catesby (1682 – 1749), the best source is Frick and Stearns (1961) "Mark Catesby, the Colonial Audubon."

Some might consider that my criticism of the botanical draftsmanship and phytographic skills of this early colonial naturalist is too harsh. After all the various commentators have managed to identify the vast majority of the organisms depicted of both plants and animals. Perhaps, as a counter balance, Frick's evaluation (1974) ought to be quoted: "The flaws of the natural History of Carolina are minor in comparison with its virtues . . . No other mainland area had so complete a natural history before the American Revolution as did South Carolina and eighteenth century Georgia, and certainly none so elegant. Mark Catesby's achievement was unique."

It might be meaningful to those who are very slightly statistically oriented to compare the differences between the three commentaries presented in the table. (I suggest though that these comparisons though are really not meaningfully subjected to statistical comparison, or, if so, not to the very unsophisticated comparisons made here where any change be it in authority or in spelling was tallied as a change equally important as a change in identity.) Be that as it may be, between Ewan and Howard and Staples there is a 24.5% difference, between Ewan and Wilbur there was a 28.5% difference, and between Howard and Staples and Wilbur a 10.2% change.

The identifications of the plants in Catesby's Natural History made by me and the two most recent commentators are arranged in three parallel columns in the following comparative table. Where there are differences in identification, I have provided a brief explanation in the numbered footnotes referred to in the right-hand margin.

IDENTIFICATION OF CATESBY'S PLATES

Ewan (1974)	Howard and Staples (1983)	Wilbur (1990)
Vol. I		
9. *Castanea pumila* (L.) Marsh.	9. *Castanea pumila* (L.) Miller	9. *Castanea pumila* (L.) P. Mill.
10. *Columbrina reclinata* (L'Her.) Brongn.	10. *Colubrina elliptica* (Sw.) Briz. & Stern	10. *Colubrina elliptica* (Sw.) Briz. & Stern *1
11. *Taxodium distichum* (L.) Rich.	11. *Taxodium distichum* (L.) Rich.	11. *Taxodium distichum* (L.) L.C. Rich.
13. *Myrica pennsylvanica* Loisel.	13. *Myrica pensylvanica* Loisel.	13. *Myrica heterophylla* Raf. *2
14. *Oryza sativa* L.	14. *Oryza sativa* L.	14. *Oryza sativa* L.
15. *Smilax laurifolia* L.	15. *Smilax laurifolia* L.	15. *Smilax laurifolia* L.
16. *Quercus phellos* L.	16. *Quercus phellos* L.	16. *Quercus phellos* L.
17. *Quercus virginiana* (L.) L. [sic!]	17. *Quercus virginiana* Miller	17. Quercus *virginiana* P. Mill.
18. *Quercus prinos* L. [sic!]	18. *Quercus prinus* L.	18. *Quercus michauxii* Nutt. *3
19. *Quercus marilandica* Muenchh.	19. *Quercus marilandica* Muenchh.	19. *Quercus marilandica* Muenchh.
20a. *Quercus nigra* L.	20a. *Quercus nigra* L.	20a. *Quercus nigra* L.
20b. *Mitchella repens* L.	20b. *Mitchella repens* L.	20b. *Mitchella repens* L.
21l. *Quercus alba* L.	21l. *Quercus alba* L.	21l. *Quercus alba* L.
r. not noted	r. *Quercus rubra* L.	r. *Quercus* sp. *4
22. *Quercus laevis* Walt.	22. *Quercus incana* Bartr.	22. *Quercus incana* Bartr. *5
23. *Quercus rubra* L.	23. *Quercus laevis* Walter	23. *Quercus laevis* Walt. *6
24. *Podophyllum peltatum* L.	24. *Podophyllum peltatum* L.	24. *Podophyllum peltatum* L.
25. *Chrysobalanus icaco* L.	25. *Chrysobalanus icaco* L.	25. *Chrysobalanus icaco* L.
26. *Zanthoxylum clava-herculis* L.	26. *Zanthoxylum clava-herculis* L.	26. *Zanthoxylum clava-herculis* L.
27. *Cornus florida* L. f. *rubra*	27. *Cornus florida* L. f. *rubra* (Weston) Schelle	27. *Cornus florida* L.
28. *Prunus virginiana* L.	28. *Prunus virginiana* L.	28. *Prunus serotina* Ehrh. *7
29. *Aristolochia serpentaria* L.	29. *Aristolochia serpentaria* L.	29. *Aristolochia serpentaria* L.
30. *Elaphrium simaruba* L.	30. *Bursera simaruba* (L.) Sarg.	30. *Bursera simaruba* (L.) Sarg. *8
31. *Ilex cassine* L.	31. *Ilex cassine* L.	31. *Ilex cassine* L.
32. *Uniola paniculata* L.	32. *Uniola paniculata* L.	32. *Uniola paniculata* L.
33. *Hypoxis hirsuta* (L.) Cov.	33. *Hypoxis* sp.	33. *Hypoxis* sp. *9
34. *Populus balsamifera* L.	34. *Populus heterophylla* L.	34. *Populus heterophylla* L. *10
35. *Ipomoea sagittata* Cav.	35. *Ipomoea sagittata* Poiret	35. *Ipomoea sagittata* Poir.
36. *Monotropa uniflora* L.	36. *Monotropa uniflora* L.	36. *Monotropa uniflora* L.
37. *Tabebuia bahamensis* (Northrop) Britt.	37. *Tabebuia bahamensis* (Northrop) Britt.	37. *Tabebuia bahamensis* (Northrop) Britt.
38a. *Carya tomentosa* (Poir.) Nutt.	38a. *Carya alba* (L.) K. Koch	38a. *Carya tomentosa* (Poir.) Nutt. *11
b. *Carya cordiformis* (Wang.) K. Koch	b. *Carya cordiformis* (Wang.) K. Koch	b. *Carya glabra* (P. Mill.) Sweet *12

(Identification of Catesby's plates continued)

39. *Magnolia virginiana* L.	39. *Magnolia virginiana* L.	39. *Magnolia virginiana* L.
40. *Metopium toxiferum* (L.) Krug & Urban	40. *Metopium toxiferum* (L.) Krug & Urban	40. *Metopium toxiferum* (L.) Krug & Urb.
41. *Nyssa aquatica* L.	41. *Nyssa sylvatica* Marsh.	41. *Nyssa sylvatica* Marsh. *13
42. *Jacaranda caerulea* (L.) Griseb.	42. *Jacaranda caerulea* (L.) Griseb.	42. *Jacaranda caerulea* (L.) Griseb.
43. *Gleditsia aquatica* Marsh.	43. *Gleditsia aquatica* Marsh.	43. *Gletitsia aquatica* Marsh.
44. *Gordonia lasianthus* (L.) Ellis	44. *Gordonia lasianthus* (L.) Ellis	44. *Gordonia lasianthus* (L.) Ellis
45. *Trillium catesbaei* Ell.	45. *Trillium catesbaei* Ell.	45. *Trillium catesbaei* Ell.
46. *Calycanthus floridus* L.	46. *Calycanthus floridus* L.	46. *Calycanthus floridus* L.
47. *Smilax herbacea* L.	47. *Smilax pumila* Walter	47. *Smilax pumila* Walt. *14
48. *Liriodendron tulipifera* L.	48. *Liriodendron tulipifera* L.	48. *Liriodendron tulipfera* L.
49. *Catalpa bignonioides* Walt.	49. *Catalpa bignonioides* Walter	49. *Catalpa bignonioides* Walt.
50. *Trillium sessile* L.	50. *Trillium maculatum* Raf.	50. *Trillium maculatum* Raf. *15
51. *Menispermum canadense* L.	51. *Cocculus carolinus* (L.) DC.	51. *Cocculus carolinus* (L.) DC. *16
52. *Smilax bona-nox* L.	52. *Smilax tamnoides* L.	52. *Smilax* an unidentifiable mixture of 2 − 3 species *17
53. *Gelsemium sempervirens* (L.) Ait.	53. *Gelsemium sempervirens* (L.) Aiton	53. *Gelsemium sempervirens* (L.) J. St.-Hil. *18
54. *Symplocos tinctoria* (L.) L'Her	54. *Symplocos tinctoria* (L.) L'Her.	54. *Symplocos tinctoria* (L.) L'Her.
55. *Sassafras albidum* (Nutt.) Nees	55. *Sassafras albidum* (Nutt.) Nees var. *molle* (Raf.) Fern.	55. *Sassafras albidum* (Nutt.) Nees
56. *Platanus occidentalis* L.	56. *Platanus occidentalis* L.	56. *Platanus occidentalis* L.
57. *Rhododendron viscosum* (L.) Torr.	57. *Rhododendron viscosum* (L.) Torr. var. *aemulans* Rehder	57. *Rhododendron viscosum* (L.) Torr.
58a. *Cleistes divaricata* (L.) Ames	58a. *Cleistes divaricata* (L.) Ames	58a. *Cleistes divaricata* (L.) Ames
b. *Echites umbellata* Jacq.	b. *Echites umbellata* Jacq.	b. *Echites umbellata* Jacq.
59. *Casasia cluiaefolia* (Jacq.) Urban	59. *Casasia clusiifolia* (Jacq.) Urban	59. *Casasia clusiifolia* (Jacq.) Urb.
60. *Nyssa ogeche* Bartr.	60. *Nyssa aquatica* L.	60. *Nyssa aquatica* L. *19
61. *Osmanthus americanus* (L.) Benth. & Hook.	61. *Osmanthus americanus* (L.) Gray	61. *Osmanthus americanus* (L.) Benth. & Hook.f.ex A. Gray
62. *Acer rubrum* L.	62. *Acer rubrum* L.	62. *Acer rubrum* L.
63. *Persea borbonia* (L.) Sprengel	63. *Persea borbonia* (L.) Sprengel	63. *Persea borbonia* (L.) Sprengel
64. *Halesia carolina* L.	64. *Halesia tetraptera* Ellis	64. *Halesia tetraptera* Ellis *20
65. *Campsis radicans* (L.) Seem.	65. *Campsis radicans* (L.) Seem.	65. *Campsis radicans* (L.) Seem.
66. *Clethra alnifolia* L.	66. *Clethra alnifolia* L.	66. *Clethra alnifolia* L.
67. *Juglans nigra* L.	67. *Juglans nigra* L.	67. *Juglans nigra* L.
68. *Chionanthus virginica* L.	68. *Chionanthus virginicus* L.	68. *Chionanthus virginicus* L.
69. *Myrica cerifera* L.	69. *Myrica cerifera* L.	69. *Myrica cerifera* L.
70. *Gentiana catesbaei* Walt.	70. *Gentiana catesbaei* Walter	70. *Gentiana catesbaei* Walt.
71. *Oxydendrum arboreum* (L.) DC.	71. *Oxydendrum arboreum* (L.) DC.	71. *Oxydendrum arboreum* (L.) DC.
72. *Salmea petrochiodes* Griseb. [sic!]	72. *Salmea petrobioides* Griseb.	72. *Salmea petrobioides* Griseb.
75. unidentified	75. *Reynosia septentrionalis* Urb.	75. *Reynosia septentrionalis* Urb.
77. *Phymosia abutiloides* (L.) Desv.	77. *Phymosia abutiloides* (L.) Ham.	77. *Phymosia arbutiloides* (L.) Desv. ex Ham.
79. *Scaevola plumierii* (L.) Vahl	79. *Scaevola plumieri* (L.) Vahl	79. *Scaevola plumieri* (L.) Vahl
80. *Fraxinus americanus* L. [sic!]	80. *Fraxinus americana* L.	80. *Fraxinus caroliniana* P. Mill. *21
82. *Orontium aquaticum* L.	82. *Orontium aquaticum* L.	82. *Orontium aquaticum* L.
83. *Peltandra sagittaefolia* (Michx.) Morong	83. *Peltandra virginica* (L.) Schott & Engler [sic!]	83. *Peltandra virginica* (L.) Schott & Endl. *22
85. *Avicennia nitida* Jacq.	85. *Avicennia germinans* (L.) L.	85. *Avicennia germinans* (L.) L. *23
86. unidentified	86. *Laguncularia racemosa* (L.) Gaertn.	86. *Laguncularia racemosa* (L.) Gaertn. *24

(Identification of Catesby's plates continued)

92. *Wedelia bahamensis* (Britt.) Schulz	92. *Wedelia bahamensis* (Britt.) Schulz	92. *Wedelia bahamensis* (Britt.) O.E. Schulz
93. *Borrichia arborescens* (L.) DC.	93. *Borrichia arborescens* (L.) DC.	93. *Borrichia arborescens* (L.) DC.
98. *Jacquinia keyensis* Mez	98. *Jacquinia keyensis* Mez	98. *Jacquinia keyensis* Mez
Vol. II		
24. *Ecastophyllum brownei* Pers.	24. *Dalbergia ecastophyllum* (L.) Taub.	24. *Dalbergia ecastophyllum* (L.) Taub. *25
26. *Xylophylla epiphyllanthus* (L.) Britt.	26. *Phyllanthus epiphyllanthus* L.	26. *Phyllanthus epiphyllanthus* L. *26
28a. *Ocotea coriacea* (Sw.) Britt.	28a. *Ocotea coriacea* (Sw.) Britt.	28r. *Ocotea coriacea* (Sw.) Britt.
b. *Galactia rudolphioides* (Griseb.) Hook. & Arn.	b. *Galactia rudolphioides* (Griseb.) Benth. & Hook.	l. *Galactia rudolphioides* (Griseb.) Benth & Hook.
30. *Samolus ebracteatus* H.B.K. (?)	30. Unidentified	30. Unidentified *27
32. *Picrodendron macrocarpum* (A. Rich.) Britt.	32. *Picrodendron baccatum* (L.) Krug & Urban	32. *Picrodendron baccatum* (L.) Krug & Urban *28
33a. *Conocarpus erecta* L.	33a. *Conocarpus erectus* L.	33a. *Conocarpus erectus* L.
b. *Amyris elemifera* L.	b. *Amyris elemifera* L.	b. *Amyris elemifera* L.
38. *Thallasia testudinum* König	38. *Thalassia testudinum* König	38. *Thalassia testudinum* König
42l. *Leucaena glauca* (L.) Benth.	42l. *Lysiloma latisiliquum* (L.) Benth.	42l. *Lysiloma latisiliquum* (L.) Benth. *29
r. *Banara reticulata* Griseb.	r. *Banara minutiflora* (A. Rich.) Sleumer	r. *Banara minutiflora* (A. Rich.) Sleumer *38
43. *Leucothoë racemosa* Gray	43. *Leucothoë racemosa* (L.) Gray	43. *Leucothoë racemosa* (L.) A. Gray
44. Unidentified legume	44. *Acacia tortuosa* (L.) Willd.	44. *Acacia tortuosa* (L.) Willd.
45. *Colocasia esculenta* (L.) Schott	45. *Alocasia* sp. or *Xanthosoma* sp.	45. *Alocasia* or *Xanthosoma* *31
46. *Croton eluteria* (L.) Sw.	46. *Croton eluteria* (L.) Sw.	46. *Croton eleuteria* (L.) Sw.
47. *Callicarpa americana* L.	47. *Callicarpa americana* L.	47. *Callicarpa americana* L.
48. *Cissus tuberculata* Jacq.	48. *Cissus tuberculata* Jacq.	48. *Cissus tuberculata* Jacq.
49. *Erythrina herbacea* L.	49. *Erythrina herbacea* L.	49. *Erythrina herbacea* L.
50. *Canella winterana* (L.) Gaertn.	50. *Canella winterana* (L.) Gaertn.	50. *Canella winterana* (L.) Gaertn.
51a. *Caesalpinia bahamensis* Lam.	51a. *Caesalpinia bahamensis* Lam.	51a. *Caesalpinia bahamensis* Lam.
b. *Passiflora pallida* L.	b. *Passiflora suberosa* L.	b. *Passiflora suberosa* L. *32
52. *Decumaria barbara* L.	52. Unidentified	52. Unidentified *33
53. *Urechites lutea* (L.) Britt.	53. *Urechites lutea* (L.) Britt.	53. *Urechites lutea* (L.) Britt.
54. *Silene virginica* L.	54. *Silene virginica* L.	54. *Silene virginica* L.
55. *Polystachya minuta* (Aubl.) Britt.	55. *Polystachya concreta* (Jacq.) Garay & Sweet	55. *Polystachya concreta* (Jacq.) Garay & Sweet *34
56. *Lilium michauxii* Poir.	56. *Lilium superbum* L.	56. *Lilium superbum* L. *35
57. *Ilex vomitoria* Ait.	57. *Ilex vomitoria* L. [sic!]	57. *Ilex vomitoria* Ait.
58. *Lilium catesbaei* Walt.	58. *Lilium catesbaei* Walt.	58. *Lilium catesbaei* Walt.
59. *Echinacea purpurea* (L.) Moench	59. *Echinacea purpurea* (L.) Moench	59. *Echinacea purpurea* (L.) Moench
60. *Ipomoea batatas* (L.) Lam.	60. *Ipomoea batatas* (L.) Lam.	60. *Ipomoea batatas* (L.) Lam.
61. *Magnolia grandiflora* L.	61. *Magnolia grandiflora* L.	61. *Magnolia grandiflora* L.
62. *Commelina virginica* L.	62. *Commelina virginica* L.	62. *Commelina erecta* L. *36
63. *Rhizophora mangle* L.	63. *Rhizophora mangle* L.	63. *Rhizophora mangle* L.
64. *Annona glabra* L.	64. *Annona glabra* L.	64. *Annona glabra* L.
65. *Liquidambar styraciflua* L.	65. *Liquidambar styraciflua* L.	65. *Liquidambar styraciflua* L.
66. *Haemotoxylum campechianum* L.	66. *Haematoxylon campechianum* L. [*Haematoxylum* is the original spelling.]	66. *Haematoxylum campechianum* L.

(Identification of Catesby's plates continued)

67. *Annona cherimola* Mill	67. *Annona glabra* L.	67. *Annona glabra* L. *37
68. *Epidendrum nocturnum* Jacq.	68. *Epidendrum nocturnum* Jacq.	68. *Epidendrum nocturnum* Jacq.
69l. ______	69l. ______	69l. *Sarracenia minor* Walt. *38
r. *Sarracenia flava* L.	r. *Sarracenia × catesbaei* (Ell.) Bell	r. *Sarracenia flava* L.
70. *Sarracenia purpurea* L.	70. *Sarracenia purpurea* L.	70. *Sarracenia purpurea* L.
71. *Symplocarpus foetidus* (L.) Nutt.	71. *Symplocarpus foetidus* (L.) Nutt.	71. *Symplocarpus foetidus* (L.) Nutt.
72. *Cypripedium calceolus* L.	72. *Cypripedium acaule* Aiton	72. *Cypripedium acaule* Ait. *39
73. *Cypripedium calceolus* var. *pubescens* (Willd.) Correll	73. *Cypripedium pubescens* Willd.	73. *Cypripedium pubescens* Willd.
74. *Epicladium boothianum* (Lindl.) Small	74. *Epidendrum boothianum* Lindley	74. *Encyclia boothianum* (Lindl.) Dressler *40
75. *Sideroxylon foetidissimum* Jacq.	75. *Mastichodendron foetidissimum* (Jacq.) Lam	75. *Mastichodendron foetidissimum* (Jacq.) Lam *41
76. *Diospyros virginina* L.	76. *Diospyros virginiana* L.	76. *Diospyros virginiana* L.
77. *Catopsis berteroniana* (Schultes) Mez	77. *Catopsis berteroniana* (Schultes) Mez	77. *Catopsis berteroniana* (J.A. & J.H. Schultes) Mez
78. *Spigelia marilandica* L.	78. *Spigelia marilandica* (L.) L.	78. *Spigelia marilandica* (L.) L.
79. *Bourreria ovata* Miers	79. *Bourreria ovata* Miers	79. *Bourreria ovata* Miers
80. *Magnolia macrophylla* Michx.	80. *Magnolia tripetala* (L.) L.	80. *Magnolia tripetala* (L.) L. *42
81a. *Swietenia mahogani* Jacq.	81a. *Swietenia mahagoni* (L.) Jacq.	81a. *Swietenia mahagoni* (L.) Jacq.
b. *Phoradendron rubrum* (L.) Griseb.	b. *Phoradendron rubrum* (L.) Griseb.	b. *Phoradendron rubrum* (L.) Griseb.
82. *Anisostichus capreolata* (L.) Bur.	82. *Bignonia capreolata* L.	82. *Bignonia capreolata* L. *43
83. *Ptelea trifoliata* L.	83. *Ptelea trifoliata* L.	83. *Ptelea trifoliata* L.
84a. *Philadelphus inodorus* L.	84a. *Philadelphus inodorus* L.	84a. *Philadelphus inodorus* L.
b. *Smilax lanceolata* L.	b. *Smilax lanceolata* L.	b. *Smilax smallii* Morong *44
85. *Asimina triloba* (L.) Dunal	85. *Asimina triloba* (L.) Dunal	85. *Asimina triloba* (L.) Dunal
86. *Annona reticulata* L.	86. *Annona reticulata* L.	86. *Annona reticulata* L.
87a. *Sloanea emarginata* L.	87a. *Manilkara bahamensis* Lam & Meeuse	87a. *Manilkara bahamensis* Lam & Meeuse *45
b. ______	b. *Ipomoea microdactyla* Griseb.	b. *Ipomoea microdactyla* Griseb.
88l. *Epidendrum plicatum* Lindl.	88l. *Epidendrum plicatum* Lindley	88l. *Encyclia plicata* (Lindl.) Britt. & Millsp.*46
r. *Epidendrum cochleatum* L.	r. *Epidendrum cochleatum* L.	r. *Encyclia cochleata* (L.) Lemee
89. *Tillandsia fasciculata* Sw.	89. *Tillandsia balbisiana* (Schultes) Roemer & Schultes	89. *Tillandsia balbisiana* Schultes f. *47
90. *Thespesia populnea* (L.) Soland.	90. *Hibiscus tiliaceus* L.	90. *Hibiscus tiliaceus* L. *48
91a. *Cordia sebestena* L.	91a. *Cordia sebestena* L.	91a. *Cordia sebestena* L.
b. *Ipomoea carolina* L.	b. *Ipomoea carolina* L.	b. *Ipomoea carolina* L.
92. *Plumeria rubra* L.	92. *Plumeria rubra* L.	92. *Plumeria rubra* L.
93a. *Plumeria obtusa* L.	93a. *Plumeria obtusa* L.	93a. *Plumeria obtusa* L.
b. *Passiflora cupraea* L.	b. *Passiflora cuprea* L.	b. *Passiflora cuprea* L.
94. *Coccoloba diversifolia* Jacq.	94. *Coccoloba diversifolia* Jacq.	94. *Coccoloba diversifolia* Jacq.
95a. *Hippomane mancinella* L.	95a. *Hippomane mancinella* L.	95a. *Hippomane mancinella* L.
b. *Dendropemon purpureus* (L.) Krug & Urban	b. *Dendropemon purpureum* (L.) Krug & Urban	b. *Dendropemon purpureum* (L.) Krug & Urban
96. *Coccoloba uvifera* (L.) Jacq.	96. *Coccoloba uvifera* (L.) L.	96. *Coccoloba uvifera* (L.) L.
97. *Pithecolobium mucronatum* Britt.	97. *Pithecellobium bahamense* Northrop	97. *Pithecellobium bahamense* Northrop *49
98. *Kalmia latifolia* L.	98. *Kalmia latifolia* L.	98. *Kalmia latifolia* L.
99. *Clusia rosea* Jacq.	99. *Clusia rosea* Jacq.	99. *Clusia rosea* Jacq.

(Identification of Catesby's plates continued)

100. *Catesbaea spinosa* L. Appendix	100. *Catesbaea spinosa* L. Appendix	100. *Catesbaea spinosa* L. Appendix
1. *Dodecatheon meadia* L.	1. *Dodecatheon meadia* L.	1. *Dodecatheon media* L.
2. *Hamamelis virginiana* L.	2. *Hamamelis virginiana* L.	2. *Hamamelis virginiana* L.
3. *Cypripedium acaule* L.	3. *Cypripedium acaule* Ait.	3. *Cypripedium acaule* Ait. *50
4. *Rhus glabra* L.	4. *Rhus glabra* L.	4. *Rhus glabra* L.
5. *Pancratium carolinianum* L.	5. *Hymenocallis caroliniana* (L.) Herbert	5. *Hymenocallis caroliniana* (L.) Herbert *51
6. *Theobroma cacao* L.	6. *Theobroma cacao* L.	6. *Theobroma cacao* L.
7. *Vanilla planifolia* Andr.	7. *Vanilla mexicana* Miller	7. *Vanilla planifolia* Andr. *52
8. *Lilium philadelphicum* L.	8. *Lilium philadelphicum* L.	8. *Lilium philadelphicum* L.
9. *Anacardium occidentale* L.	9. *Anacardium occidentale* L.	9. *Anacardium occidentale* L.
11. *Lilium canadense* L.	11. *Lilium canadense* L.	11. *Lilium canadense* L.
12. *Zephyranthes atamasco* (L.) Herbert	12. *Zephyranthes atamasco* (L.) Herbert	12. *Zephyranthes atamasco* (L.) Herbert
13. *Stewartia malacodendron* L.	13. *Stewartia malacodendron* L.	13. *Stewartia malacodendron* L.
15. *Magnolia acuminata* (L.) L.	15. *Magnolia acuminata* (L.) L.	15. *Magnolia acuminata* (L.) L.
16. *Panax quinquefolium* L.	16. *Panax quinquefolius* L.	16. *Panax quinquefolius* L. *53
17l. *Kalmia augustifolia* L. r. *Rhododendron maximum* L.	17l. *Kalmia angustifolia* L. r. *Rhododendron maximum* L.	17l. *Kalmia angustifolia* L. r. *Rhododendron maximum* L.
18. *Ficus brevifolia* Nutt.	18. *Ficus citrifolia* Miller	18. *Ficus citrifolia* P. Mill. *54
20. *Robinia hispida* L.	20. *Robinia hispida* L.	20. *Robinia hispida* L.

1) Johnston (1971), the most recent monographer of *Colubrina* (Rhamnaceae), included *Colubrina reclinata* (L'Hér.) Brongn. in the synonymy of *Colubrina elliptica* (Sw.) Brizicky & Stern.

2) Although Catesby's illustration is certainly not detailed enough alone to permit one to distinguish species of *Myrica*, geographic distribution is of considerable assistance. It has been identified as *Myrica pensylvanica* Loisel. by Ewan and also by Howard and Staples. However, I believe it to be *Myrica heterophylla* Raf. as *Myrica pensylvanica* occurs no further south than northeastern North Carolina while *Myrica heterophylla* is common in the coastal plain from northern Florida into southern New England including of course coastal South Carolina, the site of Catesby's most intensive work. Linnaeus (1753, p. 1024) cited this Catesby plate as the only element of the β [var.] of *Myrica cerifera*.

3) The two eastern chestnut oaks were not distinguished from each other by Linnaeus or by other botanists. Early in the nineteenth century Willdenow (1805, 4:440.) proposed *Q. montana* as the name for the mountain chestnut oak before Nuttall's publication (1818, 2:215) of *Q. michauxii* for the swamp chestnut oak. Both species were previously included under the binomial *Q. prinus* L. Hardin (1979) recommended that botanists discontinue using the binomial *Q. prinus* L. since the material in the Linnaean herbarium cannot be determined with certainty and the Linnaean binomial has been applied almost equally to either species. However most authors in recent decades have applied *Quercus prinus* L. to the mountain or rock chestnut oak (= *Q. montana* Willd.) and *Quercus michauxii* to the swamp chestnut oak. Linnaeus included a reference to Catesby's account and plate in the synonymy of *Quercus prinus* but it is to be remembered that he included both species of chestnut oak under *Q. prinus*. *Catesby's treatment was clearly that of the*

swamp chestnut oak, Quercus michauxii Nutt., as his statements as to habitat and morphology indicate. Hardin's suggested solution seems tempting since we have no way of knowing what is meant when *Q. prinus* is used alone in the literature without synonyms or common names or the mention of the other chestnut oak that had been originally confused with it.

4) Ewan did not make note of the inadequate rendition of the oak depicted on the right side of Catesby's plate 1:*t.21* and I find both the illustration and brief description unidentifiable. Linnaeus (1753, p. 996) cited Catesby's account of this taxon as a synonym of *Q. rubra* [var.] β. Howard and Staples indicate it to be *Quercus rubra* L. which would be difficult to prove — or disprove from Catesby's publication. Linnaeus included within his concept of *Quercus rubra* L., comprising both the typical element and the β variant, the very distinctive southern red or Spanish oak (*Q. falcata*), the turkey oak, (*Q. laevis*.) as well as the red (or northern red) oak (*Q. rubra*). After a most rancorous series of papers dealing with the lectotypification of *Q. rubra*, extending through much of the first half of the century we hopefully have settled the application of the name.

5) Ewan (1974, p. 92) no doubt carelessly identified this Catesbian account as *Quercus laevis* Walt., the turkey oak with pinnately lobed leaves. Linnaeus (1753, p. 994) based his *Quercus phellos* [var.] γ solely upon this citation of Catesby. The plate and description given by Catesby both confirm that Howard and Staples were correct in identifying the plant as the blue jack oak, *Quercus incana* Bartr. (= *Q. cinerea* Michx.), with its unlobed leaves.

6) Although Catesby's plate and account was included by Linnaeus in the synonymy of *Quercus rubra*, it should be remembered that Linnaeus included under that binomial several of the eastern species of North American red oaks: *Quercus falcata* Michx., *Q. laevis* Walt. and *Q. rubra s.s.* Catesby surely was dealing with the turkey oak, *Q. laevis*, as noted by Howard and Staples and not with the northern red oak, *Q. rubra*, as suggested by Ewan.

7) Catesby, like Linnaeus and most eighteenth century biologists, did not distinguish between *Prunus virginiana* L. and *Prunus serotina* Ehrh. The description and plate do not provide the necessary details to enable us to distinguish what Catesby had. The scanty description with its indication of potential large size and indication of abundance in the thick woods of Carolina make it certain that the plant Catesby knew from field experience was *Prunus serotina* Ehrh. *Prunus virginiana* is unknown in South Carolina and very rare in the mountains of North Carolina and unknown elsewhere in that state.

8) The generic name *Bursera* Jacq. ex L. (1762) is conserved over *Elaphrium* Jacq. (1760).

9) Like Howard and Staples, I do not find that Catesby's plate of what appears to be an *Hypoxis* can be identified to species. The description with its mentioned five perianth segments and 5 stamens instead of 6 is most unusual. Detailed information needed to make specific determinations is lacking.

10) I agree with Rouleau (1946, 106) and with Howard and Staples (1983, p. 536) that Catesby illustrated the common coastal plain, swamp poplar of the Carolinas, *Populus heterophylla* L., and neither *P. deltoides* L. with its strongly flattened petioles nor *P. balsamifera* with which it has been synonymized in the past.

11) Constant juggling with the provisions of the International Code of Botanical Nomenclature would seem to be a perfect prescription for instability in nomenclature. For over

four decades we have enjoyed relative stability in the scientific names of two of our commonest hickories but this stability seems threatened due to nomenclatural tinkering. *Carya alba* (L.) K. Koch had been abandoned at least since the mid-1940s as an ambiguous name (see Rehder, 1945) since it was sometimes applied to the mockernut hickory (*Carya tomentosa* (Poir.) K. Koch) and sometimes to the shagbark hickory (*Carya ovata* (Mill.) K. Koch) as Linnaeus had included both in his *Juglans alba*. Originally no type was designated for *Juglans alba*, and hence it would appear Article 69 in its 1978 version of the ICBN could not be applied. The current form of Art. 69 permitting the abandonment of names used in two or more senses not including the type hardly applies when no type was designated and the original concept proves to have been a mixture. Earlier versions of Article 69 rejected a name "if it is used in different senses and so has become a long-persistent source of error." Howard & Staples argued that *Juglans alba* L. was typified by Crantz (1766, 1:157) since Crantz cited only Catesby in his brief account of *Juglans alba*.

This three-line account by Crantz consisted of the following:

2. IVGLANS *alba*.
IUGLANS foliis septenis lanceolatis serratis,
impari sessili. CATESB. *car.* 1. T. 38.

It would not seem that such action constitutes typification unless the author makes it clear that he intends to remove dissident elements from the protologue. No evidence exists that Crantz was doing more than citing that element mentioned in the protologue seen by him. Therefore, *Carya tomentosa* (Poir.) Nutt. is the correct binomial for the mockernut hickory. Just as is the case for *Quercus prinus* L. as suggested by Hardin, the best solution might well be to abandon *Carya alba* as a name used so often in such different senses that it would be better to exclude it from scientific use. This was proposed by Rehder (1945). Dr. James Luteyn of the New York Botanical Garden most kindly provided me with a copy of Crantz's treatment.

12) Ewan (1974, p. 93) reported Donald E. Stone's identification of the separate, single nut of Catesby's 1:*t.38* as *Carya cordiformis* (Wangenh.) K. Koch. Howard and Staples (1983, p. 528) repeated this determination without comment. In a genus as notoriously variable as is *Carya*, one surely must hesitate to determine the identity of a species based on a single nut especially when the artist is as careless as Catesby repeatedly demonstrated he was. Probably overly influenced by the most usual application of the common name, I had thought the sketch of the fruit and description referred to *Carya glabra* (P. Mill.) Sweet. Since the apparently nearly globose fruit lacked a ridged husk, the identification seemed at least possibly correct. Sargent state (1895, 7:167) that the "earliest authentic account of *Hicoria glabra*, with an excellent figure of the nut, appeared in Catesby's *Natural History of Carolina* . . ." However it would be unwise to make much of a wager on the identity of a great many of Catesby's plates especially on one in which only a single fruit is illustrated.

13) I agree with Eyde (1959 and 1964) and Howard and Staples (1983, p. 533) that Catesby's plate and description (1: *t.41*) is *Nyssa sylvatica* Marsh. and not *Nyssa aquatica* L. as identified by Ewan.

14) The fruits of this species were illustrated and descibed by Catesby as "red of an oval form" which agrees with *Smilax pumila* Walt. and is in conflict with the black, globose berries of *S herbacea* L. with which Ewan (1974, p. 93) identified it. Catesby (1:*t.47*)

stated that each berry has "a very hard pointed seed" which is true of *S pumila* Walt. (see Coker, 1944, p. 60), while the berry of *S herbacea* L. has "3 – 6 brownish seeds" according to Mangaly (1968, p. 250).

15) Although Linnaeus cited to Catesby 1: *t.50* in the protologue of *Trillium sessile* L., Freeman (1975) demonstrated that the Linnaean species in the modern restricted sense does not occur in coastal South Carolina and is represented there instead by *Trillium maculatum* Raf.

16) The fruits of *Menispermum canadense* are black while those of *Cocculus carolinus* are red. Catesby's description and plate are of red fruit and Catesby's 1:*t.51* illustrates *Cocculus*.

17) The identity of Catesby's plate is both crucial to nomenclatural stability and highly controversial. Fernald (1944, p. 38) stated that there "can be no question that the type of *S. tamnoides* L. was the Catesby plate." Fernald concluded that Catesby's plant was a perennial, woody, terete-stemmed vine. Howard and Staples (1983, p. 517), although accepting Fernald's identification of Catesby's plate, indicated that "a specimen obtained by Kalm (LINN 1132. 10) is preferable as lectotype" of *S. tamnoides*. Fernald had excluded Kalm's specimen from *S. tamnoides* as it was "a specimen of the herbaceous *S. Pseudo-China*." Clausen (1951, p. 109) reached a very different conclusion as to the identity of Catesby's plate and hence of the identity of *Smilax tamnoides* L. Clausen agreed that "Catesby's description and illustration are all important in the typification of *S. tamnoides* " but concluded with, I feel, convincing evidence that "Catesby's illustration and description were prepared from diverse materials" and "probably no species exists with the combination of characteristics as depicted." Evidence was presented that two and more probably three species entered into Catesby's description and illustration. Clausen concluded, since it was impossible to make a definite identification of what Catesby had, that the Linnaean name should be disregarded as "ambiguous." It would seem to me impossible to identify Catesby's plate and, as the specimen of the herbaceous element also included in the Linnaean protologue of *S. tamnoides* is of a herbaceous species and identifiable with *S. pseudo-china* L., it would seem for the present at least the woody species had best be known as *Smilax hispida* Muhl. ex Torr.

18) There is an obvious discrepancy in the authority of the combination of the binomial *Gelsemium sempervirens* (= *Bignonia sempervirens* L.) The combination is usually attributed to W.T. Aiton or Ait.f. (1811) and not to his father, W. Aiton (1789). Jaume Saint-Hilaire (1805) apparently first made the combination *Gelsemium sempervirens*.

19) Eyde (1959, p. 212 and 1964, p. 130) stated that Catesby's 1: *t.61* and the accompanying description are of *Nyssa aquatica* L. The plate and description support this decision and argue against Ewan's identification of it as *Nyssa ogeche* Bartr. ex Marsh.

20) The general confusion and misuse of the names applied to *Halesia* Ellis ex L. has been exhaustively dealt with by Reveal and Seldin (1976) and their clarifying conclusions are reflected by Howard and Staples (1983) and by me.

21) Fernald (1946, p. 390) pointed out that, although cited by Linnaeus in the protologue of *Fraxinus americana* L., Catesby's plate and description clearly apply to the "southern Water-Ash which we call *F. caroliniana* P. Mill."

22) Catesby's plate (1: *t.83*) and description clearly is that of the green spathed, greenish berried *Peltandra virginica* (L.) Schott & Endl. and not the white spathed, red berried *P. sagittifolia* (Michx.) Morong.

23) As demonstrated by Compère (1963) among others, the correct name for the Afro-American Black Mangrove is *Avicennia germinans* (L.) L. and not *Avicennia nitida* Jacq.

24) In spite of the depiction of alternate leaves in 1:*t*.86. by Catesby, the plate surely is a crude representation of *Laguncularia*.

25) The generic name *Dalbergia* L.f. (1782) is conserved over the earlier *Ecastaphyllum* P. Br. (1756).

26) The genus *Xylophylla* L. was segregated from *Phyllanthus* L. based upon an erroneous description of the flower as pointed out by Webster (1956, 37:94). The segregate genus *Xylophylla* L. has been maintained by very few authors in recent decades.

27) Catesby's 2:*t.30* seems to be a badly garbled account and depiction of a most improbable mixture. One can hardly trust the description as it seemingly has internally contradictory statements *e.g.* the description of the fruit. Since it is said to be a shrub up to twelve feet high, Ewan's suggestion that it is *Samolus ebracteatus* HBK. can be ruled out as a possibility. The flowers possibly suggest something in the Lauraceae like *Litsea aestivalis* (L.) Fern. but the capsular fruit seems more suggestive of some member of the Andromedae like *Lyonia* or *Leucothoë*. This plate continues to resist all attempts at its identification.

28) Correll and Correll (1982, p. 410) place *Picrodendron macrocarpum* (A. Rich.) Britt. in the synonymy of *P. baccatum*. C.D. Adams (1972, p. 216) is more uncertain for under *P. baccatum* he states "Probably endemic," but *P. macrocarpum* (A. Rich.) Britt., occurring in Bahamas, Cuba, Hispaniola and Grand Cayman is suggested as probably not really distinct. As might be expected others take an intermediate position treating the element occurring in the Bahamas as *Picrodendron baccatum* var. *bahamense* Krug & Urb.

29) Both Ewan and Britton and Millspaugh (1920, p. 162) identify Catesby's 2: *t.2* as *Leucaena glauca* sensu authors which has been shown by de Wit (1961) to be *Leucaena leucocephala* (Lam.) de Wit. Catesby's treatment describes a plant "very high" with "large straight trunks some being three feet in diameter" and "large spreading limbs." The pod was described as "an inch broad and almost five long." The wood is said to be the best the Bahamas afford and of the quality to be shipped to England. All of these features exclude *Leucaena*. The plant represented is probably *Lysiloma latisiliquum* (L.) Benth.

30) The basionym of *Banara minutiflora* (A. Rich.) Sleumer (= *Ilex minutiflora* A. Rich., 1845) has priority over *Banara reticulata* Griseb. (1860).

31) The diagnostic details needed to distinguish between *Xanthosoma* and *Alocasia* are not made evident in Catesby's generalized plate. *Colocasia* can be ruled out as it has peltate leaves.

32) Although Linnaeus recognized three species of *Passiflora* in what is today treated as one variable species, uncertainty exists as to which is the correct name. Dr. John McDougal (MO), an authority on the meso-American Passifloraceae, has looked into the problem and to date has not found any author earlier than Master (1872) who has unequivocally placed one name in the synonymy of the other. Master treated *P. pallida* L. as a variety of *P. suberosa* L. which would establish *P. suberosa* as the name to be maintained if the taxa were combined. MacDougal found that Robert Combs (1897, p. 424) appears to be the first author who unequivocally reduced one species to the synonymy of the other and he also chose to retain *Passiflora suberosa* L. This choice of binomials should settle the matter at least until someone finds an earlier publication that unequivocally made another choice.

33) Like Howard and Staples (1983, p. 540 – 542) I am unable to accept Ewan's determination that the plant was *Decumaria barbara* L. The "certain discrepancies of habit, flower color, and corolla shape are just too numerous to accept such an identification." Like them I am unable to suggest an acceptable candidate for the name. *Decumaria* is a woody vine with opposite leaves which are much more ovate than the alternate, elliptical leaves of Catesby's plate and description. The inflorescence of *Decumaria* is a cymose corymb while that of Catesby's plate is basically racemous. Catesby states the fruit to be 2-parted; *Decumaria* is 7 – 10-loculate.

34) Although its basionym is the first name applied to the species, the combination *Polystachya minuta* (Aubl.) Britt. (1903) is a later homonym of *P. minuta* Rich. & Gal. (1845) and consequentially cannot be used.

35) The identity of 2:*t*.56 is somewhat controversial as the differences between *Lilium michauxii* Poir. and *L. superbum* L. are too subtle to be distinguished by either Catesby's artistic skills or his ability in phytography. Since only *L. superbum* grows in Pennsylvania (Wherry, Fogg and Wahl. 1979: p. 103) that part of Catesby's account can be assigned with confidence. The bulk of the plate, although not based on the Pennsylvania plant, I would also identify it as *L. superbum* since its leaves seem more elliptical than spatulate. If the majority of the plate was derived from South Carolina material as seems more probable, then Ewan's identification as *L. michauxii* Poir. seems more understandable since that species is widespread in South Carolina and *L. superbum* does not occur in South Carolina. However, the depicted leaves appear to fit *L. superbum* better than do those of *L. michauxii*.

36) Both Ewan (1974, p. 97) and Howard and Staples (1983, p. 515) identified Catesby's 2:*t*.62 as *Commelina virginica* L. but that Linnaean species has all blue petals while Catesby's description indicates "two blue petals . . . and one very small white petal . . ." Therefore it seems more probable that Catesby had *Commelina erecta* L. whose flowers would at least match this description of the petal colors.

37) Ewan identified Catesby's 2:*t*.67 as *Annona cherimolia* P. Mill. but that species has three large outer petals and three minute, scale-like inner petals while Catesby's description calls for six sizable petals. *P. cherimola* is a montane species and is certainly not to be expected in the Bahamas and was not reported from those islands by either Britton and Millspaugh (1920) or by the Corrells (1982). Catesby's plate is almost certainly *Annona glabra* L.

38) Identification of the plants in this plate is difficult and the three interpretations of it reflect our collective uncertainties. The plate is not carefully delineated and the colors are particularly unsatisfactory. Elliott (1824, 2:11) cites Catesby's plate as part of the protologue of his *Sarracenia catesbaei* and Howard and Staples disposition of 2:*t*.69 reflects this interpretation. The only suggestion of Catesby's plate being *Sarracenia catesbaei* is that the venation of the flap-like hood is said to be purple. Elliott's type of *S. catesbaei* is usually judged to be a hybrid between *S. flava* and *S. purpurea* and this is reflected in that the petals of the hybrid, instead of being clear yellow as they are in *S. flava* or dark maroon as they are in *S. purpurea* are said by Bell (1952, p. 61) to be maroon externally and red-yellow internally. Catesby's plate is no match for that description but it is equally a poor match for *S. flava* as its petals are depicted (at least in the copy I have seen) as a sickly greenish yellow. In spite of what is said above I feel that there is nothing in Catesby's account or plate (the right-hand figures) that would exclude *S. flava* as the

most likely identification. The hood-like or cowl-topped leaf shown on the left side of the plate is in my opinion a crude effort to picture the distinctive leaf of *S. minor* Walt.

39) The difficulty in attempting to identify many of Catesby's plates is demonstrated by Catesby's rendition (2:*t.72*) of this lady's-slipper. The illustration is, like a large number in the two volumes, more of a crude caricature than a reasonable rendition of the botanical features upon which identification must rest. Ewan (1972, p. 94) identified the poor picture as *C. calceolus*, the yellow lady's-slipper, and Howard and Staples (1983, p. 516) and Wilbur have identified it as *C. acaule*. The deeply fissured lip and the hint of red in the lip are about all there is to defend the latter choice. Illustrations indeed must border on being wretched if one has difficulty in distinguishing between two such dissimilar species.

40) The differences in our three identifications of Catesby's 2: *t.74* merely reflect the three different commentators accepting different standards in the rapidly changing generic dismemberment in such large orchid genera as the broadly conceived *Epidendrum*.

41) All are agreed as to the identity of Catesby's 2: *t.75* but reflect the well-founded dismemberment of such broadly conceived genera as *Sideroxylon* L., now restricted to the Old World, by accepting the genus *Mastichodendron* Lam. as the American segregate.

42) Catesby's description and plate are again not easy to reconcile with what exists in nature. The tapering leaf bases are clearly those of *Magnolia tripetala* as no doubt impressed Linnaeus when he cited Catesby's 2: *t.80* in synonymy of *Magnolia virginiana* [var.] *tripetala*. This is in considerable conflict with the somewhat cordate or auriculate leaf base of *M. macrophylla*. No indication is evident on the plate or in the description that the leaves are other than green beneath while the lower surface of the leaves of *M. macrophylla* are strikingly white-glaucous. Catesby stated that the leaves of this species of *Magnolia* "are usually thirty inches in length" which greatly influenced Ewan in his identification of Catesby's plate as *M. macrophylla* which has leaves reportedly up to 10 dm long. The leaves of *M. macrophylla* according to Fernald (1950, p. 676) are $3-9$ dm long while Radford, Ahles & Bell (1968, p. 476) state them to be up to one meter long. Comparable figures stated by these last authors for *Magnolia tripetala* are $3-6$ dm long and $1-4.5$ dm long. In spite of the striking lack of agreement in leaf length by these authors, it would seem that Catesby's stated size of the leaves better fits *M. macrophylla*. The lack of detail in both illustration and description as to the pubescence on young twigs, buds and follicles prevents using these prime distinguishing features to separate the two species. On balance it seems to me that it is most likely that Catesby's 2:*t.80* represents *Magnolia tripetala*.

43) The discrepancy in the comparative table between Ewan and the other two commentaries on the identity of the plant shown in 2:*t.82* is more apparent than real. There has been much discussion on the type of the Linnaean genus *Bignonia* over at least the past century and these differences have only recently been resolved by fiat of the International Botanical Congress. Something of the background can be gleaned from papers by Gentry (1972) and by Wilbur (1980). The result is that the International Code of Botanical Nomenclature (1988, p. 265) has listed *Bignonia* L. as conserved with *Bignonia capreolata* L. as its type. Consequently the current correct name is *Bignonia capreolata* L.

44) Fernald (1944b) carefully analyzed the confused tangle into which this greenbrier had grown in the past two centuries and concluded that *Smilax lanceolata* L. was based upon

Virginian material and was nothing more than "the narrowest-leaved *S. laurifolia*" with the expected black fruit. Catesby's 2: *t.84* is described as a non-spinous plant with red or even scarlet berries. Catesby's plant is *Smilax smallii* Morong which in Fernald day was unknown north of northern coastal North Carolina but is included in the recent Atlas of the Virginia Flora (see Harvill *et al.* 1986, p. 25). In deciphering the tangled history of *Smilax laurifolia* but applying equally well to the history of a great many of the species discussed in these notes, Fernald (1944b) made the following perceptive observation: "One sometimes doubts the wisdom of starting our nomenclature of American plants with Linnaeus (1753). It is almost an exceptional North American species about which he was not hopelessly confused."

45) Although *Sloanea emarginata* L. is the first binomial given to this species, the generic name is typified by a member of the Elaeocarpaceae and *S. emarginata* is a species of *Manilkara* (Sapotaceae). The Linnaean binomial cannot be transferred to *Manilkara* as there is an earlier Hawaiian species named *Manilkara emarginata* Lam (1925). Correll and Correll (1982, p. 1099), Long & Lakela (1971, p. 681) and Little (1979, p. 170) all treat this species as *Manilkara bahamense* (Baker) Lam & Meeuse. Cronquist (1945 and 1946) considers it to be but one of four subspecies which together comprise *Manilkara jaimiqui* (Wright) Dubard. The south Bahaman and Cuban representative was treated as *Manilkara jaimiqui* ssp. *emarginata* (L.) Cronq.

46) The recent tendency among orchidologists has been to segregate distinctive groups of species from the formerly all-inclusive genus *Epidendrum* L. One of the most distinctive groups of approximately 150 species has been segregated as *Encyclia* Hook. and is characterized by its column being either free from the lip or at most partially adnate to it while in *Epidendrum* the column is completely adnate to the lip (see Dressler 1961).

47) Smith (1938, p. 136 and 1977, p. 985) cites Catesby's account and plate as illustrating *Tillandsia balbisiana* while Britton and Millspaugh (1920, p. 65) identify Catesby's account with *T. fasciculata* Sw. I take the unscientific expedient of casting my vote with the more eminent authority on the Bromeliaceae. The differences between the two species strike me as too subtle to be discernible from either Catesby's vague plate or description.

48) Linnaeus (1753, p. 694) cited Catesby 2:*t.90* with the treatment of *Hibiscus populneus* L. Catesby's description and plate both indicate the pronounced calycine teeth of *Hibiscus tiliaceus* which contrast greatly with the truncate calyx of *Thespesia* with which Ewan (1976, p. 99) equated it following Linnaeus. Britton and Millspaugh (1920, p. 273) correctly cited Catesby 2: *t.90* with *Parti tiliaceum* (L.) St. Hil., a synonym of *Hibiscus tiliaceus* L.

49) The difference between the three commentaries concerning *Pithecellobium* are of little consequence. Correll and Correll's observation (1982, p. 678) has convinced them that the alleged differences between *P. mucronatum* Britt. ex Coker and *P. bahamense* Northrop are of no taxonomic significance.

50) Although we are all agreed that Catesby's *t.9* of the Appendix must be *Cypripedium acaule* Ait., it should be pointed out that this plate well demonstrates the crudeness of many of Catesby's illustrations. The two leaves supposedly nearly basal in this species are illustrated as being borne about the midpoint of the stem and separated from each other by more than an inch of stem. It is by elimination that one determines the identity of many of Catesby's plates rather than by the faithfulness of the illustration.

51) Again we are all agreed that this must be *Hymenocallis caroliniana* (L.) Herb. or its basionym, but there is considerable question as to just what the name applies. Any hope to resolve this uncertainty must await a badly needed revision of the genus.

52) Until the much-needed revision of the genus *Vanilla* is undertaken and completed, one can scarcely be dogmatic as to the identity of Catesby's plate or for that matter even of the name of most widely cultivated species of the genus. The protologues of the earliest named species seem often to be mixtures and it seems impossible to straighten out the confusion until a modern revision is completed. Fawcett and Rendle (1963, a rearrangement of the 1910 edition, p. 118) indicated "that some of the old drawings suggest *V. inodora* rather than *V. pompona* or *V. planifloia*, *e.g.* Catesby's plate (Nat. Hist. Carol., App. t.7) which is quoted by Miller as his *V. mexicana*."

53) In spite of the fact that Linnaeus treated the genus *Panax* as neuter, the genus is masculine in accordance with it classical treatment (see Flora N. America 28B: 9. 1944).

54) General agreement exists that *Ficus brevifolia* Nutt. (1846) is a synonym of *Ficus citrifolia* P. Mill. (1768). A sampling of recent authors treating the two binomials in this manner include Correll and Correll (1982, p. 419), Little (1979, p. 131), DeWolf (1960, p. 146) and Howard (1988, p. 60).

APPENDIX: TAXA SYSTEMATICALLY ARRANGED

GYMNOSPERMS

Taxodiaceae

Taxodium distichum (L.) L. C. Rich. (1: *t.11*)

ANGIOSPERMS

MONOCOTS

Amaryllidaceae (see Liliaceae)

Araceae

Orontium aquaticum L. (1: *t.82*) Peltandra virginica (L.) Schott & Endl. (1: *t.83*) Symphoricarpus foetidus (L.) Nutt. (2: *t.71*) ?Alocasia or Xanthosoma (2: *t.45*)

Bromeliaceae

Catopsis berteroniana (J.A. & J.H. Schultes) Mez (2: *t.77*) Tillandsia balbisiana Schult. f. (2: *t.89*)

Commelinaceae

Commelina erecta L. (2: *t.62*)

Gramineae

Oryza sativa L. (1: *t.14*)Uniola paniculata L. (1: *t.32*)

Hydrocharitaceae

Thalassia testudinum König (2: *t.38*)

Liliaceae

Hymenocallis caroliniana (L.) Herb. (2 App.: *t.5*)
Hypoxis sp. (1: *t.33*)
Lilium canadense L. (2 App.: *t.11*)
Lilium catesbaei Walt. (2: *t.58*)
Lilium philadelphicum L. (2 App: *t.8*)
Lilium superbum L. (2: *t.56*)
Trillium catesbaei Ell. (1: *t.45*)
Trillium maculatum Raf. (1: *t.50*)
Zephyranthes atamasco (L) Herb. (2 App.: *t.12*)

Orchidaceae

Cleistes divaricata (L.) Ames (1 *t.58* above)
Cypripedium acaule Ait. (2: *t.72* and 2 App.: *t.3*)
Cypripedium pubescens Willd. (2: *t.73*)
(= *C. calceolus* var. *pubescens* (Willd.) Correll)
Encyclia boothianum (Lindl.) Dressler (2: *t.74*)
Encyclia cochleata (L.) Lemee (2: *t.88* right)
Encyclia plicata (Lindl.) Britt. & Millsp. (2: *t.88* left)
Epidendrum nocturnum Jacq. (2: *t.68*)

Polystachya concreta (Jacq.) Garay & Sweet. (2: *t.55*)
Vanilla planifolia Andr. (2 App.: *t.7*)

SMILACACEAE

Smilax lanceolata L. (2: *t.84* below)
Smilax laurifolia L. (1: *t.15*)
Smilax pumila Walt. (1: *t.47*)
Smilax spp. (a hopeless mixture) (1: *t.52*)

DICOTS

ACERACEAE

Acer rubrum L. (1: *t.62*)

ANACARDIACEAE

Anacardium occidentale L. (2 App.: *t.9*)
Metopium toxiferum (L.) Krug & Urb. (1: *t.40*)
Rhus glabra L. (2 App.: *t.4*)

ANNONACEAE

Annona glabra L. (2.*t.64* and 2 *t:67*)
Annona reticulata L. (2: *t.86*)
Asimina triloba (L.) Dunal (2: *t.85*)

APOCYNACEAE

Echites umbellata Jacq. (1: *t.58* below)
Plumeria obtusa L. (2: *t.93*) above)
Plumeria rubra L. (2: *t.92*)
Urechites lutea (L.) Britt. (2: *t.53*)

AQUIFOLIACEAE

Ilex cassine L. (1: *t.31*)
Ilex vomitoria Ait. (2: *t.57*)

ARALIACEAE

Panax quinquefolius L. (2 App.: *t.16*)

ARISTOLOCHIACEAE

Aristolochia serpentaria L. (1: *t.29*)

BERBERIDACEAE

Podophyllum peltatum L. (1: *t.24*)

BIGNONIACEAE

Bignonia capreolata L. (2: *t.82*)
Campsis radicans (L.) Seem. (1: *t.65*)
Catalpa bignonioides Walt. (1: *t.49*)
Jacaranda caerulea (L.) Griseb. (1: *t. 42*)
Tabebuia bahamensis (Northrop) Britt. (1: *t.37*)

BORAGINACEAE

Bourreria ovata Miers (2: *t.79*)
Cordia sebastena L. (2: *t.91* above)

BURSERACEAE

Bursera simaruba (L.) Sarg. (1: *t.30*)

CALYCANTHACEAE

Calycanthus floridus L. (1: *t.46*)

CANELLACEAE

Canella winterana (L.) Gaertn. (2: *t.50*)

CARYOPHYLLACEAE

Silene virginica L. (2: *t.54*)

CHRYSOBALANACEAE

Chrysobalanus icaco L. (1: *t.25*)

CLETHRACEAE

Clethra alnifolia L. (1: *t.66*)

COMBRETACEAE

Conocarpus erectus L. (2: *t.33* above)
Languncularia racemosa (L.) Gaertn. (1: *t.86*)

COMPOSIATAE

Borrichia arborescens (L.) DC. (1: *t.93*)
Echinacea purpurea (L.) Moench (2: *t.59*)
Salmea petrobioides Griseb. (1: *t.72*)
Wedelia bahamensis (Britt.) O.E. Schulz (1: *t.92*)

CONVOLVULACEAE

Ipomoea batatas (L.) Lam. (2: *t.60*)
Ipomoea carolina L. (2: *t.91* below)
Ipomoea microdactyla Griseb. (2: *t.87* below)
Ipomoea sagittata Poir. (1: *t.35*)

CORNACEAE

Cornus florida L. (1: *t.27*)

EBENACEAE

Diospyros virginiana L. (2: *t.76*)

ERICACEAE (and see Monotropaceae)

Kalmia angustifolia L. (2 App.: *t.17* left)
Kalmia latifolia L. (2: *t.98*)
Leucothoë racemosa (L.) A. Gray (2: *t.43*)
Oxydendrum arboreum (L.) DC. (1: *t.71*)

Rhododendron maximum L. (2 App.: *t.17* right)
Rhododendron viscosum (L.) Torr. (1: *t.57*)

EUPHORBIACEAE

Croton eluteria (L.) Sw. (2: *t.46*)
Hippomane mancinella L. (2: *t.95* above)
Phyllanthus epiphyllanthus L. (2: *t.26*)
Picrodendron baccatum (L.) Krug & Urb. (2: *t.32*)

FAGACEAE

Castanea pumila (L.) P. Mill. (1: *t.9*)
Quercus alba L. (1: *t.21* left)
Quercus incana Bartr. (1: *t.22*)
Quercus laevis Walt. (1: *t.23*)
Quercus marilandica Muenchh. (1: *t.19*)
Quercus michauxii Nutt. (1: *t.18*)
Quercus nigra L. (1: *t.20* above)
Quercus phellos L. (1: *t.16*)
Quercus virginiana P. Mill. (1: *t.17*)
Quercus sp. (1: *t.21* right)

FLACOURTIACEAE

Banara minutiflora (A. Rich.) Sleumer (2: *t.42* right)

GENTIANACEAE

Gentiana catesbaei Walt. (1: *t.70*)

GOODENIACEAE

Scaevola plumieri (L.) Vahl (1: *t.79*)

GUTTIFERAE

Clusea rosea Jacq. (2: *t.99*)

HAMAMELIDACEAE

Hamamelis virginiana L. (2 App.: *t.2*)
Liquidambar styraciflua L. (2: *t.65*)

JUGLANDACEAE

Carya glabra (P. Mill.) Sweet (1: *t.38*)
Carya tomentosa (Poir.) Nutt. (1: *t.38*)
Juglans nigra L. (1: *t.67*)

LAURACEAE

Ocotea coriacea (Sw.) Britt. (2: *t.28* above)
Persea borbonia (L.) Sprengel (1: *t.63*)
Sassafras albidum (Nutt.) Nees (1: *t.55*)

LEGUMINOSAE

a) Mimosoideae

Acacia tortuosa (L.) Willd. (2: *t.44*)
Lysiloma latisiliquum (L.) Benth. (2: *t.42* left)
Pithecellobium bahamense Northrop (2: *t.97*)

b) Caesalpinoideae

Caesalpinia bahamensis Lam. (2: *t.51* above)
Gleditsia aquatica Marsh. (1: *t.43*)
Haematoxylon campechianum L. (2: *t.66*)

c) Papilionoideae

Dalbergia ecastophyllum (L.) Taub. (2: *t.24*)
Erythrina herbacea L. (2: *t.49*)
Galactia rudolphioides (Griseb.) Benth. & Hook. (2: t.28 below)
Robinia hispida L. (2 App.: *t.20*)

LOGANIACEAE

Gelsemium sempervirens (L.) J. St. Hil. (1: *t.53*)
Spigelia marilandica (L.) L. (2: *t.78*)

LORANTHACEAE (INCL. VISCACEAE)

Dendropemon purpureum (L.) Krug & Urban (2: *t.95* below)
Phoradendron rubrum (L.) Griseb. (2: *t.81* below)

MAGNOLIACEAE

Liriodendron tulipifera L. (1: *t.48*)
Magnolia acuminata (L.) L. (2 App.: *t.15*)
Magnolia grandiflora L. (2: *t.61*)
Magnolia tripetala (L.) L. (2: *t.80*)
Magnolia virginiana L. (1: *t:39*)

MALVACEAE

Hibiscus tiliaceus L. (2: *t.90*)
Phymosia abutiloides (L.) Desv. ex Ham. (1: *t.77*)

MELIACEAE

Swietenia mahagoni (L.) Jacq. (2: *t.81* above)

MENISPERMACEAE

Cocculus carolinus (L.) DC. (1: t.51)

MONOTROPACEAE

Monotropa uniflora L. (1: *t.36*)

MORACEAE

Ficus citrifolia P. Mill. (2 App: *t.18*)

MYRICACEAE

Myrica cerifera L. (1: *t.69*)
Myrica heterophylla Raf. (1: *t.13*)

NYSSACEAE

Nyssa aquatica L. (1: *t.60*)
Nyssa sylvatica Marsh. (1: *t.41*)

OLEACEAE

Chionanthus virginicus L. (1: *t.68*)
Fraxinus caroliniana P. Mill. (1: *t.80*)
Osmanthus americanus (L.) A. Gray (1: *t.61*)

PASSIFLORACEAE

Passiflora cupraea L. (2: *t.93* below)
Passiflora suberosa L. (2: *t.51* below)

PLATANACEAE

Platanus occidentalis L. (1: *t.56*)

POLYGONACEAE

Coccoloba diversifolia Jacq. (2: *t.94*)
Coccoloba uvifera (L.) L. (2: *t.96*)

PRIMULACEAE

Dodecatheon meadia L. (2 App.: *t.1*)

RHAMNACEAE

Colubrina elliptica (Sw.) Briz. & Stern (1: *t.10*)
Reynosia septentrionalis Urb. (1: *t.75*)

RHIZOPHORACEAE

Rhizophora mangle L. (2: *t.63*)

ROSACEAE

Prunus serotina Ehrh. (1: *t.28*)

RUBIACEAE

Casasia clusiifolia (Jacq.) Urb. (1: *t.59*)
Catesbaea spinosa L. (2: *t.100*)
Mitchella repens L. (1: *t.20* below)

RUTACEAE

Amyris elemifera L. (2: *t.33* below)
Ptelea trifolia L. (2: *t.83*)
Zanthoxylum clava-herculis L. (1: *t.26*)

SAPOTACEAE

Manilkara bahamensis Lam & Meeuse (2: *t.87* above)
Mastichodendron foetidissimum (Jacq.) Lam (2: *t.75*)

SARRACENIACEAE

Sarracenia flava L. (2: *t.69* right)
Sarracenia minor Walt. (2. *t.69* left)
Sarracenia purpurea L. (2: *t.70*)

SAXIFRAGACEAE (INCL. HYDRANGEACEAE)

Philadelphus inodorus L. (2: *t.84* above)

STERCULIACEAE

Theobroma cacao L. (2 App.: *t.6*)

STYRACACEAE

Halesia tetraptera Ellis (1: *t.64*)

SYMPLOCACEAE

Symplocus tinctoria (L.) L'Hér. (1: *t.54*)

THEACEAE

Gordonia lasianthus (L.) Ellis (1: *t.44*)
Stewartia malacodendron L. (2 App.: *t.13*)

THEOPHRASTACEAE

Jacquinia keyensis Mez (1: *t.98*)

VERBENACEAE

Avicennia germinans (L.) L. (1: *t.85*)
Callicarpa americana L. (2: *t.47*)

VITACEAE

Cissus tuberculata Jacq. (2: *t.48*)

UNDETERMINED PLATES

(2: *t.30*)
(2: *t.52*)

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THE *CLEMATIS VIRGINIANA* (RANUNCULACEAE) COMPLEX IN THE SOUTHEASTERN UNITED STATES

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ABSTRACT

The *Clematis virginiana* complex of eastern North America consists of two closely related and often confused species. The morphological, phenological, ecological and geographical characterization of these two species is clarified here, accompanied by notes on typification, nomenclature and synonymy. *Clematis catesbyana* Pursh is distinguished from the more widespread *C. virginiana* L. on the basis of leaves 5-foliolate to biternate as opposed to 3-foliolate, and carpels 18 − 35 as opposed to 40 − 60. *Clematis catesbyana* also flowers earlier in the season than *C. virginiana* and occupies drier habitats. *Clematis catesbyana* is restricted to several disjunct regions of the southeastern United States, while *C. virginiana* is widespread throughout eastern North America.

The Virgin's Bower of eastern North America consists of two closely related species that are often confused. Both are rampant vines that produce a profusion of small white flowers in the summer (fig. 1), followed by heads of long-tailed achenes in the fall (fig. 2). *Clematis virginiana* was described by Linnaeus in 1755 from a specimen probably collected in Pennsylvania (Essig & Jarvis 1989), and is common throughout much of eastern North America, from Quebec to Florida and westward to eastern Texas and Manitoba. *Clematis catesbyana* was described by Frederick Pursh in 1814, from a specimen collected by Mark Catesby in South Carolina in 1722 (fig. 3). According to Pursh, it differed from *C. virginiana* primarily in having biternate leaves with typically 3-lobed leaflets rather than ternate leaves with coarsely toothed leaflets (fig. 4). Specimens matching the description of *C. catesbyana* have subsequently been found in scattered areas throughout the southeastern U.S., from Virginia to Florida, and westward to Louisiana, Oklahoma and Kansas (fig. 5).

Since Pursh, authors have differed on whether *C. catesbyana* is truly distinct from *C. virginiana*. The flowers of the two species are essentially identical in appearance, and it has not previously been clear whether the described vegetative differences correlated with geographically or ecologically distinct taxa, or were merely forms of one variable taxon. DeCandolle (1817, 1824) recognized both species, while Torrey and Gray

FIG. 1. Flowers of *Clematis catesbyana* from central Florida.

FIG. 2. *Clematis catesbyana* from northwestern Florida, in fruit.

(1838 – 1840) treated *C. catesbyana* as a synonym of *C. virginiana*. Kuntze (1885), employing an extremely broad species concept, included both *C. virginiana* and *C. catesbyana* as subspecies under *Clematis dioica* (which was technically incorrect because the epithet *virginiana* has priority over *dioica*). Gray (1895) recognized both species, essentially on Pursh's criteria. Small (1933) also recognized both species, and described an additional species in the complex, *C. micrantha*, which supposedly had smaller flowers.

Recent floristic authors have generally recognized one or the other species, without attempting to differentiate the two, implying usually that *C. catesbyana* represents only a morphological variant of *C. virginiana*. Steyermark (1963), Radford et al. (1968), and Wunderlin (1982) recognized only *C. virginiana*, with the latter two authors citing *C. catesbyana* as a synonym. Clewell (1985), on the other hand, recognized *C. catesbyana* as the species occurring in the Florida panhandle, but did not take into consideration specimens matching *C. virginiana* that occur there. He therefore did not deal with the differentiation of the two species. Keener (1975) and Keener & Dennis (1982), in the broader context of studies of the Ranunculaceae of the southeastern United States, recognized *C. virginiana* and *C. catesbyana*, but placed Small's *C. micrantha* in synonymy under the latter. Keener's (1975) study is the only recent work that attempts to differentiate between the two species, and provides some tentative morphological criteria for separating them.

The present investigation, part of a long-term study of *Clematis* section *Clematis* (sensu Tamura 1968) worldwide, was undertaken to clarify the status of *Clematis catesbyana* relative to *C. virginiana*, and perhaps to achieve a better understanding of specific differences within the section as a whole. Throughout the section there are difficult complexes of species, and the differences between species seem at times to be minor and insignificant. Experience with this well-known complex from North America should therefore help illuminate other complexes.

MATERIALS AND METHODS

Specimens of the *Clematis virginiana* complex were borrowed from major herbaria throughout the eastern U.S. (A/GH, AUA, DUKE, FLAS, FSU, GA, KANU, LSU, MO, NCU, NO, NY, OKLA, PH, SMU, TENN, TEX, UARK, UNA, US, USCH, and USF). Data from herbarium sheets were entered into a computerized database using Asksam, a text-oriented database system that allows variable length fields. Label data, reproductive status, and various morphological characters were recorded. Specimens were initially sorted according to leaf character (leaflets 3 vs leaflets 5 or more), following Pursh and Keener. The database was then analyzed for

FIG. 3. Holotype (OXF) of *Clematis catesbyana*, collected by Mark Catesby in South Carolina.

correlations between morphological, ecological, phenological and geographical parameters.

RESULTS

Comparative study of about 750 sheets of the *Clematis virginiana* complex in the southeastern U.S. revealed a strong correlation between the leaf characters described by Pursh and several previously unrecognized morphological, phenological, and ecological features, as well as with geographic distribution.

Morphology: achene number

Plants with leaves 5-foliolate to biternate (*C. catesbyana*) consistently possess fewer than 35 carpels per flower (mostly 20 – 25), while plants with ternate leaves (*C. virginiana*) consistently have more than 40 carpels per flower (mostly 45 – 55). This is roughly twice as many carpels per flower in *C. virginiana* as in *C. catesbyana*, giving the achene heads of the former a fuller, more globose appearance than the heads of *C. catesbyana* (fig. 6).

A related character, achene color, was used by Keener (1975) to distinguish between the two species. According to him, *C. virginiana* has achenes "light to dark-brown or greenish brown," while *C. catesbyana* has achenes "reddish or purplish brown to dark blackish-purple." This seems to be valid to a degree, but is not as clear-cut or reliable as achene number. Achene color in dried specimens varies considerably depending on ripeness and drying conditions. I found a number of specimens that could not be properly placed on the basis of this character.

Phenology

A measure of the flowering phenology of each species was obtained by treating individual specimens as data points. It was found that the two species respond differently to seasonal cues (fig. 7), with *C. catesbyana* flowering early in the season (early July to early August) and *C. virginiana* flowering later (early August to late September in the southeast). The data were plotted against latitude because, as one moves southward, flowering is progressively later in the season. Thus, within particular latitudinal belts there is little overlap in blooming period. In central Florida, for example, where natural populations and cultivated plants have been observed for several years, flowering periods of the two species are consistently separated by 2 – 3 weeks. Where there does appear to be some overlap, it is between specimens that are geographically remote from one another. Thus it appears that the opportunity for hybridization between the two species is

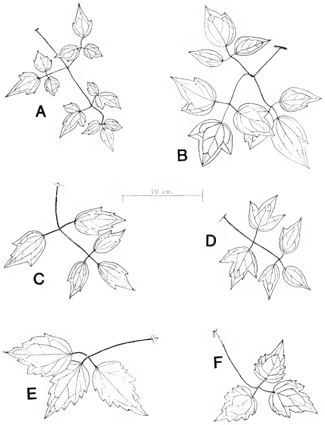

FIG. 4. Representative leaves of *Clematis catesbyana* (A – D) and *C. virginiana* (E – F).

extremely limited, if it exists at all. The Atlantic coastal populations of *Clematis catesbyana* (see fig. 5) were not included in figure 6, because the latitudinal effect is offset, possibly because of the longer growing season along the coast. In North Carolina, for example, coastal populations flower from late July to early September, a full month later than inland populations at the same latitude, and even a little later than the Florida populations. The question of hybridization with *C. virginiana* does not arise here, since these populations are geographically quite isolated.

Ecology and Geography

Both species are weedy, rampant vines inhabiting disturbed sites. *Clematis virginiana*, however, is confined to river margins and other habitats with damp to saturated soil, while *Clematis catesbyana* tends to occur on drier, well-drained, often calcareous sites. The latter has major populations on the Ozark Plateau, the Nashville Dome region of central Tennessee, loess bluffs along the Mississippi, Apalachicola, and Chattahoochee rivers, on shell mounds and sand dunes along the Atlantic coast, and in forested regions, often over exposed limestone, in west-central Florida (fig. 5). A few isolated populations in the Appalachians are associated with limestone outcrops. Both species are peculiarly lacking from the coastal plain of the Carolinas and Georgia, except for the narrow coastal population of *C. catesbyana* that extends from North Carolina to northeastern Florida. Although *C. catesbyana* is more often cited from calcareous habitats, habitat selection appears to be primarily for topography and drainage, rather than soil types or pH. Both taxa can sometimes be found over limestone substrates as well as on soils of more acid reaction, and thrive equally well when cultivated in rich, slightly acid soil.

A great many recent specimens of both species were collected along roadsides and other man-made habitats. Thus it is possible that some isolated populations have been spread beyond their natural range by humans in recent times. A large population of *C. virginiana*, for example, occurs in central Florida, in land disturbed by phosphate mining and along road sides. It most likely was introduced here recently, for it was not collected until 1976. This despite the fact that the population is traversed by State Highway 60, which had been travelled by a number of earlier botanists. When blooming and fruiting, the plants are very conspicuous along the road. Plants, apparently from this population, have now spread northward along Interstate 75, in low, wet roadside depressions into southern Pasco County. *Clematis catesbyana*, on the other hand, is apparently moving southward along the same highway in higher and drier spots, from natural populations in Hernando County into northern Pasco County.

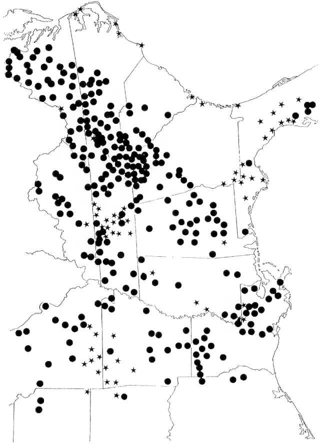

FIG. 5. Distribution of *Clematis catesbyana* (stars) and *C. virginiana* (dots) in the southeastern United States.

DISCUSSION AND CONCLUSIONS

Extensive analysis of herbarium material of *Clematis catesbyana* and *C. virginiana* has shown that the two species differ significantly in morphology (carpel number, leaf dissection), in phenology, in geographical distribution, and in habitat preference. Living populations, and populations represented by complete herbarium material, can be readily identified by the criteria presented here. No clear evidence of hybridization or true intermediates has been seen. The combination of spatial and temporal separation of known populations, moreover, strongly suggests that the opportunity for hybridization is rare if it exists at all. This isolation, despite broadly overlapping geographical ranges, indicates that the speciation process between *Clematis catesbyana* and *C. virginiana* is essentially complete. The disjunct distribution and greater variation of *Clematis catesbyana* suggests that it may be the older of the two species. These are well-defined, natural taxa and their recognition as species, as done recently by Keener (1975), is fully justified.

TAXONOMIC TREATMENT

General description (*Clematis virginiana* complex): Woody, deciduous to evergreen, dioecious vines, climbing by means of tendril-like petioles and petiolules. Leaves compound, thin, membranous, nearly glabrous above, coarsely toothed to entire, with sparse to dense short, simple, white hairs below; inflorescence of simple to compound, leafy to bracteate dichasia in the axils of leaves of current year's growth; axes hairy; flower buds ovoid (pistillate) or obovoid to pyriform (staminate), flowers white, sepals 6 − 14 mm long, 2 − 5 mm wide, linear-lanceolate to long-obovate; sparsely hairy above, more thickly so below, and densely hairy on margins, hairs fine, white; staminate flowers with ca. 30 to over 50 stamens, these somewhat shorter than the sepals, filaments flat, nearly as wide as the anthers, anthers ellipsoid, ca. 1 mm long, pistillodes rudimentary, inconspicuous, hidden in the thick hairs of the receptacle or often lacking altogether; pistillate flowers with numerous staminodes, similar to fertile stamens but shorter, sterile anthers rudimentary to nearly normal in appearance, lacking pollen; carpels numerous, ovary swollen, short-hairy, style elongate, nearly equalling the sepals, densely hirsute, stigma simple, curved-clavate; achenes lens-shaped, light to dark brown or reddish black, sometimes with a distinct, thickened, lighter rim, sparsely short-hairy, persistent style 2.5 − 3.5 cm long, covered with long, white hairs.

These species are adapted to the mesic conditions of eastern North America, and are distinguished most readily from related western species by their large and membranous leaves. *Clematis ligusticifolia* Nuttall, for

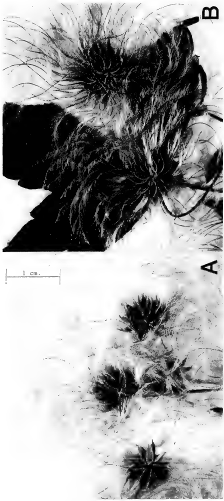

FIG. 6. Achene heads of *Clematis catesbyana* (A) and *C. virginiana* (B).

example, differs in having slightly succulent or coriaceous, 5- to 7-pinnate leaves with stomata on both surfaces, and in other subtle characters (Keener 1975).

Diagnostic Key to *Clematis catesbyana* and *C. virginiana*

1. Mature vegetative leaves 5-foliolate to biternate, leaflets usually 3-lobed, few-toothed, petiole about 1/3 the length of the entire leaf; pistillate flowers with $18-35$ carpels; flowering early July to mid-August; well-drained, often calcareous sites, southeastern U.S. . . . . *C. catesbyana*
1. Mature vegetative leaves ternate, leaflets usually coarsely dentate, petiole 1/2 the length of the entire leaf or more; pistillate flowers with $40-60$ carpels; flowering July to August in the northeastern U.S., early August to late September in the southeastern U.S.; low, moist areas, riverbanks, roadside ditches, throughout eastern U.S. and Canada . . . . *C. virginiana*

Clematis catesbyana Pursh, Fl. Amer. Sept. 2:736. 1814. — Type: SOUTH CAROLINA, *Catesby 1135* (holotype: OXF, photo!, see figure 3). *Clematis dioica* subsp. *catesbyana* var. *variabilis* Kuntze, Verh. Bot. Vereins Prov. Brandenburg 26:103. 1885, in part. *Clematis virginiana* var. *catesbyana* (Pursh) Britton in Britton and Brown, Ill. Fl. N. U.S. 2:67. 1897.

In the protologue to this name, Pursh cited a Catesby specimen in the Sherard Herbarium at Oxford ("v.s. herb Sherard"). A single specimen attributable to this species (fig. 3) has been located in the Sherard Herbarium. The specimen, numbered 1135, was collected by Catesby in Carolina in 1722 and matches Pursh's description well. It therefore can be considered the holotype.

Clematis cordata Pursh, Fl. Amer. Sept. 2:384. 1814. — Type: WEST VIRGINIA. Summers Co.: on the ascent of Keeny's Knob, above the precipice called the Claypinch, *Pursh s.n. 1806* (lectotype, designated here: PH!). *Clematis dioica* subsp. *cordata* (Pursh) Kuntze, Verh. Bot. Vereins Brandenburg 26:103. 1885.

Clematis cordata was published at the same time as *C. catesbyana*, and has traditionally been treated as a synonym of *C. virginiana*. However, Pursh described the leaves as 5-foliolate, which suggests that it should properly be placed under *C. catesbyana*. Pursh indicated in the protologue only that he had seen living material of this species in the high mountains of Virginia. No type was designated. However, a Pursh specimen from the mountains of West Virginia (Keeny's Knob, Summers Co.), matching the type description, and most likely collected in $1806-07$ (preceding the publication of the name in 1814), has been located at PH. It is designated here as the lectotype. Most of the leaflets have fallen off of the specimen, but from the elongated leaf rachis and the presence of scars, it is clear that the specimen was at least 5- foliolate. Similar material has been recently

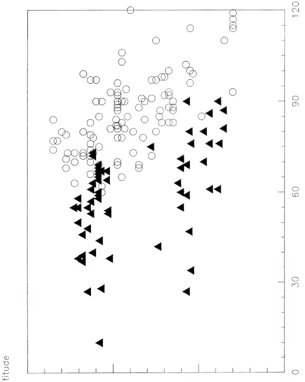

FIG. 7. Blooming time of *Clematis catesbyana* (solid triangles) and *C. virginiana* (circles).

collected from limestone outcrops in nearby Giles County, Virginia, which is clearly identifiable as *C. catesbyana*. There is no reason to consider C. cordata as a distinct taxon.

CLEMATIS MICRANTHA Small, Man. S.E. Fl., p. 525. 1933. — TYPE: FLORIDA. Hernando Co.: Choocochattee Hammock, S of Brookesville, *Small, Small & DeWinkeler 10602* (LECTOTYPE, designated here: NY!; ISOTYPE: GH!).

In the appendix to his Manual (p. 1504), Small (1933) cites two specimens under this name as follows: "Type, Devil's Punchbowl, w. of Brooksville, Fla., Small, No. 11337; for fr. Choocochattee hammock, s. of Brooksville, Fla., Small, No. 10602, in herb N.Y.B.G". Of these two syntypes, only number 10602 is annotated by Small as the type, and this is the specimen that contains the small flowers (not fruit) that figure prominently in his description. Sheet number 11337 in fact is a sterile specimen. Therefore, I designate *Small et al. 10602* as lectotype of *Clematis micrantha*.

Clematis micrantha was defined on the basis of its smaller flowers. Flowers on the type are indeed unusually small, with sepals only 5 – 6.5 mm long. In the newly collected material from the type locality (Brookesville area, Hernando County, Florida), however, sepals range from 6.5 to 10.5 mm long, well within the range of *C. catesbyana* as a whole. Also according to Small, plants are closely fine-pubescent in *C. micrantha* and minutely pubescent or glabrate in *C. catesbyana*. I can see no difference when a wide range of material is examined. All specimens have fine, white hairs on stems and leaves that range from sparse to thick even on individual specimens. Small therefore based his species on a specimen that was evidently atypical of its population. The most distinctive feature of the Brookesville plants is the strong degree of leaf dissection. The leaves are biternate or even further divided into 11 or 15 small leaflets. This degree of dissection gradually diminishes northward, however, with leaves 5-foliolate to biternate in north Florida and mostly 5-foliolate in the Ozark region.

Representative specimens examined — CLEMATIS CATESBYANA: (complete list of exsiccate available from the author)

ALABAMA. **Clark Co.**: borders of woods in rich soil, 1859, *Denny 4* (UNA).

ARKANSAS. **Benton Co.**: Ozark Plateau, Boston Mtns., generally wooded area near Bella Vista, 5 mi N of Bentonville, elev. 1000 – 1200 ft, 22 Sep 1928, *Demaree s.n.* (UARK). **Carroll Co.**: Ozark Plateau, Province of White River Hills, wooded NE facing slope along White River at Catron Bend, 5 mi NW of Eureka Springs, elev. 900 – 1000 ft, Rockwood, 27 – 30 Jul 1953, *Leonard & May 6* (UARK). **Cross Co.**: Crowley's Ridge, Levesque, elev. 300 ft, 24 Jul 1939, *Demaree 19587* (MO). **Izard Co.**: along road from Croker to Guion near White River, 23 Jul 1970, *Thomas 20192* (FLAS, TENN). **Logan Co.**: Mt. Magazine, plateau surface at ca 2800 ft, 17 Sep 1967, *Tucker 6620* (NCU). **Newton Co.**: bank of Clark Creek and park entrance, occasional, 14 Jul 1974, *Thompson s.n.* (UARK). **Washington Co.**: in Fayetteville on Dickson St., in a ditch adjacent to the street on Mt. Sequoyah, 10 Jun 1975, *Davis 891* (UARK).

FLORIDA. **Alachua Co.**: Paynes Prairie State Preserve, S of Gainesville, N side of Alachua Sink, twining up trees, 23 Oct 1981, *Easterday 755* (FLAS). **Citrus Co.**: limestone outcrops, 3 mi SW of Pineola, 1 Aug 1948, *Ford 2295a* (TENN). **Dixie Co.**: S of Old Town, 11 Aug 1937, *West & Arnold s.n.* (FLAS); swamp at Suwanee, 5 Sep 1957, *Godfrey*

56042 (FSU). **Duval Co.**: Fort George Island, in delta of St. John's River, E of Jacksonville, abundant in roadside vegetation along E side of island, growing in crushed shell, 26 Nov 1987, *Essig 871126 – 1* (USF). **Franklin Co.**: Apalachicola, *Chapman s.n.* (MO). **Gadsden Co.**: near ground level, old wood stem 2.5 cm diam, at 6 m above ground 1.5 cm diam, shrouding crown of willow tree, borders of floodplain woodland, Apalachicola R., by US 90 bridge, Chattahoochee, 21 Sep 1981, *Godfrey 79145* (FLAS, FSU). **Hernando Co.**: abundant in old limestone quarry along CR 491, just N of jct. with US 98, 26 Sep 1986, *Essig 860926-1* (USF). **Jackson Co.**: climbing in trees along n-s paved rd. at Marianna Caverns State Park, 22 Jun 1960, *Mitchell 447* (FSU). **Lake Co.**: vic. Eustis Lake, 16 – 25 Aug 1894, *Nash 1731* (MO). **Leon Co.**: growing in roadside shrubbery along Hwy 90 at Sun Ray Rd., 1 Sep 1987, *Essig & Hansen 870901-1* (USF). **Levy Co.**: on roadside vegetation to 3 m high at Magnolia, 22 Sep 1959, *Cooley et al. 7182* (FSU, NCU, USF). **Liberty Co.**: floodplain woodland, Apalachicola R., E of Sneads, 16 Aug 1982, *Godfrey 79924* (FSU). **Marion Co.**: calcareous woodland near the Silver R., on Dupont property, 3 Oct 1984, *Godfrey 81651* (FSU). **Pasco Co.**: on fence beside I-75, W side, ca 0.25 mi S of CR 41, 27 Aug 1987, *Essig 870827-1* (USF). **Polk Co.**: at edge of swamp forest, dirt extension of Hinson AvE, near Lake Marion, E of Haines City, 4 Oct 1987, *Essig 871004-1* (USF).

GEORGIA. **Decatur Co.**: on edges of mixed woodland by the office of Resource Manager, Lake Seminole, 9 Sep 1979, *Godfrey 77204* (FSU, GA). **Early Co.**: bank of Chattahochee R. at Sheffield's Landing, 14 Aug 1901, *Harper 1222* (MO). **Liberty Co.**: St. Catherine's Island, N end, edge of woods beside the housing compound, 24 Aug 1983, *Jones, et al. 23999* (GA). **Seminole Co.**: bank of Chattahoochee R. at Butler, 25 Jul 1947, *Thorne 5663* (GA).

KANSAS. **Cherokee Co.**: 6 mi E of Baxter Springs, near MO border, rocky wooded hillside, Ozark region, growing on thicket of *Cornus asperifolia*, 3 Jul 1948, *McGregor 1937* (KANU).

KENTUCKY. **Warren Co.**: along roadsides and ditches on Jenkins Rd. ca 1 mi south of U.S. Lock & Dam £1 on Barren R., ca 5 mi NNW of Bowling Green, 20 Jul 1970, *Nicely & Gough 3069* (NCU).

LOUISIANA. **St. Helena Parish**: abundant in open shrubby area ca 1 mi W of Chipola, assoc. with *Ilex* and *Cornus*, 30 Jul 1971, *Allen 1296* (DUKE, LSU). **West Feliciana Parish**: ca 1 mi from post office of Plettenberg, trailing on trees along logging road, 22 Aug 1938, *Correll & Correll 10467* (DUKE, LSU).

MISSOURI. **Barry Co.**: roadside, NE facing cherty slope, Hwy 112 east (T22N, R27W, W1/2, sec. 27), 16 Jul 1979, *Hornberger 532* (UARK). **Christian Co.**: Low thickets along east fork of Bull Creek, 3 mi SW of Chadwick, 8 Jul 1937, *Steyermark 23111* (MO); Rocky Hills, 28 Sep 1905, *Bush 3479* (MO). **Douglas Co.**: beside White R. and MO 14 at Twin Bridges, 28 Jul 1969, *Thomas 15817* (TENN). **Greene Co.**: 10 mi SE of Springfield, James River & MO Hwy 125, 25 Jul 1975, *Stalker & Nelson 478* (NCU). **Howell Co.**: rocky wooded slope bordering Indian Creek, 3.5 mi W of willow Springs, 18 Jul 1982, *Summers 1079* (MO). **Shannon Co.**: Montier, common, 29 Aug 1894, *Bush 1* (MO). **Stone Co.**: thickets along rocky creek, near Galena, 25 Sep 1923, *Palmer 23881* (MO). **Taney Co.**: common in woods, Swan, 4 Jun 1899, *Bush 99* (MO).

MISSISSIPPI. **Union Co.**: State Hwy 346, roadisde 10 mi E of New Albany, 18 Jul 1966, *Temple 3504* (GA, NCU). **Warren Co.**: edge of wooded loessal bluffs facing delta region, 2 mi N of Redwood, 12 Jul 1955, *Ray 4910* (NCU). **Wilkinson Co.**: roadside, sandy soils, Smith Place, ca 5.5 mi WNW of Woodville, 22 Jul 1970, *Jones, Jones & Clark 19800* (NCU). **Yazoo Co.**: 6 mi SE of Yazoo City, loessial soil along creek, common, high-climbing, 29 Aug 1959, *McDaniel 1286* (UNA).

NORTH CAROLINA. **Brunswick Co.**: Smith's Island, Summer 1925, *Blomquist 3643*

(DUKE). **Carteret Co.**: very abundant as liana in low dense live oak-juniper forest on Shackleford Banks, 7 Aug 1962, *Anderson 386* (DUKE, FSU). **Currituck Co.**: thicket, 3 mi N of Waterlily, 31 Jul 1958, *Ahles & Duke 48210* (NCU). **Dare Co.**: depression between dunes of Duck, 28 Aug 1952, *Radford 660* (NCU). **Onslow Co.**: Bear Island or Hammock Beach State Park at the western quarter of the island, abundant spreading sprawling vine forming dense cover on stabilized dunes at the western end of island, 25 Aug 1967, *Wilbur 9590* (DUKE).

OKLAHOMA. **Cherokee Co.**: open woods of creek valley, 22.1 mi NE of Tahlequah on State 10, 29 Jul 1951, *Wallis 860* (OKLA).

SOUTH CAROLINA. **Beaufort Co.**: very abundant in sunny disturbed areas and roadsides through abandoned fields, central Callawassie Island, 13 Oct 1981, *Aulbach-Smith 2036* (USCH).

TENNESSEE. **Cannon Co.**: in limestone valley, fencerow on Rt. 145, 3 mi N of Woodbury, 29 Jul 1958, *Ellis 249-E* (TENN). **Carter Co.**: on roadside in open place, toll rd. to Roan Mt. at 3800 ft, 26 Jul 1934, *Brown 100* (DUKE). **Cheatham Co.**: Ellis 196-E (TENN). **Clay Co.**: 1 mi N of Clay Co., line on Hwy 53, roadside, 7 Jul 1958, *Ellis 24736* (TENN). **Coffee Co.**: edge of woods, escarpment area, 28 Jun 1955, *DeSelm 593* (TENN). **Davidson Co.**: on fence by Mountain View Rd., N of Murphreesboro Rd., toward Percy, Priest Lake, 14 Aug 1968, *Kral 32340* (NCU). **Giles Co.**: NE of Pulaski, roadside on limestone, 13 Jul 1948, *Sharp et al. 9796* (TENN). **Grundy Co.**: borders of hardwood forest on mountain slope, 2.3 mi N of Monteagle, ?4 Aug 1970, *Godfrey 69759* (FSU, NCU). **Jackson Co.**: 0.25 mi from Hwy 85 on Haydensville Rd., 7 Jul 1958, *Ellis 24409* (TENN). **Macon Co.**: bank of Long Cr., 9 Jul 1958, *Ellis 24457* (TENN). **Maury Co.**: on Green's Mill Rd., ca 1 mi from US 31, 27 Jul 1957, *Chappell s.n.* (TENN). **Moore Co.**: moist soil of slope SE of Lynchburg, 7 Aug 1947, *Sharp et al. 5685* (TENN). **Rutherford Co.**: growing over limestone on sides of road, between Rt. 231 and Christiana, 31 Jul 1958, *Ellis 326-E* (TENN). **Williamson Co.**: in limestone bottom, 1.5 mi SE of McDaniel, 6 Aug 1958, *Ellis 322-E* (TENN). **Wilson Co.**: limestone hillside 0.5 mi N of 70 N, on old roadbed of Hwy 109, 23 Jul 1958, *Ellis 24771* (TENN).

VIRGINIA. **Giles Co.**: 1.4 mi W of Mt. Lake Hotel on Va 613, 28 Jul 1965, *Scheer s.n.* (NCU).

CLEMATIS VIRGINIANA L., Cent. I Pl., p. 15. 1755. — TYPE: unnumbered specimen (LECTOTYPE: UPS, photo!), see Essig and Jarvis 1989. *Clematis dioica* subsp. *virginiana* (L.) Kuntze, Verh. Bot. Vereins Brandenburg 26:102. 1885. *Clematis virginiana* var. *genuina* Kuntze, Rev. Gen. 1:2. 1891, nom. inadmiss.

CLEMATIS CANADENSIS Miller, Gard. Dict. ed. 8, *Clematis* No. 5, 1768. — TYPE: not designated.

Miller described this species as having ternate leaves with cordate, toothed leaflets, which places it with *C. virginiana*. He cited " *Clematitis canadensis* latifolia & triphylla. Sar.", most likely referring to the French Canadian botanist Michel Sarrazin, who collected in southern Quebec between 1697 and 1734. There may be a specimen matching the description at Paris.

CLEMATIS HOLOSERICEA Pursh, Fl. Amer. Sept. 2:384. 1814. — TYPE: "v.s. Herb. Walter."; not seen.

Pursh described this species as ternate, and holosericeous-pubescent, with small white flowers. The vestiture of the foliage is of no taxonomic consequence, and the species clearly falls under *C. virginiana*. Pursh cites a specimen in the Walter Herbarium (BM) from Carolina. Walter's specimens are mounted several to a page. Two specimens on page 34 of this collection, seen in a photograph only, possibly match Pursh's description. Most likely, one of these could be designated the lectotype, but I refrain from doing so until I have the opportunity to examine the specimens.

CLEMATIS MISSOURIENSIS Rydberg in Britton, Man. Fl. N. U.S. 1901, in part. — TYPE: *Webber s.n.* Sep 1886, Lincoln, Nebraska (LECTOTYPE, designated here: NY!). *Clematis virginiana* var. *missouriensis* (Rydberg) Palmer & Steyermark, Ann. Missouri Bot. Gard. 22:542. 1935. *Clematis virginiana* forma *missouriensis* (Rydberg) Fernald, Rhodora 39:309. 1937.

Rydberg mentioned only that the type came from Lincoln, Nebraska. The Webber specimen at NY is annotated as the type by an unknown hand. It is in fact the only known specimen, matching the description and coming from the type locality, that would have been available to Rydberg at New York at the time. Therefore, I designate this specimen as the lectotype.

The species was distinguished on the basis of the undersides of leaflets being densely hirsute, and the achenes lacking the characteristic thickened rim of *Clematis virginiana*. The achene character, cited most recently by Gleason and Cronquist (1963), was discounted by both Fernald (1937) and Steyermark (1963). The distinction disappears when many specimens are examined. Specimens with densely hirsute leaves are particularly common from western Missouri northward into Minnesota and Ontario, but can be found sporadically throughout the northeastern United States. Also, many specimens with hairy leaves from southwestern Missouri, cited as *Clematis virginiana* forma missouriensis by Steyermark (1963) actually belong to *Clematis catesbyana*. Formal recognition of this taxon at any level is thus likely to lead to confusion and therefore should be avoided.

Representative specimens examined — *Clematis virginiana*: (complete list of exsiccate available from the author).

ALABAMA. **Clarke Co.**: Oak-Pine woodland, 6 mi S of Thomasville School, 5 Sep 1970, *Kral 41126* (NY). **Monroe Co.**: Haines Island, high limestone ridge and ravines along the Alabama River, 3 Sep 1985, *Diamond 1742* (AUA).

ARKANSAS. **Marion Co.**: Buffalo Pt., ca 14 mi S of Yellville on Hwy 14 and off on Rd. 268, 6 Aug 1975, *Smith 219* (UARK). **Saline Co.**: 2 mi W of Benton, on gravel shores of river, 6 Sep 1942, *Tolstead & Demaree* (NEB). **Sevier Co.**: 1 mi W of Lorksburg in small bottom, 20 Oct 1932, *Demaree 9885* (MO, NY, US).

FLORIDA. **Escambia Co.**: near Molino, along W side of L&N RR tracks between Pretty Branch and its south fork, 9 Sep 1980, *Burkhalter 7190* (FLAS, FSU). **Hillsborough Co.**: Edward Medard State Park, Turkey Cr. Rd., ca 5 mi S of Plant City, 25 Sep 1987, *Essig 870925-5* (USF). **Jefferson Co.**: at and just within borders of hardwood hammock at Wacissa Spring, 6 Sep 1982, *Godfrey 79947* (FLAS, FSU). **Pasco Co.**: in roadside vegetation, low, mesic areas along I-75, ca 3 mi S of Hwy 54, 20 Oct 1987, *Essig & Hansen 871020-2* (USF). **Polk Co.**: growing in low moist area, along the N side of FL 630, ca 1.5 mi W of Ft Meade, 15 Oct 1977, *Shuey 1998* (USF).

GEORGIA. **Harris Co.**: low, sunny roadside, rocky soil along GA 190 at Dowdell's Knob on Pine MtN, 25 Aug 1971, *Jones 21361* (GA, NCU). **Morgan Co.**: Hard Labor Creek State Park, swampy area beside main highway, 24 Aug 1978, *Hill 668* (GA, NCU). **Walker Co.**: Pigeon Mtn. Wildlife Management Area, NE of Harrisburg Gulf, 18 Aug 1981, *Coile et al. 2285* (GA).

KANSAS. **Douglas Co.**: 2 mi E of Lecompton, Kansas River Bluff, growing over thicket, 20 Sep 1975, *McGregor 28301* (KANU). **Shawnee Co.**: 1 mi E of Topeka, Kansas River Bluff, growing over thicket, 20 Sep 1975, *McGregor 28306* (KANU).

KENTUCKY. **Bracken Co.**: rare, in weedy field at Meldahl Dam, ca 3 mi SE of Foster on Rt. 8, 24 Aug 1983, *Buddell 2318* (NCU). **Edmonson Co.**: ca 1.5 mi NW of Pleasant Grove Church, Little Sally Branch, beside stream, 3 Aug 1968, *Elmore 367* (NCU). **McCreary Co.**: Daniel Boone NF, along Beaver Cr., 4.5 mi N of jct. Funston Ridge Plantation Rd. & Beaver Cr. Rd., 20 Aug 1972, *Browne & Browne 72H28.2* (NCU). **Todd Co.**: roadside swamp in area of Guthrie clay, 0.5 mi from Guthrie, 8 Oct 1949, *Shanks et al. 14335* (TENN).

LOUISIANA. **Caddo Parish**: common in open woods off Ellerbe Rd, 9 mi S of Shreveport, 17 Sep 1977, *MacRoberts & MacRoberts 269* (NO). **Oachita Parish**: woods near Hogpen Rd, Lapine Rd., 3 mi S of LA 34, 10 Sep 1968, *Holler 78* (NCU). **Plaquemines Parish**: margin of woods, Road C, eastern extension, 20 Sep 1978, *Fleming 411* (NCU). **West Feliciana Parish**: roadside, 5 mi E of Tunica center on Rt. 66, 31 Oct 1976, *Paulson s.n.* (LSU). **Washington Parish**: on LA 483, 2.1 mi W of Warnerton, 29 Nov 1958, *Stone 451* ().

MISSOURI. **Butler Co.**: swamps, 16 Oct 1905, *Bush 3710* (MO). **Dallas Co.**: upper limestone thickets along Niangua R., 0.5 mi upstream from mouth of Douisenburg Cr., 5 Aug 1937, *Steyermark 24261* (MO). **Dent Co.**: low thickets along N prong of Maramec R., between Stone Hill and Indian Trail State Park, 4 Aug 1936, *Steyermark 12472* (MO). **Jackson Co.**:, 5 Oct 1888, *Bush s.n.* (MO). **Marion Co.**: Bear Cr. Bluffs, Oakwood, 10 Aug 1916, *Davis 1628* (MO).

MISSISSIPPI. **Amite Co.**: common along roadside and ditches, 15 mi N of Liberty, 20 Sep 1973, *Westbrook s.n.* (UARK). **Forrest Co.**: bottomland hardwoods along Leaf R. at McCallum, SE of Hattiesburg, 16 Sep 1966, *Jones et al. 10463* (NCU). **Jefferson Co.**: weedy roadsides along US 61, 0.7 mi N of South Fork Coles Cr., 3.3 mi N of Stanton, 7 Sep 1980, *Pruski 1893* (TEX); Laurel, disturbed woods along road between Reedy Cr. & Bogue Homo Cr., 1 Sep 1978, *Morgan 1167* (FSU). **Montgomery Co.**: right-of-way and rich deciduous woods along LA Hwy 404, 0.9 mi W of Ava, 19 Aug 1967, *Temple 6534* (GA). **Tishomingo Co.**: Hwy 72 at Yellow Cr., moist power line, 26 Sep 1974, *Coleman 48426* (TENN). **Wilkinson Co.**: roadside, full sun, loess bluffs, ca 8 mi via air NW of Woodville on on Beaver Cr. Rd., between Lessley & Lanhart, 15 Sep 1970, *Jones et al. 20143* (GA).

NORTH CAROLINA. **Chatham Co.**: seasonal stream bed, 1.2 mi E of NC 1008 on NC

1743, 31 Oct 1981, *Jones K-8* (NCU). **Cherokee Co.**: Bog, near Grape Cr., 6 mi NW of Murphy, 31 Aug 1956, *Radford 17625* (NCU). **Granville Co.**: creek bank, 3.2 mi S of Goshen, 28 Sep 1956, *Ahles & Leisner 20118* (FLAS, NCU). **Lincoln Co.**: low pasture by Howard's Cr., 0.6 mi E of Cat Square, 10 Sep 1958, *Bell 15300* (NCU). **Madison Co.**: boggy pasture, 7.4 mi N of jct. with U.S 19 and 23 on 23, north of Mars Hill, 14 Jul 1958, *Ahles & Duke 46326* (NCU).

OKLAHOMA. **Cherokee Co: open roadside of Illinois River Valley, 2.8 mi NE of Tahlequah on State 10, 30 Aug 1950,** *Wallis 162* **(OKLA).**

SOUTH CAROLINA. **Barnwell Co.**: King Cr., Savannah R. Plant, 5 Oct 1953, *Kelley & Batson s.n.* (USCH). **Lancaster Co.**: deciduous forest, NE side of Flat Cr., 0.1 − 0.6 mi SE of CR 37, 2 Sep 1961, *Williamson & Ahles 2001* (NCU). **Richland Co.**: rocky, open floodplain area along the Saluda River, under the I-126 overpass, 2 Oct 1976, *Aulbach 763* (USCH). **Oconee Co.**: N-facing wooded slopes of hill, 1.25 mi NW of Salem, 10.5 mi NE of Walhalla, 28 Aug 1950, *Duncan 11892* (GA). **McCormick Co.**: near Troy, 20 Aug 1921, *Davis s.n.* (MO).

TENNESSEE. **Bedford Co.**: calcareous banks, borders of wooded slope, 2.5 mi S of Shelbyville, 30 Aug 1958, *Godfrey 57528* (FSU). **Carter Co.**: deciduous forest, Round Bald Mtn., N slope, rocky spring below grass bald, 6 Aug 1956, *Ramseur 1386* (NCU). **Cheatham Co.**: bank of Harpeth R. on Hwy 70, 15 Jul 1958, *Ellis 24366* (TENN). **Clay Co.**: jct. Hwy 53 & Dale Hollow Rd., N of Celina, 6 Jul 1958, *Ellis 24730* (TENN). **Coffee Co.**: Morton Lake, growing on trees and shrubs, 27 Nov 1980, *Terry 137* (AUA). **Johnson Co.**: edge of deciduous forest slope, bank of Watauga Lake on Hwy 67, S side of Butler, 3 Oct 1967, *Mahler & Mahler 4590* (NCU). **Marion Co.**: spray-zone slope at Foster Falls, Fiery Gizzard Gorges, 24 Aug 1964, *Clark 1201* (NCU). **Obion Co.**: Reelfoot (Lake) Wildlife Refuge Area, Walnut Log Division, Blue Basin, 18 Sep 1982, *Utech et al. 82-480* (NCU). **Robertson Co.**: roadside 3 mi W of Greenbrier, 24 Jun 1958, *Ellis 347-E* (TENN). **Polk Co.**: along RR S of Hiwassee R. at McFarlands in Cherokee NF, 3 Sep 1970, *Odenwelder & Bowers 45577* (TENN). **Tipton Co.**: beside gravel road at foot of Chickasaw Bluff No. 2, 1.3 mi N of jct. with Herring Hill & River Bluff RdS, 4 Oct 1968, *Warrington 406.3* (NCU). **Union Co.**: edge of corn field by river, Island-F, Norris Lake, 18 Sep 1934, *Kelley s.n.* (TENN).

TEXAS. **Harrison Co.**: edge of swamp forest, ca 3.5 mi NW of Karnack, 15 Sep 1964, *Correll 30155* (LL, NY). **Jasper Co.**: 1.5 mi NW of jct. US 190/63, on 63 at bridge crossing, SE side, 14 Oct 198x, *Cheatham s.n.* (TEX). **San Augustine Co.**: climbing on trees and shrubs, edge of swamp woods, ca 1 mi S of San Augustine, 14 Sep 1968, *Correll 36560* (FSU, LL).

VIRGINIA. **Buchanan Co.**: in Grundy, on VA 83, 18 May 1968, *James 9976* (NCU). **Frederick Co.**: 2.6 mi SE of jct. CR 615 & US 50, upland woods, 21 Jun 1968, *James 10844* (NCU). **Giles Co.**: jct. VA 604 and 110, along margin of Sinking Cr., weedy roadside & creek margin, 20 Sep 1975, *Rich 72* (GA). **Henrico Co.**: edge of marsh W of Elko Station, 3 Sep 1967, *Harvill 17369* (NCU). **Lee Co.**: edge of old field near Wilderness Rd. campground, elev. 1300 ft, 28 Aug 1974, *Hinckle 49612* (TENN). **Prince William Co.**: in shrubs on edge of swamp and on edge of open field of Marumsco Acres Lake Recreation Area, 8 Aug 1981, *Keyser 397* (FLAS).

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CYPERUS ENTRERIANUS (CYPERACEAE), AN OVERLOOKED SPECIES IN TEMPERATE NORTH AMERICA

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ABSTRACT

Cyperus entrerianus Böckeler, an apparently recent introduction from South America or Mexico, is reported in temperate North America. It is presently known from 20 sites in five states in southeastern United States. Its distribution and ecology are discussed, and differences between it and closely related *Cyperus luzulae* (L.) Retz. are detailed. A key is given to distinguish *Cyperus entrerianus* from other members of section *Luzuloidei*, which occur in North America.

RESUMEN

Cyperus entrerianus Böckeler es registrada para la zona templada de America del Norte; esta especie aparentemente es de reciente introduccion de Mexico o America del Sur. Esta expecie se conoce actualmente de 20 localidades en cinco estados en el sureste de los Estados Unidos. Se discute aqui su distribucion y ecologia y se detallan las diferencias entre esta y la especie mas afin *Cyperus luzulae* (L.) Retz. Se incluye una clave taxonomica para distinguir *Cyperus entrerianus* de los otros miembros de la seccion *Luzuloidei*, que ocurren en America del Norte.

INTRODUCTION

While conducting field work in southern Georgia during 1987, an unfamiliar species of *Cyperus* Section *Luzuloidei* was located in Ware County. I tentatively identified it as *Cyperus ochraceus* Vahl var. *excelsior* Kükenthal? and sent a duplicate to Robert Kral (VDB) who identified it as *C. surinamensis* Rottb. Intensive field work during 1988 and 1989 revealed 12 additional sites from southern Georgia and western Florida to southeastern Texas. Additional specimens from Florida, Louisiana, and Texas have been located at FSU, IBE, and VDB.

This sedge has now been identified as *Cyperus entrerianus* Böckeler, which is primarily a temperate South American species (Kükenthal 1936). The epithet "entrerianus" is derived from Entre Rios, the name of an historically disputed area presently in Argentina and the type locality of *C. entrerianus* (Böckeler 1878). Kükenthal (1936) and Pedersen (1968) recognized *C. entrerianus* as a distinct species, and Kükenthal (1936) placed it into section *Luzuloidei* of *Cyperus*. Also, this taxon was treated as a variety

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of *C. luzulae* by Barros (1938). Denton (1978), in a taxonomic treatment of the "Luzulae group" of *Cyperus*, placed the name into the synonymy of *Cyperus luzulae* (L.) Retz., but, in discussion, referred to " 'entrerianus' and 'luzulae' modes of variation". Furthermore, Denton (1978) cited specimens of *C. luzulae* from Florida, Missouri, Oklahoma, and Texas, which I have not seen; it is unclear whether these are *C. luzulae* or *C. entrerianus*. However, *C. luzulae* is primarily a tropical species, and it seems doubtful that it has or will become established in other than subtropical regions of the United States, such as extreme southern Texas or perhaps southern Florida.

TAXONOMY

Cyperus entrerianus is a stout rhizomatous perennial, which may be as much as 120 cm tall. It has bicarinate, dorsally grooved scales and florets characterized by a single stamen. It clearly belongs to section *Luzuloidei* as circumscribed by Kükenthal (1936) and is closely related to *Cyperus luzulae*. I have observed *Cyperus luzulae* in the field in Peru [*McDaniel 23640, Rimachi, Carter* (IBE, VDB)] and in Dominican Republic [*Carter 5201, 5220* (MO, VSC)], and I believe it and *Cyperus entrerianus* are specifically distinct.

There are a number of differences between these two taxa. *Cyperus entrerianus* is a larger plant than *C. luzulae*. The leaf bases of *C. entrerianus* are heavily black-pigmented, and their fibrous remains are persistent. Its base, unlike that of *C. luzulae*, is deeply set in the substrate and has thick rhizomes with short internodes. Spikes of *C. entrerianus* are conspicuously compound and composed of one to several globose units, while those of *C. luzulae* generally are dense and conical and appear simple. The spikelets of *C. entrerianus* are more loosely arranged and have 16 – 32 pale greenish scales, while those of *C. luzulae* are tighter and have 12 – 16 whitish to tawny scales.

Certain specimens (e.g., *Carter 6296, 7319, 7447, 8040, 8093, and 8102*) from southeastern United States exhibit sparsely scabrid culms and, thus, will key to *Cyperus surinamensis* with most conventional keys (e.g. Godfrey and Wooten 1979). The culm teeth are mostly retrorsely oriented as they are in *C. surinamensis*. This characteristic has not been previously noted in *C. entrerianus* in the literature. Also, the number of fertile scales per spikelet in *C. entrerianus* specimens from United States seems to be greater than in specimens from South America and falls within the range for *C. surinamensis* (see table 1). Furthermore, specimens of *C. entrerianus* from southeastern United States apparently are more robust than ones from South America, and in the United States *Cyperus entrerianus* appears to be an aggressive weed and is often locally abundant and dominates its disturbed

TABLE 1. Morphological comparison of *Cyperus entrerianus* with *C. luzulae* and *C. surinamensis*.

CHARACTERS	TAXA		
	C. entrerianus	*C. luzulae*	*C. surinamensis*
HEIGHT	>5 dm	<5 dm	1.0 − 7.5 dm
RHIZOME	stems more or less loosely loosely clustered, connected by thick rhizomes with short internodes	cespitose, rhizomes not at all evident	cespitose, rhizomes not at all evident
LEAF BASE	blackish purple; persistent & fibrous	brown to reddish brown; neither persistent nor fibrous	brown to reddish brown; neither persistent nor fibrous
SPIKE			
DENSITY	loose, thus individual spikelets distinct	tight, thus individual spikelet not distinct	loose, thus individual spikelets distinct
SHAPE	compound, units globose	appearing simple, conical	compound, somewhat flattened
SPIKELET			
FERTILE SCALES	16 − 32	12 − 16	18 − 48
WIDTH	1.8 − 2.1 mm	1.4 − 1.8 mm	1.6 − 2.3 mm
SCALE			
COLOR	pale green	whitish to tawny	golden yellow to stramineous
SCALE			
POSTURE	divergent ca 30°	divergent ca 30°	divergent ca 45°

habitat. The aggressive nature and robust size of plants of *C. entrerianus* from southeastern United States might well be due to heterosis. These characteristics suggest introgression between *C. entrerianus* and *C. surinamensis*, which frequently occur together in southeastern United States. A morphological comparison of *Cyperus entrerianus*, *C. luzulae*, and *C. surinamensis* is given in table 1. Following is a key by which the North American species of section *Luzuloidei* may be identified.

KEY TO *CYPERUS* SECTION *LUZULOIDEI* IN NORTH AMERICA

1. Culm triquetrous, angles sharp, usually flattening when pressed and dried.
   2. Achene about 1/2 − 2/3 as long as scale; inflorescence open; bracts exceeding inflorescence more than 4. . . . . *C. virens* Michx.
   2. Achene at least 3/4 as long as scale; inflorescence compact; bracts exceeding inflorescence 4 or fewer . . . . *C. drummondii* T. & H. [= *C. robustus* Kunth]

1. Culm obtusely trigonous to subterete, usually not flattening when pressed and dried.
    3. Culm smooth.
        4. Achene with conspicuous basal callosity . . . . *C. distinctus* Steud.
        4. Achene without basal callosity.
            5. Achene linear, $4-5$ times as long as wide; dorsal edge of scales weakly S-shaped. . . . . *C. pseudovegetus* Steud.
            5. Achene broadly ellipsoidal to oblong-ellipsoidal, $2-3$ times as long as wide; dorsal edge of scales merely curved into a simple arc or angle, but not as above.
                6. Bracts less than 3 mm wide, 3 or fewer bracts present, the longest of these usually strict and appearing as a continuation of the culm; culms slender, $1-2$ mm wide at midculm.
                    7. Achenes broadly ellipsoidal; scale tips conspicuously excurved; species common and wide-ranging in U.S. . . . . *C. acuminatus* T. & H.
                    7. Achenes narrowly ellipsoidal to oblong; scale tips more or less straight, not conspicuously excurved; species rare in U.S., restricted to Texas, Oklahoma, Louisiana, and western Florida. . . . . *C. reflexus* Vahl
                6. Widest bract usually more than 4 mm broad, 4 or more bracts exceeding the inflorescence, all bracts ascending to spreading; culms mostly (2-) $3-5$ mm wide at midculm.
                    8. Spikelet at least 3.0 mm wide; scales with straight to excurved tips, thus spikelet with toothed outline; scales golden-yellow; in U.S., species restricted to California and Oregon. . . . . *C. eragrostis* Lam.
                    8. Spikelet less than 3.0 mm wide; spikelet with an entire outline; scales stramineous to brown, sometimes yellow or red tinted, or pale green or whitish; species of south-central and southeastern U. S.
                        9. Achene broadly ellipsoidal, $2-3$ times as long as wide, $0.5-0.6$ mm wide; scales ovate, 0.6 mm wide as seen laterally, stramineous to yellowbrown; in the U.S., species restricted to Texas and Louisiana. . . . . *C. ochraceous* Vahl
                        9. Achene narrowly ellipsoidal, $3-4$ times as long as wide, $0.2-0.3$ mm wide; scales lanceolate, $0.3-0.4$ mm wide as seen laterally, pale green or whitish.
                            10. Plants robust, usually more than 5 dm high, base blackish purple, leaf bases persistent and becoming fibrous with age; spikes conspicuously compound (or rarely simple), units globose; spikelets loosely arranged, with $16-32$ scales; mature scales pale green. . . . . *C. entrerianus* Böck.

10. Plants less than 5 (7) dm high, base purplish to brownish; leaf bases not persistent; spikes compact, conical, and appearing simple, thus individual spikelets difficult to distinguish; spikelets with $12-16$ scales; mature scales whitish to tawny. . . . . *C. luzulae* (L.) Retz.

3. Culm scabrid.
   11. Scale tips conspicuously excurved. . . . . *C. acuminatus* T. & H.
   11. Scale tips straight to slightly incurved.
       12. Plants robust, mostly more than 5 dm high; leaf bases blackish purple; culms sparsely scabrid; scales pale green, divergent at about 30 degrees. . . . . *C. entrerianus* Böck.
       12. Plants mostly less than 5 (8) dm high; leaf bases stramineous to brownish; culms densely scabrid; scales yellowish, divergent at about 45 degrees. . . . . *C. surinamensis* Rottb.

DISTRIBUTION AND ECOLOGY

As shown in figure 1, *Cyperus entrerianus* is primarily distributed in temperate South America and rarely in Mexico. Thus, it is not surprising that it has persisted and increased its range upon introduction into temperate North America, and it probably will continue to spread.

Cyperus entrerianus is a copious producer of achenes and is often locally abundant in its disturbed habitat. It has been observed growing on mucky sands in southeastern Georgia and northwestern Florida and sticky clays in southern Louisiana and southeastern Texas. Thus, soil texture seems not to be a major factor determining its distribution. However, it does apparently require disturbed sites with high-hydroperiod soils, such as ditches, depressions in flatwoods, pond margins, stream bottoms, and edges of salt marsh. Table 2 contains a composite list of species associated with *C. entrerianus* in southeastern Georgia.

In addition to collections made by me from $1987-1989$, other specimens of *C. entrerianus* have been located at FSU, IBE, and VDB, which had been identified variously as *Cyperus pseudovegetus* Steud., *C. robustus* Kunth, *C. virens* Michx., and *C. virens* var. *drummondii* (T. & H.) Kükenth. Distribution of *C. entrerianus* in the United States is shown in figure 2. Following is a complete list of *Cyperus entrerianus* specimens from United States, which I have seen.

Specimen citations. **ALABAMA: Baldwin Co.**: 1.1 mi E of Mobile, heavily disturbed fill area along and S of Battleship Parkway at edge of Mobile Bay, 8 Aug 1989, *Carter 8095* (MO, SMU, VDB, VSC). FLORIDA: **Calhoun Co.**: S of Blountstown, 23 Jul 1977, *Godfrey 75970* (FSU, IBE, VDB). **Escambia Co.**: Pensacola, on Scenic Highway, 24 Jul 1974, *Godfrey 73755* (FSU, VDB); S side of Ensley, wet ditch along hwy. US 29, 8 Aug 1989, *Carter 8093* (FSU, MO, VDB, VSC). **Gulf Co.**: 7.5 mi N of White City, by Fla. Rt. 71, 4 Aug 1981, *Godfrey 79070* (FSU, IBE); M & K Tract, generally 6.5 air mi NW of Apalachi-

TABLE 2. A composite list of species associated with *Cyperus entrerianus* in southeastern Georgia.

Carex festucacea Schk.	*Lipocarpha maculata* (Michx.) Torr.
Cuphea carthagensis (Jacq.) Macbr.	*Ludwigia microcarpa* Michx.
Cyperus croceus Vahl	*L. palustris* (L.) Ell.
C. haspan L.	*Lythrum alatum* Pursh var. *lanceolatum* (Ell.) T.&G.
C. odoratus L.	*Mitreola petiolata* (Gmel.) T. & G.
C. pseudovegetus Steud.	*Murdannia nudiflora* (L.) Brenau
C. strigosus L.	*Phyllanthus urinaria* L.
C. surinamensis Rottb.	*Polygonum hydropiperoides* Michx.
C. virens Michx.	*Rhynchospora cephalantha* Gray
Eleocharis tuberculosa (Michx.) R. & S	*R. corniculata* (Lam.) Gray.
Hypericum mutilum L.	*R. inexpansa* (Michx.) Vahl
Juncus marginatus Rostk.	*R. microcarpa* Baldw. ex Gray
J. repens Michx.	*Verbena brasiliensis* Vell.

cola, W of Sand Creek, T8S, R8W, S 1/2 Sec. 7, 8 Nov 1985, *Anderson 9018* (FSU); 2 mi W of Daniels Road, ca 4 air mi NE of Overstreet, Sec. 15, T5S, R11W, 1 Jun 1989, *Anderson 12034* (VSC), 20 Jul 1989, *Anderson 12172* (MO, VSC); western edge of Wewahitchka, ditch by hwy. FL 22, 5 Aug 1989, *Carter 8040* (FSU, MO, VDB, VSC). GEORGIA: **Brantley Co.**: 0.8 mile W of Nahunta, 4 Jul 1988, *Carter & Carter 6960* (FSU, GA, MO, SMU, VDB, VSC). **Camden Co.**: 2 mi NE of Waverly, along Hwy. US 17, 4 Jul 1988, *Carter & Carter 6935* (FSU, GA, MO, SMU, VDB, VSC). **Glynn Co.**: ca 1.5 mi S of Brunswick near intersection of Hwys. US 84 and GA 50, edge of saltmarsh, 26 Aug 1988, *Carter & McCormick 7435* (FSU, GA, MO, SMU, VDB, VSC). **Liberty Co.**: just SE of Flemington city limits along Hwy. US 82, 26 Aug 1988, *Carter & McCormick 7447* (FSU, GA, MO, SMU, VDB, VSC). **Ware Co.**: western part of Waycross, N of Hwy. US 84, near corner of New Mexico and Virginia Avenues, 2 Sep 1987, *Carter 6296* (FSU, GA, MO, SMU, VDB, VSC); Waycross, creek bottom at corner of Blackshear and Riverside Streets, 18 Aug 1988, *Carter 7319* (MO, SMU, VDB, VSC). LOUISIANA: **Calcasieu Parish**: 9.3 mi N of Hackberry, ditch along Hwy. LA 27, local in sticky clay, 10 Aug 1989, *Carter 8130* (MO, SMU, VDB, VSC). **Jefferson Davis Parish**: E of Hwy. US 165 and 0.25 mi S of Hwy. I-10, 1.4 mi E of Hwy. LA 383 Iowa exit, locally common along mowed ditch and adjacent road shoulder in vicinity of rice fields, 10 Aug 1989, *Carter 8127* (MO, SMU, VDB, VSC). **St. Landry Parish**: ca 3 mi W of Eunice along Hwy. 190, 25 Jul 1975, *Allen 6674* (VDB). TEXAS: **Chambers Co.**: 9.8 mi E of Wallisville exit and 11.9 mi E of Trinity River, sticky black clay at edge of rice field N of Hwy. I-10, common and locally abundant along an approximately 6 mile stretch of Hwy. I-10, 10 Aug 1989, *Carter 8142* (MO, SMU, VDB, VSC). **Fort Bend Co.**: roadside clearing on Hwy. 59, 0.1 mi S of Redding Road, sandy soil, 29 Jul 1981, *Kessler 4739* (VDB). **Harris Co.**: 0.5 mi E of Peek Road exit to Katy, ditch along Hwy. I-10 near rice fields, sticky black clay, 10 Aug 1989, *Carter 8144* (MO, SMU, VDB, VSC).

DISCUSSION

The earliest collection of *Cyperus entrerianus* that I have seen from the United States is *R. K. Godfrey 73755* (FSU) collected in 1974 in Escambia County, Florida. Thus, it would appear that *C. entrerianus* is a relatively recent introduction into southeastern United States. The largest popula-

FIG. 1. The distribution of *Cyperus entrerianus*. Closed circles based on specimens; open circles based on Kükenthal (1936) and Pedersen (1968).

tion (*Carter 8142*) was seen in Chambers County, Texas, where *C. entrerianus* is common and locally abundant, in places forming almost pure stands, along an approximately 6 mile stretch of highway I-10.

Cyperus entrerianus is often locally abundant, and in eastern Texas and

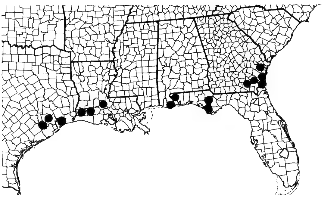

FIG. 2. The distribution by county of *Cyperus entrerianus* in the United States.

southern Louisiana it seems to be highly correlated with rice culture. Curiously, label data on a specimen (*E. Lurvey 440*, MO) of *Cyperus entrerianus* indicates that it was collected in a rice paddy in Paraguay. Additional information about sources of rice seed used in southeastern Texas and southern Louisiana might be helpful in determining the origin of *C. entrerianus* in the United States. If the introduction of *C. entrerianus* is not an artifact of human activity, then it seems reasonable to assume that it might have been introduced by migrating water fowl. Electrophoretic analysis and comparison of proteins from individuals of different populations might show whether multiple introductions of *C. entrerianus* have occurred along the Gulf and Atlantic Coasts of southeastern United States or whether it has spread out from a single colony.

All of the southern Georgia populations were located in ditches along highways and two particularly extensive populations (*Carter & Carter 6960* and *Carter & McCormick 7447*) were beside highways along which major construction had recently occurred. Thus, it is likely that *C. entrerianus* is being moved about along highways and perhaps in part by highway construction and maintenance equipment.

Cyperus entrerianus is to be expected in at least coastal regions of other southeastern states from North Carolina to Texas. Based upon its widespread occurrence in temperate South America far inland and at altitudes up to 410 m (*P. Goetghebeur 4791*, VSC), it is reasonable to expect that it will continue to spread from the outer coastal plain into interior physiographic regions. Additional life history and ecological studies should be done to determine the extent that *C. entrerianus* might become a harmful weed in North America.

ACKNOWLEDGEMENTS

I would like to thank Sidney McDaniel (IBE) for access to specimens and use of the library of the Institute for Botanical Exploration and, also, for sharing his knowledge of *C. luzulae* in Peru. Paul Goetghebeur (GENT) very kindly sent an excellent specimen (*Goetghebeur 4791*) of *C. entrerianus* from Argentina, which was most helpful. I am grateful to Robert Godfrey and Loran Anderson (FSU) for lending specimens, to Loran Anderson for sending recently collected material of *C. entrerianus*, and to curators and staff at MO for making specimens available for study. Loran Anderson, Charles Bryson (SWSL), Gerrit Davidse (MO), and Gordon Tucker (NYS) made helpful comments on the manuscript, Robert Kral (VDB) made specimens available for study, Blanca Leon provided the Spanish translation of the abstract, and Sandra Howell (Louisiana Tech University), while she was a student intern at Missouri Botanical Garden, rendered able assistance by patiently trying out my key. The holotype of *C. entrerianus* was examined through the courtesy of the staff at B. Publication costs were met by a Valdosta State College Faculty Research Grant.

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CALL FOR APPLICATIONS FOR THE 1990 DELZIE DEMAREE TRAVEL AWARD

An endowment to underwrite an annual travel award ($250-$300) in memory of Dr. Delzie Demaree has been established. This award is given annually to a graduate student in systematics for travel to the Systematics Symposium sponsored each fall by the Missouri Botanical Garden in St. Louis. Such an award is a very appropriate way to honor Dr. Demaree because of the high esteem and long record of attendance (right up to the meeting of October 1986 prior to his death at age 97 the following July). In addition, this is a significant way to continue his legacy of assistance to students of botany.

The recipient of the 1989 travel award was Mr. Scott C. Zager, University of Northern Iowa, Cedar Falls. Scott is studying 15 Iowa species of *Carex*, section *Ovales*. His major professor is Dr. Lawrence J. Eilers.

Letters of application for the 1990 travel award should be mailed to Donna M.E. Ware, Herbarium, Dept. of Biology, The College of William and Mary, Williamsburg, Virginia 23185. Applications should be **postmarked by 15 Aug 1990**. A complete application shall consist of a letter from the graduate student describing briefly their research and the benefits of symposium attendance, and a letter of recommendation from the student's major professor.

EXTENSION OF NATIVE RANGE OF *SABAL MEXICANA* (PALMAE) IN TEXAS TO INCLUDE CENTRAL COAST

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ABSTRACT

Authors report discovery of a wild population of *Sabal mexicana* Mart. in the Central Coast (Coastal Bend) region of Texas, present evidence that the species is indigenous to that region, and discuss conservation prospects.

RESUMEN

Los autores relatan el descubrimiento de una población salvaje de *Sabal mexicana* Mart. en el litoral central de Texas, presentan evidencia de que esta región es parte de la distribución nativa de la especie, y discuten las perspectivas de su conservación.

Although *Sabal mexicana*, the caulescent palm native to Texas, has undergone several changes in its classification since first identified as a species distinct from *Sabal palmetto*, most botanists have described its native range in the U. S. as limited to the Lower Rio Grande Valley, at the extreme southern end of Texas. In identifying this palm as *S. texana* Small (1927), for example, described its distribution as "confined to a comparatively small area in the lower Rio Grande Valley."

Orator F. Cook, however, apparently believed otherwise. Cook (1908, p. 5n.a) stated that "Tall palmettos were seen in Jackson County as late as 1876 by Mr. J. D. Mitchell, of Victoria," and in 1913 (p. 11) Cook noted that "*Inodes texana*," as he called it, "seems to have extended much farther northward only a few decades ago, and specimens may still be found about Indianola or at other points along the Gulf coast."

Cook (1913) goes on to describe a new taxon — *Inodes exul* — in order to identify a population of sabal palms, of unknown origin, that for many years had been cultivated in Victoria, Texas. Beccari (1907) had by then rejected the genus *Inodes*, and a careful comparison by Davis (1942) eliminated *exul* as a separate species by showing that the morphological features Cook considered distinctive for *exul* fell within the range of variation of

SIDA 14(1):79–85. 1990.

Sabal texana. Finally Moore (1971) reduced *S. texana* to synonymy of *S. mexicana*, a single species ranging from Texas to Central America.

But the basic mystery remained. Where had the Victoria palms come from? No Victoria resident, either in Cook's time or today, seemed to know. Prompted by Cook's footnote, however, we suspected that Victoria's mystery palms were of local origin, and in August of 1989 initiated a search. We were soon rewarded by the discovery of a wild population of *S. mexicana* in the Central Coast, as well as of evidence that this species is native there.

After our inquiries in Victoria about wild palms, either past or present, resulted in an article in the THE VICTORIA ADVOCATE (Bowen 1989), four fishermen called to tell of palms, up to twenty feet tall, on nearby Garcitas Creek. Historian Brownson Malsch, of Edna, told us of a tall palm on the east bank of Garcitas Creek that used to be visible from the Highway 616 bridge. Rancher John M. Bennett took us to the fallen remains of this palm, which we found to have a trunk of at least 37 feet. Nearby stood a living specimen of *S. mexicana* with a 13-foot trunk, and scattered about the Bennett ranch, in the bottomland forest along Garcitas Creek, were other caulescent specimens, and seedlings. Bennett told us the tall palm had been standing there when his grandfather bought the ranch in 1890, and that there had been no prior settlement on the east side of the creek.

A boat trip up Garcitas Creek revealed a population of *S. mexicana* beginning approximately 300 yards north of the Highway 616 bridge and extending for 2 – 3 miles upstream. Specimens ranging in size from seedlings to 20 – 25 feet stood along the bank and were scattered through the bottomland forest, up to perhaps 50 yards from the creek. Some were on the edge of the water and looked as though they would soon be lost to erosion. Others stood on relatively high banks. All but two of the specimens we saw were on the east or Jackson County side of Garcitas Creek. The two on the west (Victoria County) side were both near the southern end of the population. Upstream from these two the only palms seen on the west side were an occasional specimen of *S. minor.* We saw no *S. minor* on the east side, or anywhere in association with *S. mexicana*. Specimens were sent to US (*Lockett 101*, Aug 1989) and SMU (*Lockett 102*, Sep 1989).

Sabal mexicana is readily distinguishable from *S. minor*, the only other palm known to occur in the Central Coast. Aside from being caulescent, mature specimens show highly filiferous, strongly downcurved leaves having a costa measuring at least two feet, and dead petioles with split bases cling to their trunks. Even young specimens differ from *S. minor* by their relatively longer petioles and leaf segments, lighter color, and highly filiferous, strongly costa-palmate leaves. The long, lax segments of the many seedlings give them a grass-like appearance.

Because *S. mexicana* is widely cultivated in South Texas it would be easy to suggest that the Garcitas Creek population has escaped cultivation. Historic evidence, however, indicates that tall, trunked palms have been found in the Central Coast since the earliest attempt at colonization. According to Weddle (1987, p. 11), in 1685 French explorer René-Robert Cavelier, Sieur de La Salle, established his short-lived Fort Saint-Louis colony on Garcitas Creek. The colony's historian, Henri Joutel, devoted several pages of his account of the colony to a careful and impressively accurate description of local flora and fauna. As related in Margry (1876 – 86, vol. 3, p. 212), this description includes the following passage: "*Il y a une autre espèce d'arbres qui ont des branches longues d'environ trois ou quatre pieds, et leurs feuilles sont comme celles des lataniers, seulement plus grandes et plus larges. Ils portent un petit fruit, mais je n'en sçaurois dire le goust, n'en ayant point mangé; mais un de nos gens me dit qu'il luy avoit semblé bon.*"

Carlos E. Castañeda (1936 – 58, vol. 1, pp. 289 – 290) called him "the trusty Joutel, a man of sense and observation." This is evident from Joutel's account. Though knowing no names for many of the creatures and plants of the Texas coast, he describes recognizably everything from horned lizards to yucca — which, by the way, he clearly distinguishes from palms. There is no reason to suppose Joutel was imagining the plants he described in the quoted passage.

What were these plants? If palms, were they *S. mexicana*, or *S. minor*? *Latanier* is the vulgar name applied to *Sabal* in Haiti. Bomhard (1935) remarks that "*Latanier* is the French form of the native name of tall, fan-leaved palms indigenous to certain islands belonging to France off the southeast coast of Africa." She adds that in Louisiana this name, or "latania," is commonly applied to *S. minor.* Perhaps Joutel had *S. minor* in mind when he used the word *latanier.* If so, he clearly distinguished the "trees" (*arbres*) he saw on the Central Coast of Texas from *S minor.* The 3- or 4-foot petioles (*branches*) would be within normal range for *S. mexicana* (Davis, p. 94), but too long for most *S. minor.* The blades (*feuilles*) are "*plus grandes et plus larges*" than those of the *lataniers.* Most important of all, Joutel describes the palms he saw as bearing an edible fruit. This clearly fits the fruit of *S. mexicana* (Tull 1987), but not the very small fruit of *S. minor.*

In 1688 Karankawa Indians massacred the adult inhabitants of Fort Saint-Louis, but spared a few children, including Jean-Baptiste Talon. Almost 10 years later Jean-Baptiste and his brother Pierre, whom La Salle had left with the Tejas Indians, had made their way to France, where they were interrogated about their years spent with Indians in what is now Texas. In their deposition the Talons reported that there were *"palmiers"* along all the rivers, including one — possibly the Guadalupe — to which the Karankawas had taken their women and children (including Jean-Baptiste) while they waged war against another tribe. (Weddle 1987, Part IV.)

During the 300 years since the time of La Salle's colony most of the Central Coast palms appear to have been lost to wharf building. *Teredo navalis*, the shipworm, destroys wood immersed in warm salt water. Because *Sabal* palm trunks were immune to such destruction palm logs were in demand for wharf construction, and during the 19th century many were used as piles for the wharves at the port of Indianola, on Matagorda Bay (Malsch 1988). According to Malsch (pers. comm.), Francis E. Huck, whose father operated a lumber yard in Indianola before the city's destruction by a hurricane in 1886, reported to him that locally acquired palm logs were used for wharf pilings until the supply was exhausted, and that thereafter Huck's father had had to import them.

This evidence from Malsch fits with J. D. Mitchell's statement to O. F. Cook. If Mitchell saw tall palmettos in Jackson County "as late as 1876," the implication is that something happened to them after that, but before the destruction of Indianola in 1886. Cook's notes, salvaged by Dr. Andrew Archer of the Smithsonian Institution (where they are now housed) after they had been discarded by Cook's employer, the United States Department of Agriculture, help complete the picture. In an item dated "Kingsville, [Texas] Aug. 3, 1906" Cook records Mitchell's tall-palmetto remark, then adds, "They were cut down for the sake of the wood. This may be taken to indicate that the native palmetto of Texas ranged at one time much farther North than at present, and that it will grow freely in the open air over the whole southern part of the state, as many casual plantings also prove."

Mitchell, whom Burke (1978) called "the first native Texas naturalist," was in contact with Cook because from 1904 almost until his death in 1922 Mitchell did field work for the U.S.D.A. Entomologist W. D. Hunter (1922), with whom Mitchell collaborated for years, called Mitchell "a fountain of accurate information."

Palms are prized as ornamentals, and early settlers encountering them in the wild sometimes eliminated whole populations by digging them up for transplant. Brown (1976b, p. 152) documented cases where "two populations [of *S. palmetto*] north of North Inlet [S. Carolina] have been either completely removed for landscaping purposes or otherwise destroyed since 1930. A small group of trees near North Litchfield Beach at Midway Inlet were removed in the early 1960's. At Murrells Inlet a much larger population on Drunken Jack Island was removed beginning in the early 1930's. This extinct population represents the northernmost modern extension of the species on the South Carolina coast . . ."

Historian Malsch's notes indicate that in 1925 Mrs. Alexander Lowe told him that in 1875 her husband bought two small palms from a wagon lot that pioneer nurseryman Gilbert Onderdonk brought from Jackson County for sale in Victoria. According to Malsch (pers. comm.) a few of these original transplants are still standing in Victoria, and many younger palms have been propagated from their seed. Cook (1913) identified the "type individual of the new species" (*Inodes exul*) as the tree that "graces the lawn of Mrs. Martin O'Connor, of Victoria." Mrs. O'Connor's nephew, Mr. Dennis O'Connor (pers. comm.) reports that this palm, today over 40 feet tall, still stands at the junction of Liberty and Power streets. Although he has no record to prove it Malsch, who as a child was a neighbor of the Martin O'Connors, believes this palm is one of Onderdonk's original transplants.

Even if historical evidence were lacking we believe it would be reasonable to conclude that the native range of *S. mexicana* includes the Central Coast. The existence of a wild, viable, reproducing population, only 200 miles from the known native range, is in itself evidence that the site of this population is part of the native range. Noting that sea currents on the southern Atlantic coast are northerly in late spring and summer, when the fruit of *S. palmetto* is dry and buoyant, Brown (1976a) suggested sea dispersal as the mechanism that could have carried seed of that species from Florida up the Carolina coast to the northern extreme of its range. Although alongshore currents on the Texas coastal bend are normally southerly, approximately twice a year, usually in spring and early summer, this flow may be reversed. Likewise eddies off of the northerly loop current, in the central gulf, can cause a northerly alongshore current when they split upon arrival at the coast. (Kerry Whitledge, Senior Marine Scientist, University of Texas Marine Science Institute, Port Aransas, TX, pers. comm.) Brown also demonstrated that dry *S. palmetto* fruit remains buoyant several weeks. Since we have observed that dry *S. mexicana* fruit floats readily, the dry skin forming an air chamber in which the seed rattles, we see no reason why *S. mexicana* could not follow the same dispersal pattern as that suggested by Brown for *S. palmetto*. According to Davis (1942, p. 85) *S. mexicana* in the lower Rio Grande Valley may bloom almost any time of year, meaning dried fruit would be available year round. Floating fruit, washed down the Rio Grande, or rivers in Mexico, could be carried north to the Central Coast where tides and storms could push it into rivers and lowlands. Once mature trees were established on the Central

Coast their fruit could be spread by birds and small mammals. Coyotes, raccoons, chachalacas and rodents have been observed to eat *S. mexicana* fruit. (Rose Farmer, Manager, Sabal Palm Grove Sanctuary, Brownsville, TX, pers. comm.).

Obviously there are no cold stress restrictions on establishment of *S. mexicana* along the stretch of coast now determined to be populated with this species. As stated by Read (1974, p. 41) ". . . over a broad area of uniform edaphic and climatic conditions the same species of palm will likely be seen. On the other hand a change in the substrate is likely to support distinct species, . . ."

We thus believe it is safe to assume that in prehistoric times currents would have carried the seeds to all nearby suitable habitat. Putting it another way, it is questionable to speak of escape from cultivation when we find a population so well adapted to its environment, and showing evidence of having grown in that environment for many years, if the site of that population appears to be within the natural dispersal radius of the known native range.

Since we know of no age studies of *S. mexicana* we do not know the age of the larger Garcitas specimens. We suspect, however, that since their height is well below the approximately 50 feet the species can attain (Texas Forest Service 1989, p. 8), and since we found a dead specimen with a trunk of at least 37 feet, the Garcitas trees are younger generation, seeded by a few specimens that survived lumbering and transplantation. Further, we suspect that since the days of wharf building transplantation has continued to be a factor tending to limit the wild population. In Bennett Park, a small, unimproved and unpoliced county park on Garcitas Creek, we saw many young specimens of *S. mexicana*, but none that were caulescent, even though caulescent specimens were observable on adjacent private land.

Given the apparent reproductive vigor of the Garcitas population, we believe that conservation prospects for this and other possible stands in the Central Coast (or elsewhere) are promising, if habitat remains undisturbed and if, through education and protection, transplantation can be discouraged. Meanwhile we continue to look for other wild populations of *S. mexicana*, as well as further evidence of the species' historic range. We urge all who discover specimens in the wild, or historic references to trunked palms ("tall palmettos," etc.), whether in the Central Coast or beyond, to contact us.

ACKNOWLEDGMENTS

We thank Greg Bowen of THE VICTORIA ADVOCATE for publicizing our search; Lon Drushel, Elbert Post, Victor Spiegalhower, and Rawley Koehl for telling us of the Garcitas palms; and Lon Drushel for taking us in his boat to see them. We also thank John M. Bennett and Emily Dial for letting us search and take specimens on their ranches. We are grateful to Charles Spurlin, Robert Shook, Wayne McAlister and Mitzi Stewart, all of Victoria College, for information provided, and to the Victoria College Library for access to its J. D. Mitchell materials. We thank Sister Ann Linda Bell, Chairman of the Foreign Language Department of Our Lady of the Lake University, for her help in interpreting references to palms in the Joutel and Talon documents, and we are especially thankful to Carol Ramsay, James Stewart and George Stevenson for helping with searching and specimen collecting, and for their constant encouragement.

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This is an update of the Correll & Johnston "Manual of the Vascular Plants of Texas," published in 1970. This Manual is still available from the University of Texas at Dallas Book Store in Richardson, Texas. The new data is organized by page numbers corresponding to those of the Manual facilitating quick reference between the two. The literature citations follow the page numbers with the index last. Not only does this update the current knowledge but it was also to make some corrections in the original Manual. In doing so, I find in the reference section that my middle initial "F." has been replaced with "J." and "H." Once a mistake is made, it is certain to be repeated not only by others but by myself as well. There will always be some aspect that one does not agree upon but this is an excellent attempt for this moment in time without reproducing the entire manual. WFM.

JOHNSTON, MARSHALL C. 1990. The Vascular Plants of Texas. A List, up-dating the Manual of the Vascular Plants of Texas. Second edition. Published by the author, 3905 Avenue G, Austin, TX 78751. Paper $14.00 (US) prepaid shipment to North American addresses not requiring invoicing or billing. For shipments outside North America or shipments requring invoicing or billing send $17.00 (US). For deliveries to Texas addresses add 7.75% sales tax.

WOFFORD, B.E. 1989. Guide to the Vascular Plants of the Blue Ridge. 384 pp. University of Georgia Press, Athens, GA 30602. Paperback $15.00; Hardbound $35.00.

This is an excellent manual for the identification of the vascular plants of the Blue Ridge Province. It has an illustrated glossary with the text consisting of dichotomous keys followed by indices to both common and scientific names. In identification manuals, the species description is a summation of the taxonomic characteristics that are usually present in the keys that distinguish each taxon from the others in the treatment. Only in monographic treatments are the detailed species descriptions given in full. Thus, the lack of species descriptions does not diminish the effectiveness of this manual but actually enhances it.

SYNOPSIS OF *CAREX* SECTION *LUPULINAE* (CYPERACEAE) IN TEXAS

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ABSTRACT

Five species of *Carex* section *Lupulinae* occur in Texas; *C. lupulina*, *C. lupuliformis*, *C. louisianica*, *C. intumescens* and *C. gigantea*. *Carex lupulina* is the most common and widespread of the five. *Carex lupuliformis*, which is rare, grows mostly in calcareous sites in swampy woodlands. It has been recorded only in the northeast corner of the state in Bowie and Marion counties. *Carex louisianica* occurs infrequently in the eastern 1/3 of Texas growing in acidic soils of swampy woods or bottomland hardwood forests. *Carex intumescens* is widespread across the distributional range of section *Lupulinae* in Texas but is infrequent within its diminishing habitat of acidic bottomland hardwood forests. In Texas, *C. gigantea* is the rarest member of the section having not been collected for 46 years. The only two collections were made in Harris and Polk counties in acidic swampy woodlands. An artificial dichotomous key, county distribution maps and comparable species descriptions are provided.

INTRODUCTION

Carex, with 31 sections represented by more than 80 species, is the largest genus of vascular plants in Texas. As is the case with most genera of the family Cyperaceae, *Carex* is difficult taxonomically. The section *Lupulinae* (J. Carey) Mackenzie is endemic to central and eastern North America (Reznicek and Ball 1974). It is restricted to the eastern 1/3 of Texas, being found westward to Hays County and southward to Nueces County. However, the greatest concentration and diversity are found in the eastern 1/5 of the state. Section *Lupulinae* in the subgenus *Carex* has 3 stigmas, trigonous achenes, and unisexual spikes. Other characteristics of this section include perigynia 1 cm long or longer, coarsely nerved perigynia, a perigynium-body that is ovoid or globose-ovoid, and leaf blades that are strongly septate-nodulose.

Six species have been recognized in this section by Mackenzie (1935, 1940), Fernald (1950), Gleason (1952), Voss (1972), Reznicek and Ball (1974) and Menapace et al. (1986). Five occur in Texas: *C. lupulina* Willd., *C. lupuliformis* Sartwell, *C. louisianica* Bailey, *C. intumescens* Rudge and *C. gigantea* Rudge. The remaining species *C. grayi* Carey is found immediately east and northeast of Texas and from the Gulf states north to southwestern Quebec. Waterfall (1979) listed *C. grayi* as occurring in

SIDA 14(1):87–99. 1990.

Oklahoma. Rob Naczi (MICH; per. comm.) has recently collected it in McCurtain County, Oklahoma (Naczi 1890, MICH). Tony Reznicek (MICH; per. comm.) has collected *C. grayi* (*Reznicek 8490*, MICH) along the Little River in Sevier County, Arkansas. He stated, not only is it found immediately adjacent to Texas, but it quite likely occurs locally in river bottoms in extreme northeastern Texas, although it has not yet been collected there.

Correll and Johnston (1970) recognized *C. intumescens* Rudge, *C. gigantea* Rudge, and *C. lupulina* Muhlenb.. *Carex lupuliformis* Sartwell and *C. louisianica* Bailey were recognized as forms of *C. lupulina* Muhlenb.. They referred to Muhlenberg as the authority for *C. lupulina* as have other authors. However, Reznicek and Ball (1974) stated that Willdenow is the correct authority.

The primary objective of this paper is to examine the taxonomic status of *C. lupuliformis* and *C. louisianica* in the Texas flora. Other objectives are to provide distribution maps by county for each of the five species occurring in Texas and provide comparable diagnosis for each of the five taxa. The distribution maps were based on herbarium specimens.

METHODS AND PROCEDURES

This study was based on about 300 specimens examined from the following herbaria: (acronyms follow Holmgren et al. 1981) ASTC, MO, NLU, SHST, SMU, SWT, TAES, TAMU, TEX, UA and US. In addition, an isotype of *C. lupuliformis* was examined from PH. Field trips to east and southeast Texas were conducted throughout 1988 to supplement existing distribution and habitat records. Dorsal and ventral are used synonymously with abaxial and adaxial in this paper. Maturation dates are given as opposed to flowering dates because mature plants in fruit are used to establish the diagnostic characters in all previously published artificial keys for Cyperaceae.

Micrographs were taken of representative achenes of each species using a JOEL-25s scanning electron microscope. Achenes were mounted on aluminum stubs via doubled sided tape and coated with 400 Å of gold-palladium using a Hummer 1 sputter coater. Micrographs were taken at an accelerating voltage of 12.5 Kv's. Photographs of the pistillate and staminate spikes were taken from herbarium sheets using a 35 mm Canon AE-1 single lens reflex camera with Kodak MTAX film (100 ASA).

Species descriptions will be abbreviated to reflect characters that are diagnostic or which can be used in conjunction with other characters to distinguish between *C. lupulina*, *C. lupuliformis* and *C. louisianica*, or where new previously unrecorded information is provided. The chosen characters will be given for all five Texas species. For a recent and complete species description of the section see Reznicek and Ball (1974).

RESULTS

KEY TO THE SPECIES

1a. Pistillate spike outline tending to be globose (Fig. 1c); perigynia loosely arranged, spreading, drying dark olive-drab green .... 4. *C. intumescens*

1b. Pistillate spike outline oblong to cylindric (Figs. 1a,b,d,e); perigynia either loosely arranged or not, drying stramineous, green or light olive-drab green.

 2a. Staminate peduncles greatly exceeding the uppermost pistillate spike (Fig. 1d); perigynia loosely arranged, ascending-spreading ..... 3. *C. louisianica*

 2b. Staminate peduncles shorter than to only slightly exceeding the uppermost pistillate spike (Figs 1a,b,c); perigynia either loosely arranged or tightly arranged.

  3a. Achenes distinctly wider than long (Fig. 2c), widest above the middle, subtruncate to truncate apically; perigynia loose to tightly arranged, usually spreading at right angles to the main axis (Fig. 1e) .... 5. *C. gigantea*

  3b. Achenes as wide as long or longer, widest near the middle, not subtruncate or truncate apically, perigynia tightly arranged, ascending or slightly spreading but usually not at right angles to main axis.

   4a. Angles of achene smoothly curved (Fig. 2a), not knobbed, faces flat to slightly concave. .... 1. *C. lupulina*

   4b. Angles of achene pointed (Fig. 2d), with nipple-like knobs, faces strongly concave .... 2. *C. lupuliformis*

1. CAREX LUPULINA Willd., "HOP-SEDGE", Sp. Pl. 4:266. 1805. TYPE: *Willdenow 17210* (HOLOTYPE: B, photo only TRTE).

Blades flat, 1.5 − 6.4 dm long × 4 − 15 mm wide, long-attenuate, antrorsely scabrous distally on the adaxial and abaxial sides on the nerves, strongly antrorsely scabrous on margins of upper half, septate-nodulose. Bracts leaf-like, flat, 10 − 55 cm long × 2 − 11 mm wide, much exceeding the culm, antrorsely scabrous on the margins distally, the lower, at least strongly sheathing, septate-nodulose. Pistillate infructescence (Fig. 1a), below staminate spike, (1-)2 − 5 per culm, not aggregated, 1.5 − 6.5 cm long × 1.3 − 3 cm wide, oblong; peduncles 0.5 − 20 cm long, distance between 2 lowest peduncles 1 − 20 cm. Staminate inflorescence terminal, 1 or rarely 2 per clum, 1.5 − 8.5 cm long × 1 − 5 mm wide, narrowly linear; peduncles 0.5 − 6 cm long, antrorsely scabrous, base of staminate spike shorter than or barely exceeding the top of the uppermost pistillate spike; anthers 2 − 4 mm long. Pistillate scales 6 − 15 mm long × 1 − 2.7 mm wide, lanceolate to lanceolate-ovate, 1 − 7-nerved, nar-

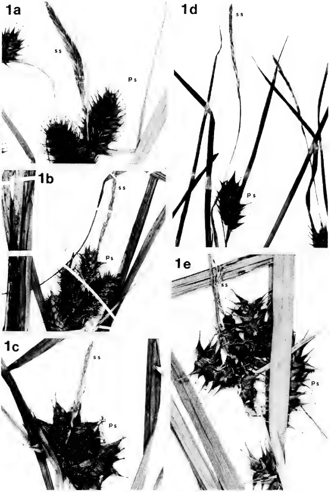

FIG. 1. a – e. Pistillate spike (ps) and staminate spike (ss). 1a. *Carex lupulina*, 1b. *C. lupuliformis*, 1c. *C. intumescens*, 1d. *C. louisianica*, 1e. *C. gigantea*.

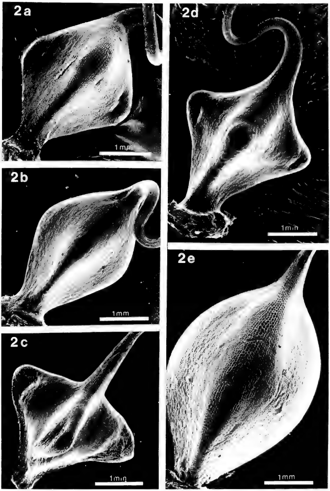

FIG. 2. a – e. Achenes: 2a. *Carex lupulina*, 24×. 2b. *C. louisianica*, 23×. 2c. *C. gigantea*, 23×. 2d. *C. lupuliformis*, 23×. 2e. *C. intumescens*, 23×.

rower and shorter than perigynia, white hyaline with green centers, acute to awned, awns to 6 mm long, antrorsely scabrous. Perigynia $11-19$ mm long $\times$ $3-6$ mm wide, narrowly ovoid, glabrous, shiny, light to medium green to stramineous at maturity, wingless, not corky, inflated, stiffly erect to strongly spreading, sessile to $\pm$ stipitate, (4-) $8-80$ per spike, strongly $13-22$-nerved; beak conic, $6-10$ mm long, bidentate. Achenes (Fig. 2a) $3-4$(-4.5) mm long $\times$ $1.7-2.8$ mm wide, rhomboid, trigonous, $\pm$ stipitate, faces flat to concave, angles thickened internally. Distribution: Minnesota to Nova Scotia and south to Florida and Texas. Texas: by counties (Fig. 3b); regions 1,2,3 and 4 as defined by Gould (1975). Chromosome number $2n=56$ (Reznicek and Ball 1974) $n=30$ (Wahl 1940). Since *C. lupuliformis* has a chromosome number of $2n=60$, Reznicek has suggested that it is possible that Wahl may have had that species instead of *C. lupulina*. Maturation dates: April through October. Habitat: Open swamps, wet ditches, somewhat acidic-neutral to calcareous soils.

Representative specimens: **Angelina Co.**: 25 Jun 1980, *J. Ward & S. Hupp 459* (ASTC). **Bowie Co.**: 06 Aug 1983, *E. Nixon, J. Ward & M. McCrary 12493* (ASTC). **Brazos Co.**: 11 May 1980, *P. Fryxell 3181* (SMU). **Cass Co.**: 18 Jul 1967, *R. Mitchell 3250* (TEX). **Freestone Co.**: 28 Oct 1983, *E. Nixon & J. Ward 13170* (ASTC). **Galveston Co.**: 06 May 1976, *F. Waller 3808* (TEX). **Gonzales Co.**: 04 Aug 1941, *B. Tharp 47561* (TAES). **Grimes Co.**: 10 Jul 1988, *S. & G. Jones 1818* (ASTC). **Hardin Co.**: 21 May 1986, *L. Brown 10006* (ASTC). **Harris Co.**: 21 May 1986, *L. Brown 10006* (ASTC). **Harrison Co.**: 09 Aug 1980, *E. Nixon 10496* (ASTC). **Hays Co.**: Summer 1928, *G.M.W. s.n.* (SWT). **Henderson Co.**: 08 May 1970, *D. Correll & H. Correll 38642* (TEX). **Hopkins Co.**: 08 Jun 1953, *L. Shinners 15054* (SMU,TEX-LL). **Houston Co.**: 10 Jun 1970, *D. Correll & H. Correll 38939* (TEX). **Jasper Co.**: 07 Jun 1981, *J. Kessler 4527* (TAES). **Jefferson Co.**: 21 May 1948, *J. Brenckle 48023* (SMU,TEX). **Lamar Co.**: 16 Jul 1968, *D. Correll & H. Correll 35913* (TEX). **Liberty Co.**: 25 Apr 1941, *R. Crockett 937* (TEX). **Nacogdoches Co.**: 15 Jul 1964, *F. Waller, Jr. 183* (TAES). **Newton Co.**: 21 May 1967, *J. Crutchfield 2585* (TEX). **Orange Co.**: 19 Jul 1946, *D. Correll 13342* (TEX). **Polk Co.**: 11 May 1988, *S. Jones & J. Wipff 1493* (ASTC,TAES). **Red River Co.**: 21 Jul 1969, D. Correll 37501 (TEX). **Robertson Co.**: 15 Aug 1982, *T. Starbuck 2974* (TAMU). **Sabine Co.**: 19 May 1970, *D. Correll & H. Correll 38765* (TEX). **San Augustine Co.**: 11 Apr 1987, *E. Nixon 16194* (ASTC). **Shelby Co.**: 17 May 1988, *S. & G. Jones & E. Nixon 1376* (TAES). **Trinity Co.**: 25 Apr 1988, *E. Nixon 16411* (ASTC,TAES). **Upshur Co.**: 09 Aug 1950, *V. Cory 57724* (SMU). **Walker Co.**: 15 Jun 1968, *J. Bhatt 54* (TAMU). **Wood Co.**: 26 Aug 1985, *E. Nixon 14967* (ASTC).

2. CAREX LUPULIFORMIS Sartwell, "HOP-LIKE SEDGE", Carices Amer. Sept. Exsiccatae, 2: No. 147. 1848 (BASIONYM: *C. lupulina* Willd. var. *polystachia* Schwein. & Torrey). TYPE: (HOLOTYPE: NY; ISOTYPES: BM, PH!). *C. lupulina* Willd. var. *polystachia* Schwein. & Torrey, Ann. Lyceum Nat. Hist. New York 1:337. 1825. *Carex lurida* Wahl. var. *polystachia* (Schwein. & Torrey) Bailey, Proc. Amer. Acad. Arts 22:63. 1886.

Bracts leaf-like, flat, $20-70$ cm long $\times$ $4-11$ mm wide, much exceeding the culm, antrorsely scabrous on the margins, sheathing rarely absent, septate-nodulose. Pistillate infructescence (Fig. 1b), below staminate spike, occasionally with staminate above, 2 − 6 per culm, not aggregated, 2 − 8 cm long × 1.5 − 3 cm wide, the uppermost usually overlapping for most of their length, oblong or cylindric; peduncles 1 − 13 cm long, smooth, distance between 2 lowest penduncles 2 − 17 cm. Staminate inflorescence terminal, occasionally below pistillate, 1 or 2 per culm, 2 − 10 cm long × 2 − 5 mm wide, narrowly linear, peduncles 1 − 12 cm long, smooth, base of staminate spike shorter than or barely exceeding the top of the uppermost pistillate spike; anthers 2.5 − 3 mm long (based on 2 specimens). Pistillate scales 6 − 13 mm long × 1.8 − 3.2 mm wide, lanceolate, 3 − 7-nerved, narrower and usually shorter than the perigynia, brownish-hyaline with darker stramineous centers, tapering into an awn, awn to 5.5 mm long, antrorsely scabrous. Perigynia 12 − 18 mm long × 3.8 − 6 mm wide, ovoid, glabrous, shiny, dull-green when immature to brownish-yellow at maturity, wingless, not corky, strongly inflated, ascending to slightly spreading, sessile, 8 − 75 per spike, strongly 17 − 25-nerved; beak conic, 6 − 9 mm long, bidentate. Achenes (Fig. 2d) 3 − 4.5 mm long × 2.4 − 3.4 mm wide, rhombic, trigonous, ± stipitate, faces concave, angles thickened internally with prominent nipple-like knobs. Distribution: Northward to Quebec, as far south as Florida and westward to Texas: Texas: by counties (Fig. 3c); regions 1 and 3, known only from Bowie and Marion counties; rare. It is never common within its range. Chromosome number $2n = 60$ (Reznicek and Ball 1974). Maturation dates: The only Texas dates are September and October. In conjunction with specimens examined from other states and Steyermark (1968) the maturation dates are June-October. Habitat: Swampy woodlands, mostly in calcareous sites.

Representative specimens: **Bowie Co.**: 28 Sep 1948, *E. Whitehouse 20450* (SMU). **Marion Co.**: Jul 1962, *D. Correll 26409* (TEX).

3. CAREX LOUISIANICA Bailey, "LOUISIANA SEDGE," Bull. Torrey Bot. Club 20:428. 1893 (based on *C. halei* Carey). TYPE: (HOLOTYPE: K).

Blades flat, 1 − 40 cm long × 2 − 6 mm wide, long-attenuate, glabrous, upper half antrorsely scabrous on the margins, septate-nodulose. Bracts leaf-like, flat, 10 − 30 cm long × 2 − 4 mm wide, much exceeding the culm, margins antrorsely scabrous, sheathing, septate-nodulose. Pistillate infructescence (Fig. 1d), below staminate spike, 1 − 4 per culm, not aggregated, 1.5 − 4.5 cm long × 1.5 − 2.5 cm wide, subcylindric to cylindric; peduncles 0.5 − 5 cm long, smooth, distance between lowest 2 peduncles 2 − 10 cm. Staminate inflorescence terminal, 1 per culm, 0.5 − 7 cm long × 1.5 − 3 mm wide, narrowly linear; peduncles 3 − 10 cm long, with sparse antrorse scabrosity, base of staminate spike much exceeding the top of the uppermost pistillate spike; anthers 2.5 − 3.3 mm long. Pistillate scales 4.5 − 6.5 mm long × 1.5 − 2 mm wide, lanceolate-ovate 3 − 7-nerved, narrower and shorter than the perigynia, white hyaline with a green center stripe, long tapering apically. Perigynia 10 − 14 mm long × 3.5 − 6 mm wide, ovoid, glabrous, shiny, dull green when immature to stramineous at maturity, wingless, not corky, strongly inflated, stiffly ascending to somewhat spreading, sessile, 10 − 30 per spike, strongly 15 − 18-nerved; beak conic, 4.5 − 7 mm long, bidentate. Achenes (Fig. 2b) 2.5 − 3.5 mm long × 1.7 − 2 mm wide, rhomboid, trigonous, broadly stipitate, faces nearly flat, angles thickened internally. Distribution: Florida to Texas, northward to Indiana and east to the mountains of New Jersey. Texas: by counties (Fig. 3d); regions 1,2,3 and 4. Chromosome number unknown. Maturation dates: April through August. Habitat: Swampy woods, bottomland hardwood forests, acidic soils.

Representative specimens: **Bowie Co.**: 06 Aug 1983, *E. Nixon, J. Ward & M. McCrary 12401* (ASTC). **Fannin Co.**: 27 Apr 1959, *K. Rochart & B. Sinclair 70* (TEX). **Gregg Co.**: 14 Jul 1942, *C. York s.n.* (TEX). **Hardin Co.**: 28 Mar 1982, *J. Matos & D. Rudolf 344* (ASTC). **Harris Co.**: 08 May 1982, *J. Kessler 5684* (TAES). **Jefferson Co.**: 20 May 1948, *J. Brenckle 48024* (SMU); 29 Apr 1936, *J. Steyermark 36120* (SMU). **Liberty Co.**: 13 Apr 1972, *R. McFarlane 27* (ASTC). **Newton Co.**: 18 Apr 1958, *A. Traverse 525* (SMU, TEX). **Orange Co.**: 22 May 1988, *S & G. Jones 1640* (ASTC, TAES). **Panola Co.**: 17 May 1967, *J. Crutchfield & E. Nixon 2737* (TEX). **Polk Co.**: 12 Apr 1941, *E. Girvin s.n.* (TEX). **Robertson Co.**: 27 Apr 1982, *T. Starbuck 1853* (TAES,TAMU). **San Jacinto Co.**: 14 Apr 1972, *E. Nixon s.n.* (ASTC). **Trinity Co.**: 17 Jul 1936, *Goodrum s.n.* (TEX). **Walker Co.**: 10 May 1941, *S. Warner 9* (TEX). **Wood Co.**: 18 May 1988, *S. & G. Jones & E. Nixon 1426* (TAES).

4. Carex intumescens Rudge, "BLADDER SEDGE", Trans. Linn. Soc. London 8:97. 1804. Type: (holotype: BM; isotype: BM).

Blades flat, 9 − 30 cm long × 3 − 9 mm wide, long-attenuate, glabrous,upper half antrorsely scabrous on the margins, septate-nodulose. Bracts leaf-like, flat, 5.5 − 22 cm long × 2 − 6 mm wide, much exceeding the culm, antrorsely scabrous on the margins, sheathless, rarely with short sheaths, septate-nodulose. Pistillate infructescence (Fig. 1c), below staminate spike, 1 − 4 per culm, aggregated, 1 − 2.7 cm long × 1 − 2.8 cm wide, globose to subglobose; peduncles 0.3 − 1.5 cm long, antrorsely scabrous, distance between lowest 2 peduncles 0.2 − 2.1 cm; staminate inflorescence terminal, 1 per culm, 1 − 5 cm long × 1 − 3 mm wide, narrowly linear; peduncles 0.5 − 4 cm long, antrorsely scabrous, base of staminate spike may or may not exceed the top of the uppermost pistillate spike;

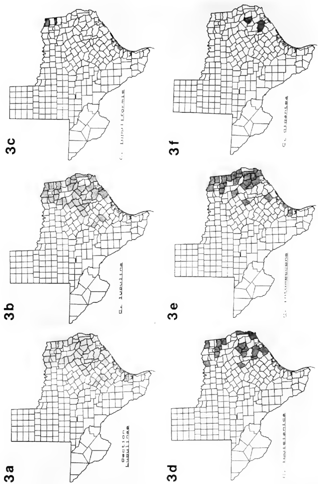

FIG. 3. a – f. Distribution by counties in Texas. 3a. Section *Lupulinae*. 3b. *Carex lupulina*. 3c. *C. lupuliformis*. 3d. *C. louisianica*. 3e. *C. intumescens*. 3f. *C. gigantea*.

anthers 1.7 − 2.4 mm long. Pistillate scales 4 − 9.5 mm long × 2 − 3.8 mm wide, lanceolate-ovate to ovate,(1-) 3-nerved, narrower and shorter than the perigynia, white hyaline with green centers, obtuse to awned, usually strongly cuspidate, awn to 6.5 mm long, antrorsely scabrous, Perigynia 10 − 17 mm long × 2.5 − 7.5 mm wide, broadly or narrowly ovoid, glabrous with a satiny luster, dark olive drab green, wingless, not corky, strongly inflated, usually spreading at all angles, sessile, (1-) 4 − 15 per spike, strongly 13 − 23-nerved; beak poorly defined, 2 − 4.2 mm long, bidentate. Achenes (Fig. 2e) 3.5 − 5.7 mm long ×(2.2-) 2.5 − 3.9 mm wide, ellipsoid to obovoid, trigonous, sessile, faces convex to nearly flat, angles not thickened. Distribution: Newfoundland to southeastern Manitoba, then southward to Texas and Florida. Texas: by counties (Fig. 3e); regions 1,2,3 and 4. Chromosome number $n = 24$ (Wahl 1940), $2n = 48$ (Reznicek and Ball 1974). Maturation dates: March through September. Habitat: Swampy woods, bottomland hardwood forests, acidic soils.

Representative specimens: **Anderson Co.**: 08 Sep 1971, *E. Nixon & R. Sniffen 3359* (ASTC). **Bowie Co.**: 10 May 1984, *E. Nixon 13752* (ASTC). **Cass Co.**: 17 May 1970, *D. Correll & H. Correll 38690* (TEX). **Galveston Co.**: 08 Apr 1975, *F. Waller & J. Baum 3506* (TAES). **Hardin Co.**: 28 Mar 1982, *J. Matos & D. Rudolf 347* (ASTC). **Harris Co.**: 23 Apr 1980, *J. Kessler 3385* (SMU,TAES,TEX). **Harrison Co.**: 06 Aug 1977, *E. Nixon & R. Hicks 7702* (ASTC). **Jasper Co.**: 19 Apr 1951, *E. Whitehouse 25036* (SMU). **Jefferson Co.**: 04 Apr 1946, *R. Crockett 8295* (TEX). **Nueces Co.**: 18 May 1933 Parks & Cory 22615 (TAES). **Orange Co.**: 22 May 1988, *S & G. Jones 1634* (ASTC,TAES). **Polk Co.**: 25 Apr 1937, *C. York & B. Tharp 43319* (TEX). **Red River Co.**: 29 Apr 1969, *D. Correll 37127* (SMU,TEX). **Sabine Co.**: 30 Mar 1971, *E. Nixon 2247* (ASTC). **San Augustine Co.**: 15 Apr 1987, *E. Nixon 15877* (ASTC,TAES). **San Jacinto Co.**: 11 Apr 1974, *D. Hartman 1308* (TAES). **Shelby Co.**: 05 Jul 1956, *D. Correll 15350* (SMU,TEX). **Trinity Co.**: 10 Jul 1988, *S. & G. Jones 1802* (TAES). **Tyler Co.**: 22 May 1988, *S. & G. Jones 1677* (TAES). **Upshur Co.**: 14 Apr 1916, *M. Young 113* (TEX). **Wharton Co.**: 07 Apr 1939, *B. Tharp 43272* (TEX). **Wood Co.**: 18 May 1988, *S. & G. Jones & E. Nixon 1440* (TAES).

5. CAREX GIGANTEA Rudge, "GIANT SEDGE", Trans. Linn. Soc. London 8:99. 1804. TYPE: (HOLOTYPE: BM).

Blades flat, 2 − 6 dm long × 5 − 16 mm wide, long-attenuate, glabrous, upper half antrorsely scabrous on the margins, septate-nodulose. Bracts leaf-like, flat, 3 − 6 dm long × 6 − 11 mm wide, much exceeding the culm, antrorsely scabrous on the margins, sheathing, septate-nodulose. Pistillate infructescence (Fig. 1e), below staminate spike, 2 − 5 per culm, not aggregated or only very little, 3 − 8 cm long × 2 − 3 cm wide, oblong to cylindric; peduncles nearly sessile (4) cm long, smooth, distance between lowest 2 peduncles 5 − 20 cm; staminate inflorescence terminal, 1 − 5 per culm, 2 − 8 cm long × 2 − 4 mm wide, narrowly linear; peduncles $2-8$ cm long, smooth, base of staminate spike shorter than or not much exceeding top of uppermost pistillate spike; anthers $2.5-3.3$ mm long (based on 5 specimens). Pistillate scales $4.5-10.5$ mm long $\times$ $1.5-2$ wide, lanceolate to lanceolate-ovate, $3-5$-nerved, narrower and shorter than perigynia, white-stramineous hyaline with green centers, acuminate to awned, awns to 2.5 mm long, entire to slightly antrorsely scabrous. Perigynia $11-18$ mm long $\times$ $4-6$ mm wide, narrowly ovoid, glabrous, shiny, yellowish green to dark green, wingless, not corky, inflated, frequently spreading at right angles to main axis to slightly ascending, $20-75$ per spike, strongly $17-22$-nerved; beak conic, $6-9$ mm long, bidentate. Achenes (Fig. 2c) $2.2-2.6$ mm long $2.7-3.3$ mm wide, obconic with subtruncate to truncate summit, trigonous, broadly stipatate, faces concave, angles thickened internally. Distribution: Florida to Texas, northward in the Mississippi Valley to Kentucky, Missouri and Indiana, east and northward to Delaware. Texas: by counties (Fig. 3f); regions 1 and 2 found only in Polk and Harris counties, rare. Chromosome number unknown. Maturation dates: May through September. Habitat: Swampy woodlands, acidic soils.

Representative specimens: **Harris Co.**: 16 Jul 1943, *E. Boon 224* (TEX). **Polk Co.**: 14 May 1942, *E. Brinklen 42 – 160* (TEX).

DISCUSSIONS

Reznicek and Ball (1974) stated that the series is clearly divided into two groups based on external morphology of the achenes. *Carex lupulina*, *C. lupuliformis*, *C. louisianica* and *C. gigantea* are in one group, and *C. intumescens* and *C. grayi* are in the other. Menapace et al. (1986) assessed the phenetic affiliation of species in section *Lupulinae* by examining achene epidermal micromorphology using scanning electron microscopy. Using silica platforms with or without central bodies in conjunction with macromorphological features, they supported the division of section *Lupulinae* into subsection *Lupulinae* (J. Carey) Kukenth., (*C. lupulina*, *C. lupuliformis*, *C. louisianica* and *C. gigantea*) and subsection *Intumescentes* Menapace, Wujek and Reznicek (*C. intumescens* and *C. grayi*).

Based on our examination of herbarium specimens *C. louisianica* of subsection *Lupulinae* is frequently confused with *C. intumescens*. Both species grow in the same habitat and have the same basic habit. However, *C. louisianica* (Fig. 1d) has subcylindric to cylindric pistillate spikes (ps), perigynia ascending to slightly spreading, perigynia drying to a light olive-drab green or stramineous brown in color, and the peduncle of the staminate spike (ss) greatly exceeds the uppermost pistillate spike. *Carex intumescens* (Fig. 1c) has subglobose to globose pistillate spikes (ps), perigynia spreading at all angles, perigynia drying to dark olive-drab green, and the staminate spike (ss) moderately surpassing the uppermost pistillate spike. *Carex louisianica* (Fig. 1d) can be easily separated from *C. lupulina* (Fig. 1a) by the peduncle of the staminate spike (ss) of *C. louisianica* greatly exceeding the uppermost pistillate spike (ps). In *C. lupulina* the staminate spike rarely or slightly exceeds the uppermost pistillate spike.

Carex lupulina, a common species, is frequently confused with the rare *C. lupuliformis*. *Carex lupuliformis* has only been collected twice in Texas. The most recent collection was made in October of 1962. Morphologically they are similar and difficult to differentiate in the field. However, *C. lupulina* is most frequently found in open acidic swampy sites, swampy acidic forest edges and acidic roadside ditches associated with adjacent swamps, whereas *C. lupuliformis* is most frequently found in basic or calcareous swamps. *Carex lupulina*, variable in stature, can grow as large as *C. lupuliformis* under favorable conditions. However, *C. lupuliformis* is consistently the largest *Carex* of the section and one of the largest species of the genus in North America. Reznicek and Ball (1974) stated that when grown in favorable conditions, *C. lupuliformis* is certainly one of the largest and most stately of *Carex* in Canada and also one of the rarest. The achenes of *C. lupuliformis* (Fig. 2d) are the best diagnostic character. They have pointed angles with nipple-like knobs and deeply concave faces. Achenes of *C. lupulina* (Fig. 2a) have neither pointed angles nor nipple-like knobs and the faces are flat to slightly concave. We concur with Reznicek and Ball (op. cit.) that Willdenow is the correct authority of *C. lupulina*.

Carex gigantea, like *C. lupuliformis*, has only been collected twice in Texas. The most recent collection was made in July 1943. Site locations listed on the herbarium labels for both collections are unclear making original locations impossible to find. If these two species are found to be extant in Texas, then serious consideration should be made by the Texas Organization for Endangered Species to list both species as "state endangered species" as defined by Beaty and Mahler (1987).

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This is an excellent identification manual that contains keys and diagrammatic illustrations, more often than not, emphasizing and illustrating the key taxonomic characters. The arrangement of the taxa and illustrations is simplifed by being alphabetical. It is recommended as a supplement to anyone's library for its wide ranging application. WFM.

GRAINGE, MICHAEL and SALEEM AHMED. 1988. Handbook of Plants with Pest-Control Properties. John Wiley & Sons. The authors are with the Resource Systems Institute of the East-West Center in Honolulu, Hawaii.

The volume is a computerized database with data taken from the literature. "Information in this document is presented in three sections. Section I catalogues about 2,300 plants having pest-control properties; Section II is a listing of about 800 pests and the plants that reportedly control them; and Section III lists another 1,000 plants that are either poisonous in nature or reportedly control diseases and nematodes of humans and animals. The latter are candidate plants for screening for activity against crop pests." This is an excellent basic reference for any comtemplated study of this subdiscipline. WFM.

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This volume is a collection of annotated black and white photographs depicting the vegetation and life of the Colombian Amazon. In addition to the Preface and Foreward, there is a very informative chapter on "Amazonia" covering the history, topography, climate, people, etc.

XYLOTHAMIA (ASTERACEAE: ASTEREAE), A NEW GENUS RELATED TO *EUTHAMIA*

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ABSTRACT

The 27 species of *Ericameria* sensu stricto occur primarily in the western United States and northwestern Mexico. Eight species traditionally associated with *Ericameria* are primarily endemics of the Chihuahuan Desert region and comprise a well-defined natural group separated from the others. Although the last are superficially similar to *Ericameria* in habit and morphology of the leaves and capitulescence, they are strongly divergent in other aspects, particularly their zygomorphic (vs. regular) disc corollas with long (vs. short) lobes and phyllaries with an apical glandular patch but without a prominent midline (vs. no apical patch but a resinous midline). Studies of patterns of restriction site variation in chloroplasr DNA corroborate the observations that these two groups are widely divergent phylogenetically and place *Ericameria* sensu stricto nearest *Chrysothamnus* and the Chihuahuan species closest to *Euthamia*. The latter species are segregated as a new genus, **Xylothamia** Nesom, Suh, Morgan, & Simpson, and the following new combinations are proposed: **X. diffusa** (Benth.) Nesom, **X. palmeri** (A. Gray) Nesom, **X. parrasana** (S. F. Blake) Nesom, **X. pseudobaccharis** (S. F. Blake) Nesom, **X. purpusii** (Brandegee) Nesom, **X. riskindii** (B. Turner & Langford) Nesom, and **X. triantha** (S. F. Blake) Nesom. One new species is described: **X. johnstonii** Nesom. A key to the species is provided, as well as a summary of typification, morphological description, and distribution map for each one.

KEY WORDS: *Xylothamia*, *Ericameria*, *Haplopappus*, Asteraceae, Astereae, Mexico.

RESUMEN

Las 27 especies de *Ericameria* sensu stricto se encuentran distribuidas principalmente en el oeste de los Estados Unido y el noroeste de Mexico. Ocho especies que anteriormente han sido incluidas en *Ericameria* comprenden un grupo natural bien definido y separado de las demás especies, y son principalmente especies endémicas del desierto Chihuahuense. Aunque estas ocho especies son semejantes a *Ericameria* en cuanto al hábito y la morfología de las hojas y la capitulescencias, se destacan fuertemente en otros aspectos, especialmente en cuanto a las corolas zigomórficas (vs. actinomórficas) con lóbulos largos (vs. cortos) de las flores del disco, y los filarios con una mancha apical glandulosa pero sin una linea medial prominente (vs. sin mancha apical pero con linea medial resinosa promiente). Los estudios de los patrones de variación de los sitios de restricción del ADN de los cloroplastos apoyan a las observaciones que estos dos grupos son fuertemente divergentes filogeneticamente e indican que *Ericameria* sensu stricto es mas semejante a *Chrysothamnus* mientras que las ocho especies del desierto Chihuahense se asemejan mas a *Euthamia*. Estas últimas especies se incluyen en el género nuevo **Xylothamia** Nesom, Suh, Morgan, and Simpson, con las siguientes combinaciones nuevas: **X. diffusa** (Benth.) Nesom, **X. palmeri** (A. Gray)

Nesom, **X. parrasana** (S. F. Blake) Nesom, **X. pseudobaccharis** (S. F. Blake) Nesom, **X. purpusii** (Brandegee) Nesom, **X. riskindii** (B. Turner & Langford) Nesom, and **X. triantha** (S. F. Blake) Nesom. Una especie nueva se describe: **X. johnstonii** Nesom. Se incluyen una clave para la identificación de las especies, asi como un resumen de la tipificación, una descripción morfológica, y un mapa de la distribución para cada una.

Hall (1928) treated as *Haplopappus* sect. *Ericameria* a group of species with a subshrubby habit, punctate-resinous, mostly narrow, entire leaves, and heads arranged in relatively compact, flat-topped capitulescences. He divided sect. *Ericameria* into two groups, (1) those with a paniculate or racemose-paniculate capitulescence or with solitary heads and (2) those with a regularly corymboid capitulescence. With the exception of *E. diffusa*, however, all of the species that he treated belong to *Ericameria* sensu stricto in the sense of the arrangement proposed in the present paper.

Various authors have followed the early lead of Nuttall (1841) in recognizing *Ericameria* as distinct, but most have provided little or no comment on their concept of the genus (e.g., Bentham 1844; Wiggins 1933; Shinners 1950). In a study that preceded his treatment of *Haplopappus*, Hall (1907) himself considered *Ericameria* distinct. Urbatsch (1976, 1978) has recently published several taxonomic studies of species groups of *Ericameria* as a genus, and with Wussow (1979) he transferred *Haplopappus linearifolius* DC. of Hall's *Haplopappus* sect. *Stenotopsis* into *Ericameria*. In his contribution to the North American checklist by Kartesz and Kartesz (1980), Urbatsch treated the genus as distinct and included some of the species of *Haplopappus* sect. *Asiris*. Jepson (1925) treated *Ericameria* as a separate genus, but since Hall's monograph (1928), the only major floristic treatment to segregate it from *Haplopappus* has been that of Johnston (1970) for Texas. Finally, in concert with the exclusion of the group of species discussed in the present paper, Nesom (1990) has formally broadened *Ericameria* to 27 species by including those of *Haplopappus* sects. *Stenotopsis*, *Asiris*, and *Macronema*, creating a taxon coordinate in rank and variability with the closely related genus *Chrysothamnus*.

Urbatsch (1978, p. 298) noted that the Chihuahuan Desert species of *Ericameria* "stand apart from one another and from their California relatives in that each has a unique flavonoid complement and one or more extraordinary morphological features (Urbatsch, ined.). However, two characters, their zygomorphic disk corollas and their relatively long, thick style branches, give the Chihuahuan Desert species unity." Only five species were treated by Urbatsch, and he observed that one of them, *E. laricifolia*, is most closely related to the Californian species *E. pinifolia* and *E. brachylepis* rather than to any Chihuahuan Desert species.

Johnston (1967) transferred *Aster palmeri* to *Ericameria* (as the nomen novum *E. austrotexana)* and perceptively noted that its closest relatives included *E. triantha*, *E. diffusa*, *E. parrasana*, and *E. pseudobaccharis*. In his treatment of *Ericameria* for the flora of Texas (Johnston 1970), he made the even more remarkable observation that "There is a superficial and perhaps more than superficial resemblance of [*Euthamia pulverulenta* E. Greene] to *Ericameria austrotexana*."

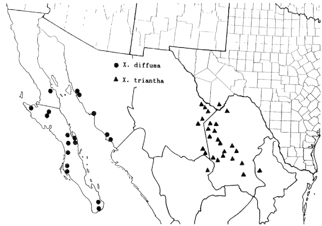
In this study, we corroborate and extend Johnston's hypothesis of interspecific relationships and Urbatsch's observation that the eastern ("Chihuahuan") and western ("Californian") species groups of *Ericameria* sensu lato are distinct from one another. Further, we find evidence to support Johnston's speculation regarding the relationships of *E. austrotexana*, as discussed below. In the following discussion, the phrase "Californian" species refers to those of sect. *Ericameria* (Nesom 1990), of which the "Chihuahuan" species (the group of 8 treated in this paper) have been considered a part. The "Chihuahuan" species include one that is endemic to western Mexico but that is clearly related to those from the east.

Comparison of the Chihuahuan and Californian species of *Ericameria*

The the obvious similarities in their woody habit, narrow, resinous leaves, flat-topped capitulescences, and their base chromosome number of $x=9$, the Chihuahuan and Californian groups of *Ericameria* are sharply separated by the contrasts in the following couplet.

1. Phyllaries not basally indurated, with a discrete, orange-glandular midrib from base to tip, sometimes prominently broadened distally but without an apical glandular patch; disc corollas regular, with lobes cut 1/4-1/2 the length of the throat, all lobes of equal or nearly equal length, erect or sometimes recurved; species primarily of the Sonoran and Mohave Deserts .... Californian *Ericameria*
1. Phyllaries white-indurated on the lower half with the midrib not perceptible or else very thin, and with a prominent glandular or herbaceous-glandular patch on the distal half; disc corollas strongly zygomorphic, with lobes deeply incised, usually nearly to the base of the throat, and strongly unequal in length, reflexing or coiling; species primarily of the Chihuahuan Desert (Fig. 1).................................... Chihuahuan *Ericameria*

The difference in phyllary morphology is consistent and easily observable and in itself is strongly suggestive that two phylads are represented. As pointed out to us by Loran Anderson (pers. comm.), the presence or absence of an apical glandular patch is not constant within *Chrysothamnus*, but among the species considered here, it appears to be diagnostic. The zygomorphic corollas of the Chihuahuan species are even more remarkable, because, to our knowledge, they do not occur in any other North American



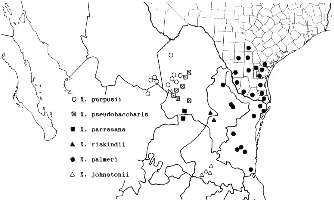


FIG. 1. Geographic distribution of the species of *Xylothamia*.

Astereae. Typically, two of the sinuses are cut nearly to the base of the throat, one is very shallow, and the other two are intermediate in depth. The two lobes on either side of the shallow sinus are erect, but the other three are sharply reflexed to coiling.

Comparison of the Chihuahuan species with *Euthamia*

Euthamia is a very sharply defined genus of about eight species (Sieren 1981), although the putative species are so similar to one another that disagreement still exists with regard to species limits. It has been considered a part of *Solidago* in the past, but recent workers (Kapoor and Beaudry 1966; Anderson and Creech 1975; Cronquist 1980) have recognized it as a distinct genus. All species of *Euthamia* are primarily herbaceous, viscid perennials with a branching system of fibrous-rooted rhizomes and numerous heads usually in a compact corymboid capitulescence, although the heads may be more loosely arranged in some species (e.g., *E. occidentalis* Nutt.). The leaves are narrow, often 3-nerved, and punctate-resinous. The phyllaries are strongly graduated in several series, narrowly oblong-lanceolate with white, indurated bases, and have an apical herbaceous patch that is strongly viscid-glandular. The disc corollas are generally, though not always, fewer than the rays, and they are deeply lobed but regular in symmetry. As noted by Kapoor and Beaudry (1966), the anther filaments are joined to the corolla at the tube-throat junction, in contrast to most other genera with which it has been compared. The base chromosome number is $x=9$, and diploids, tetraploids, and hexaploids are known (Sieren 1981).

One of the few floristicians yet to include species of both groups in a single treatment has noted that the the resemblance between *Euthamia* and the Chihuahuan species of *Ericameria* might be more than superficial (Johnston 1970). Plants of both groups have narrow, resinous-punctate leaves, very similar phyllaries, the disc corollas are relatively deeply lobed with coiling-reflexing lobes and similar insertion of the staminal filaments, and all have at least a tendency to produce flat-topped capitulescences. Of the other genera that appear to be closely related on the basis of molecular evidence, *Gutierrezia*, *Gymnosperma*, *Amphiachyris*, and *Bigelowia* (Suh 1989), only the last has a chromosome number of $n=9$. In its herbaceous habit with leaves primarily basally disposed and its turbinate-cylindric heads in a densely compact corymb, it appears far less similar than *Euthamia* to the species of Chihuahuan *Ericameria*.

The species of Chihuahuan *Ericameria* are separated from *Euthamia* by the differences in the following couplet.

1. Plants woody subshrubs from woody roots, not rhizomatous, with stems and leaves minutely papillate in all but one species; leaves 1-nerved; heads solitary or in a loosely to compactly corymboid capitulescence; disc corollas strongly zygomorphic . . . . Chihuahuan *Ericameria*
1. Plants primarily herbaceous perennials from a system of fibrous-rooted rhizomes, with stems and leaves glabrous to sparsely hairy, never papillate; leaves often 3-nerved; heads in a compact capitulescence; disc corollas regular . . . . *Euthamia*

Relationships According to Molecular Evidence

Studies of molecular variation show that the Chihuahuan species of *Ericameria* are only distantly related to those of the Californian group. Recently completed comparisons of North American Astereae using data from restriction site variation in chloroplast DNA by Suh (1989) and Morgan (in prep.) have each included three species of *Ericameria*, including the Chihuahuan group. In both studies, *Ericameria ericoides* (Californian) is most closely related to *E.* [sect. *Macronema*] *discoidea* and *Chrysothamnus*. Suh found that *Ericameria austrotexana* (Chihuahuan) is most closely similar to *Euthamia*, and Morgan, whose study did not include *Euthamia* or its close relatives according to Suh's analysis, found *Ericameria triantha* (Chihuahuan) equally similar to *Solidago*, *Aster*, *Machaeranthera*, and *Heterotheca*.

Figure 2 shows an abbreviated summary of the combined results of Suh and Morgan, each of whom is preparing more detailed analyses of his data for publication. Each of the lineages shown is named as a "group" for one of the major genera that occurs within it and each group has some representative members listed. Each of the six groups represented in the terminal polytomy is strongly defined, but hypotheses of relationships among them are weakly supported and an unequivocal resolution is not possible. Nevertheless, the complete separation of the Chihuahuan and Californian species of *Ericameria* is clearly shown. *Ericameria ericoides* (Californian) is related to *Chrysothamnus*, and *E. austrotexana* and *E. triantha* (Chihuahuan) are most closely related to *Euthamia* of the *Gutierrezia* group. In summary, the Chihuahuan species of *Ericameria* are sharply distinct morphologically from the Californian species. The former are shown by molecular data to be much more closely related to *Euthamia*, to which they are similar in features of capitular and leaf morphology. To account for their unique position according to both morphological and molecular evidence, we segregate this group of 7 species as a new genus.

Xylothamia Nesom, Suh, Morgan, & Simpson, gen. nov.

Type species: *Xylothamia (Aplopappus) triantha*.

Aspectu *Ericameriae* Nutt. similis sed differt phyllariis in dimidio inferno albi-induratis nervo medio non perceptibili in dimidio superno area prominenti glandulosa vel herbacei-

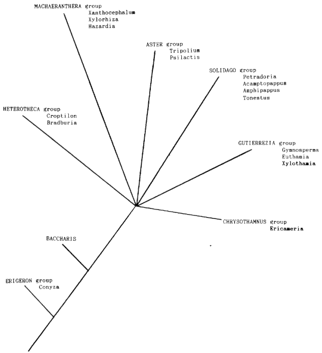


FIG. 2. Phylogenetic relationships of selected genera of North American Astereae, based on data from restriction site analyses of chloroplast DNA combined from the studies by Y. Suh and D. R. Morgan. *Ericameria* and *Xylothamia* are members of different clades.

glandulosa et corollis disci zygomorphis lobis profunde incisis in longitudine inaequalibus. *Euthamiae* Nutt. affinis sed habitu ligneo non rhizomato et corollis disci zygomorphis lobis profunde incisis in longitudine inaequalibus differt.

Woody, evergreen subshrubs 0.2 – 3.0 m tall, from woody, non-rhizomatous roots; stems and leaves minutely papillate in all except *X. diffusa*. Stems often minutely ridged. Leaves linear-oblong to linear-lanceolate or obovate, 1-nerved, entire, flat to involute-terete, strongly to weakly or not at all punctate-resinous. Heads campanulate to turbinate-campanulate, 3 – 6 (-8) mm wide, more or less solitary and loosely aggregated to densely aggregated in a compact, corymbiform capitulescence; phyllaries strongly graduated, narrowly oblong-lanceolate with white-indurated, enervate bases, with an apical, strongly viscid-glandular herbaceous patch, the margins hyaline; receptacles deeply alveolate, with the alveoli margins broad to deeply dissected and linear, nearly naked in *X. triantha*. Ray flowers 0 − 8 (-13), fertile, the corollas yellow to white, with ligules barely extending past the phyllaries. Disc flowers 4 − 22 (-50), more numerous than the ray, perfect, fertile, the corollas yellow, sometimes drying purplish, 3.0 − 5.0 (-5.5) mm long, strongly zygomorphic, with two of the sinuses cut nearly to the base of the throat, one very shallow (1/4 − 1/3 as deep as the former), and the other two intermediate in depth, the two short lobes erect, the others reflexed-coiling; staminal filaments inserted at the tube-throat junction; collecting appendages of the style branches ovate-lanceolate to linear-triangular. Achenes subcylindric to turbinate, 1.5 − 2.4 mm long, with 5 − 8 barely discernible nerves, moderately to densely sericeous; pappus bristles persistent, in a single series.

Base chromosome number, $x = 9$. A chromosome number of $n = 9$ pairs has been reported for *X. diffusa* (Pinkava and Keil 1977), *X. palmeri* (Urbatsch 1975), *X. triantha* (Anderson et al. 1974; Urbatsch 1975; Powell and Powell 1977), and *X. purpusii* (Urbatsch 1975).

The name of the genus is intended as a reference to its close relationship to *Euthamia* as well as to emphasize the relative woodiness of the plants.

KEY TO THE SPECIES OF *XYLOTHAMIA*

1. Leaves spatulate or lanceolate-triangular; heads solitary. (2)
1. Leaves mostly linear; heads in loose to compact, cymose clusters. (3)
2. Leaves obovate-spatulate, minutely papillate; heads 7 − 8 mm wide, radiate; southeastern Coahuila, Nuevo Leon .... *X. riskindii*
2. Leaves narrowly lanceolate-triangular, minutely hirtellous-hispidulous; heads 4 − 5 mm wide, eradiate; Chihuahua, Durango, Coahuila .... *X. purpusii*
3. Leaves involute, appearing terete; heads eradiate or with 1 − 3 tiny rays hidden within the involucre; disc flowers 3 − 7. (4)
3. Leaves narrow but evidently flattened; heads radiate; disc flowers 7 − 22. (5)
4. Stems minutely papillate-scabrous, ray flowers absent; Chihuahua, Durango, Coahuila, Nuevo Leon, and southwest Texas .... *X. triantha*
4. Stems glabrous; ray flowers 0 − 3; coastal and near coastal Baja California Sur, Baja California Norte, Sonora, Sinaloa .... *X. diffusa*
5. Leaves widely spaced and inconspicuous, heads in short racemes; disc flowers 7 − 14; south-central Coahuila .... *X. pseudobaccharis*
5. Leaves relatively crowded and conspicuous, heads in loose corymbs; disc flowers 9 − 22. (6)
6. Stems minutely papillate-scabrous; heads in corymbs; phyllaries weakly graduated; southern Coahuila and adjacent Zacatecas .... *X. parrasana*

6. Stems glabrous; heads in loose panicles; phyllaries strongly graduated. (7)
7. Leaf margins smooth; ray flowers 5 − 11; disc flowers 9 − 13; corollas white to cream; flowering August-October (-February); southeastern Texas, northern Nuevo Leon and Tamaulipas . . . . *X. palmeri*
7. Leaf margins minutely scabrous-ciliate; ray flowers 12 − 15; disc flowers 15 − 20; corollas yellow; flowering May-June; San Luis Potosi . . . . *X. johnstonii*

1. XYLOTHAMIA **diffusa** (Benth.) Nesom, comb. nov. — *Ericameria diffusa* Benth., Bot. Voy. Sulphur 2:23. 1844. TYPE: MEXICO. BAJA CALIFORNIA SUR. Magdalena Bay, 1839, *R. B. Hinds s.n.* Non *Aplopappus diffusus* DC., 1836. *Solidago diffusa* (Benth.) A. Gray, Proc. Amer. Acad. Arts 5:159. 1861. *Bigelovia diffusa* (Benth.) A. Gray, Proc. Amer. Acad. Arts 8:640. 1873. *Chrysoma diffusa* (Benth.) E. Greene, Erythea 3:10. 1895.

Linosyris sonoriensis A. Gray, Proc. Amer. Acad. Arts 8:291. 1870. TYPE: MEXICO. SONORA. District of the Yaqui River, 1869, *E. Palmer s.n.* (HOLOTYPE: GH!). *Aster sonoriensis* (A. Gray) Kuntze, Rev. 317. 1891. *Aplopappus sonoriensis* (A. Gray) S. F. Blake, Contr. U.S. Natl. Herb. 23:1490. 1926.

Subshrubs 3 − 15 (-20) dm tall, glabrous, resinous, punctate. Leaves 2 − 10 (-25) mm long, involute, linear and more or less terete, spreading to ascending, sometimes upcurved or downcurved, with an apiculate, slightly falcate apex. Heads sessile to short-pedicellate in compact cymes, turbinate, 2.5 − 3.5 mm wide; phyllaries strongly graduated, the inner 3.0 − 4.5 mm long. Ray flowers 0 − 3, the corollas 1 − 3 mm long when present, hidden within the involucre. Disc flowers 4 − 5, the corollas 3 − 4 mm long, sometimes drying purplish. Achenes sparsely to moderately sericeous, surface not obscured. Chromosome number, $n = 9$ pairs.

Baja California Norte, Baja California Sur, Sonora; coastal and near coastal sites, sandy and gravelly plains, bottomland alluvium, dunes, in coastal scrub, salt flats, *Yucca-Larrea-Pachycereus*, *Prosopis-Larrea*; 0 − 90 (-450) m; Oct-Dec (-Jan, Apr).

Distinguished by its discoid heads and terete, usually upturned leaves, which are variable in length but tend to be very short. We have not seen the type of this species, but Bentham's description of the disc corollas as "subbilabiate" leaves no doubt as to its identity. There is some variation in the relative depth to which the deepest lobes are cut, and rare plants produce flowers with lobes of nearly equal length. Even in these, however, the lobes are much deeper than in species of *Ericameria* sensu stricto, the distinctive morphology of the phyllaries is apparent, and the plants have rarely been misidentified as to species.

The existence of a close relationship between *Xylothamia diffusa* and *Chrysothamnus paniculatus* hypothesized by Hall and Clements (1923) was based on similarities in leaf and phyllary morphology. The latter species, along with *C. teretifolius*, is unusual in *Chrysothamnus* in its punctate leaves and phyllaries with an apical, herbaceous-glandular patch, and the two have been recognized as a separate section within the genus (Anderson 1984). Both species, however, have narrowly cylindrical heads and phyllaries in vertical files, features that ally them with *Chrysothamnus*.

The flavonoids of *Xylothamia diffusa* have been studied (Urbatsch *et al.* 1976), but hypotheses of relationship among species of *Ericameria* (as previously understood) based on flavonoid data have been undocumented (Urbatsch 1978; Clark et al. 1980) or have included only a few species (Urbatsch and Wussow 1979).

2. XYLOTHAMIA **johnstonii** Nesom, sp. nov.

Xylothamia palmeri (A. Gray) Nesom similis sed foliis majoribus marginibus scabriciliatis, flosculis radii et disci numerosioribus, corollis luteis, et florescentia vernali differt.

Shrubs up to 0.7 m tall, with slender, woody branches, glabrous, resinous, not punctate or papillate. Leaves linear to narrowly oblanceolate, (10-) 15 − 40 mm long, 1 − 2 (-45) mm wide, the margins minutely scabrous-ciliate. Heads broadly turbinate, 6 − 7 mm wide, on bracteate peduncles, in loose panicles; phyllaries strongly graduated, the innermost 4 − 6 mm long, with thin-hyaline margins. Ray flowers 12 − 15, the corollas yellow, commonly drying purplish, 4 − 6 mm long, with ligules 2 − 4 mm long. Disc flowers 16 − 20, the corollas yellow, 4 − 5 mm long. Achenes ca. 1.5 mm long, densely strigose-sericeous.

Endemic to central San Luis Potosi; ca. 1200 − 1700 m; May-Jun.

TYPE: MEXICO. SAN LUIS POTOSI. Bagre, Minas de San Rafael, May 1911, *C. A. Purpus 5021* (HOLOTYPE: GH!; ISOTYPE: US!).

Additional collections examined: MEXICO. **San Luis Potosi**. Santa Maria del Rio, Microondas Hill, steep slope, 3 Aug 1988 (almost completely past flower and fruit), *Boldt 29643* (TEX); region of San Luis Potosi, 1878, *Parry and Palmer 383* (GH); 15 km NE of Guadalcazar, 22 Jun 1955, *Rzedowski 6028* (US).

Xylothamia johnstonii is similar to *X. palmeri* in its flat, linear, non-punctate leaves, strongly graduated phyllaries with thin-hyaline margins, radiate heads in loose panicles. The new species differs in its larger leaves with minutely scabrous-ciliate margins, greater number of disc and ray and disc flowers, yellow corollas (commonly drying purplish), and spring flowering. It is named for Dr. Marshall C. Johnston, who first recognized its distinctness (Johnston 1967).

3. XYLOTHAMIA **palmeri** (A. Gray) Nesom, comb. nov. — *Aster palmeri* A. Gray, Proc. Amer. Acad. Arts 17:209. 1882. LECTOTYPE (Johnston 1967): UNITED STATES. TEXAS. [Maverick Co.:] Eagle Pass on the Rio Grande, Sep-Oct 1879, *E. Palmer 516* (GH!; ISOLECTOTYPES: PH, US). *Isocoma palmeri* (A. Gray) Shinners, Field & Lab. 18:27. 1950. *Ericameria austrotexana* M. C. Johnston, nom.

nov., Southw. Nat. 12:106. 1967; not *Ericameria palmeri* (A. Gray) H. M. Hall. Johnston (1967) selected Palmer 516 from among several syntypes. He referred to the GH sheet as the "holotype," although his intention clearly was the selection of a lectotype.

Bushy shrubs 0.5 – 3.0 m tall, the stems, leaves, and phyllaries glabrous, resinous but not punctate. Leaves linear-elliptic to narrowly oblanceolate, 5 – 15 mm long, 0.8 – 1.5 mm wide, the margins smooth. Heads turbinate-campanulate, 4 – 5 mm wide, immediately subtended by reduced cauline leaves, solitary but loosely clustered in cymose panicles; phyllaries strongly graduated, the innermost 4 – 5 mm long. Ray flowers 5 – 11, the corollas white, 4 – 5 mm long with ligules 2 – 3 mm long. Disc flowers 8 – 15, the corollas white to cream, 3.8 – 5.0 mm long. Achenes 1.5 – 1.8 mm long, densely strigose-sericeous.

Northern Nuevo Leon and Tamaulipas, southern Texas; 10 – 600 m; brushy vegetation, saline flats, coastal dunes; Aug-Oct (-Feb).

Distinguished from the other species of *Xylothamia* in its leaf surfaces that are not evidently punctate and its white ray and disc corollas.

Xylothamia palmeri, *X. johnstonii*, *X. parrasana*, and *X. pseudobaccharis* have narrow, flattened leaves and appear to be closely related among themselves. *Xylothamia riskindii* also probably belongs with this cluster of species, but its spatulate leaves, large heads, and relatively shallower (though unequal) corolla lobes are unusual.

One Mexican collection (Tamaulipas, Buena Vista "Hda" [Hidalgo?], 21 Jun 1919, *Wooton s.n.*, US) is anomalous and appears to show some of the features of *Xylothamia johnstonii*. These plants appear to belong with *X. palmeri* in their relatively few-flowered (8 pistillate, 8 hermaphroditic) heads and in their geographic location. Like *X. johnstonii*, however, they have leaves with minutely scabrous margins, yellow corollas, and they are early flowering.

4. Xylothamia **parrasana** (S. F. Blake) Nesom, comb. nov. — *Ericameria parrasana* S. F. Blake, Contr. Gray Herb. 52:26. 1917. Type: MEXICO. Coahuila. Sierra de Parras, rocky slopes, Mar 1905, *Purpus 1005* (holotype: GH!). *Haplopappus parrasanus* (S. F. Blake) S. F. Blake, Contr. U. S. Natl. Herb. 23:1490. 1926.

Subshrubs 1.5 – 2.0 dm tall, punctate-resinous. Stems minutely scabrous with thick, translucent, short, papillose projections. Leaves flat, mostly linear-lanceolate with a slightly falcate apex, 5 – 10 mm long, glabrous to papillate like the stems, with sunken glands. Heads campanulate, 5 – 6 mm wide, short-pedicellate in a distinctly corymboid capitulescence; phyllaries weakly graduated, the inner 3.0 – 3.5 mm long. Ray flowers 5 – 11, the corollas 5 mm long, the ligules 3.5 mm long, 1.0 mm wide. Disc flowers $15-22$, the corollas $3.5-4.0$ mm long. Achenes densely sericeous.

Sierra de Parras in s. Coahuila and adjacent Zacatecas; rocky slopes; (Mar-) Jul-Aug.

Recognized by its flat, linear, punctate leaves, campanulate, radiate heads, weakly graduated phyllaries, and numerous disc flowers.

5. XYLOTHAMIA **pseudobaccharis** (S. F. Blake) Nesom, comb. nov. — *Haplopappus pseudobaccharis* S. F. Blake, J. Washington Acad. Sci. 40:47. 1950. TYPE: MEXICO. COAHUILA: arid limestone hills of Sierra Paila, Valle Seco, General Cepeda, 1700 m, 4 Jul 1944, *J. C. Hinton* (*G. B. Hinton et al. 16546*) (HOLOTYPE: US!). *Ericameria pseudobaccharis* (S. F. Blake) Urbatsch, Sida 7:299. 1978.

Subshrubs $2-10$ dm tall, glabrous to minutely papillate. Leaves resinous but not evidently punctate, flat, linear, $2-14$ mm long, $0.5-1.0$ mm wide. Heads solitary to sessile or short-pedicellate in short, loose racemes, campanulate-turbinate, $3.0-3.5$ mm wide; phyllaries strongly graduated, the inner $3-5$ mm long. Ray flowers $3-6$, with ligules $2.5-3.0$ mm long, $0.5-0.8$ mm wide. Disc flowers $7-14$, the corollas $4.0-4.5$ mm long, often drying purplish. Achenes moderately sericeous.

South-central Coahuila, rare; limestone or gypsum slopes; izotal; $1200-1500$ m; Jul-Sep.

Recognized by it short, widely spaced, inconspicuous leaves, the plants appearing primarily as a mass of erect, intricately branched stems.

6. XYLOTHAMIA **purpusii** (Brandegee) Nesom, comb. nov. — *Ericameria purpusii* Brandegee, Univ. California Publ. Bot. 4:191. 1911. TYPE: MEXICO. COAHUILA: Cerro de Macho, *Purpus 4479* (HOLOTYPE: UC; ISOTYPE: GH!). *Aplopappus purpusii* (Brandegee) S.F. Blake, Contr. U.S. Natl. Herb. 23:1491. 1926.

Subshrubs $15-30$ cm tall, the stems and leaves minutely and densely hirtellous-hispidulous; axillary fascicles of leaves often prominent on older stems. Leaves stiffly erect, thick with the thick midrib $1/4-1/3$ as broad as the blade, narrowly lanceolate-triangular, mostly $2-5$ mm long, appearing prominently short-decurrent, not punctate or resinous. Heads solitary, campanulate, $4-5$ mm wide; phyllaries graduated, the inner $5-6$ mm long. Ray flowers absent. Disc flowers $8-10$, the corollas hairy, $4.2-5.0$ mm long. Achenes densely sericeous.

Chihuahua, Durango, Coahuila; rocky hills of gypsum, sometimes mixed with limestone; $1100-1200$ m; May, Aug-Oct.

Xylothamia purpusii, with its stiffened, lanceolate-triangular, non-punctate leaves, dense and minutely hirtellous-hispidulous vestiture, and solitary, eradiate heads is morphologically isolated within the genus.

7. Xylothamia **riskindii** (B. Turner & Langford) Nesom, comb. nov. — *Ericameria riskindii* B. Turner & Langford, Madrono 29:234. 1982. Type: MEXICO. Coahuila: ca. 24 km E of Saltillo, S side of Sierra La Viga, ca. 6.5 km E of Jame along wood cutter's road, 10,000 ft, 15 May 1977, *Henrickson et al. 16156b* (holotype: TEX!; isotypes: MEXU, RSA).

Low, rounded subshrubs ca. $8-15$ cm tall, with thick, translucent, short, papillose projections, punctate-resinous. Leaves obovate-spatulate, $8-10$ mm long, with a falcate apiculum. Heads solitary, sessile to subsessile, broadly turbinate, $7-8$ mm wide; phyllaries obovate to ovate or ovate-lanceolate, the innermost $6.5-7.0$ mm long. Ray flowers ca. 13. Disc flowers $30-50$, the corollas $4.5-5.5$ mm long, the lobes uneven but not so strongly as in the other species. Achenes moderately strigose, the surface not obscured.

Southeastern Coahuila, Nuevo Leon; limestone and gypsum areas, pine-fir-oak woodland; $2100-3000$ m; Apr-May

8. Xylothamia **triantha** (S. F. Blake) Nesom, comb. nov. — *Aplopappus trianthus* S. F. Blake, J. Washington Acad. Sci. 28:485. 1938. *Type: UNITED STATES. Texas. Brewster Co.: Chisos Mountains area, along road from Study Butte to Terlingua, 31 Aug 1937, B.H. Warnock 1126* (holotype: US!). *Ericameria triantha* (S. F. Blake) Shinners, Field & Lab. 19:133. 1951.

Subshrubs $2-10$ dm tall, with minute, translucent papillae, resinous but not or only weakly punctate-glandular. Leaves $5-15$ (-20) mm long, $0.3-0.5$ mm wide, involuted, more or less terete. Heads turbinate, $3-4$ mm wide, short-pedicellate to sessile, in loose cymes. Phyllaries strongly graduated, sometimes in subvertical files, the inner $4-5$ mm long. Ray flowers absent. Disc flowers $3-7$, the corollas glabrous, $4-5$ mm long. Achenes densely sericeous.

Chihuahua, Durango, Coahuila, Nuevo Leon, and sw. Texas; gypseous, calcareous, igneous, or saline habitats, slopes or commonly desert flats with gravelly to fine alluvial soils, matorral, mesquite-creosote bush, or *Suaeda-Atriplex*; $700-1500$ m; Jul-Oct, continuing sporadically with rain.

Recognized by its reduced, terete leaves, and turbinate, eradiate, few-flowered heads in clusters.

Xylothamia triantha and *X. diffusa* are similar in their highly reduced number of disc flowers as well as their involuted, terete leaves. The latter is the only species in the genus with a distribution primarily in western Mexico. The former is also unusual in its wide geographic range, which reaches Chihuahua and Durango. Blake (1938), in his description of *Aplopappus trianthus*, was the first to point out its similarity to *X. diffusa*.

Urbatsch (1978) later noted that the flavonoid complement of *X. triantha* is most similar to that of *X. diffusa*.

In contrast to the notable similarity among species of *Euthamia*, those of *Xylothamia* display an extreme degree of differentiation among themselves. The species of *Xylothamia* with long, flat leaves as well as clustered heads, *X. palmeri*, *X. johnstonii*, and *X. parrasana*, are perhaps the most closely related to *Euthamia*. *Xylothamia triantha* and *X. diffusa*, with terete leaves appear to be more distantly related, although these two species have the most *Euthamia*-like capitulescences of the species of *Xylothamia*.

In *Xylothamia*, the ovate style appendages of the disc flowers with a minutely papillate vestiture in several species (*X. diffusa*, *X. palmeri*, *X. parrasana*, and *X. riskindii*) contrast with those in *X. triantha*, which are linear-triangular with long, relatively sparse, and widely divergent collecting hairs. The remaining two species have appendages that are more or less intermediate in morphology between those two extremes. *Xylothamia parrasana*, which was included in *Haplopappus* sect. *Stenotopsis* by Hall (1928) on account of its silvery-white pappus bristles and ovate style appendages, was correctly excluded from that group by Urbatsch and Wussow (1979). *Xylothamia palmeri* also has white pappus and even more strongly ovate style appendages. It is clear, however, that these similarities between *Xylothamia* and *Ericameria* cannot be considered to be strictly homologous.

In all the species of *Xylothamia* except *X. diffusa*, which is completely glabrous, the stems and leaves have a vestiture of minute, translucent papillae. The papillae are pronounced and conspicuous in *X. parrasana*, *X. triantha*, and *X. riskindii* but poorly developed in *X. palmeri* and *X. pseudobaccharis*. In *X. purpusii* the tips of the papillae are drawn out into fine, acicular tips and, densely arranged, give the plants a hirtellous-hispidulous appearance. *Ericameria juarezensis* (R. Moran) Urbatsch and *E. martirensis* Wiggins have short, translucent-vitreous hairs that are similar to the papillae of *Xylothamia*.

The only species of *Xylothamia* that is not resinous is *X. purpusii*. There is variability, however, in the occurrence of the recessed glandular-punctations that are characteristic of *Ericameria*. Most taxa are punctate-resinous but there are no punctations in *X. purpusii*, *X. palmeri*, or *X. johnstonii*. In *X. diffusa*, the punctations are evident on some plants but not on others. Although Hall (1928) heavily emphasized the occurrence of such "resin pockets" in his classification of sections of *Haplopappus*, variation in their occurrence is known in other natural groups. For example, Hall himself noted that some species of *Isocoma* lack them, whereas they are present in others.

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THE HERBACEOUS FLORA OF THREE WECHES FORMATION OUTCROPS IN EASTERN TEXAS

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ABSTRACT

The Weches Geologic Formation, which was formed during the Eocene Epoch, supports a herbaceous flora in a region where forest is the general climax vegetation. Soils are shallow and basic in contrast to the deeper acid soils of eastern Texas and the sites are usually waterlogged during spring. Species with the highest importance values in the Weches plant communities are *Sedum pulchellum, Satureja arkansana, Sporobolus vaginiflorus, Arenaria patula, Valerianella* spp. and *Trifolium dubium*. *Lesquerella pallida* and *Leavenworthia texana* are endemic to these outcrops. Disjunct species include *Calylophus drummondianus, Liatris mucronata, Paronychia virginica* and *Petalostemon pulcherrimum*. Species richness ranged from 49 to 81 species for the sites studied, while species diversity ranged from 3.23 to 4.56. Although the Weches sites contained many species in common with cedar glade plant communities in the southeastern United States, overall similarity was generally low.

RESUMEN

La formación geológica del Weches, formada durante la época Eocena, sostiene una flora herbacea en una región donde el bosque es el clímax vegetal. Los terrenos son poco profundos y básicos en contraste con los terrenos más profundos y ácidos del Este de Tejas; los sitios por lo general están anegados durante la primavera. Las especies más valiosas e importantes en las comúnidades de plantas del Weches son *Sedum pulchellum, Satureja arkansana, Sporobolus vaginiflorus, Arenaria patula, Valerianella* spp. y *Trifolium dubium*. *Lesquerella pallida* y *Leavenworthia texana* son endémicas al Weches. Las especies dislocadas incluyen *Calylophus drummondianus, Liatris mucronata, Paronychia virginica* y *Petalostemon pulcherrimum*. La riqueza en especies varió de 49 a 81 especies en los sitios estudiados, mientras la diversidad de especies varió de 3.23 a 4.56. Aunque los sitios del Weches contienen muchas especies en común con la comúnidad de cedros en la región sudeste de los Estados Unidos, la semejanza en general no es muy grande.

INTRODUCTION

The geological deposits of eastern Texas are quite interesting because they result from activities of Gulf of Mexico waters and continental rivers (Sellards et al. 1932). Marine deposits were laid down when oceanic waters advanced over the land. When these waters receded, rivers deposited sediment seaward. Thus, there are several layers of marine deposits alternating with terrestrial deposits. The Weches Geologic Formation is a marine deposit formed during the Eocene Epoch. It extends from Sabine County near the Louisiana border to Atascosa and Frio counties in south central

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Texas in a line generally paralleling the coast. The formation is composed of glauconitic clays, marl and rich fossiliferous deposits. Mud stone often is associated with the Weches. Fresh exposures of the glauconitic stratum have an olive green cast, but they turn reddish-brown with age. These exposures usually occur naturally on the slopes of hills as a result of erosional activity. Generally, outcrops are about five to 20 m wide and occur in isolated or segmented strips, usually not more than 100 m in length.

Conditions associated with these outcrops are unique for East Texas. Because of the presence of mudstone, the soils are generally rocky and shallow, precluding the growth of woody vegetation. Hence, these sites are conducive to the growth of herbaceous heliophytes. In contrast, the predominant vegetation in East Texas is generally a pine-hardwood forest. Weches soils are basic and calcareous as a result of the rich marine fossil component (Sellards et al. 1932). Because of the glauconitic clay stratum, outcrops are often very wet, especially in early spring. Downward percolating water from overlying soils moves laterally over the impermeable clay of the Weches until it exits on hillsides where outcrops occur. On the other hand, soils frequently become very dry in summer and fall due mainly to their shallowness. These characteristics are in contrast to the generally acid, deep, well drained sandy loam soils of East Texas.

Interest in the floristics of Weches outcrops began in 1981 when E. S. Nixon and J. R. Ward rediscovered a population of a white flowered mustard, *Lesquerella pallida*, on an outcrop near San Augustine, Texas (Nixon et al. 1983). This species, which is endemic to outcrops of the Weches Formation, had not been seen since its initial collection in the 1830's. Since little was known concerning the plants that grow on the Weches Formation, we analyzed the herbaceous vegetation and compiled a list of plants of three naturally occurring outcrops.

STUDY SITES

The three study sites, located in San Augustine County in eastern Texas, are within Gould's (1975a) Pineywoods Vegetational Area and Braun's (1950) Oak-hickory Forest Region. The topography of the area is characterized by gently rolling hills. Average precipitation, which is fairly evenly distributed throughout the year, is about 122 cm and average annual minimum and maximum temperatures are about 12° to 25° C respectively (Larkin and Bomar 1983). January, February and March precipitation was below normal during the study year, 1986. This caused a reduced seepage flow over the Weches in early spring and thus affected the number of individual plants present. In contrast, May and June experienced above average rainfall.

The three study sites are located within pastures on gently sloping hills. Mudstone is exposed at all three sites. The Weches outcrops studied are about 60 m long and up to 20 m wide. Soils over mudstone generally are less than 15 cm deep, whereas those associated with the glauconitic clays are deeper. Some woody vines, shrubs and small trees occur on deeper soil but the sites are generally open. Some of the more common woody species are *Gleditsia triacanthos, Liquidambar styraciflua, Rosa bracteata, Juniperus virginiana, Forestiera ligustrina, Rhamnus lanceolata, Cornus drummondii* and the vine *Cissus incisa*.

The pastures have been mowed and grazed by cattle for many years. These factors undoubtedly have influenced the flora of the Weches outcrops. Topography and lack of woody plants generally hindered or did not require the mowing of the study sites. Pastures are usually mowed to impede woody plant invasion.

METHODS AND PROCEDURES

The herbaceous flora was analyzed using 50 x 100 cm quadrats. Two transects were established at each of the three study sites. The transects were parallel to the length of the Weches outcrops; and sample plots were placed every two meters along the transects. Thirty quadrats systematically were placed at each site in January of 1986. During the growing season (March through October) of 1986, quadrats were visited approximately every two weeks. During each visit, all plants were identified, and those in plots counted. Because *Valerianella radiata* and *Valerianella stenocarpa* can be distinguished in the field only by their small fruits (about 2 mm long), we lumped the two species. Based on collecting information, it is likely that *V. radiata* is the most abundant of the two species. For each species, frequency and density data were used to calculate relative frequency and relative density, which then were summed to give an importance value. Voucher specimens of all species on the three sites are on deposit in the Stephen F. Austin State University Herbarium (ASTC). Nomenclature follows Correll and Johnston (1970), Gould (1975b) and Kartesz and Kartesz (1980).

Sorenson's index ($IS = 2C/A + B$) was used to compare floristic similarity of the vegetation of the three Weches sites and of the Weches vegetation with the vegetation of cedar glades in the Southeastern United States. In this index, C is the number of species common to the two communities being compared, A is the total number of species in one community and B the total number of species in the other community.

Species diversity for the three Weches sites also was computed using the Shannon-Weiner diversity index (Shannon and Weaver 1949): $H^1 = - \Sigma pi$

$\log_2$ pi, where pi is the decimal fraction of the individuals belonging to the i^{th} species.

Soil samples were collected from the upper 15 cm of soil at the three study sites and pH, phosphorous, potassium, calcium, magnesium, and texture were determined by personnel at the Stephen F. Austin State University soil testing laboratory.

RESULTS

Soils

Soil pH at the three sites ranged from 7.6 to 8.2 and averaged almost 8. Levels of calcium (>2500 ppm), potassium (>250 ppm), and magnesium (>250 ppm) also were high. Available phosphorus ranged from 10 to 12 ppm. Soil textural class ranged from sandy loams to sandy clay loams.

Herbaceous Flora

Plants began flowering on the Weches outcrops during March, with the spring flora consisting primarily of *Satureja arkansana, Sedum pulchellum, Valerianella* spp., *Arenaria patula* and the introduced clover *Trifolium dubium* (Table 1). These taxa made up 62 percent of the density and 45 percent of the importance value of the spring flora. From March through May, 59 taxa flowered and 12,734 plants were recorded in the quadrats. These plants averaged 284 individuals per m^2.

The spring flora of the three Weches sites varied in species richness ranging from 45 taxa at site 1 to 35 taxa at site 3. Although site 3 had the fewest taxa, it had the highest number of plants (4,655), and thus the highest average number of plants per m^2 (314). *Valerianella* spp. and *Satureja arkansana* were the most important species at site 1; *Plantago virginica, Trifolium dubium* and *Melilotus indicus* were of secondary importance. *Trifolium dubium* was prevalent at site 2, along with *Arenaria patula, Plantago aristata, Bromus japonicus* and *Cerastium glomeratum. Sedum pulchellum, Satureja arkansana* and *Arenaria patula* dominated site 3. Fifty-three percent of the species on Weches outcrops flowered in the spring.

Species richness and density were lower in summer (June through August) than in spring. Species richness declined to 29 species and density to 23 plants per m^2 (Table 1). Only 1,021 plants were recorded in quadrats. During the summer, the Weches flora was composed primarily of *Croton monanthogynous* in association with *Euphorbia nutans, Cynodon dactylon, Helenium amarum* and *Euphorbia maculata* (Table 1).

Croton monanthogynous was important at all three sites. Other species with high importance values at site 1 were *Euphorbia nutans, Cynodon* *dactylon, Petalostemon pulcherrimum* and *Palafoxia rosea*. At site 2, *Helenium amarum, Cynodon dactylon* and *Paspalum notatum* were dominants where as the more important species at site 3 were *Leucospora multifida, Euphorbia maculata* and *Croton capitatus*.

Grasses dominated the fall (September through November) flora of Weches outcrops, with *Sporobolus vaginiflorus* being the principal species (Table 1). *Lespedeza striata* was the only non-grass species among the top five dominants. These five dominants comprised 71 percent of the importance value and 73 percent of the density. Species present averaged 39 plants per m^2, nearly double the number present during summer (Table 1). There were 1,729 plants recorded in the 90 quadrats representing 24 species. *Sporobolus vaginiflorus* was the most important species at site 1. Associated species were *Digitaria ciliaris, D. ischaemum, Aristida oligantha* and *A. dichotoma*. These same species dominated sites 2 and 3 along with *Panicum hallii* at site 2 and *Lespedeza striata* at site 3. *Sporobolus vaginiflorus* had an importance value of 143 at site 3.

In summary, 112 herbaceous taxa were recorded in quadrats at the three study sites; site 1 had 81 taxa, site 2 76 and site 3 49. The 90 quadrats contained, at one time or another during the growing season, 15,484 plants. Dominants at the Weches sites included weedy introduced species such as *Trifolium dubium, Cynodon dactylon, D. ischaemum, Lespedeza striata, Bromus japonicus* and *Cerastium glomeratum*, the widespread rock outcrop plant *Sedum pulchellum*, plants that are indicative of wet sites like *Satureja arkansana*, and plants such as *Valerianella radiata, Sporobolus vaginiflorus* and *Croton monanthogynous* which grow on more mesic to dry sites. Most of the dominant taxa are rather small plants.

Forty-five herbaceous species were found on the Weches study sites in addition to the 112 recorded in quadrats (Table 2). Of these 157 taxa, 81 (52%) were annuals or biennials and 76 (48%) were perennials. These 157 taxa represent 39 plant families. The three largest families are the Poaceae (38 taxa), Asteraceae (16), and Fabaceae (14). These three families accounted for 43% of the Weches outcrop species. Of the species recorded in quadrats, 53% flower in the spring, 27% in summer and 20% flower in fall.

Indices of Similarity and Species Diversity

The index of similarity was 0.62 between sites 1 and 2, 0.63 between sites 2 and 3, and 0.52 between sites 1 and 3. Twenty eight taxa, most of which are weedy species, occurred at all three sites.

The species diversity index was 4.52 at site 1, 4.56 at site 2 and 3.23 at site 3.

TABLE 1. Frequency, density and importance value data for herbaceous species of three Weches outcrops during spring, summer, and fall.

Species	Frequency %	Relative Frequency %	Density No/M²	Relative Density	Imp. Value[1]
Spring (March through May)					
Satureja arkansana	62.2	6.19	44.28	16.26	22.45
Sedum pulchellum	44.4	4.42	41.54	15.25	19.67
Trifolium dubium	73.3	7.30	31.38	11.52	18.82
Valerianella spp.	52.2	5.20	26.80	9.84	15.04
Arenaria patula	42.2	4.20	26.42	9.70	13.90
Others[2]		72.64	114.16	37.44	110.08
Totals		99.95	284.58	100.01	199.96
Summer (June through August)					
Croton monanthogynous	54.4	21.68	5.94	26.15	47.83
Euphorbia nutans	36.7	14.60	1.72	7.54	22.14
Cynodon dactylon	16.7	6.64	2.92	12.83	19.47
Helenium amarum	12.2	4.87	2.88	12.73	17.60
Euphorbia maculata	18.9	7.52	1.16	5.09	12.61
Others		44.66	8.08	35.69	80.35
Totals		99.97	22.70	100.03	200.00
Fall (September through November)					
Sporobolus vaginiflorus	75.6	22.74	14.92	38.81	61.55
Digitaria ciliaris	44.4	13.38	5.46	14.23	27.61
Digitaria ischaemum	41.1	12.37	4.24	11.05	23.42
Lespedeza striata	25.6	7.69	2.66	6.94	14.63
Aristida oligantha	26.7	8.03	2.34	6.07	14.10
Others[2]		35.75	9.84	22.92	58.67
Totals		99.96	39.46	100.02	199.98

[1]Sum of relative frequency and relative density.
[2]Other species recorded in plots at the study sites:

Acalypha virginica
Allium canadense
Ambrosia artemisiifolia
Andropogon virginicus
Anemone heterophylla
Arenaria drummondii
Aristida dichotoma
Aristida longespica
Asclepias verticillata
Astranthium integrifolium
Boerhaavia erecta
Bothriochloa saccharoides
Bouteloua curtipendula
Briza minor
Bromus japonicus
Calylophus drummondianus
Lesquerella pallida
Leucospora multifida
Liatris mucronata
Limnodea arkansana
Lolium perenne
Melilotus indicus
Mirabilis collina
Modiola caroliniana
Monarda citriodora
Nothoscordum bivalve
Oenothera speciosa
Oxalis dillenii
Palafoxia rosea
Panicum anceps
Panicum flexile
Panicum hallii

(Table 1 cont.)

Carex muhlenbergii	Paronychia virginica
Cassia fasciculata	Paspalum dilatatum
Cenchrus incertus	Paspalum notatum
Cerastium glomeratum	Paspalum setaceum
Chaerophyllum tainturieri	Petalostemon pulcherrimum
Conyza canadensis	Phalaris caroliniana
Croton capitatus	Physalis viscosa
Croton glandulosus	Plantago aristata
Cuphea viscosissima	Plantago virginica
Cyperus flavescens	Poa annua
Cyperus ovularis	Polanisia dodecandra
Dichanthelium laxiflorum	Portulaca oleracea
Diodia teres	Pyrrhopappus multicaulis
Dracopis amplexicaulis	Ranunculus parviflorus
Eleocharis compressa	Sabatia campestris
Eragrostis hirsuta	Salvia lyrata
Eragrostis intermedia	Setaria geniculata
Erigeron strigosus	Sherardia arvensis
Euphorbia dentata	Solanum carolinense
Euphorbia spathulata	Sphenopholis obtusata
Galactia volubilis	Sporobolus asper
Galium virgatum	Stachys crenata
Geranium carolinianum	Stipa leucotricha
Geranium dissectum	Tridens flavus
Hedeoma hispidum	Trifolium repens
Hedyotis crassifolia	Triodanis perfoliata
Hedyotis nigricans	Trisetum interruptum
Heliotropium tenellum	Verbena brasiliensis
Hordeum pusillum	Verbena halei
Hypericum drummondii	Veronica arvensis
Krigia occidentalis	Vicia angustifolia
Leavenworthia texana	Vulpia octoflora
Lepidium virginicum	

Endemic, Disjunct and Rare Species

Only two of the 157 taxa on Weches sites in East Texas are endemic to Weches outcrops. One, the white flowered mustard, *Lesquerella pallida*, is listed as endangered by the U. S. Fish and Wildlife Service (U.S. Dept. of the Interior 1987). Only five populations of this species are known to exist, all in San Augustine County, Texas. With the designation of the Texas populations of *Leavenworthia aurea* as *L. texana* by Mahler (1987), this new taxon is now endemic to East Texas Weches outcrops. Although *Sedum pulchellum* is found only on Weches outcrops in eastern Texas, it grows on rock outcrops elsewhere in the southeastern United States (Clausen 1975).

Weches disjuncts include *Calylophus drummondianus*, *Liatris mucronata*, and *Paronychia virginica*, which are disjunct from the Edwards Plateau (about 380 km to the southwest) and north central Texas (about 328 km to the northwest) (Correll and Johnston 1970). Another disjunct, *Petalostemum pulcherrimum*, is disjunct from central Texas about 225 km to the west (Correll and Johnston 1970). Other species considered rare in eastern Texas are *Heliotropium tenellum, Eleocharis compressa* and *Cuphea viscosissima* (Correll and Johnston 1970).

DISCUSSION

In contrast to the generally acid soils of eastern Texas bottomlands (pH 4.4 to 4.8, Nixon 1986), mesic uplands (pH 4.4 to 4.6, Nixon et al. 1980), and dry sandy uplands (pH 4.6 to 6.2,Ward 1984), Weches soils are basic with pH ranging from 7.1 (Nixon et al. 1983) to 8.2 (this study). Calcium content, likely a result of the fossilized shells of marine organisms, is much higher than that of the surrounding forest soils (Nixon et al. 1980, Marietta and Nixon 1983, Nixon et al. 1987).

In addition, Weches outcrops are partly characterized by shallow soils over mudstone. The shallow depth and dry conditions of summer generally preclude woody plant establishment. Some trees, shrubs and woody vines are present on the outcrops, but only in pockets or areas where deeper soils occur. Shallow soils also are characteristic of cedar glades in the southeastern United States, where they form over limestone and dolomite (Baskin et al. 1968, Baskin and Baskin 1988). Thus both the Weches and cedar glade communities, which are dominated by herbaceous species, are examples of edaphically controlled plant communities (Baskin and Baskin 1988).

Because Weches Formation outcrops in eastern Texas usually contain mudstone, communities growing on them can be classified as rock outcrop communities. These types of communities have received much attention in the southeastern United States (e.g. Baskin and Baskin 1985a, Baskin and Baskin 1988). Where limestone or dolomite is at or near the surface they are called cedar glades (Baskin and Baskin 1985a). Since eastern Texas is within the Eastern Deciduous Forest (Braun 1950), comparisons were made of Weches and cedar glade communities. Comparisons indicate some floristic similarity. All of the Weches dominants (Table 1), with the exception of *Trifolium dubium, Euphorbia nutans, Lespedeza striata, Digitaria ciliaris* and *D. ischaemum* are present in cedar glade communities (Baskin et al. 1968, Baskin and Baskin 1975a, Somers et al. 1986, Bridges and Orzell 1986). Quarterman (1986) noted that the thinner soils of Tennessee glades are dominated in the spring by *Leavenworthia* spp., *Arenaria patula* and *Sedum pulchellum*, and that *Sporobolus vaginiflorus* is a dominant grass on these soils during the summer.

TABLE 2. Herbaceous species recorded from outside the plots at the study sites.

Alophia drummondii	Ipomopsis rubra
Andropogon glomeratus	Lamium amplexicaule
Asclepias tuberosa	Lespedeza cuneata
Aster subulatus	Manfreda virginica
Aster texanus	Mecardonia acuminata
Berlandiera texana	Melica mutica
Cacalia plantaginea	Onosmodium occidentale
Cassia obtusifolia	Petalostemon multiflorum
Centrosema virginianum	Phlox pilosa
Chasmanthium sessiliflorum	Physalis heterophylla
Cyperus strigosus	Prunella vulgaris
Delphinium vimineum	Ranunculus fascicularis
Desmodium marilandicum	Ruellia humilis
Dichanthelium angustifolium	Ruellia pedunculata
Draba brachycarpa	Rumex pulcher
Draba cuneifolia	Sisyrinchium albidum
Elephantopus carolinianus	Sisyrinchium langloisii
Euphorbia bicolor	Sisyrinchium sagittiferum
Euphorbia corollata	Spiranthes cernua
Fimbristylis annua	Verbesina virginica
Galium pilosum	Viola pratincola
Gaura parviflora	Viola rafinesquii
Geum canadense	

Lists of species found on southeastern glades also were compared with our combined Weches list using Sorensen's index of similarity. Indices of similarity between cedar glade communities in middle Tennessee and the Weches were .26 (Bridges and Orzell 1986) and .25 (Baskin et al. 1968, Baskin and Baskin 1975a). Glades in Kentucky were less similar with indices of .17 (Baskin and Baskin 1975b) and .16 (Baskin and Baskin 1985b).

Plant families most representative of the herbaceous vegetation of Weches outcrops are the Poaceae, Asteraceae, Fabaceae and Euphorbiaceae. These same families are principal components of cedar glade communities in middle Tennessee (Somerset al. 1986). About one-half of the Weches outcrop species are perennials, whereas 70% percent of the 414 taxa of cedar glade communities in the southeastern United States are perennials (Baskin and Baskin 1985a). Fourteen percent of the 157 Weches site taxa are introduced whereas 20% of the cedar glade taxa are introduced (Baskin and Baskin 1985a).

Of over 400 taxa of vascular plants growing on cedar glades in the southeastern United States, 29 are endemic to those sites (Baskin and Baskin 1985). Only two of the 157 Weches taxa in eastern Texas are endemic to Weches sites (Nixon et al. 1983). Baskin and Baskin (1985a) found that all of the endemic annuals were winter annuals and flowered in the spring. The two Weches endemics are annuals that flower in the spring. Baskin and Baskin (1988) noted that light, rather than soil or lack of genetic variability, seems to be the most important factor governing the distribution of annual glade endemics. Another interesting aspect is that narrow endemics such as those of glades seem to produce large seed banks to ensure their continuance (Baskin and Baskin 1978), which also seems to be the case with *Lesquerella pallida*. During a dry spring on a particular site less than 100 plants will occur as compared to 3000 to 4000 plants during a favorable wet spring.

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"In Volume 1 an introductory section provides a perspective on cocaine and cocaine-related chemistry. The bibliography begins with the pre-1950 references. The annotated section includes 4,055 annotated citations covering international scientific publications from 1950 through 1986. Entries are arranged alphabetically by author. Unsigned articles are listed under anonymous. Patents, books and book chapters are also listed by author."

"The author index and an extensive, cross-referenced subject index are contained in Volume II. ...The pre-1950 citations are indexed by author only. The 1950 - 1986 references are indexed by author and subject."

MOHLENBROCK, R.H. 1990. The illustrated flora of Illinois flowering plants: Nightshades to Mistletoe. 225 pp, 100 illus. Southern Illinois University Press, P. O. Box 3697, Carbondale, IL 62901. ISBN 0-8093-1567-X. Hardbound.

This is the latest volume in the continuing series on the flora of Illinois. This book treats the following families: Solanaceae, Convolvulaceae, Cuscutaceae, Polemoniaceae, Campanulaceae, Celastraceae, Santalaceae, and the Viscaceae.

HUNTER, CARL G. 1984. Wildflowers of Arkansas. 296 pp, 484 color photographs. The Ozark Society Foundation, P. O. Box 3503, Little Rock, AR 72203.

The purpose of this publication is to include a comprehensive cross section of the wildflowers from over the entire state. In addition to the descriptions of the colored plates, there are chapters on "History of Botanical Investigations," "Family Descriptions," and several other chapters covering the state of Arkansas and general botanical information regarding nomenclature and terminology.

NOTES

A NOMENCLATURAL NOTE ON *EUPATORIUM FISTULOSUM* (ASTERACEAE)[1] — *Eupatorium fistulosum* Barratt ranges from "s Me to Iowa, s to c Fla, Ala, Miss, La, and Tex" (Cronquist 1980). Barratt (1841) separated *E. fistulosum* from *E. purpureum* L. He described the former species and few other eupatoriums with whorled leaves in a single folio page publication (fig. 1), titled *Eupatoria verticillata*. Robinson (1904), probably unaware of Barratt's *Eupatorium fistulosum*, described a new *Eupatorium* species from Costa Rica, as *E. fistulosum*. Robinson's *E. fistulosum* is a later homonym and illegitimate, which was corrected by B. Robinson (1931) by renaming his Costa Rican *Eupatorium* sp., as *E. angulare* B. Robins. King and H. Robinson (1970) treated *E. angulare* as a synonym of *Neomirandea angularis* (B. Robins.) King & H. Robins.

Barratt intended to distribute his single folio page publication accompanied with a set of exsiccatae among his friends and botanists. This information is found in figure 1. It is evident from ICBN article 31 (Greuter 1988), that the above procedure, practiced by Barratt in this case, would validate a name if done prior to Jan 1953. We believe that Barratt did distribute his single folio page publication to other botanists. Wood (1847) stated that his treatment of *Eupatorium* was adopted from Barratt's *Eupatoria verticillata*. Jackson (1881) and B. Robinson (1931) cited Barratt's 1841 publication.

The name *E. fistulosum* was attributed to Barratt by several authors such as Mackenzie (1920), Weatherby (1921), Wiegand and Weatherby (1937), Deam (1940), Fernald (1950), Gleason and Cronquist (1963), Steyermark (1963), Radford et al. (1968), King and Robinson [1970; as *Eupatoriadelphus fistulosus* (Barratt) King & H. Robins.], Correll and Johnston (1970), Strausbaugh and Core (1978), Cronquist (1980), Wunderlin (1982; in *Eupatoriadelphus*), and Kartesz (1990). However, Jones and Fuller (1955) attributed the name *E. fistulosum* to Barrett ex Wood, and Soil Conservation Service (1982) attributed the name to Barratt ex Hooker (in *Eupatoriadelphus*). We could not locate any Hooker publication of this name. Since Barratt published this name in 1841, Hooker's usage of this name, if any, cannot be prior to 1841 (hence not in his Fl. Bor. Amer., vol. 2. 1840). Weatherby (1921) mentioned that Hooker, for his Fl. Bor. Amer. publication, invited Barratt to contribute the treatment of

[1]Please send reprint requests to Fryxell.

EUPATORIA VERTICILLATA.

Ea 2'8ő

SPECIMENS TO ILLUSTRATE THE NORTH AMERICAN VERTICILLATE SPECIES AND VARIETIES

OF THE

GENUS EUPATORIUM:

With Synonymes and References.

BY JOSEPH BARRATT, M. D.

MIDDLETOWN, CONNECTICUT

MAY, 1841.

** A number of uniform sets of Specimens have been preserved for distribution among Botanical friends and correspondents.

No. 1. EUPATORIUM FISTULOSUM* *Barratt*; = E. purpureum *Willd. sp. pl.* 3, *p.* 1759; (partly; excl. ref. et Syn. except Cornuti (q. v.) *Pursh, fl.* 2, *p.* 515; *Ell. fl.* 2, *p.* 307!; *Bigelow, fl.* 2d *Ed, p.* 297!; *Decand. Prodr.* 5, *p.* 151, *n.* 68, (in part); = E. maculatum. *Linn. sp. pl.* 1174, (in part,) *et Herb.* fide Dr. Gray. = E. purpureum γ *angustifolium*. *Torr. & Gray Flor.* 2, *p.* 82.

(Eupatoria) foliis Enulæ, *Cornuti Canad. p.* 191. "Caules rubescentes cinereo tamen colore suffusi rotundi inanes intus." *Cornuti*, (*l. c.*)

The specific character given by Willdenow of E. purpureum, applies to our E. fistulosum. The full description there taken from L. sp. pl. n. 13 is = E. verticillatum W.! so that Willdenow has has confounded two different species. These and other discrepancies detected several years ago, induced me to study the plants in the *growing state*, nor was I able to settle the synonyms satisfactorily, till I had made a full collection of specimens.

Stem hollow from the corymb to the base; height 6–9 or 10 feet; smooth bluish purple and glaucous; reddish purple upwards; petioles and midrib purple. This is one of the most stately herbaceous plants in New-England, and truly distinct from the next species, no. 2. In some rare instances I have found 2 or 3 upper joints of whole solid. The small varieties which grow on uplands, retain the hollow stem, and other characteristics. The hollow stems of this species have been used extensively for blasting rocks at the Middletown Feldspar Quarry. E. fistulosum does not appear to possess the acrid properties of E. maculatum. The original E. purpureum, *Linn.* is shown, (no. 3,) to be a different plant, presenting also several interesting varieties, but all retaining the characteristics of that species, and not passing by gradations into other species. The name here given by me, (since a new name was required,) is sufficiently expressive to remove all ambiguity. The confusion in systematic works on this group of North American Eupatoriums, is most extraordinary! It is hoped that these specimens, with the notes and references, will render the study of this group easy and perfectly satisfactory to the Botanist. Should our European correspondents detect from our specimens after comparison with the original Herbaria cited, any errors, it will give us pleasure to receive their communications and corrections.

1. EUPATORIUM FISTULOSUM.* *Barratt*
A small variety

2. EUPATORIUM MACULATUM *Linn. Amæn. Ac.* 4, *p.* 288; *Linn. sp. pl.* 1174; *Willd. sp. pl.* 3 1760; *Michaux. Flor.* 2, *p.* 99; *Pursh fl.* 2, *p.* 515; *Decand. Prodr.* 5, *p.* 152, *n.* 69.

Stem 6 feet high, solid striate hispid or pubescent, greenish and purple, with numerous glands and purple lines. The glands on the stem and leaves give out an acrid effluvium in flowering time. There are several varieties in the number of its leaves.

2. EUPATORIUM MACULATUM *L.*
With 4 leaves in a whorl.

2. EUPATORIUM MACULATUM. *L.*
With 3 leaves in a whorl.

2. EUPATORIUM MACULATUM.
Var. β urticifolium.* *Barratt.*

Height 4–5 feet, stem solid, slender; the leaves are thin and much longer than the usual form of E. maculatum. It is found in the Middletown meadows, near the banks of the Connecticut; and to this river we are perhaps indebted for many of our Eupatoriums, and other interesting plants.

3. EUPATORIUM PURPUREUM *Linn. sp. pl.* 1173, et Herb. ejus!; (spec. char. bad, excl. syn.;) not *E. purpureum of Decandolle, Willdenow or Pursh.* = E verticillatum, *Willd. sp. pl* 3 1760, (et Herb. fol. 1 and 2!) *fide Gray; Bigelow fl.* 2d *ed. p.* 298, excl. Syn. Michx. 2, p. 99.

Stem solid, 6 feet high, glabrous green, sometimes purplish, with a purple band, at the joints about 1 inch broad—leaves in whorls of 3, 4 and 5—smooth above, with a soft pubescence beneath and along the midrib and nerves; length from 9–12 inches, wedge-shaped at the base, including a petiole of 1 or two inches, 4 inches wide, with large serratures. The leaves are thin, soft, and of greater size than any species of Eupatorium known to me. Corymb lax, flowers mostly pale purple, varying to whitish.

REM. Grows in dry woods or meadows. The Linnean name has not been [illegible] applied to this species, and that great Botanist, (l. c.) has mixed up [illegible] of two distinct species.

3. EUPATORIUM PURPUREUM.
Var. β album.* *Barratt.*

Flowers dull white; with 5 leaves in a whorl, large and distant. Grows in dry woods, and hill sides in rocky places. Stem solid.

3. EUPATORIUM PURPUREUM.
Var. β album* *Barratt.*

With 4 leaves in a whorl – a tall variety, upper leaves sub-falcate—flowers dull white, an *E. falcatum Mich*? Grows in dry woods. Stem solid.

3. EUPATORIUM PURPUREUM.
Var. β album* *Barratt.*

With 3 leaves in a whorl; stem tall and slender, upper leaves subfalcate; *Elliott Flor.* 2, *p.* 307; note! sub *E. ternifolium*, the last 4 lines! = E. trifoliatum. Darlington Flor. Cæstrica 2d ed. p. 453!

Stem solid, variable in size; leaves with a soft pubescence beneath, deeply serrate, flowers white or sometimes faint purple. An attention to the number of leaves of the Verticillate Eupatoria rather than other characters, has led the older botanists into frequent errors, and has occasioned much perplexity and confusion in systematic works, which requires to be cleared away.

4. EUPATORIUM TERNIFOLIUM. *Elliott Flor.* 2, *p.* 306! (in part.) *Decandolle Prodr* 5, *p.* 151, *n.* 67.

Stem solid, somewhat hispid and glandular; greenish, with purple dots and lines. Height from 3–5 feet, a rather slender species; the upper and last whorls of leaves small and finely serrate. There is a variety of *E. ternifolium*, with smooth purple stems, which is sometimes irregularly branched upwards. It has mostly 4 leaves in a whorl.

4. EUPATORIUM TERNIFOLIUM.
Var, β. vesiculosum.* *Barratt.*

Height 2–3 feet; stem solid, striate purplish; in meadows and pastures abundant—Staddle Hill west part of Middletown. This handsome variety bears a profusion of purple flowers with a large branched and spreading corymb, (in the finest plants.) The *E. dubium Poir. D. C. Pr.* 5, *p.* 152, (excl. Syn.) may perhaps prove a small variety of our plant? The leaves are strongly reticulated. The upper surface presents a vesicular appearance, in a remarkable degree, but which is mostly effaced in the hard pressed dried specimens.

FIG. 1. Barratt's 1841 publication, titled *Eupatoria verticillata*.

the genus *Salix*. Although Barratt declined this offer, he did provide Hooker a synopsis of this genus. Based on Barratt's synopsis, Hooker described two sections and few taxa in *Salix*, and attributed the new names to Barratt, but the correct authority for these *Salix* taxa is Barratt ex Hook (cf. Weatherby; Argus 1986). Probably this situation might have led a few taxonomists to believe that the correct authority for *Eupatorium fistulosum* is Barratt ex Hook. We speculate that taxonomists who attributed the name *Eupatorium fistulosum* either to Barratt ex Hook. or to Barratt ex Wood, might not have seen Barratt's single folio page publication or might have considered that publication as ineffective.

From Barratt's single folio page publication, it is evident that he validly described a new species, and from Wood (1847), Jackson (1881), and B. Robinson's (1931) references, we believe that Barratt's name was effectively published. Hence, the correct authority for *Eupatorium fistulosum* is Barratt. The authors thank Hunt Botanical Institute Library, Barney Lipscomb (Editor, Sida), Hollis G. Bedell (The Botany Libraries, Harvard University) for providing relevant literature for this study; and Larry E. Brown (Houston Community College), William R. Anderson (University of Michigan Hebarium) and Martin Cheek (Royal Botanic Gardens, Kew) for helpful suggestions. — *Kancheepuram N. Gandhi, Dept. of Biology, University of North Carolina, Chapel Hill, NC 27599-3280 and Paul A. Fryxell, U. S. D. A. Research Botanist in colloboration with Texas A&M University, College Station, TX 77843.*

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CORRECT NAMES FOR THE VARIETIES OF *CAREX ALBICANS / C. EMMONSII* — Rettig (Sida 13:449 – 452. 1989) reduced *Carex artitecta* Mackenzie and *C.physorhyncha* Steudel to varieties of *C. emmonsii* Dewey ex Torrey. In doing so, I stated that the oldest specific epithet, *C. albicans* Willd. ex. Sprengel, should not be used under article 69.1 of the ICBN (Greuter et al., eds. International Code of Botanical Nomenclature. 1988). It has been pointed out, however, that the name may not have been used "widely and persistently" enough to warrant rejection. Regardless, unless a formal proposal to reject the name *C. albicans* is approved by the Committee for Spermatophyta and the Botanical Congress, the correct names for the three varieties are:

SIDA 14(1):132. 1990.

CAREX ALBICANS Willd. ex Sprengel var. *albicans*, Syst. veg. 3:818. 1826. TYPE: CAROLINA (HOLOTYPE: B, GA [photo!]). Includes *C. artitecta* Mackenzie (*C. emmonsii* var. *muhlenbergii* (A. Gray) J. Rettig).

CAREX ALBICANS var. EMMONSII (Dewey ex Torrey) J. Rettig, comb. nov. BASIONYM: *C. emmonsii* Dewey ex Torrey, Ann. Lyceum Nat. Hist. New York 3:411. 1836. TYPE: Williamstown, Massachusetts, 1828 (NEOTYPE: NY!). *Carex novae-angliae* Schwein. var. *emmonsii* (Dewey ex Torrey) Carey in A. Gray, Manual:556. 1848. *Carex varia* var. *minor* Boott in Hooker, Fl. Bor.-Amer. II:223, 1839, has neither a description nor a reference to a previously published description and is thus not validly published. The specimen taken as the type for *C. emmonsii* (Rettig 1989) postdates the name it typifies (*C. davisii* Dewey) by two years and should be called a neotype.

CAREX ALBICANS var. AUSTRALIS (L. Bailey) J. Rettig, comb. nov. BASIONYM: *C. varia* var. *australis* L. Bailey, Bot. Gaz. (Crawfordsville) 17:153. 1892. (LECTOTYPE: *Tracy s.n.* in 1889, Mississippi, BH!; ISOLECTOTYPE: NY!, US!). Includes *C. physorhyncha* Steudel (*C. emmonsii* var. *australis* (L. Bailey) J. Rettig).

For complete synonymy see Rettig (1989). I thank Dr. A. A. Reznicek for pointing out the problem and reviewing this manuscript. — *J. H. Rettig, Department of Biology, Texas A & M University, College Station, TX 77843, U.S.A.*

KOELERIA GERARDII (VILL.) SHINNERS (POACEAE) NEW TO LOUISIANA — *Koeleria gerardii* (Vill.) Shinners was reported to be adventive at a few coastal localities in the United States including Texas by Gould, 1975. Hitchcock, 1951 reported this taxon as *Koeleria phleoides* (Vill.) Pers. and stated that it was introduced from Europe at Pensacola, Florida., Mobile, Alabama, Cameron County, Texas, Portland, Oregon, and at several points in California. Additionally, he reported it to be cultivated in nursery plots at Beltsville, Maryland and Tucson, Arizona. A recent collection of this taxon from Vernon Parish, Louisiana is apparently the first for the state (Allen, 1980). *Koeleria gerardii* is usually called annual koeleria and is characterized by its annual habit and pubescent spikelets. The other species of *Koeleria (K. pyramidata* (Lam.) Beauv.) in Louisiana is perennial and has scabrous spikelets. The collection data are:

LOUISIANA. **Vernon Parish**: disturbed area near Range Control off Texas Ave. on Ft Polk ca 4 mi ENE of Pickering, 12 May 1989, *Allen 16433* (LAF,LSU,NLU).

— *Charles M. Allen and Harland D. Guillory, Division of Sciences, Louisiana State University at Eunice, Eunice, LA 70535, U.S.A.; Charles H. Stagg and Stephen D. Parris, Environmental Section, Directorate of Engineering and Housing, Fort Polk, LA 71459, U.S.A.*

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RHYNCHOSPORA CAPILLACEA (CYPERACEAE), NEW TO TEXAS — *Rhynchospora capillacea* Torr., a cespitose perennial; culms delicately slender somewhat capillary to 4 dm tall; leaves filiform 0.2 – 0.4 mm wide, often as long as the inflorescence. Achene 1.7 – 2.6 mm long, long-elliptic, faintly marked horizontally rugose. Perianth bristles usually 6, retrorsely barbed as long as or surpassing the tubercle; tubercle subulate, about as long as the achene body. This species is usually found in calcareous seepage areas, bogs, swamps, shores and ledges ranging from Newfoundland to Saskatchewan, south to New Jersey, Pennsylvania, Virginia, Tennessee, Ohio, Indiana, Illinois, South Dakota and Missouri (Steyermark 1963, Godfrey & Wooten 1979). Waterfall (1966) listed *R. capillacea* as occurring in Bryan County, Oklahoma. Correll & Correll (1972) also listed *R. capillacea* as occurring in Oklahoma referencing Waterfall. Neither Correll & Johnston (1970), Stanford (1976), or Johnston (1989) listed *R. capillacea* as occurring in Texas. A collection of this distinct species, Kerr Co.: 3 Jun 1989, *S. & G. Jones 2456* (HPC,SMU,SWT,TAES,TEX), is apparently the first report for Texas. The specimen was collected in an open calcareous hillside seepage at its interface with the south fork of the Guadalupe River with a SE aspect. It was locally frequent restricted to or near the seepage area. This site is situated 19 km (11.8 mi) NE on Highway 39 from its junction with Ranch road 187 at its crossing with the south fork of the Guadalupe River. The seepage is at the NE corner of said intersection. Elevation of the collection site is 575 – 578 m with the geology being Edwards limestone of the Fort Terrett Members (Kft) (Lower Cretaceous). Associated species included *Fuirena* *simplex*, *Rhynchospora colorata*, *Cladium jamaicense*, *Eleocharis* sp., *Agrostis semiverticillata*, *Adiantum capillus-veneris*, *Justicia americana* and *Utricularia gibba*. This collection site appears to be the southwesternmost United States record. A search in SMU, TAES, and TEX herbaria did not yield any additional specimens. Further investigations in suitable habitats and herbaria research might yield additional Texas distribution records. — *Stanley D. Jones, S.M. Tracy Herbarium, Department of Range Science, Texas A&M University, College Station, TX 77843 and Gretchen D. Jones, Department of Biology, Texas A&M University, College Station, TX 77843, U.S.A.*

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WATERFALL, U.T. 1966. Keys to the flora of Oklahoma. 6th ed. Oklahoma State Univ. Press, Stillwater, OK.

ADDITIONS TO THE FLORA OF TEXAS FROM EL PASO COUNTY. — An intense survey of the flora of the El Paso area of Texas over the past decade has yielded a number of additions to the flora of the state, most of which have now been recorded by Johnston (1988, The vascular plants of Texas, a list, up-dating the manual of the vascular plants of Texas, privately published). The following records have not yet been published for Texas and are worthy of note.

Lepidium latifolium L. (BRASSICACEAE). **El Paso Co.**: along the Rio Grande at the NM 273 bridge, *Worthington 3146*, 19 Aug 1978 (UTEP); Country Club Rd. bridge, *Worthington 14119*, 20 May 1986 (SMU,UCR,UTEP); Borderland Rd. bridge, *Worthington 3254*, 27 Aug 1978 (UTEP); and at Canutillo, *Worthington 3254*, 27 Aug 1978 (UTEP). Rollins (1981, J. Arnold Arbor. 62:517−540) notes that the species is now established in widely separated localities in Canada, United States and Mexico. The species is also common in sandy areas along the Rio Grande in El Paso County.

Baccharis sarothroides Gray (ASTERACEAE). **El Paso Co.**: lower W slope of the Franklin Mts., along Trans-Mountain Rd. 1.1 mi E of jct. with I-10, 4100 ft elev., 16 Oct 1988, *Worthington 17615* (NY, SMU,SRSU,TEX,UTEP); 3 mi E of jct. with I-10, 4800 ft elev., 14 Jan 1978, *Worthington s.n.* (UTEP); Three Sister Hills (31°52′N-106°33′30″W), 4100 ft elev., 23 Oct 1988, *Worthington 17623* (NY,SMU,UTEP). This species has apparently been recently seeded into the area along roadways where isolated plants are infrequently encountered. The species is also occasionally used as an ornamental in desert landscaping in El Paso.

Filago californica Nutt. (ASTERACEAE). **El Paso Co.**: Franklin Mts., 1.7 mi NW jct. Trans-Mountain Rd. with Gateway South (31°54′50″N-106°27′42″W), 4400 ft elev, 8 Apr 1978, *Worthington 4304* (TEX,UTEP); 27 Mar 1983, *Worthington 9622* (NY,SMU,UCR,UTEP); 10 Apr 1988, *Worthington 13585* (SMU,UTEP); 1 mi WNW jct. Trans-Mountain Rd. with Gateway South, 4400 ft elev., 16 Mar 1983, *Worthington 9463* (UTEP). The species occurs on rocky grante slopes among grasses and small shrubs. Mr. James D. Moorefield kindly brought to my attention an earlier record for "El Paso, Texas" (*M.E. Jones s.n.*, 22 Apr 1884, NMC,NY,POM).

Stylocline micropoides Gray (ASTERACEAE). **El Paso Co.**: NW El Paso 0.3 mi N jct. Belvidere and Westwind (31°51′15″N-106°32′28″W), 4200 ft elev., crest of a low andesite rock hill, 29 Apr 1983, *Worthington 10130* (TEX,UTEP). This species has long been suspected to be a part of the Texas flora as the type locality, "hills near Frontera, New Mexico," might be on the Texas side of the Rio Grande. A smelting operation established in that area in 1887 has all but eliminated winter annuals from the Cerro de Cristo Rey of New Mexico and Chihuahua and the Campus Andesite hills in El Paso, Texas, making it impossible to duplicate the collection. The discovery of a small population on an isolated outcrop of

Andesite Rock in NW El Paso confirms that this species is part of the Texas flora.

I wish to express my thanks to James D. Morefield, Guy Nesom and Andrew C. Sanders for helpful comments and determinations. — *Richard D. Worthington, Department of Biological Sciences, The University of Texas at El Paso, El Paso, TX 79968, U.S.A.*.

Reviewers for Volume 13

The following individuals have kindly supported *Sida* through their time and efforts in reviewing manuscripts published in volume 13, 1989 – 1990. Without your interest and support *Sida* would not be the journal that you all have come to expect.

I hope each and every one of you that *Sida* has come in contact with have enjoyed it over the years. I trust that *Sida* will continue to improve and with continued support it can remain a top quality journal of systematic botany. *Sida's* subscription base continues to expand each year with subscriptions approaching 700 in almost 70 countries. Thanks to all of the authors, reviewers, subscribers, and readers for your continued interest.

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BOOK REVIEWS

VERGUNOV, A. P. AND V. A. GOROKHOV. 1988. Russian Gardens and Parks. 418 pp. Moscow: Nauka. Text in Russian.

The volume begins with an Introduction and is subsequently divided into two sections: 1) Developmental Stages of Garden and Park Art and 2) Creation of Garden and Park Compositions. There are 5 chapters in each of the sections. There are 83 colored photographs and numerous other black and white photographs as well as architectural illustrations. "This book deals with the specialised and little studied art of creating gardens and parks - artistic groups. On the basis of extensive factual material and the results of previous studies, the originality of this art's historical development in Russia from the times of Rus, before Czar Peter the Great's reign, to the turn of the 20th century has been shown for the first time. ...This book is intended for specialists: art experts, architects, artists, dendrologists, park and museum personnel and everybody who is interested in landscape architecture."

HIGNIGHT, K.W., J.K. WIPFF, AND S.L. HATCH. 1988. Grasses (Poaceae) of the Texas Cross Timbers and Prairies. 174 pp. MP-1657. Texas Agricultural Experiment Station, The Texas A&M University System, College Station, TX.

This publication contains several descriptive sections prior to the diagrammatic illustrations of the taxa: Introduction, The Grass Plant, Vegetative Parts, Inflorescence Types, and Spikelet Parts. There are 6 Figures of diagrammatic illustrations of the grass plant, inflorescence types, spikelet parts, and spikelets representing major genera and tribes. A checklist of the taxa precedes the Key to the Genera and the Key to Species. The "text" consists of diagrammatic illustrations of the species in alphabetical order (pp. 31 – 166) followed by a glossary, references, and index.

GOODRICH, S. and E. NEESE. 1986. Uinta Basin Flora. 320 pp. + xvii. USDA Forest Service-Intermountain Region, Ogden, Utah. Paperback.

The flora contains about 1,600 specific and subspecific taxa of vascular plants. Uinta Basin is bounded on the north by the crest of the Uinta Mountains, on the west by the divide of the Strawberry drainage, and on the south by the breaks of the West and East Tavaputs Plateaus (parts of Colorado and Utah). Contents include preface, introduction, history of collections, the flora, plant communities, acknowledgements, glossary, key to families, descriptive flora, excluded names, addenda, literature cited, and index.

MOERMAN, DANIEL E. 1986. Medicinal plants of Native America. Research reports in ethnobotany, contribution 2. Vol. 1, 2. 910 pp. The University of Michigan Museum of Anthropology Technical Reports, Number 19. University Museums building, Ann Arbor, Michigan 48109.

A state of the art in ethnomedical data management. The medicinal uses of plants by 122 tribes from 92 references are summarized in two volumes. The first volume catagorizes the tribal usage by plant taxon, genus and species and concludes with the bibliography. Volume 2 provides information of the medicinal uses of plants by Native Americans by the basic medical usage, by plant family and by group or tribe. These volumes will certainly be of use to scholars in anthropology, botany, geography, Native American studies, medicine and the allied health delivery sciences. This is the most important medical reference guide to Native American medical plants ever assembled. *John E. Ubelaker.*

VUILLEUMIER, FRANCOIS and MAXIMINA MONASTERIO (Editors). 1986. High Altitude Tropical Biogeography. Oxford University Press (and American Museum of Natural History), 200 Madison Avenue, New York, NY 10016. Cloth $75.00. 649 pp.

This volume is recommended for all those interested in endemic, rare and endangered species, either plant or animal. WFM.

(Continued from front cover)

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A NEW SPECIES OF *ACOURTIA* (ASTERACEAE-MUTISIEAE) FROM SOUTHERN MÉXICO

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ABSTRACT

Acourtia ovatifolia, a new species from Guerrero and Oaxaca, México, is described and illustrated. This species is similar in some characters to *A. lozanii*.

RESUMEN

Se describe e ilustra una nueva especie, **Acourtia ovatifolia**, colectada en Guerrero y Oaxaca, México. Esta especie es similar a *A. lozanii* en algunos caracteres.

ACOURTIA OVATIFOLIA L. Cabrera, sp. nov. (Fig. 1)

Acourtia lozanii (Greenm.) Reveal & King similis indumento glanduloso, foliis ovatis, et phyllariis apicibus adaxialibus reflexis glandulosis sed differt foliorum ad bases rotundatis, et capitulis flosculis paucioribus.

Perennial plant up to 1 m tall; stems several from the base, green to dark-purple, striate, densely stipitate-glandular and with scattered crispy-articulated hairs, with a tuft of wooly brown hairs in the leaf axils. Leaves, petiolate, with the main blades ovate to ovate-elliptic, $3-8$ cm long, $1.5-4$ cm wide, progressively decreasing in size towards the inflorescence, basally rounded, acute and short-apiculate at the apex, semicoriaceous, with a dense crispy-articulated indument with some of the hairs with small glandular tips, usually shiny and scabrid on the stipitate- to sessile-glandular upper surface, with both crispy-articulated and stipitate-glandular hairs on the veins, prominently veined on both surfaces; the margins entire to denticulate, sometimes slightly sinuate and subrevolute; petioles $1-3.5$ mm long, with a dense indument of crispy-articulated and stipitate-glandular hairs. Inflorescence cymose; floral branch nodes with prominent tufts of brownish hairs; heads in clusters of several at the end of the branches or in loosely compound cymes, sessile to shortly pedunculate; peduncles up to 5 mm long, stipitate glandular, with a few leafy, ovate to elliptic and stipitate-glandular scales grading into the phyllaries; involucre cylindric to cylindric-campanulate, $1.5-2$ cm tall; phyllaries in $4-5$ series, dorsally stipitate-glandular, with the outer ovate, acute at the

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reflexed, leafy-green tip, with the exposed adaxial surface stipitate-glandular, marginally ciliolate and the innermost oblong-lanceolate, gradually apiculate, adaxially glabrous; receptacle scrobiculate, glabrous. Flowers 9 per head; corollas pale pink, bilabiate, 11 − 12 mm long, including the 4 − 5 mm long outer tridentate lobe, with the inner two lobes slightly shorter; anthers 7 − 7.5 mm long with sterile pink tips; style and branches orange, 11 − 11.5 mm long, including the 0.8 − 0.9 mm long, papillose, truncate branches. Achenes linear-fusiform, 4 − 4.5 mm long, stipitate-glandular and hispidulous; pappus 9 − 10 mm long with white bristles in 3 series.

TYPE: MÉXICO. GUERRERO: limestone hill 9 mi by road N of Iguala, in shrubby oak-woods, 1450 − 1790 m, 7 Feb 1970, *W. R. Anderson & C. Anderson* 5656 (HOLOTYPE: MICH!).

Additional collections examined: MÉXICO. OAXACA: Road Nacaltepec-Jayacatitlan, 7.8 km SW of Hwy 135, on steep slope in tropical forest with *Ipomoea*, *Brahea*, *Lantana hirta*, 1600 m, 20 Oct 1989, *Cabrera 779, 780* (TEX).

As a part of a monographic revision of *Acourtia* (in prep.), a study of herbarium specimens revealed this previously undescribed species, collected in 1970 in the state of Guerrero by W. R. Anderson and C. Anderson. Attempts to locate additional material from the same locality were unsuccessful. Nevertheless, in a trip during October of 1989 to the state of Oaxaca, the same species was found coexisting with another *Acourtia* species, the scapiform *A. scapiformis* (Bacigalupi) B. Turner.

Only two individuals of *Acourtia ovatifolia* were found in the Oaxaca locality, growing in shady and steep places. Both plants had only a few buds, thus the flowering period may start during the winter, as is commonly the case for many other species within the genus. The type specimen was collected during the month of February and was in full bloom.

Acourtia ovatifolia is similar to *A. lozanii* in its phyllaries with reflexed and glandular tips, an unusual character within the genus. Both species have a glandular indumentum and ovate leaves, but in *A. ovatifolia* the leaves are rounded at the base, and in *A. lozanii* the bases are cordate to auriculate. Also, compared to *A. ovatifolia*, *A. lozanii* has a campanulate to hemispherical involucre and a greater number of florets per head (25 − 39). The rounded bases of the leaves, as well as the prominent tufts of hairs on the nodes of the floral branches, easily distinguish *A. ovatifolia* from all other *Acourtia*.

In *Acourtia ovatifolia* both types of glandular hairs, stipitate and sessile, are of a resinous nature. This characteristic seems to be widespread within the genus.

Bacigalupi (1931) recognized 44 species of *Acourtia*. With the species

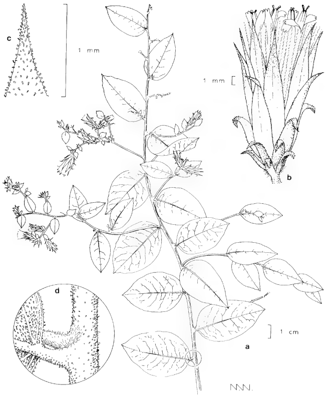

FIG. 1. *Acourtia ovatifolia*. a) habit; b) capitulum; c) adaxial view of the involucral bract apex; d) detail of the leaf-stem junction illustrating the indument. Illustration based on the specimen *W. R. Anderson & C. Anderson* 5656 (MICH).

described here, and others recently or in the process of being described, the number of species within this genus is ca. 60.

ACKNOWLEDGEMENTS

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BACIGALUPI, R. 1931. A monograph of the genus *Perezia*, section *Acourtia* with a provisional key to the section *Euperezia*. Contr. Gray Herb. 97:1 – 81.

TURNER, B. L. 1978. Taxonomic study of the scapiform species of *Acourtia* (Asteraceae-Mutisieae). Phytologia 38:456 – 468.

TAXONOMY OF *DIGITARIA* SECTION *AEQUIGLUMAE* (POACEAE: PANICEAE)

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ABSTRACT

Twelve species are recognized in a taxonomic revision of *Digitaria* section *Aequiglumae*. The DELTA computer system was used in the collection, analysis, and presentation of taxonomic data. A comprehensive set of data was gathered from herbarium specimens and analyzed in order to produce a description of the section, key to the species, and comparative species descriptions. Given with each species is a complete set of specimen citations and discussion of diagnostic characters and taxonomic relationships. Recognized species include *D. aequiglumis*, *D. connivens*, *D. costaricensis*, *D. cuyabensis*, *D. ekmanii*, *D. eriostachya*, *D. lanuginosa*, *D. leucites*, *D. pauciflora*, *D. sabulicola*, *D. simpsonii*, and *D. texana*.

INTRODUCTION

Digitaria Haller consists of approximately 240 species, occurs in temperate and tropical regions of the world, and is commonly recognized as one of the most taxonomically difficult genera of the Paniceae R. Br. This difficulty is a result of the relatively large number of taxa, wide geographical distribution, wide range and complexity of the significant taxonomic characters, and a general lack of knowledge concerning the morphological relationship among the taxa. *Digitaria* is usually easy to separate from other genera of the Paniceae; however, rarely specimens may be encountered which can be confused with *Panicum* L. To distinguish these genera one has to ultimately determine whether the margins of the upper lemma are inrolled or flat, and this can sometimes be a difficult or subjective decision. Diagnostic characters of *Digitaria* include the following: ligule a membrane or ciliate membrane, primary inflorescence branch with secund spikelets, branches of inflorescence terminating in a spikelet,

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spikelets abaxial, and lemma of upper floret with flat, thin-textured margins (Webster 1988, Webster and Valdes 1988). Possible close relatives include *Panicum*, *Anthaenantia* P. Beauv.,and *Homolepis* Chase; however, detailed quantitative studies of the character distribution for all genera of the Paniceae are required before definitive statements are possible concerning generic relationships. Until that time, all statements concerning proposed relationships among these genera provide only a limited service to the biological community.

Henrard's (1950) monograph of *Digitaria*, though 40 years out-of-date, continues to serve as the starting reference for all serious studies in the genus. That study recognized approximately 325 species and grouped these into the following four subgenera; *Eu-Digitaria* Stapf, *Leptoloma* Chase, *Setariopsis* Stapf, and *Solitaria* Hack. Approximately 306 of the species were placed in the 32 recognized sections of subgenus *Digitaria* (= *Eu-Digitaria* Stapf). The section *Aequiglumae* Henrard (described on page 641 of his monograph) was defined primarily on the basis of the second glume being equal in length to the lower lemma and upper floret. Other significant characteristics include paired spikelets and the typical absence of the first glume. Agrasar (1974) and Webster (1983) provide more detailed and comparative descriptive data for this section. Henrard's monograph recognized the following taxa, all native to the New World, as comprising the *Aequiglumae*: *D. aequiglumis* (Hack. & Arech.) L. Parodi, *D. albicoma* Swallen, *D. campestris* Henrard, *D. connivens* (Trin.) Henrard, *D. cuyabensis* (Trin.) L. Parodi, *D. distans* (Chase) Fern., *D. ekmanii* Hitchc., *D. eriostachya* Mez, *D. laetevirens* Mez, *D. lanuginosa* (Nees) Henrard, *D. leucites* (Trin.) Henrard, *D. malacophylla* (Hitchc.) Henrard, *D. pauciflora* Hitchc., *D. runyonii* Hitchc., *D. sabulicola* Henrard, *D. simpsoni* (Vasey) Fern., *D. subcalva* Hitchc., and *D. texana* Hitchc. Since that time, one new species, *D. costaricensis* Pohl, has been named to this section.

The formal taxonomic history of the species in this section began in the early 1800's with the work of Trinius, Nees, and Arechavaleta. These authors named five species and placed them in *Panicum* or *Paspalum*. The first North American taxon was recognized by Vasey in 1892, who described it under *Panicum*. In the early 1900's Chase named three taxa and placed them in *Syntherisma* Walter. During this period, Mez named two new species and was the first taxonomist to place a member of the section in *Digitaria*. This generic concept was followed by Parodi who described one new species and made two new combinations in the section. Between 1913 and 1934, Hitchcock contributed nine new combinations or new species in the section. The first three of these, those prior to 1926, were described in

Syntherisma and the subsequent ones in *Digitaria*. From 1930 to 1950 Henrard provided ten names and formally recognized the section.

As with most other sections of *Digitaria* there has been little significant research to clarify taxonomic relationships among taxa of the *Aequiglumae*. A cursory analysis of some taxa related to *D. leucites* is given in Boonbundarl (1985), but undoubtedly the most meaningful recent revision is Agrasar's (1974) treatment of the Argentine *Digitarias*. It is not surprising that frequently the best sources of new taxonomic data are regional floristic treatments, however, these have the obvious shortcoming of being limited in aspects of geography and data collected. Floristic treatments of grasses of direct significance to the present study include: Hitchcock's (1927, 1936, & 1951) treatments for Ecuador, Peru, Bolivia, the West Indies, and the United States; Smith, Wasshausen, and Klein's (1982) treatment for Santa Catarina; Rosengurtt's (1970) treatment for grasses of Uruguay; and McVaugh's (1983) treatment for Nueva Galicia.

The objective of this research was to clarify the taxonomic relationships among taxa of the *Aequiglumae*. To accomplish this goal, available herbarium specimens were studied and used to collect a comprehensive set of morphological and geographical data. The specific characters recorded for the recognized taxa are listed on microfiche in Webster et al. (1989). In addition to these characters, an anatomical examination of the leaf blade epidermis for all recognized taxa was made. Data for the following characters were recorded: (1) average number of rows of stomates in the intercostal zones, (2) average stomate length, (3) average stomate width, (4) average number of rows of long cells in the intercostal zones, (5) average long cell width, (6) average long cell length, (7) average width of the intercostal zones, (8) relative abundance of prickles, and (9) the shape of the apex of the distal cell of the bicellar microhairs. Selection of these characters which we feel to be important was based on previous anatomical studies of species of *Digitaria* by Webster (1983). Results from these anatomical studies on taxa of the *Aequiglumae* indicated that the average values for certain characters could be used to separate some taxa. However, the range of variation within each taxon was great enough to prevent these characters from being useful or reliable for identification. Therefore, the anatomical data is not presented here. An interesting unifying anatomical feature of the members of this section is the presence of a bulbous swelling at the apex of the microhair distal cell. All members possessed this unique character, although it was not well-developed in *D. pauciflora*. Presence of this feature in all members of this section and its absence from other species of the genus support a monophyletic interpretation for this section.

The morphological and geographical data were stored in DELTA format (Dallwitz 1974 & 1980) and used in the production of a key and descriptions. Data for 285 characters (see the microfiche in Webster et al. 1989) were recorded for each of the recognized taxa. INTKEY (the information retrieval program in Dallwitz's DELTA system) was used to combine the taxonomically significant characters for the section into one description. In the following description of the *Aequiglumae*, each character state is accompanied by a number or fraction indicating the distribution of data for the species. For example, "Plants annual (1) or perennial (11)", indicates that one of the twelve recognized species is annual and eleven are perennial. The fraction 1/9 indictaes that the character was coded for 9 taxa and 1 possessed the character state. This is followed by a key produced via CONFOR and KEY, which represents an efficient use of characters and placement of taxa for the practical identification of the species. Our concepts of the reliability of the characters are incorporated in the key. Descriptions of the recognized species includes a subset of characters of diagnostic value for the section. General methods used with this technology are adequately described elsewhere, but we consider it important to make the following general statement. Application of DELTA computer technology serves as an efficient means of collecting, analyzing, presenting, and storing taxonomic data. It also allows for quick experimentation with the production of descriptions, keys, and database interrogation for various taxonomic purposes. However, those parameters that ultimately determine the value or usefulness of taxonomic research (i.e., development of character concepts and taxon concepts and the detailed, precise, and comparative collection of data) are and must be the responsibility of the taxonomist and not the methods applied — whether computerized or not.

TAXONOMIC TREATMENT

DIGITARIA section AEQUIGLUMAE Henrard, Monograph of the genus *Digitaria* 641. 1950. — TYPE SPECIES: *D. aequiglumis* (Hackel & Arechav.) L. Parodi.

Description: Plants annual (1) or perennial (11). Main axis present or absent (2). Primary branches with appressed secondary branches; not winged; with neatly arranged spikelets. Pedicels truncate (8) or cupuliform at the apex (5). Cleistogamous inflorescence present (2) or absent (10). Cleistogamous spikelets similar to the chasmogamous spikelets (2/2). Spikelets paired; densely (3) or slightly overlapping (11); evenly distributed on the rachis or becoming more concentrated at the rachis apex (1). First glume present (2) or absent (11). Rachilla not pronounced below the second glume. Second glume present; 0.9 – 1.0 times spikelet length. Lower floret lacking stamens. Lemma of lower floret with equal internerve spacing (7) or with the first internerve space wider than the second (8); the nerves pronounced but not swollen; lacking distinct transverse nerves; glabrous (7) or hairy (9). Lower lemma hairs not forming a distinct horizontal line (9/9); overtopping (1/9) or subequal to the upper floret (8/9); smooth and terete (1/9) or flattened and coiled (8/9); without apical modifications (9/9). Palea of lower floret vestigial (3) or absent (10). Upper floret 0.7 – 1.05 times the length of the lower floret. Lemma of upper floret smooth; grey (8), or yellow (7), or purple (3).

Remarks: This study recognized twelve taxa in *Digitaria* section *Aequiglumae*. All are native to the New World with one species, *D. aequiglumis*, introduced into the Old World. Significant diagnostic characteristics of this section include the following; most are perennial, the primary branches are not winged, the first glume is typically absent, length of the second glume equals spikelet length, the lower floret lacks a well-developed palea, and when hairs are present on the spikelet parts they are simple, smooth, and unmodified. Additional interesting characters of the section include the presence of cleistogamous inflorescences in two species and the presence of both cupiliform and truncate pedicel apices. Typically, members of a section within *Digitaria* will be consistent for the latter character.

Recognized taxa: *D. aequiglumis* (Hackel & Arechav.) L. Parodi, *D. connivens* (Trin.) Henr., *D. costaricensis* Pohl, *D. cuyabensis* (Trin.) L. Parodi, *D. ekmanii* Hitchc., *D. eriostachya* Mez, *D. lanuginosa* (Nees) Henr., *D. leucites* (Trin.) Henr., *Digitaria pauciflora* Hitchc., *D. sabulicola* Henr., *D. simpsonii* (Vasey) Fern., *D. texana* Hitchc.

Key to the Species of *Digitaria* Section *Aequiglumae*

1(0). Cleistogamous inflorescence present in the axil of the uppermos leaf 2
Cleistogamous inflorescence absent 3
2(1). Upper floret 0.7 – 0.87 times the length of the lower floret; plants annual; plants lacking rhizomes . . . . *D. aequiglumis*
Upper floret 0.88 – 1.0 times the length of the lower floret; plants perennial; plants rhizomatous . . . . *D. lanuginosa*
3(1). Spikelets less than 3.3 mm long 4
Spikelets 3.3 – 5.0 mm long 12
4(3). Spikelets 0.4 – 0.5 mm wide . . . . *D. sabulicola*
Spikelets more than 0.5 mm wide 5
5(4). Spikelets 0.51 – 0.89 mm wide 6
Spikelets greater than 0.89 mm wide. 11
6(5). Second glume 7 – nerved; first glume frequently present. 7
Second glume 5 – nerved; first glume absent 8
7(6). Leaf blades filiform; leaf blades about 2 mm wide and purple in color; culms wiry . . . . *D. pauciflora*

Leaf blades linear; leaf blades typically $3-4$ mm wide and green in color; culms not wiry . . . . *D. simpsonii*
8(6). Primary inflorescence branches $0.2-0.3$ mm wide 9
Primary inflorescence branches greater than 0.3 mm wide 10
9(8). Leaf blades glabrous; leaf blades with the midrib not obviously differentiated; South America . . . . *D. eriostachya*
Leaf blades hairy; leaf blades with the midrib obviously differentiated; Carribean . . . . *D. ekmanii*
10(8). Leaf blades with the midrib obviously differentiated; spikelets usually densely hairy, with the hairs turning purple early; peduncle usually more than 10 cm long; mainly Texas . . . . *D. texana*
Leaf blades with the midrib not obviously differentiated; spikelets sparsely hairy, the hairs white and occasionally turning purple; peduncle usually less than 10 cm long; mainly South America . . . . *D. cuyabensis*
11(5). Lemma of lower floret glabrous; second glume 7-nerved; spikelets lanceolate; Florida . . . . *D. simpsonii*
Lemma of lower floret hairy; second glume 5-nerved; spikelets elliptic; Mexico . . . . *D. leucites*
12(3). Mid-culm leaf blades not reflexed; spikelets hairy; leaves hairy; Mesoamerica . . . . *D. costaricensis*
Mid-culm leaf blades reflexed; spikelets glabrous; leaves glabrous; South America . . . . *D. connivens*

DIGITARIA AEQUIGLUMIS (Hack. & Arech.) L. Parodi, Revista Fac. Agron. Veterin., Buenos Aires 4:47. 1922. *Syntherisma aequiglumis* (Hack. & Arech.) Hitchc., Contr. U.S. Natl. Herb. 7:211. 1913. *Panicum debile* Desf. var. *aequiglume* (Hack. & Arech.) Hack., in Stuckert, Anales Mus. Nac. Hist. Nat. Buenos Aires 11:69. 1904. *Panicum aequiglume* Hack. & Arech., Gram. Urug. 93. 1894. — TYPE: URUGUAY, Montevideo, 3 – 1885, *Arechavaleta 220* (HOLOTYPE: W; ISOTYPE: US!).

Panicum ramosum Arech., Anales Mus. Nac. Montevideo 1:111. 1894. *Digitaria campestris* Henr., Blumea 1:97. 1934. — TYPE: URUGUAY, *Arechavaleta* (HOLOTYPE: W).

Panicum tridactylum Phil., Anales Univ. Chile 93:712. 1896. — TYPE: CHILE, Curico, (HOLOTYPE: W, # 40680).

Digitaria chillanensis Phil. ex Henr. Monogr. *Digitaria* 29. 1950. — TYPE: CHILE, (HOLOTYPE: W).

Digitaria laetevirens Mez, Bot. Jahrb. Syst. 56:8. 1921. *Digitaria aequiglumis* var. *laetevirens* (Mez) Henr., Monogr. *Digitaria* 370. 1950. — TYPE: Evidently destroyed.

Description: Plants annual; stoloniferous; lacking rhizomes (rarely with poorly developed compacted rhizomes). Nodes glabrous (rarely sparsely pilose). Auricles $1-2$ mm long. Sheaths glabrous or hairy. Ligule $1.2-2.2$ mm 14 long. Leaf blades flexuous; spreading; mostly $2-12$ cm long; $2-6$ mm wide; usually glabrous on the lower surface; glabrous or hairy on the upper surface; with the midrib not obviously differentiated. Main axis 5 − 30 mm long; with quaquaversal primary branches. Primary branches appressed to to spreading from the main axis; whorled only at the lower nodes; (2 −)3 − 6(-8) on the main axis; 0.3 − 0.5 mm wide. Pedicels 2 − 3.5 mm long. Cleistogamous inflorescence present. Spikelets 26 − 42 on a typical primary branch; lanceolate; (3 −)3.2 − 4.2 mm long; 0.6 − 0.8 mm wide. First glume absent. Second glume 1 times spikelet length; 5 or 7-nerved; glabrous or hairy; acuminate. Lemma of lower floret 7-nerved; acuminate; glabrous or hairy. Lower lemma hairs shorter than the upper floret; white. Upper floret 0.7 − 0.87 times the length of the lower floret. Lemma of upper floret grey (yellow when immature); acuminate.

Distribution: Brazil, Paraguay, Uruguay, Chile, and Argentina.

Remarks: *Digitaria aequiglumis* is the only representative of this section known to occur in the Old World, in that it has been introduced in Europe and naturalized in a few localities in southern Australia. This species, as treated here, is relatively easily to recognize; however, previous authors have placed some specimens under *D. lanuginosa* and *D. cuyabensis*. Usually it can be recognized at a glance by the presence of a relatively high degree of branching, dark-colored nodes, and yellow-green leaves. Taxonomically significant spikelet characters include the relatively long acuminate second glume and lower lemma which overtop the upper floret by 0.5 − 1.0 mm. Presence of the cleistogamous inflorescence in the upper leaf sheath was positively correlated with the other primary characters used to define this species. As far as we are aware, this is the only species of this genus where this feature serves as a significant character for differentiating a species. This species lacks rhizomes and well-developed stolons and was therefore described as an annual, but it is believed that plants survive for more than one year.

Henrard (1950) differentiated *D. campestris* from *D. aequiglumis* based primarily on variation in pubescence of the nodes and leaves. Our studies of specimens in this section have shown that such variation cannot be correlated with important diagnostic characters and since there were no other differentiating characters we are treating *D. campestris* as a synonym. *Digitaria laetevirens* Mez appears to be identical to *D. aequiglumis* except for the complete absence of hairs on the second glume and lower lemma. This pattern of pubescence, where there exists essentially identical glabrous and hairy forms, is not uncommon in *Digitaria*. Henrard frequently gave formal taxonomic rank, usually varietal, to this variation, however, recent revisions by Veldkamp (1973), Webster (1983), and Webster (1987) tended to minimize the taxonomic importance of this character variation.

Representative specimens: **ARGENTINA**. (locality uncertain) *T. Stuckert 13862* (US #557989). Buenos Aires: Dock Sur, 8 Apr 1909, *S.I. No. 12524* (US). Cordoba: *Herbarium Hackel* (US #297953); Bezirk Rio Primero, Villamonte, Jan 1904, *Stuckert 545* (MO, US); Corrientes: Santa Fé, Villa Ocampo, 20 Jan 1895, *C. Quarín 1895* (US). Entre Rios: Paraña: Chaná Miní, *L. Parodi 4926* (US); Punilla: Orilla NE del Lago San Roque, 29 Feb 1976, *Hunziker 22925* (NY). Tucumán: Capital, Rio Sali, 16 Dec 1923, *S. Venturi 2167* (US); Cerro de Campo, 15 Mar 1930, *S. Venturi 10212* (US). **BRAZIL**. Brasilia: RGS, Cristal, Porto Alggre, 31 Mar 1949, *B. Rambo J. 40741* (US). Curitiba, Parque Rio Iguacu, 27 Dec 1979, *R. Kummrow 1297* (MO, NY). Rio Grande do Sul: Dom Pedrito, 15 Apr 1946, *Swallen 9102* (US); Santa Victoria do Palmar, 27 Apr 1946, *Swallen 9207* (US). Santa Catarina: Itajaí, 7 Dec 1972, *R. M. Klein 10.458* (US). **CHILE**. Palguin, Nov 1928, *C. Joseph 4846* (US); Santos de Chillan, (US #1126084). **URUGUAY**. Campos del Uruguay (locality unknown) *J. Arechavaleta s.n.* (US #927949, #927950, #927951, #927952). *Hackel 30* (US #927958). Cerro Largo: Dec 1935, *B. Rosengurtt 1049* (US). Durazno: Estancia Las Palmas, 1926, *Osten 18743* (US); San Gregorio, La Paloma, *Osten 19536* (US). Canelones: Arroyo Sarandi sobre el río de la Plata, Costa Azul, 26 Feb 1956, *B.Rosengurtt B-6524½* (F). Flores: rio fi y Arroyo Marindro, 10 Apr 1937, *B. Rosengurtt B-1508b* (US). Florida: Campo experimenta de Pastos, Estancia Rincon de Santa Elena, 23 Feb 1948, *B. Rosengurtt 5960* (F, US); Mausavillagra, 31 Dec 1936, *B. Rosengurtt B- 850* (US). Montevideo: 1 Apr 1888, *Arechavaleta* (US #927960). Rocha: Laguna Negra, 20 Mar 1938, *B. Rosengurtt B-2615½* (US). Soriano: Monzón-Heber, Juan Jackson, 1 May 1940, *B. Rosengurtt PE-4385* (F, US, NY).

DIGITARIA CONNIVENS (Trin.) Henr., Meded. Rijks-Herb. 61:6. 1930. *Panicum connivens* Trin., Mém. Acad. Imp. Sci. St. Petersbourg 6(3):206. 1834. — TYPE: BRAZIL (HOLOTYPE: LE; ISOTYPE: P, W).

Description: Plants perennial; stoloniferous; lacking rhizomes. Nodes glabrous. Sheath auricles 0.5 – 1.5 mm long. Sheaths glabrous. Ligule 1.5 – 3 mm long. Leaf blades straight to flexuous; reflexed; 2 – 5 cm long; 1 – 6 mm wide; glabrous on the lower surface; glabrous on the upper surface; with the midrib not obviously differentiated. Main axis 3 – 15 mm long; with quaquaversal primary branches. Primary branches appressed to the main axis; not whorled; 2 – 4 on the main axis; 0.4 – 0.5 mm wide. Pedicels 2 – 6 mm long. Cleistogamous inflorescence absent. Spikelets 16 – 34 on a typical primary branch; lanceolate (approaching elliptic); 3.3 – 5 mm long; 0.9 – 1.2 mm wide. First glume mostly absent (occasionally present as a vestigial scale ca. 0.2 mm long). Second glume 1 times spikelet length; 7(-9)-nerved; glabrous; acuminate. Lemma of lower floret 7-nerved; acuminate; glabrous. Upper floret 0.94 – 1 times the length of the lower floret. Lemma of upper floret grey or yellow; acuminate.

Distribution: Southeast Brazil.

Remarks: *Digitaria connivens* occurs in southern coastal regions of Brazil, where it is commonly associated with coastal sand dunes. Important diagnostic characteristics possessed by this easily recognizable species include the relatively short, reflexed, and obviously distichous leaf blades; an inflorescence consisting of only a few primary branches appressed to the central axis; relatively large and completely glabrous spikelets; and a caryopsis which completely fills the interior of the upper floret.

Representative specimens: **BRAZIL**. (location and collection date uncertain), *Schott 4844* (US). Paraña: Caiobá, Praia do Mendanha, June-1 – 1961, *R. Braga 1627* (US). Rio de Janeiro: Rio de Janeiro, collection date unknown, *Luschnath s.n.* (US). Rio Grande do Sul: Sacco du Mangeira, 1902, *G. O. Mealme 1561* (US); Brasilia, Torres, 11 Feb 1954, *B. Rambo S. J. 54777* (US); Rio Grande, 3 May 1946, *J. R. Swallen 9241* (US); Camaqua, Fazenda Aguada, Lagoa dos Patos, 12 May 1946, *J. R. Swallen 9287* (US). Santa Catarina: Jurerê, 15 Feb 1966 *Klein, Souza S. & Bresolin 6.657* (US); *Voyage A. St. Hilaire 1711*, 1816 – 1821, (US). São Paulo: Mun. Cananeia, Ilha Comprida, 16 Feb 1965, *W. D. Clayton & G. Eiten 4688* (US); Mun. Cananeia, Ilha Comprida, 16 Feb 1965, *W. D. Clayton & G. Eiten 4710* (US); Mun. Iguape, East point of Iguape Island, 19 Feb 1965, *W. D. Clayton & G. Eiten 4761* (US); Santos, Guaruja, 23 Feb 1938, *F. C. Hoehne 39261* (US).

DIGITARIA COSTARICENSIS Pohl, Fieldiana, Bot. 38:5. 1976. — TYPE: COSTA RICA, Prov. Cartago, 10 – 8 – 1986, *Pohl & Davidse 11215* (HOLOTYPE: ISC!).

Description: Plants perennial; stoloniferous; with poorly developed rhizomes. Nodes hairy. Sheath auricles about 1.5 mm long. Sheaths hairy. Ligule 1 – 2 mm long. Leaf blades flexuous; spreading; 4 – 15 cm long; 3 – 7 mm wide; hairy on the lower surface; hairy on the upper surface; with the midrib not obviously differentiated. Main axis 10 – 20 mm long; with quaquaversal primary branches. Primary branches appressed to the main axis; not whorled; 3 – 6 on the main axis; 0.3 – 0.4 mm wide. Pedicels 2 – 4 mm long. Spikelets 18 – 50 on a typical primary branch; lanceolate; 3.3 – 4.1 mm long; 0.85 – 1 mm wide. First glume absent (or present as a hyaline scale to 0.3 mm long). Second glume 1 times spikelet length; 7-nerved; hairy; acuminate to acute. Lemma of lower floret 7-nerved; acuminate to acute; hairy. Lower lemma hairs shorter than the upper floret; white. Upper floret 0.95 – 1 times the length of the lower floret. Lemma of upper floret yellow; acuminate to acute.

Distribution: Costa Rica.

Remarks: Pohl (1980) correctly placed this species in the *Aequiglumae* on the basis of the relative sizes of the spikelet parts. In addition, he indicated that it seemed to be most similar to *D. aequiglumae* but differed on the leaf pubescence, leaf width, presence of a first glume, and the number of nerves on the second glume and lower lemma. Even though there are only three known collections, it is obvious that they represent a distinct taxon. The pattern and type of leaf pubescence is similar to the hairy form of *D. cuyabensis*. The spikelets are relatively large with pronounced nerves and scattered fine hairs on the second glume and lower lemma.

Representative specimens: **COSTA RICA**. Providence Cartago: Rio Macho Reservoir, S of Orosi, 3 Oct 1968, *Pohl & Davidse 11190* (ISC); 25 km SW of Tejar along the Carretera Interamericana, 8 Oct 1968, *Pohl & Davidse 11215* (ISC); 2 km W of Paraiso, 21 Apr 1969, *Pohl & Davidse 17789* (ISC).

DIGITARIA CUYABENSIS (Trin.) L. Parodi, Physis 8:378. 1926. — *Digitaria lanuginosa* (Nees) Henr. var. *cuyabensis* (Trin.) Henr., Monogr. *Digitaria* 164 – 165. 1950. *Syntherisma cuyabensis* (Trin.) Hitchc., Contr. U.S. Natl. Herb. 22:468. 1922. *Panicum cuyabense* Trin., Mém. Acad. Imp. Sci. St. Petersbourg 3:206. 1834. — TYPE: Trinius Herbarium (HOLOTYPE: LE).

Syntherisma malacophylla Hitchc., Contr. U.S. Natl. Herb. 22:466. 1922. *Digitaria malacophylla* (Hitchc.) Henr., Meded. Rijks-Herb. 61:4. 1930. — TYPE: BRITISH GUIANA, 31 Dec 1919, *Hitchcock 17284* (HOLOTYPE: US!).

Description: Plants perennial; stoloniferous (frequently not pronounced); rhizomatous. Nodes glabrous or hairy (the upper nodes usually glabrous). Sheath auricles 0.8 – 1.5 mm long. Sheaths glabrous or hairy. Ligule 1 – 2 mm long. Leaf blades straight; spreading; 2.5 – 20 cm long; 3 – 6(-8) mm wide; glabrous or hairy on the lower surface; glabrous or hairy on the upper surface; with the midrib not obviously differentiated. Main axis 5 – 40 mm long; with quaquaversal primary branches. Primary branches appressed to the main axis to spreading; usually whorled at the lowermost node; 3 – 8 on the main axis; 0.31 – 0.4 mm wide. Pedicels 1.5 – 2.5 mm long. Spikelets 30 – 60 on a typical primary branch; lanceolate to elliptic; 2.4 – 3 mm long (-3.5); 0.6 – 0.75 mm wide. First glume absent (or present as a minute hyaline scale 0.1 – 0.2 mm long). Second glume 1 times spikelet length; 3 to 5-nerved; hairy (rarely glabrous); acuminate to acute. Lemma of lower floret 7-nerved; acuminate to acute; glabrous or hairy. Lower lemma hairs shorter than the upper floret; white or purple. Upper floret 0.95 – 1.05 times the length of the lower floret. Lemma of upper floret grey; acuminate to acute.

Distribution: South America (Guiana, Surinam or French Guiana, Brazil, Paraguay, Uruguay, and Argentina) and Central America.

Remarks: *Digitaria cuyabensis* occurs in Argentina, Paraguay, Uruguay, Brazil, and extends up the east coast of South America to Central America. It has been frequently confused with *D. aequiglumis*; however, these species, as defined here, are clearly distinct. *Digitaria cuyabensis* is an obvious perennial, spikelets are usually less than 3.1 mm long and less than 0.8 mm wide, and the leaf blades and spikelet bracts are usually hairy. The complete absence of a cleistogamous inflorescence and relative length of the florets are the most important diagnostic characters for distinguishing between these species.

Hitchcock (1922) originally described *D. malacophylla* in the genus *Syn-*

therisma and differentiated it from *D. cuyabensis* on the basis of leaf pubescence and the spreading nature of the primary inflorescence branches. His concept of the species was based only on the type specimen. Henrard (1950) transferred it to *Digitaria* and separated it from *D. lanuginosa*, which included the variety *cuyabensis*, based on a shorter spikelet length and its proposed annual nature. Our studies indicate that typical specimens of *D. cuyabensis* vary in the amount of leaf hairs from glabrous to densely hairy. Generally, specimens from northern part of South America, specifically from the Brazilian state of Pernambuco, are hairy and those from southern parts tend to be glabrous; however, there are numerous obvious exceptions. The primary branches of the inflorescence are spreading at maturity in both forms. In addition, other specimens referable to *D. malacophylla* show its perennial nature and spikelet lengths intergrade between the two forms. Therefore, it was concluded that *D. malacophylla* is best treated as a synonym of *D. cuyabensis*.

Most of the specimens in the *D. aequiglumis* complex fit well within the classification system proposed in this paper; however, a few specimens *Steinbach 6877* (US), *Parodi 8323* (US), and *Parodi 9259* (US) from Argentina; *Gines s.n.* from Venezuela; *Hitchcock 8245* from Panama} were morphologically intermediate. These specimens are perennials and lack a cleistogamous inflorescence; the spikelets are about 2.8 mm long, acuminate, with an overtopping second glume and lower lemma. Therefore, they do not fit well into the concepts of *D. aequiglumis, D. lanuginosa, D. cuyabensis*. It was concluded that these specimens do not represent a new taxon but are the products of hybridization and introgression within this complex. They were annotated as intermediates.

Representative specimens: **ARGENTINA**. Buenos Aires: Puerto Nuevo, 15 Apr 1928, *L. R. Parodi 8524*. Corrientes: Paráda Pucheta, Ruta Nac. No. 127, 17 Feb 1979, *O. Ahumada 2551* (MO). Formosa: (location not given), Jan 1918, *Jórgersen 2434* (US); (location not given), Jan 1928, *L. R. Parodi 8338* (US); (location not given), 23 Jan 1928, *L. R. Parodi 8326* (US). **BRAZIL**. Ceará: Campo Grande, 12 May 1934, *J R. Swallen 4533* (US). Mato Grosso: Mun. de Caceres, Faz. Descalvados, 4 Nov 1978, *A. Allem et al 2386* (MO); between Campo Grande and Dourados, 14 Feb 1930, *Chase 10923* (US); between Campo Grande and Dourados, 14 Feb 1930, *Chase 10923+* (US). Minas Geraes: Serra de San Antonio, Diamantina, 27 Dec 1929, *Chase 10328* (US); Serra de San Antonio, Diamantina, 27 Dec 1929, *Chase 10417* (US). Pernambuco: Recife, 12 Nov 1924, *Chase 7670* (US); Recife, 20 Nov 1924, *Chase 7763* (US); Tapéra, Feb 1929, *B. Pickel 1968* (US); Tapéra, Jan 1930, *B. Pickel 2241* (US); Tapéra, 4 Dec 1932, *B. Pickel 3171* (US); Tapéra, 9 Jan 1935, *B. Pickel 3769* (US); Tapéra, 30 May 1935, *B. Pickel 3794* (US). Rio Grande do Norte: Estremoz to Natal, 1 Jun 1934, *J. R. Swallen 4788* (US). **GUYANA**. North Guiana, Rockstone, 13 Jul 1921, *H. A. Gleason 636* (US); Rockstone, 31 Dec 1919, *Hitchcock 17284* (US); (location unknown), 1838, *Leprieur s.n.* (US). **PARAGUAY**. Central: Asunción, Banco San Miguel, Rio Paráguay, Jan 1949, *Rosengurtt 5442* (US); Bord sablonneux du Rio Paráguay, Feb 1877, *B. Balansa 147* (US); Loma Pará, (Chaco), 15 May 1917, *T. Rojas 2668* (US); Pilcomayo River, May 1906, *T. Rojas 92* (US); Pilcomayo River, 1888 – 1890, *T. Morong 962* (US); Puerto Casado, Jan 1917, *T. Rojas 2723* (US); Puerto Colon, May 1943, *T. Rojas 10525* (US); Regione lacus Ypacaray, Jan 1913, *E. Hassler 12464* (US); Ypacaray, (collection date unknown) *E. Hassler 13018* (US). **PANAMA**. Chirinqui: between El Hato and Cerro Punta, 4 Aug 1960, *E. Ebinger 765* (US); vicinity of El Boquete, 7 Oct 1911, *Hitchcock 8262* (US).

DIGITARIA EKMANII Hitchc., U.S.D.A. Misc. Publ. 243:176. 1936. — TYPE: CUBA, Pinar del Rio, Herradura, 26 Jun 1922, *Ekman* (HOLOTYPE: US!; ISOTYPE: MO!).

Digitaria ekmanii Hitchc. var. *curtissii* Henr., Monogr. *Digitaria* 213. 1950. — TYPE: CUBA, Isla de Pinos, 1 Jun 1904, *Curtiss 521* (HOLOTYPE: HAC; ISOTYPES: F!, NY!, US!)

Description: Plants perennial; lacking stolons; rhizomatous. Nodes glabrous or hairy. Sheath auricles 0.5 – 2.5 mm long. Sheaths glabrous or hairy. Ligule 1.5 – 2.5 mm long. Leaf blades flexuous; spreading; 5 – 22 cm long; 3 – 6 mm wide; hairy on the lower surface; hairy on the upper surface; with the midrib obviously differentiated (on the lower surface). Main axis mostly 15 – 40(-60) mm long; with quaquaversal primary branches. Primary branches appressed or spreading from the main axis; not whorled; 4 – 9 on the main axis; 0.2 – 0.3 mm wide. Pedicels about 2.2 mm long (with relatively long narrow lateral pedicels). Spikelets 40 – 120 on a typical primary branch; oblong or elliptic; 2.2 – 2.5 mm long; 0.6 – 0.7 mm wide. First glume always completely absent. Second glume 1 times spikelet length; 3 to 5-nerved; glabrous or hairy; acute. Lemma of lower floret 7-nerved; acute; glabrous or hairy. Lower lemma hairs shorter than the upper floret; silvery. Upper floret 1 times the length of the lower floret. Lemma of upper floret yellow (soon becoming purple); acuminate to acute.

Distribution: Cuba.

Remarks: *Digitaria ekmanii* is currently known only from Cuba, however, we feel that future collections will likely show that it occurs elsewhere in the Caribbean. Spikelets of this species, specifically on the lower lemma and second glume, may be either glabrous or hairy. As with other species of *Digitaria* especially in this section, little or no taxonomic significance can be applied to this variation since it does not correlate with other characteristics. Specimens with glabrous spikelets (e.g. *E. L. Ekman 1052 & 14086*) are otherwise essentially identical to those with a fine line of white villous hairs in the internerve spaces (e.g. *E. L. Ekman 10938 & 11310*) varies relative to the density of the hairs. Additional important characteristics of this species include the presence of a pronounced raised midnerve on the lower surface of the leaf blades, relatively long and filiform pedicels, and the complete absence of the lower glume. Finally, the spikelets are narrowly ovate to elliptic or nearly oblong.

Representative specimens: **CUBA**. Isla de Pinos, Apr 1904, *A. H. Curtiss s.n.* (NY); Isla de Pinos, Nueva Gerona, 1 Jun 1904, *A. H. Curtis 521* (F, MO, NY, US); Isla de Pinos, Santa Bárbara, 2 Nov 1920, *E. L. Ekman 12021* (F, NY). Pinar del Rio: Herradura, 26 Jun 1922, *E. L. Ekman 1052* (MO, NY, US); Herradura, 21 Jun 1922, *E. L. Ekman 14086* (NY); Arroyo Nantua, Damuje, 27 May 1920, *E. L. Ekman 10938* (F, NY); between Remates and La Fé, 17 Jun 1920, *E. L. Ekman 11310* (F, NY, US). Santa Clara: Sabanas des Manaca, near Asiento Viejo, 25 Jul 1920, *Bro. León 9294* (NY).

DIGITARIA ERIOSTACHYA Mez, Bot. Jahrb. Syst. 56, Beibl. 125(4):80. 1921. — TYPE: PARAGUAY, *Balansa 146* (HOLOTYPE: L).

Digitaria fallens L. Parodi, Revista Soc. Arg. Ciencias Naturales 8:375. 1926. — TYPE: ARGENTINA, *Parodi 7130* (HOLOTYPE: BAA; ISOTYPE: US!).

Description: Plants perennial; stoloniferous; rhizomatous or lacking rhizomes. Nodes glabrous. Sheath auricles 1 − 2 mm long. Sheaths glabrous. Ligule 1 − 3 mm long. Leaf blades flexuous; spreading; 3 − 20 cm long; 3 − 8 mm wide; glabrous on the lower surface; glabrous on the upper surface; with the midrib not obviously differentiated. Main axis 20 − 40 mm long; with quaquaversal primary branches. Primary branches appressed to the main axis to spreading; not whorled; 4 − 7 on the main axis; 0.2 − 0.3 mm wide. Pedicels 2 − 3 mm long. Cleistogamous inflorescence absent. Spikelets 36 − 60 on a typical primary branch; lanceolate or elliptic; (2.2 −)2.4 − 2.9 mm long; 0.6 − 0.8 mm wide. First glume absent (occ. present as a minute scale ca. 0.1 mm long). Second glume 1 times spikelet length; 3 to 5-nerved; hairy; acuminate to acute. Lemma of lower floret 7-nerved; acuminate to acute; hairy. Lower lemma hairs overtopping the upper floret (by 0.2 − 0.5 mm); white. Upper floret 0.92 − 1 times the length of the lower floret. Lemma of upper floret grey or yellow; acuminate.

Distribution: Paraguay and Argentina.

Remarks: Presence of long silver hairs, which turn purple at maturity, makes *D. eriostachya* a distinctive easily recognizable species within this section. This hair type, the absence of hairs between the mid-nerve and first lateral nerve, spikelet shape, relatively long slender pedicels, and the presence of secondary branching are features of *D. eriostachya* that indicate a relationship with section *Trichachne*; however, other characteristics of *D. eriostachya* support its retention in the *Aequiglumae*. Additional important diagnostic features of this species include the pronounced long stolons, glabrous leaves, and spikelet length and shape.

Representative specimens: **ARGENTINA**. Corrientes: Cuay-Grande, 4 Feb 1926, *L. Parodi 7130* (US); Mburucuyá, "Santa Maria", 1 Nov 1950, *T. M. Petersen 835* (US); San Miguel, Loreto, 12 Mar 1972, *C. Quarín 567* (US); Empedrado, Arroyo Gonzalez y Ruta 12, 27 Feb 1974, *C. Quarín et al. 2229* (US); Saladas, Estancia Bovril, 13 Dec 1949, *G. J. Schwarz 9143* (US). Entre Rios: Federacíon Santa Ana, 7 Feb 1963, *A. Burkart 22416* (US). **PARAGUAY**. Caazapá: Barrento, 14 Mar 1950, *E. Anderson 1138* (US); Pindafoy, Yutí, Jan 1949, *Rosengurtt 5461* (US). Central: In regione lacus Ypacaray, 1913, *E. Hassler 11565* (US); Prope Sapucay, (collection date unknown), *E. Hassler 13018* (US); Trinidad, Asunción, Mar 1942, *T. Rojos 9476* (US). Misiones: Santiago, 19 Jan 1952, *Rosengurtt B-6117* (US). Neembucu: Yacaré, Pilar, 22 Jan 1949, *Rosengurtt B-5525* (US). Paraguarí: Km 98+ ruta Asunción - Encarnación, 16 Jan 1949, *Rosengurtt B-5412* (US).

DIGITARIA LANUGINOSA (Nees) Henr., Meded. Rijks-Herb. 61:5: 1930. *Paspalum lanuginosum* Nees, Agrost. Bras. 63. 1829. — TYPE: ORIGINALLY AT BERLIN NOW EVIDENTLY DESTROYED.

Description: Plants perennial; stoloniferous or lacking stolons; rhizomatous. Nodes hairy (usually pilose). Sheath auricles about 1.5 mm long. Sheaths hairy. Ligule $1.5-2.2$ mm long. Leaf blades flexuous; spreading; $3-12$ cm long; $3-6$ mm wide; usually hairy on the lower surface; usually hairy on the upper surface; with the midrib not obviously differentiated. Main axis $10-20$ mm long; with quaquaversal primary branches. Primary branches appressed or spreading from the main axis; whorled at the lower nodes or not whorled; $4-8$ on the main axis; $0.4-0.5$ mm wide. Pedicels $2-4$ mm long. Cleistogamous inflorescence present. Spikelets $20-40$ on a typical primary branch; lanceolate to ovate; $2.6-3.1(-3.5)$ mm long; $0.7-0.8$ mm wide. First glume absent. Second glume 1 times spikelet length; 5 to 7-nerved; hairy; acuminate. Lemma of lower floret 7-nerved; acuminate or acute; usually hairy. Lower lemma hairs shorter than the upper floret; white. Upper floret $0.88-1$ times the length of the lower floret. Lemma of upper floret grey; acuminate to acute.

Distribution: Southern Brazil, Uruguay, and northeastern Argentina.

Remarks: *Digitaria lanuginosa* is closely allied to *D. aequiglumis* and occasionally it may be difficult to distinguish between these taxa. Both have cleistogamous inflorescences at the upper leaf nodes. In addition, these taxa possess similar spikelet shapes and the same relative length of the upper floret and lower lemma. The most significant difference between the taxa is that *D. lanuginosa* has short compacted rhizomes and is considered as a perennial, whereas *D. aequiglumis* is morphologically annual. Correlated with this difference is a smaller spikelet size and the presence of more hairs on the leaf blades and spikelet parts in *D. lanuginosa*. When the basal parts of the plant are missing from a specimen it can be difficult to distinguish between these taxa.

Representative specimens: **ARGENTINA**. Corrientes: General Paz Pueblo Cercanias, 16 Oct 1945, *T. S. Ibarrola 3544* (US); Mburucuyá, "Santa Maria", 28 Noiv 1965, *R. Rugolo 7509* (NY). Entre Rios: Isla del Francés (freute a Rosario), 15 Dec 1937, *A. Burkart 8860* (F). **BRAZIL**. Rio Grande do Sul: (precise location unknown), 1902, *Malme 1570* (US); Bagé, 11 Apr 1946, *J. R. Swallen 9045* (US); Fazenda Experimental de Criacaó Bagé, 2 Dec 1945, *J. R. Swallen 7579* (US); Itaqui, Estrada que vai de Itaqui para Alegrete, 25 Nov 1980, *R. M. Klein & U. Pastore 11 - 971* (US); Pelotas, 4 May 1946, *J. R. Swallen 9267* (US); Santa Victoria do Palmar, 27 Apr 1946, *J. R. Swallen 9232* (US); Uruaguaiana, 9 Dec 1945, *J. R. Swallen 7646* (US). **URUGUAY**. Montevideo: Cauasco, 27 Feb 1937, *Rosengurtt B-1183* (US). Rocha: Laguna Negra, 20 Mar 1938, *Rosengurtt B-2615* (US). Salto: rio Uruguay y San Antonio Grande, 27 Feb 1937, *Rosengurtt B-943*; Tacuarembó, Picada del Cuello, 12 Mar 1945, *Rosengurtt B-4755* (US).

Digitaria leucites (Trin.) Henr., Meded. Rijks-Herb. 61:6. 1930. *Panicum leucites* Trin., Gram. Pan. 85. 1826. — Type: Type specimen not located.

Milium velutinum DC., Cat. Plant. Horti Bot. Monsp. 126. 1813. *Milium filiforme* Lag., Gen. & Sp. Nov. 2. 1816, non *Digitaria filiformis* (L.) Koeler, 1802. *Syntherisma velutina* (DC.) Chase, Proc. Biol. Soc. Wash. 19:191. 1906. *Digitaria velutina* (DC.) Hitchc., Proc. Biol. Soc. Wash. 40:84. 1927, non *Digitaria velutina* (Forsk.) Beauv., 1812. — Type: from cultivated material derived from Mexican seeds (holotype: fragment US!).

Syntherisma velutina glabella Chase, Contr. U.S. Natl. Herb. 17:220. 1913. *Digitaria leucites* (Trin.) Henr. var. *glabella* (Chase) Henr., Monogr. *Digitaria* 395. 1950. — Type: MEXICO, Michoacan, 16 Sep 1910, *Hitchcock 6989* (holotype: US!; isotype: LL!, NY!).

Digitaria distans (Chase) Fern., Rhodora 22:103. 1920. *Syntherisma distans* Chase, Contr. U.S. Natl. Herb. 17:220. 1913. — Type: MEXICO, Jalisco, vicinity of Orozco, 29 Sep 1910, *Hitchcock 7376* (holotype: US!).

Description: Plants perennial; stoloniferous; rhizomatous. Nodes glabrous or hairy. Sheath auricles 0.7 − 1.5 mm long. Sheaths glabrous or hairy (the lower sheaths usually hairy). Ligule 2.3 − 3.5 mm long. Leaf blades flexuous; spreading; 6 − 20 cm long; 2 − 5 mm wide; glabrous or hairy on the lower surface; glabrous or hairy on the upper surface; with the midrib not obviously differentiated. Main axis 15 − 45 mm long; with quaquaversal primary branches. Primary branches spreading; whorled at the lower nodes or not whorled; 4 − 9 on the main axis; 0.3 − 0.4 mm wide. Pedicels 2 − 4 mm long. Spikelets 20 − 60 on a typical primary branch; elliptic; 2.4 − 3.2 mm long; 0.9 − 1.1 mm wide. First glume present or absent (mostly present as a hyaline truncate scale ca. 0.3 mm long). Second glume 1 times spikelet length; 5-nerved; hairy; acute. Lemma of lower floret (5 −) 7-nerved; acute; hairy. Lower lemma hairs subequal to the upper floret; usually purple. Upper floret 0.92 − 1 times the length of the lower floret. Lemma of upper floret grey or yellow; acute.

Distribution: Mexico.

Remarks: *Digitaria leucites* is a distinctive perennial species occurring in south-central mountainous regions of Mexico. The most characteristic feature of this species is the relatively plump spikelets in which the second glume and lower lemma do not tightly enclose the upper floret at maturity. The second glume and lower lemma are hairy with purple villose hairs, but frequently the internerve space between the midnerve and first lateral nerve is glabrous. This pattern of pubescence is common in other sections of this genus. *Digitaria distans* is known from two collections (*Hitchcock 7376 & 7372*), both collected on September 29, 1910 at Orozco, Jalisco, Mexico. Chase (1913) recognized these as a new species and used the distant and glabrous spikelets as key characters. McVaugh (1983) differentiated *D. distans* from *D. leucites* based on the absence of spikelet hairs in *D. distans*. Our study of all the available specimens of these taxa resulted in the following observations. The second glume and lower lemma of *D. distans* is glabrous whereas these structures in *D. leucites* possess a line of mostly purple hairs between the lateral nerves. However, within specimens normally accepted as *D. leucites* there exists a wide range of variation in these characters. For example, *Lyonnet 1879* shows clearly distant nearly glabrous spikelets. It was concluded that *D. distans* is best treated as a synonym.

Representative specimens: **MEXICO**. Chiapas: Mun. de Zinacantán, 5 Oct 1966, *R. M. Laughlin 2325* (ENCB, TAES). Distrito Federal: Contreras, Primer Dinamo, 14 Jan 1969, *F. García S. 128* (ENCB); Pedregal de Tlalpan, 1932, *E. Lyonnet 975* (MEXU); San Angrés, D. F., Aug 1930, *E. Lyonnet 975* (MEXU); Carretera Cuernavaca, 23 Oct 1937, *E. Lyonnet 1879* (ENCB, CHAPA, MEXU); base of Sierra de Ajusco, 29 Oct 1896, *C. G. Pringle 6623* (ENCB, MEXU); Pedregal de San Angel, cerca de Eslava, 19 Oct 1952, *J. Rzedowski 2008* (ENCB, MEXU). Hidalgo: 10 km al Este de Metepec, 7 Aug 1980, *R. Hernández M. & R. Hernández V. 4716* (MEXU). Jalisco: Los Guaybos, (collection date not given), *A. A. Beetle & R. Guzman M. 5440* (CHAPA); Sierra de Tigre, 3 mi S of Mazamitla, 18 Sep 1952, *R. McVaugh 13029* (MEXU). Mexico: Mun. de Villa Allende, San Cayetano, Oct 1963, *J. M. Alcocer s.n.* (ENCB); Chapingo, Terrenos de la E.N.A., Lomas de San Juan, 1 Oct 1965, *R. Bonilla B. s.n* (CHAPA); Terrenos de la E.N.A., Xaltepa, 29 Sep 1966, *R. Bonilla B. s.n.* (CHAPA); Chapingo, Mun. de Tezcoco, Molino de las Flores, 19 Oct 1976, *José Cantú s.n.* (CHAPA); Chapingo, Mun. de Texcoco, 22 Aug 1968, *J. Flores Crespo s. n.* (ENCB); 2 km E of Temamatla, 22 Aug 1972, *J. Elías 203* (ENCB); roadside from San Juan del Río to Mexico City, 6 Nov 1962, *F. W. Gould 10316* (ENCB, TAES); Chapingo, Mun. de Tezcoco, 2.5 km al E de Tezcoco, 14 Oct Oct 1976, *E. García M. s.n.* (CHAPA, TAES, US); Toluca, 13 Sep 1910, *Hitchcock 1560* (LL, NY, TAES); Villa de Allende, 5 Oct 1952, *E. Matuda 26429* (MEXU); Valle de Bravo, 21 Nov 1952, *E. Matuda 27791* (MEXU); Mun. de Ixtapaluca, Cerro del Pino, 30 Oct 1976, *S. Morelos O. 44* (ENCB); Mun. de Ixtapaluca, Ladera Sureste del Cerro del Pino, 3 Oct 1976, *S. Morelos O. 116* (ENCB); Mun. de Huehuetoca, Ladera Suroeste del Cerro del Sincoque, 17 Oct 1976, *A. Ortego R. 209* (ENCB); Mun. de Chalco, 2 km al NE de Miraflores, 22 Nov 1968, *A. Pineda R. s.n.* (CHAPA, ENCB, TAES); Mun. de Ixtapaluca, Cerro del Pino, 3 Oct 1976, *L. Rico R. 51* (ENCB); Mun. de Ixtapaluca, laderas inferiores SE del Cerro del Pino, 3 Oct 1976, *Rzedowski 34423*

(CHAPA, ENCB); Chapingo, Edo. Mexico, (collection date not given), *J. Tovar & E. García s.n.* (CHAPA); alrededores de San Pedro Nexapa, 13 Nov 1963, *Marina Villegas D. 276* (ENCB). Michoacán: Mun. Villa Escalante, 24 Oct 1981, *J. García P. 1555* (CHAPA, ENCB); 20 km S Zamora, 28 Sep 1946, *E. Hernández X-2804* (CHAPA); Uruápan, 16 Sep 1910, *Hitchcock 1561* (NY, LL); Uruápan, *Hitchcock 6989* (US); Patzcuaro, 19 Oct 1898, *E. W. D. Holway 3212* (US); Mun. Tangancícuaro, Las Cañas, 19 Nov 1971, *Rzedowski y McVaugh 612* (ENCB); NE side of the Volcán de Parícutin, 4 Oct 1953, *E. R. Sohns 809* (TAES); NE side of the Volcán de Parícutin, 4 Oct 1953, *E. R. Sohns 822* (TAES). Morelos: 3 mi N of Toll gate, Cuernavaca, 10 Nov 1962, *F. Gould 10388* (TAES, US); 60 km Méx.-Cuernavaca, "Campo Turista," 7 Sep 1952, *F. Gallegos Harkings 499* (MEXU); Trés Marias (Camino de Cuernavaca), Jul 1927, *E. Lyonnet 58* (MEXU); Valle del Tepeite, 17 Sep 1938, *E. Lyonnet 2442* (MEXU). Oaxaca: 42 km de Putla rumbo a Tlaxiaco, 23 Jun 1980, *A. A. Beetle M-4721* (CHAPA); Campamento Río de Molino, 4 km al SW de San Miguel Suchistepec, 21 Sep 1965, *J. Rzedowski 21025* (ENCB); District of Ixtlan, La Cumbre del Cuartel, 2 Nov 1944, *J. V. Santos 3619* (CHAPA, NY). Tlaxcala: Mun. de San Salvador, Tzompantepec, 6 Sep 1982, *H. Vibrans 1187* (ENCB).

Digitaria pauciflora Hitchc., Proc. Biol. Soc. Wash. 41:162. 1928. — Type: U.S.A., Florida, Jenkins to Everglade, 10 Nov 1903, *Eaton 207* (holotype: US!).

Description: Plants perennial; lacking stolons; rhizomatous. Nodes mostly glabrous. Sheath auricles about 1.5 mm long. Sheaths hairy (becoming glabrous with age). Ligule 1.5 − 2.0 mm long. Leaf blades flexuous or twisted; spreading; 7 − 18 cm long; 1.0 − 2.2 mm wide; hairy on the lower and upper surface (becoming glabrous with age); the midrib not obviously differentiated. Main axis 10 − 80 mm long; with quaquaversal primary branches. Primary branches appressed or spreading from the main axis; not whorled; 2 − 8 on the main axis; 0.3 mm wide. Pedicels 2 − 3 mm long. Spikelets 30 − 60 on a typical primary branch; lanceolate; 2.7 − 3.0 mm long; 0.7 − 0.9 mm wide. First glume commonly present. Second glume 1 times spikelet length; mostly 7-nerved; glabrous; acuminate to acute. Lemma of lower floret 7-nerved; acuminate to acute; glabrous. Upper floret 1 times the length of the lower floret. Lemma of upper floret becoming purple; acuminate to acute.

Distribution: Southern Florida.

Remarks: *Digitaria pauciflora* is known from the Everglades region of southern Florida. Inflorescence and spikelet characteristics are similar to those of *D. simpsonii*. However, they differ significantly on vegetative characters.

Representative specimens: U.S.A. Florida: Dade Co.: Everglades National Park, 6th glade, 19 Jun 1978, *G. N. Avery 1928* (F); Everglades National Park, Long Pine Key, W edge of 3rd glade, Block H, 20 Jun 1978, *G. N. Avery 1929* (F); Everglades National Park, Long Pine Key, Block D, 16 Jun 1978, *G. N. Avery 1932* (F); Everglades National Park, S of Long Pine Key Road in 6th glade, 20 Oct 1978, *G. N. Avery 1979* (F); Jenkin's Homestead, 14 – 20 mi S of Cutler, (collection date unknown), *A. A. Eaton s.n.* (F, US); Everglades National Park, Long Pine Key, Glade #6, 28 Apr 1986, *A. Herndon 1519* (F); In pinelands, South Miami, 2 Oct 1939, *W. A. Silveus 5285* (TAES); between Cutler and Longview Camp, 9 Nov 1903, *J. K. Small & J. J. Carter 916* (NY).

DIGITARIA SABULICOLA Henr., Blumea 1:108: 1934. — TYPE: BRAZIL, Provincia de Espirito Santo, 1816 – 1821, (HOLOTYPE: P; ISOTYPE US!).

Description: Plants perennial; lacking stolons; rhizomatous. Nodes glabrous. Sheath auricles about 0.6 mm long. Sheaths glabrous. Ligule 1 – 2 mm long. Leaf blades flexuous; spreading; 2 – 5 cm long; 1.5 – 2.5 mm wide; glabrous or hairy on the lower surface; hairy on the upper surface; with the midrib obviously differentiated. Main axis 10 – 25 mm long; with quaquaversal primary branches. Primary branches appressed to the main axis; whorled at the lower nodes or not whorled; 3 – 9 on the main axis; 0.2 mm wide. Pedicels 1.5 – 2.5 mm long. Spikelets 32 – 70 on a typical primary branch; lanceolate; 2.1 – 2.3 mm long; 0.4 – 0.5 mm wide. First glume absent. Second glume 1 times spikelet length; 5-nerved; hairy; acuminate. Lemma of lower floret 7-nerved; acuminate; hairy. Lower lemma hairs shorter than the upper floret; white. Upper floret 0.9 times the length of the lower floret. Lemma of upper floret yellow; acuminate.

Distribution: Brazil.

Remarks: The present concept of *D. sabulicola* is based on two collections from Brazil. Further collections are needed to better understand the full range of morphological variation for this species and its affinities within the section. The principle diagnostic character is spikelet length which is shorter than that found in the apparently closely related taxa, which include *D. aequiglumis, D. cuyabensis, and D. lanuginosa*.

Representative specimens: **Brazil**. Bahia: Joazeiro, near Rio Sao Francisco, 13 Dec 1924, *Chase 7910* (US). Espirito Santo: Santo, Voyage d'Auguste de Saint Hilare, from 1816 – 1821 (precise location and colleciton date not given) (US).

DIGITARIA SIMPSONII (Vasey) Fern., Rhodora 22:103. 1920. *Panicum sanguinale* var. *simpsonii* Vasey, Contr. U.S. Natl. Herb. 3:25. 1892. *Panicum simpsonii* (Vasey) Beal, Grasses of N.A. 109. 1896. *Syntherisma simpsonii* (Vasey) Nash, Bull. Torrey Bot. Club 25:297. 1898. — TYPE: U.S.A., Florida, Manatee, 1890, *J.H. Simpson* (HOLOTYPE: NY!; ISOTYPE: US!).

Description: Plants perennial; lacking stolons; rhizomatous. Nodes mostly glabrous. Sheath auricles 0.7 – 1.5 mm long. Sheaths hairy (becoming glabrous with age). Ligule 1.5 – 2.5 mm long. Leaf blades flexuous; spreading; 6 – 20 cm long; 3 – 55 mm wide; hairy on the lower surface; hairy on the upper surface (becoming glabrous with age); with the midrib not obviously differentiated. Main axis 40 – 70 mm long; with quaquaversal primary branches. Primary branches spreading from the main axis; not whorled; 6 – 9 on the main axis; 0.3 mm wide. Pedicels 1.5 – 2 mm long. Spikelets 40 – 50 on a typical primary branch; ovate to lanceolate; 2.9 – 3.1 mm long; 0.7 – 0.9 mm wide. First glume typically absent. Second glume 1 times spikelet length; mostly 7-nerved; glabrous; acuminate to acute. Lemma of lower floret 7-nerved; acuminate to acute; glabrous. Upper floret 1 times the length of the lower floret. Lemma of upper floret becoming purple; acuminate to acute.

Distribution: Florida.

Remarks: According to Nash (1898) the type material for *D. simpsonii* was taken from cultivated material originally collected from Long Key southwest of Sarasota Bay, Florida. The length of time that the plants were in cultivation before the type material was collected is unknown. The name has been applied to two collections from Florida and material from Cuba. The Cuban collections are *D. ekmanii*. The two collections from Florida are the holotype from Manatee, Florida and *Curtiss 6422* from St. Augustine, Florida. Spikelet and vegetative characters differ between these collections and it is obvious that they belong to different species. *Curtiss 6422* is a perennial with a decumbent base, the leaves are hairy with pilose or setaceous indumentum, and the spikelets are about 2.5 mm long and glabrous or with a few short purple hairs between the lateral nerves. All characteristics found in *Curtiss 6422* are also found in *D. texana*. Specific examples of *D. texana* that possess characteristics of *Curtiss 6422* include *Swallen 1533*, *H. R. Reed s.n.*, and *Swallen 10574*. It was concluded that *Curtiss 6422* is a disjunct collection of *D. texana*. Therefore, this species is only known from the type material and its present status under natural conditions is unknown.

Representative specimens: U.S.A. Florida: Manatee, garden of J. H. Simpson, 1890, *Simpson s.n.* (NY, US).

DIGITARIA TEXANA Hitchc., Proc. Biol. Soc. Wash. 41:162. 1928. — TYPE: U.S.A., Texas, 6 – 27 – 1910, *Hitchcock 5479* (HOLOTYPE: US!).

Digitaria runyonii Hitchc., J. Wash. Acad. Sci. 23:455. 1933. — TYPE: U.S.A., Texas, 21 Apr 1929, *Runyon 188* (HOLOTYPE: US!).

Digitaria subcalva Hitchc., Amer. J. Bot. 21:138. 1934, *syn. nov.* — TYPE: U.S.A., Florida, Plant City, 26 Oct 1932, *C.P. Wright 1556* (HOLOTYPE: US!; ISOTYPE: MO!).

Digitaria albicoma Swallen, J. Wash. Acad. Sci. 30:214. 1940, *syn. nov.* — TYPE: U.S.A., Florida, 18 Nov 1938, *Swallen 5644* (HOLOTYPE: US!).

Description: Plants perennial; stoloniferous; rhizomatous. Nodes glabrous. Sheath auricles 0.5 − 1.5 mm long. Sheaths glabrous or hairy. Ligule 1 − 2 mm long. Leaf blades flexuous; spreading; 2.5 − 20 cm long; 2 − 6 mm wide; glabrous or hairy on the lower surface; glabrous or hairy on the upper surface; with the midrib obviously differentiated. Main axis 10 − 70 mm long; with quaquaversal primary branches. Primary branches spreading; whorled at the lower nodes or not whorled; 5 − 12 on the main axis; 0.31 − 0.4 mm wide. Pedicels 1 − 2.5 mm long. Spikelets 18 − 65 on a typical primary branch; lanceolate to ovate; 2.3 − 3(-3.2) mm long; 0.51 − 0.7 mm wide. First glume absent (occ. present as a small hyaline scale). Second glume (0.9 −)1 times spikelet length; (3 −)5-nerved; glabrous or hairy; acuminate to acute. Lemma of lower floret 7-nerved; acuminate to acute; glabrous or hairy. Lower lemma hairs shorter than the upper floret; white. Upper floret 0.95 − 1 times the length of the lower floret. Lemma of upper floret yellow or purple; acuminate to acute.

Distribution: Texas and occ. introduced in Florida and Mesoamerica.

Remarks: The *Digitaria texana - runyonii* complex occurs on sandy coastal areas of southern Texas from Calhoun to Cameron County. One collection reported from Brazos Co., Texas [*Reeves 1040* (TAES)] probably represents an incorrectly labeled specimen. There is one collection from Veracruz, Mexico [*Hitchcock 6554* (LL, NY, US)], and future collections may show that this complex commonly occurs on sandy coastal areas in Tamaulipas. Hitchcock (1950) and Gould (1975) distinguished *D. texana* from *D. runyonii* on spikelet length and vestiture of second glume and lower lemma; however, Correll and Johnston (1970) united these species.

Our study of this complex indicated an interesting correlation between the morphological forms and habitat. These taxa are commonly associated with coastal sand dunes but extend inland for about 75 miles. The inland form has spikelets usually 2.3 − 2.6 mm long with the second glume and lower lemma glabrous to sparsely hairy. Examples of this form include *H. R. Reed s.n.* (US), *Swallen 1533* (US), *Cory 28346* (TAES), *Runyon 2783* (NY), and *W. A. Silveus 7310* (TAES, US). This small-spikelet form occurs on the coast but differs in that the second glume and lower lemma is distinctly hairy with villous hairs between the lateral nerves. A number of specimens, including the holotype of *D. texana*, are intermediate between these forms. The other morphological form identified in this complex occurs in coastal sandy areas. Vegetative characteristics overlap with the inland form; however, the spikelets are about 2.8 − 3.2 mm long and the outer bracts distinctly hairy. The holotype of *D. runyonii* falls into this group. Intermediates [*Lundell 15029* (NY), *Swallen 10563* (US), and *Swallen 10611* (US)] are common between the small and large spikelet forms. Based on these observations it was concluded that *D. runyonii* is best placed in synonymy under *D. texana*.

Digitaria albicoma is known from two collections, the holotype (collected in 1938) and a second incomplete specimen collected five years later at the same locality (Chinsegut Hill Sanctuary, Brooksville, Florida). These specimens possess the following significant characteristics: perennial with densely villose leaf sheaths; leaf blades long, narrow, with a pronounced mid-nerve; primary inflorescence branches lacking spikelets at the base; spikelets ca. 2.6 mm long, nearly glabrous but with a few purple hairs in the internerve spaces. These characters can be found in the range of variation accepted in *D. texana*. Some specific examples of *D. texana* exhibiting these characters are *Swallen 1856, 1533, & 1408 – A*, all of which occur on sandy coastal areas. It was concluded that *D. albicoma* is best treated as a synonym of *D. texana*. A similar situation exists for *D. subcalva*, which is also treated as a synonym. The presence of these specimens in Florida indicates that *D. texana* is occasionally introduced but fails to persist. It is interesting to note that these specimens were collected close to the 28th latitude, which is the same latitude where *D. texana* is native and concentrated in the Texas coastal Bend region.

Representative specimens: **MEXICO**. Veracruz: Veracruz, 31 Aug 1910, *A. S. Hitchcock 6554* (LL, NY, US). **U.S.A.** TEXAS: Aransas Co.: Aransas near Bay, 24 Nov 1932, *W. A. Silveus 847* (US); Port Aransas Pass, 24 Nov 1940, *W. A. Silveus 6790* (TAES); Rockport, 15 Oct 1941, *W. A. Silveus 7320* (TAES); Port Aransas, 10 Nov 1941, *W. A. Silveus 7450* (TAES); Copano Bay, E side, 25 Nov 1931, *B. C. Tharp 7908* (US, NY). Brazos Co.(?): Fall 1940, *R. G. Reeves 1040* (TAES). Brooks Co.: 4 mi SE of Encino Division, King Ranch, 18 Nov 1954, *F. W. Gould & J. Morrow* 6728 (TAES); Falfurrias, 26 Jun 1936, *H. R. Reed s.n.* (US); Santa Fe Division, King Ranch, 3 Nov 1949, *J. R. Swallen 10597* (US). Calhoun Co.: sand below Seadrift, 1 Dec 1928, *Tharp 5073* (US). Cameron Co.: mouth of Rio Grande, 21 Apr 1929, *R. Runyon 188* (US); Brazos Santiago Island, 25 Sep 1938, *R. Runyon 1878* (US); Brazos Santiago Island, 7 Oct 1938, *R. Runyon 2010* (F). Kenedy Co.: Sarita, 27 Jun 1910, *A. S. Hitchcock 5479* (US); Kings Ranch, 8 mi S of Sarita, 15 Oct 1946, *Lundell & Lundell 14701* (US); Kenedy Ranch, N of Mifflin, 3 Nov 1949, *C. L. Lundell 15029* (NY); between the South border and Los Norias, 11 May 1941, *R. Runyon 2783* (NY); near Encino, 30 Apr 1932, *W. A. Silveus 575* (US); Sarita, 14 Nov 1941, *W. A. Silveus 7311* (TAES, US); Sarita, 6 Apr 1931, *J. R. Swallen 1408 – A* (US); Sarita, 17 Apr 1931, *J. R. Swallen 1513* (US); Sarita, 17 Apr 1931, *J. R. Swallen 1533* (US); Riviera to Riviera beach, 8 Jun 1931, *J. R. Swallen 1856* (US); King Ranch, Norias Div., San Jose pasture, 2 Nov 1949, *J. R. Swallen 10574* (US); King Ranch, Norias Div., San Jose pasture, 2 Nov 1949, *J. R. Swallen 10579* (US); between Mifflin and Armstrong, 2 Nov 1949, *J. R. Swallen 10581* (TAES); 1½ mi S of Mifflin, 2 Nov 1949, *J. R. Swallen 10591* (US); N of Mifflin, 3 Nov 1949, *J. R. Swallen 10610* (US); N of Mifflin, 3 Nov 1949, *J. R. Swallen 10611* (US). Kleberg Co.: Padre Island, 25 Nov 1932, *W. A. Silveus 848* (NY, US); King Ranch, Lourellis Div., 1 Nov 1949, *J. R. Swallen 10563* (US); 3.1 mi S of Riviera, 8 Oct 1935, *H. D. Parks & V. L. Cory 16989* (TAES). Nueces Co.: Mustang Island, 29 Nov 1940, *B. H. Warnock 20936* (TAES, US); 15 mi S of Corpus Christi, 1 Oct 1931, *W. A. Silveus 356* (US);

Mustang Island, 18 Oct 1975, *S. R. Hill 3843* (TAES); 10 mi S of Corpus Christi, 6 Jun 1931, *J. R. Swallen 1829 ½* (US). Refugio Co.: Copano Bay, 26 Feb 1932, *B. C. Tharp 43189* (NY). Willacy Co.: Raymondville, 4 Apr 1938, *V. L. Cory 28346* (TAES); 15 mi N of Raymondville, 14 Nov 1941, *W. A. Silveus 7305* (TAES); between Laguna Madre and Raymondville, 14 Nov 1941, *W. A. Silveus 7310* (TAES, US).

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THE PLUMBAGINACEAE IN THE FLORA OF THE SOUTHEASTERN UNITED STATES

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ABSTRACT

The Plumbaginaceae is represented in the native southeastern flora by *Limonium carolinianum*, *Limonium limbatum*, and *Plumbago scandens*. *Plumbago auriculata* is widely cultivated and has become naturalized. This paper describes, illustrates, and maps these species in the southeastern flora.

Las Plumbagináceas estan representadas en la flora nativa del sureste por *Limonium carolinianum*, *Limonium limbatum*, y *Plumbago scandens*. *Plumbago auriculata* es cultivado ampliamente y se ha naturalizado. En este papel se describen, ilustran, y presentan mapas de distribución para estas cuatro especies para la flora del sureste.

The Plumbaginaceae contains 12 genera and about 400 species distributed throughout the world. It is best developed in the Mediterranean and the Middle East, mostly in xerophytic situations, on saline and calcareous soils (Luteyn 1990). In the United States, three genera, *Armeria*, *Limonium*, and *Plumbago*, occur naturally. *Limonium* is either a salt marsh plant with one species found along the entire Atlantic and Caribbean seaboard [*L. carolinianum* (Walter) Britton] and another along the Pacific coast from southern California to northern Oregon [*L. californicum* (Boiss.) Heller], *or* an inland species in salt flat areas in Texas, Oklahoma, New Mexico, Arizona, and northern Mexico (*L. limbatum* Small) (Luteyn 1976). Several species are cultivated and used in dried floral arrangements; two of these have escaped and become naturalized in southern California [viz., *L. perezii* Hubb. and *L. sinuatum* (L.) Miller]. *Plumbago scandens* L. is native to southern Florida, Texas, and Arizona, and ranges south through Central and South America. *Plumbago auriculata* Lam. (= *P. capensis* Thunb.), a native of South Africa, is widely cultivated and has become naturalized locally in Florida. In the United States, *Armeria maritima* Willd. is native on bluffs and sandy places along the Pacific coast as far south as San Luis Obispo County, California. Several other species of *Armeria* are cultivated, mostly as rock garden plants.

This treatment was originally prepared in 1976 (Luteyn, in press) for the "Vascular Flora of the Southeastern United States" (Massey et al., Editorial Board). It follows the basic format for that flora as outlined in Radford et

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al. (1967), although herein I have included illustrations and distributional maps. For geographical completeness, I have also included the entire state of Texas within the range of coverage fully realizing that some parts of the state (specifically that west of the 100th meridian) may not be phytogeographically "southeastern."

TAXONOMY

PLUMBAGINACEAE. THE LEADWORT FAMILY

Perennial herbs, subshrubs, or climbing plants. Leaves simple, alternate, basal or cauline, entire; petioled with bases persistent and often sheathing the stem; exstipulate. Inflorescence of terminal or axillary racemes or panicles, often spike-like; floral nodes bracteate. Flowers perfect, actinomorphic, 5-merous, hypogynous, bracteate, homostylous or heterostylous; calyx synsepalous, plicate, 5-ribbed, sepals scarious; corolla sympetalous or of nearly distinct petals, marcescent, exserted beyond the calyx, lobes convolute-imbricate; stamens 5, distinct, sometimes epipetalous, then borne on the corolla tube opposite the lobes, anthers introrse; stigmas 5, linear, styles 1 or 5, ovary 5-carpellate, 1-loculed, usually 5-ribbed, ovule solitary, anatropous to circinotropous. Fruit a capsule or utricle, partly or totally enclosed by the persistent calyx. Seed with straight embryo, endosperm white, mealy.

Channell, R.B. & C.E. Wood, Jr. 1959. The genera of Plumbaginaceae of the southeastern United States. J. Arnold Arbor. 40:391 − 397.

1. Leaves basal; corolla of nearly distinct petals, less than 1 cm long; styles 5, distinct to base . . . . 1. *Limonium*
1. Leaves cauline; corolla salverform, more than 1 cm long; style 1, with 5 stigmas . . . . 2. *Plumbago*

1. *LIMONIUM* Miller SEA-LAVENDER

Scapose, acaulescent, vegetatively glabrous herbs, with short to elongate, thick taproots. Leaves basal, equitant, coriaceous, long attenuate. Inflorescence of terminal panicles or corymbs, with the ultimate branch tips bearing secund, solitary or usually few-flowered spikelets. Flowers homostylous, hypogenous, sessile or nearly so, subtended by 3 (or more) sheathing bracts; calyx tubular-funnelform, 5-ribbed, limb plicate, lobes oblong to triangular, usually with smaller intervening lobes or dentate-erose sinuses; corolla with petals nearly distinct, long-clawed; stamens adnate to the base of the corolla, included; styles 5, distinct to the base, with 5 linear-clavate, papillate stigmas. Fruit a brownish-green utricle, usually exserted from the persistent calyx, usually capped by the marcescent corolla and style bases.

Luteyn, J. L. 1976. Revision of *Limonium* (Plumbaginaceae) in eastern North America. Brittonia 28: 303 – 317.

1. Calyx limb erect at maturity; spikelets loosely to moderately or even densely aggregated; plants of coastal salt marshes or flats . . . . 1. *L. carolinianum*
1. Calyx limb wide-spreading or flaring at maturity; spikelets always densely aggregated; plants of inland alkaline areas . . . . 2. *L. limbatum*

1. L. CAROLINIANUM (Walter) Britton. — Stems 1 – 9.5 dm tall. Leaves elliptic, spatulate, obovate to oblanceolate, rarely linear or semiorbicular, 5 – 15 (30) cm long, 0.8 – 4 (7.5) cm wide, apex rounded or acute to retuse, deciduously cuspidate. Inflorescence with spikelets loosely to moderately densely aggregated, the floral internodes 0.5 – 10 mm long. Flowers perfect, rarely male-sterile, solitary or 2 – 3 (5) clustered, bracts 3 – 6 mm long; calyx obconic to funnelform, (3.8) 4.5 – 6.5 (7.5) mm long, tube glabrous to densely pilose along 1 – 5 ribs, limb erect at maturity, lobes oblong to narrowly triangular, 0.4 – 1.5 (2) mm long; petals lavender, rarely white. Fruit 3 – 5.5 mm long. (n = unreported) Spring, summer, early fall. Salt marshes and salt-flats along Atlantic and Gulf seacoasts. Figs. 1 and 2. Incl. *Limonium angustatum* (Gray) Small; *L. obtusilobum* Blake; *L. nashii* Small; *L. n.* var. *trichogonum* Blake; *L. n.* var. *t.* f. *albiflorum* (Raf.) House; *L. carolinianum* var. *angustatum* (Gray) Blake; *L. c.* var. *obtusilobum* (Blake) Ahles; *L. n.* var. *angustatum* (Gray) Ahles.

My studies (Luteyn 1972, 1976) including field observations from much of its extensive geographical range (Labrador and Bermuda to Tamaulipas, Mexico), indicate that numerous local populations have resulted in a polymorphic species. Morphological variation is almost continuous throughout the range, and therefore, the recognition of several taxa is unjustified. Elaboration of the different morphologies is unnecessary; however, a word about the reproductive biology is in order and may shed light on community structure. *Limonium carolinianum* reproduces sexually and is self-compatible (Baker 1953). Its seeds are dispersed by birds and ocean currents. However, seedlings are very rare, and the spread of populations is vegetative from the horizontal rhizomes and short laterals of the branched woody stock (pers. observ.). With time, extensive clones (each possibly with distinctive morphologies) may spread and coalesce within the community.

2. L. LIMBATUM Small. — Stems to 6 (10) dm tall. Leaves spatulate, oblong-spatulate, obovate to elliptic, 4 – 16 cm long, 1.5 – 6.5 cm wide, apex rounded or retuse, shortly mucronate. Inflorescence with spikelets distichously and densely aggregated, the floral internodes 0.5 – 3 mm long; calyx funnelform to salverform, 3.3 – 5 mm long, tube glabrous to

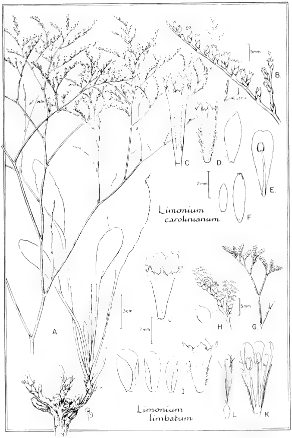

FIG. 1. *Limonium carolinianum* and *Limonium limbatum*. A – F, *Limonium carolinianum*. A. Habit. B. Portion of inflorescence. C. Calyx, glabrous. D. Calyx, pubescent, and floral bract. E. Petal with adnate stamen. F. Fruit (right) and seed (left). G – L, *Limonium limbatum*. G. Portion of inflorescence. H. Close-up of flowering spikelets and floral bract. I. Floral bracts. J. Flower. K. Longitudinal section of flower with pistil removed. L. Pistil. (A drawn from *Luteyn 2703* and *2820*, both NY; B from *Luteyn 2820*; C and F from *Luteyn 2733*, NY; D and E from *Luteyn 2777*, NY; G – I from *Ferris & Duncan 3446*, NY; and J – L from *Higgins 17938*, NY.)

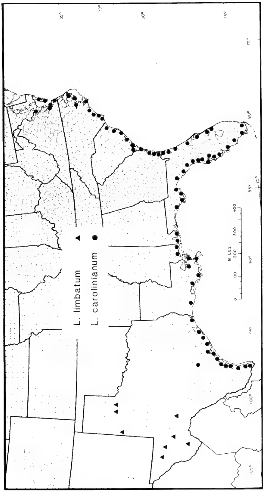

FIG. 2. Distribution of *Limonium limbatum* and *Limonium carolinianum* in the southeastern United States.

densely pubescent along 2 − 3 ribs, the other 2 ribs moderately pubescent, pubescent only at base or glabrous, limb wide-spreading or flaring at maturity, lobes broadly triangular-ovate, 0.5 − 1.2 mm long; petals blue to nearly white. Fruit 2.5 − 3 mm long. (n = unreported) Summer, early fall. Wet meadows, gypsum soils, salt-flats and alkaline depressions in the interior, 1400 − 5800 ft elevation. Figs. 1 and 2. Incl. *Limonium limbatum* var. *glabrescens* Correll.

Although *L. limbatum*, from the Trans-Pecos and Panhandle regions of Texas, is very distinct from *L. carolinianum* in its inland, higher elevation habitat, morphologically they are quite similar. The type and degree of variation within *L. limbatum* is exactly similar to that in *L. carolinianum*; therefore, no infraspecific taxa are recognized.

2. PLUMBAGO L. Leadwort

Perennial shrubs or suffrutescent herbs; stem ribbed, often elongate and climbing. Leaves cauline, alternate, membranaceous. Inflorescence of terminal or axillary, spike-like racemes or panicles. Flowers sometimes heterostylous, hypogenous, short pedicellate, pedicels bibracteolate; calyx tubular, capitate-glandular along the 5 ribs, lobes triangular, 1 − 2 mm long; corolla salverform, lobes obovate, rounded or truncate, mucronate; stamens free from the corolla, included or exserted; style 1, included or exserted, with 5 linear stigmas. Fruit a capsule, included, long-beaked, the valves coherent at apex.

1. Corolla white, tube mostly less than twice the length of the calyx; calyx with glandular hairs only; inflorescence elongate, 3 − 11 (30) cm long; plants native . . . . 1. *P. scandens*
1. Corolla pale blue, tube twice or more than twice the length of the calyx; calyx with glandular and eglandular hairs; inflorescence compact, 2.5 − 3 (5) cm long; plants cultivated and naturalized locally in Florida . . . . 2. *P. auriculata*

1. P. scandens Linnaeus. — Erect, prostrate or climbing suffrutescent herbs; stems glabrous. Leaves ovate, lance-elliptic, spatulate to oblanceolate, (3) 5 − 9 (13) cm long, (1) 2.5 − 3.5 (5) cm wide, apex acute, acuminate or obtuse, base attenuate. Inflorescence elongate, leafy, 3 − 11 (30) cm long, rachis glabrous but glandular and viscid, floral bracts lanceolate, 3 − 6.5 mm long. Flowers heterostylous; calyx 7 − 11 (13) mm long, tube glabrous but with glandular hairs along length of ribs; corolla white, 17 − 33 mm long, tube 12.5 − 28 mm long, lobes 5 − 12 mm long, 3 − 3.5 mm wide; stamens included. Capsule 7.5 − 8 mm long. Seed reddish- or dark brown, 5 − 6 mm long. (n = unreported) All year. Palm groves, thickets, shady hammocks, shell mounds, and rocky places in open areas. Figs. 3 and 4.

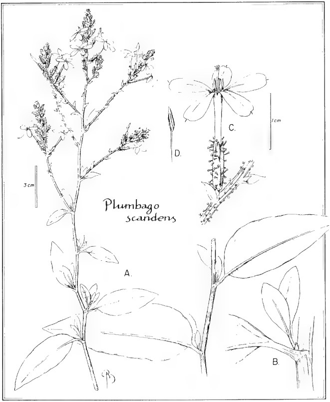

FIG. 3. *Plumbago scandens*. A. Habit. B. Close-up of leaves and leaf bases. C. Portion of inflorescence showing glandular rachis, floral bracts, and flower. D. Distal portion of stamen. (Drawn from *Hudson* 745, MO.)

Plumbago scandens is a widespread, tropical American species which reaches its northern distribution in Florida, southern Texas, and Arizona. It is morphologically quite stable throughout its geographical range.

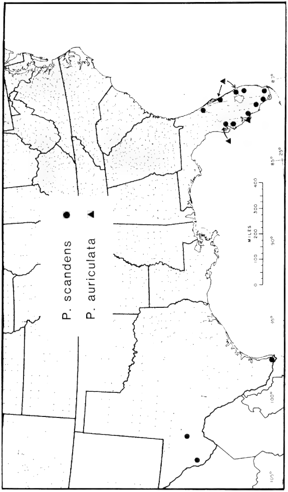

FIG. 4. Distribution of *Plumbago scandens* and *Plumbago auriculata*.

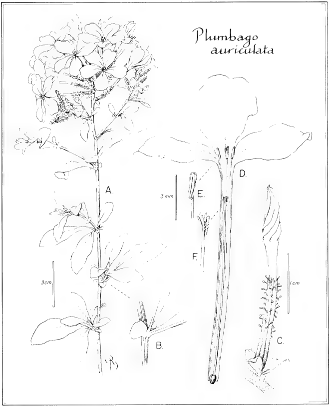

FIG. 5. *Plumbago auriculata*. A. Habit. B. Close-up of leaf bases. C. Portion of inflorescence showing pubescent rachis, floral bracts, and flower in bud. D. Longitudinal section of corolla. E. Distal portion of stamen. F. Distal portion of style. (Original illustration drawn from living material cultivated at the New York Botanical Garden.)

2. P. AURICULATA Lam. — Perennial shrub, erect, trailing or climbing; stems glabrous below becoming pubescent above. Leaves elliptic, oblanceolate, obovate to spatulate, 2.5 – 9 cm long, 1 – 2.5 cm wide, apex acute or obtuse, mucronate, base long attenuate or sometimes auriculate. Inflorescence compact, 2.5 – 3 (5) cm long, rachis short pilose, eglandular, floral bracts lanceolate, 4 – 9 mm long. Flowers tristylous; calyx 10 – 13 mm long, tube usually short pilose and also with glandular hairs along upper 1/2 – 3/4 length of ribs; corolla pale blue, 37 – 53 mm long, tube 28 – 40 mm long, lobes 10 – 16 mm long, 6 – 15 mm wide; stamens included or exserted. Capsule 8 mm long. Seed brown, 7 mm long. ($2n = 14$, 16, 28) All year. Escaped from cultivation and naturalized in Florida in hammocks, thickets, and disturbed sites in dry soil. Figs. 4 and 5. *P. capensis* Thunb.

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TAXONOMIC NOTES ON WESTERN AMERICAN GENTIANACEAE[1]

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In the manuscript on the Gentianaceae recently prepared for *The Jepson Manual* of the flora of California, departures from previous treatments of certain taxa require further explanation than would be feasible within the manual itself. The appropriate discussions, along with a nomenclatural combination that must be validated for use in the manual, are presented below.

The circumscription of *Swertia*

Wood & Weaver (1982) have called the circumscription of *Swertia* L. "perhaps the most controversial in the Gentianaceae." Over the years about a dozen genera have been segregated from *Swertia* sen. lat. Recent authors have generally treated the Eurasian and African representatives of this complex as one genus, but, with regard to the North American species, the status of *Frasera* Walt. remains unresolved.

Until recently the segregation of *Frasera* was rejected in most standard floras, following *Die natürlichen Pflanzenfamilien* (Gilg 1895) and St. John's (1941) monograph of *Swertia* s. lat. in North America. During the past thirty years, however, generic status for *Frasera* has gradually been gaining acceptance. This has been based in large part on unpublished studies by D.M. Post ca. 1948 – 1957, summarized by Hitchcock (1959) and Threadgill & Baskin (1978). *Frasera* has also been accepted in Wood & Weaver's (1982) recent discussion of generic delimitation in the Gentianaceae of the southeastern United States. My preliminary discussion of this question in 1979, in contrast, advocated the inclusion of *Frasera* in *Swertia*.

Basic chromosome numbers have been emphasized in support of generic status for *Frasera*, although a suite of morphological characters has been presented as being correlated with chromosome number. Wood & Weaver (1982) described *Frasera* as having $x = 13$, whereas "the perennial species of *Swertia* s. str. have numbers mostly based on 14." Post (paraphrased by

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Hitchcock 1959) went so far as to suggest "that *Frasera*, with a basic chromosome number of 13, is perhaps more closely related to *Gentiana* (which has a similar number) than to *Swertia*." Toyokuni (1965) expanded *Frasera* to include those Japanese species then known to have $x = 10$, essentially basing this treatment on chromosome numbers alone, but this circumscription has not been adopted by subsequent authors. Wood & Weaver (1982) commented that "this alignment is contradicted by other characters." Among the Japanese species, for example, *S. pseudochinensis* Hara, with $n = 10$, is especially similar in morphology to *S. perennis* L., the type species of the generic name *Swertia*, with $n = 14$.

Unfortunately, chromosome numbers were known for only a few species in this complex until recently. Since the papers cited above were written, chromosome counts have been published for many more species of *Swertia* s. lat. (compiled 1973 – 1988 in *Regnum Veg.* 90, 91, 96, *Monogr. Syst. Bot. Missouri Bot. Gard.* 5, 8, 13, 23, and *Taxon* 35, 36; see also Table 1). Also, as is often the case, a few early counts have not been substantiated by further investigations of the same species and must be considered unreliable. With chromosome numbers now known for over 40 species in this complex from all parts of its range, a much clearer picture of the distribution of chromosome numbers in *Swertia* s. lat. is now available. This picture is considerably at variance with some extrapolations made from early counts.

It is now evident that the majority of species in *Swertia* s. lat. have $x = 13$ (usually $n = 13$, occasionally $n = 26$ or 39). A smaller number of Asiatic species have $x = 10$ (usually $n = 10$; $n = 30$ in *S. tashiroi* (Maxim.) Makino). Associated with each of these groups are a few aneuploid species having one more or one fewer (in *S. paniculata* Wallich two fewer, $n = 8$) chromosomes per genome than the prevailing number. Of these, the amphi-Pacific *S. perennis* L. (including *S. cuspidata* (Maxim.) Kitigawa, *S. obtusa* Ledeb., and *S. stenopetala* (Regel & Tiling) Pissjauk., segregates seldom accorded specific rank) is the only species known to have $n = 14$ or any multiple thereof.

The generic name *Frasera* Walt. is typified by *S. caroliniensis* (Walt.) Kuntze (as *F. caroliniensis* Walt.), a species of eastern North America with $n = 39$. Wood & Weaver (1982) followed all of the earlier interpretations of *Frasera* except Toyokuni's in restricting this genus to North American species, implicitly assigning to it all species of *Swertia* s. lat. native to this continent except *S. perennis*. They characterized *Frasera* morphologically by: cauline leaf bases weakly connate, not decurrent (free, long-decurrent in *Swertia*); flowers always tetramerous with one nectary pit per corolla lobe (*Swertia* usually with pentamerous flowers and two nectary pits per lobe, some species either with tetramerous flowers or with solitary nectaries); and a distinct filiform style (stigma sessile or nearly so in *Swertia*). Threadgill & Baskin (1978), following Post, listed axis type, general anatomy, phyllotaxis, nodal anatomy, number of flower parts, and presence of a style as morphological features by which *Frasera* and *Swertia* s. str. were differentiated.

Swertia bimaculata (Sieb. & Zucc.) C.B. Clarke and *S. swertiopsis* Makino, both of Japan, correspond ideally to Wood & Weaver's concept of *Swertia* s. str. in morphology, being perennial and having striate internodes, pentamerous corollas with paired nectaries, and, in *S. bimaculata*, a sessile stigma, yet both have $x = 13$. *Swertia bimaculata* has the same number, $n = 13$, as the taxon called *Frasera pahutensis* Reveal (probably best included in *S. albicaulis* (Griseb.) Kuntze), an ideal "*Frasera*" with tetramerous corollas and single nectaries. Pentamerous corollas with paired nectaries also occur in species with $x = 10$, e.g. *S. japonica* (Schult.) Makino and *S. pseudochinensis* Hara, but so does the combination of tetramery and single glands, as in *S. tashiroi*.

The significance of the number of nectaries per corolla lobe can clearly be discounted. In western North America, *S. radiata* (Kellogg) Kuntze (*F. speciosa* Douglas ex Griseb.) most closely resembles *S. caroliniensis* in general aspect, life history, stem structure, phyllotaxy, foliar and floral morphology, and chromosome number (both $n = 39$). It has consistently been placed in *Frasera* by all who have accepted the genus, but it has paired nectaries. In Asia both single and paired nectaries can be found associated with both tetramerous and pentamerous flowers. Paired nectaries — i.e., the actual groups of nectariferous cells at the base of a pit — may open into a single pit, as in the Asiatic species *S. alata* (D. Don) C.B. Clarke, *S. angustifolia* Buch.-Ham. ex D. Don, *S. nervosa* (G. Don) C.B. Clarke, and *S. ciliata* (D. Don ex G. Don) B.L. Burtt; or the nectariferous zone may be w-shaped, as in the American species *S. neglecta* (H.M. Hall) Jeps. Conversely, many species have solitary nectaries opening into pits with u-shaped or notched openings. Even within a single species or on an individual plant, as in the Asiatic *S. atroviolacea* H. Sm., there may be various degrees of fusion of the nectary pits.

Pentamery is not constant in *S. perennis*; individual specimens have been found to be variable in this study, with tetramerous flowers being quite common. Occasional tetramerous flowers were also noted on specimens of *S. bimaculata* and *S. japonica*, and have been reported in other species that normally have pentamerous flowers. Stylar differences between *S. perennis* and "*Frasera*" are a matter of relative length rather than being qualitative. In this study, distinct albeit slender styles were observed in *S. perennis*,

TABLE 1. Partial list of *Swertia* species for which chromosome numbers have been published (see text for sources), with floral characters and phyllotaxy.

SPECIES	RANGE	N	COROLLA LOBES	PITS/ LOBE	PHYLLOTAXY
S. alata (D. Don) C.B. Clarke	Asia	13	4	1	opposite
S. albicaulis (Griseb.) Kuntze (*S. pahutensis* (Reveal) J. Pringle)	N.Am.	13	4	1	opposite
S. angustifolia Buch.-Ham. ex D. Don	Asia	13	4	1	opposite
S. beddomei C.B. Clarke	Asia	13	4	1	opposite
S. bimaculata (Sieb. & Zucc.) C.B. Clark	Asia	13	5	2	opposite
S. chirayita (Roxb. ex Fleming) Karsten	Asia	13	4	2	opposite
S. cordata (G. Don) C.B. Clarke	Asia	13	5	1	opposite
S. corymbosa (Griseb.) C.B. Clarke	Asia	13	4	1	opposite
S. densifolia (Griseb.) Kashyapa	Asia	13	4	1	opposite
S. lurida (D. Don ex G. Don) C.B. Clarke	Asia	13	4	2	opposite
S. nervosa (G. Don) C.B. Clarke	Asia	13	4	1	opposite
S. petiolata Royle ex D. Don	Asia	13	5	2	opposite
S. speciosa (D. Don) C.B. Clarke	Asia	13	5	2	opposite
S. thomsonii C.B. Clarke	Asia	13	5	2	opposite
S. trichotoma (Wight) C.B. Clarke	Asia	13	4	1	opposite
S. swertiopsis Makino	Asia	26	5	2	opposite
S. caroliniensis (Walt.) Kuntze	N.Am.	39	4	1	whorled
S. radiata (Kellogg) Kuntze	N.Am.	39	4	2	whorled
S. perennis L.	N.Am., Eurasia	14	5 or 4	2	opposite or alt.
S. ciliata (D. Don ex G. Don) B.L. Burtt (*S. purpurascens* (D. Don) C.B. Clarke)	Asia	10	5	1	opposite
S. diluta (Turcz.) Benth. & Hook. fil. (*S. tosaensis* Makino)	Asia	10	5	2	opposite

S. japonica (Schult.) Makino	Asia	10	5	2	opposite
S. minor (Griseb.) Knobl.	Asia	10	4	2	opposite
S. pseudochinensis Hara	Asia	10	5	2	opposite
S. tashiroi (Maxim.) Makino	Asia	30	4	1	opposite
S. tetragona (Edgew.) C.B. Clarke	Asia	9	5	2	opposite
S. paniculata Wallich	Asia	8	5 or 4	1	opposite

scarcely exceeded by those of some "*Frasera*" species. *Swertia swertiopsis*, which as noted above is otherwise an ideal "*Swertia*" in morphology, has a relatively long, slender style. Sessile stigmas do occur in *Swertia* s. lat., but are variously combined with pentamery and tetramery, single and paired nectaries, and $x = 10$ and 13.

Both whorled and opposite leaves occur within North American "*Frasera*" and within several other species-groups. Connate leaf bases, although prominent in *S. caroliniensis* and *S. radiata*, are not present in some opposite-leaved North American species, at least at the upper nodes. Post's (1958) published study of nodal anatomy, specifically the number of gaps in the stele associated with leaf traces at successive nodes, divided the North American species into five groups. The difference in nodal anatomy between his group V, which comprised *S. perennis* alone, and group IV of "*Frasera*," does not appear significantly greater than the difference between groups I and IV of "*Frasera*." Its citation by later authors as supporting a generic division was based on a supposed correlation with basic chromosome numbers and morphological features. No Eurasian or African species were included in Post's study.

The striking difference in aspect between the familiar *S. caroliniensis* and *S. radiata*, which have tall, stout, hollow stems, and *S. perennis*, which is of lower stature with slender, solid stems, cannot be used to support the segregation of *Frasera* from *Swertia* (unless *Frasera* were to be restricted to the two stout-stemmed species). Most North American species have slender, solid stems and and narrower leaves, and are of much lower stature than the two hollow-stemmed hexaploids. The basic inflorescence type throughout *Swertia* s. lat. is a thyrse or verticillaster, comprising a determinate (usually elongate) axis bearing opposite or whorled branches that terminate in dichasial cymules. Within North American "*Frasera*" there is considerable diversity in total inflorescence size, height at which the lowest inflorescence branches are produced, and length of internodes in the inflorescence — as much within "*Frasera*" as between "*Frasera*" and residual *Swertia* species. Conversely, within residual *Swertia* there is extreme diversity in general aspect and in inflorescence branching. Many Asiatic species are similar in these respects to some of the slender-stemmed "*Frasera*" species of North America, including some species with narrow, crowded inflorescences and others with diffuse inflorescences (see Pringle 1979 for examples). The Asiatic and Indonesian taxa also include, however, such highly dissimilar species as *S. dichotoma* L., with small flowers and slender, decumbent stems giving the plants a chickweed-like aspect (or, as the old name *Anagallidium* Griseb. for a generic segregate suggests, an *Anagallis*-like aspect); *S. zeylanica* (Griseb.) C.B. Clarke, with a flat-topped inflorescence; *S. acaulis* H. Sm., with a greatly reduced inflorescence axis, the long pedicels appearing to arise from the caudex; *S. pubescens* Franch., with each flower subtended by a pair of large, ovate bracts; and other species respectively resembling *Gentianella* and *Deianira* species in general aspect. These diverse habits show no correlation with the floral characters discussed above.

Nilsson (1967) found that all species of *Swertia* s. lat. that he studied had basically similar pollen, the grains being separate, prolate, and tricolporate, with the exine striato-reticulate. He did find that all North American species of *Swertia* s. lat. except *S. perennis* shared an exine structure unusual for the genus, with finer striations and more closely spaced baculae than those of most other species. Such pollen, however, was also found in one Japanese and two Himalayan species. Of these, *S. japonica* has $n = 10$, pentamerous corollas, and paired nectaries; and *S. handeliana* H. Sm. (chromosome number unknown) combines the "*Frasera*" characters of tetramerous flowers and single nectaries with the subsessile style attributed to *Swertia* s. str. (The third species has not been described, at least not under the unpublished name by which it was known to Nilsson.) Among the Asiatic species there was considerable diversity in exine structure. Nilsson retained the broad concept of *Swertia*.

Differences in xanthone chemistry have been alleged to support the segregation of *Frasera*, but the early studies (see Threadgill & Baskin 1978 for citations) dealt with too few species to reveal patterns within *Swertia* s. lat. Later investigations of the oxygen-substitution positions of xanthones in the Gentianaceae by Jossang et al. (1973) included nine species of *Swertia* s. lat., the North American species being represented by *S. albicaulis* and *S. caroliniensis*. Species represented by more than one specimen were generally variable in xanthone chemistry. Substitution at position 2 was restricted to *S. albicaulis* and *S. caroliniensis* among the species studied, but was not found in all specimens of either of these species. At least one sample of *S. caroliniensis* was identical in xanthone chemistry to samples of *S. perennis* as well as *S. chirayita* (Roxb. ex Fleming) Karsten ($n = 10$, lobes 4, nectary 1), *S. diluta* (Turcz.) Benth. & Hook. fil. var. *tosaensis* (Makino) Hara (*S. tosaensis* Makino; $n = 10$, lobes 5, nectaries 2), and *S. swertiopsis*. Their study, therefore, does not provide support for generic status for *Frasera*.

In summary, data now available show that the morphological characters associated with "*Frasera*" are restricted neither to North American species nor to species with $x = 13$, nor are they consistently correlated with one another in their occurrence. Conversely, rather than differing in basic chromosome number, most species of *Swertia* s. str. and "*Frasera*" have the same basic number. Although, as indicated particularly by Nilsson's studies, the North American species of *Swertia* exclusive of *S. perennis* may have a monophyletic origin, this group does not appear to have differentiated from its Asiatic relatives sufficiently to justify its recognition as a genus or even to permit the characterization of such a genus. No suite of correlated characters nor, as far as evidence is available, even one character reliably separates "*Frasera*" from *Swertia*. The same criteria by which Wood & Weaver rejected the segregation of Japanese taxa as *Frasera* species and restored them to *Swertia* (above) also preclude the segregation of the North American species. Therefore *Swertia* will be retained in the broad sense in *The Jepson Manual*.

THE STATUS OF *SWERTIA UMPQUAENSIS*

According to Peck & Applegate (1941), their *Frasera umpquaensis* was much like *F. fastigiata* (Pursh) Heller (*Swertia fastigiata* Pursh) in general aspect and had "quite similar foveae" (nectary pits), "differing in the setae and in the characteristics of the calyx." The former reference was evidently to "setae" (trichomes in the present paper) on the corolla in the "area below the [nectary] pit" similar to those surrounding the opening of the pit. Such trichomes would be designated corona trichomes in the terminology now prevalent for floral descriptions in this genus. Peck & Applegate may have assumed that their presence constituted a distinction because Card's (1931) "Revision of the genus *Frasera*" lacked any mention of such trichomes in his description of *F. fastigiata* or any representation of them in his illustration of corolla details (although the corona trichomes of other species were shown). Peck & Applegate described the calyx lobes of *F. umpquaensis* as being "linear to lance-linear, somewhat unequal, 9 – 12 mm long," whereas Card described those of *F. fastigiata* as "somewhat subulate, 2 cm long."

Actually, *S. fastigiata* does have a corona of trichomes near the base of the corolla, as is clearly shown in Abrams' (1951) and Hitchcock's (1959) illustrations of this species. Hitchcock described the calyx lobes of *F. fasti-*

giata as lanceolate, 5 − 13 mm long, although as illustrated they could be termed linear. Supposed differences in calyx-lobe shape appear merely to reflect different authors' interpretations of descriptive terms.

The only distinction between *S. fastigiata* and *S. umpquaensis* cited by Abrams was in the apex of the corolla lobes, described in *S. umpquaensis* as being narrowed "rather abruptly at the apex to a slender apiculation with 1-few minute teeth." Such characters tend to be variable within species of *Swertia*, and their aspect may be affected by maturity and by preparation of specimens. An "apiculation" appears in Hitchcock's illustration of the corolla of *F. fastigiata*.

In the present study, comparison of specimens from California identified as *S.* or *F. umpquaensis* with specimens from the Blue Mountains of Oregon and from Idaho identified as *S.* or *F. fastigiata* disclosed no differences by which two taxa could be distinguished.

A NEW COMBINATION IN *GENTIANA*

Extreme forms of *Gentiana newberryi* A. Gray s. lat., treated as *G. newberryi* s. str. and *G. tiogana* Heller by Mason (1960), are connected by too many intermediates to permit their interpretation as two ordinarily well-differentiated species that occasionally hybridize where their ranges overlap. Intermediate forms outnumber specimens of *G. newberryi* s. str. and prevail to the virtual exclusion of either extreme in some regions (note distribution of "hybrids" as mapped by Mason 1960). Nevertheless, the relatively tall plants with blue corollas that occur in the Klamath Ranges of California and in Oregon (*G. newberryi* sensu Mason) do appear to merit some taxonomic distinction from the more widespread "*tiogana*" plants with white or faintly blue-tinged corollas in the Sierra Nevada of California and adjacent Nevada. The following combination is therefore made:

GENTIANA NEWBERRYI A. Gray var. TIOGANA (Heller) J. Pringle, comb. nov. — BASIONYM: *Gentiana tiogana* Heller, Leafl. W. Bot. 2:221. 1940.

Gentiana newberryi var. *newberryi* in this concept corresponds to *G. newberryi* sensu Mason (1960). Some plants in the Cascade Ranges and the northernmost Sierra Nevada of California appear to be genuine intermediates. Most of the "hybrids" and "intermediates" of earlier identifications, however, should probably be included in var. *tiogana* as low-altitude forms.

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Mathew, Brian. 1989. The genus *Lewisia*. 171 (151 numbered) pp. with 28 color photographs, 12 botanical watercolors, and numerous maps and drawings. \$29.95 plus \$3.00 shipping & handling, Hardbound. Order from: Timber Press, Inc., 9999 SW Wilshire, Portland, OR 97225. Tele: 800/327-5680; Fax: 503/292-6607. This is a Kew Magazine Monograph Series published by The Royal Botanic Gardens, Kew in association with Christopher Helm and Timber Press. From the flyer accompanying the book:

"This latest in the celebrated series of Kew Monographs treats one of the genera most esteemed by alpine enthusiasts everywhere, even though the genus comprises only 19 species and its range is confined to western North America. Within the species there is much natural variation, and selection and hybridization has further enlarged the scope of plants available."

"The book presents a comprehensive taxonomic account of the genus, with much information on the history, morphology, and relationships of Lewisias. Since it is written for horticulturists as well as botanists, details of cultivation are provided, as well as a useful list of currently available cultivars. Christabel King's lovely watercolors perfectly complement Brian Mathew's authoritative text."

A NEW SPECIES OF *LIATRIS* (ASTERACEAE) FROM THE CAROLINA SANDHILLS[1]

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ABSTRACT

Liatris regimontis (Small) Schumann has been regarded as a species widely distributed in the western Piedmont and adjacent provinces of Virginia, North Carolina, South Carolina, and Georgia. Principal components analyses (PCA) show that the holotype and an isotype of *L. regimontis* from the western Piedmont of NC are close morphological approximates of the holotype of *L. graminifolia* var. *smallii* (Britton) Fern. & Griscom from the mountains of VA and that the two types of the former species fall well within the range of morphological variability described by a sample of the latter variety. It is concluded that *L. graminifolia* var. *smallii* and the types of *L. regimontis* represent the same taxon. PCA and cluster analyses show that specimens from the Fall-line sandhills of North and South Carolina previously determined by other investigators as *L. regimontis* are morphologically discontinuous with material from other portions of the species range, including the holotype and isotype, and with collections of *L. graminifolia* var. *smallii*. This distinct sandhills plant is here described as a new species, *Liatris cokeri* Pyne & Stucky. In a geographical zone in the Coastal Plain of the Carolinas, where the ranges of *L. cokeri* and *L. graminifolia* become contiguous, specimens that are morphologically intermediate between the two species have been collected.

Liatris regimontis (Small) Schumann ha sido considerada una especie ampliamente distribuida en la parte occidental del Piedmont y en provincias próximas de los estados de Virginia, Carolina del Norte, Carolina del Sur, y Georgia. Los análisis de componentes principales (PCA) muestran que el holotipo y un isotipo de *L. regimontis* de la parte occidental del Piedmont en Carolina del Norte son próximas en morfología al holotipo de *L. graminifolia* var. *smallii* (Britt.) Fern. & Griscom de las montañas de Virginia, y que los dos tipos de la primera especie se hallan dentre del rango de variabilidad morfológica circumscrita por un muestréo de la seguna variedad. Se concluye que *L. graminifolia* var. *smallii* y los tipos de *L. regimontis* representan el mismo taxon. PCA y análisis de grupos ("cluster analysis") muestran que especímenes del area Fall-line sandhills en Carolina del Norte y del Sur, anteriormente identificados como *L. regimontis* por otros investigatores, son morfológicamente discontinuos con colectas de otras areas de la distribución de la especie, incluyendo el holotipo e isotipo, y con colectas de *L. graminifolia* var. *smallii*. Esta planta distinta de las colinas arenosas se describe aquí como una espeeie nueva, *Liatris cokeri* Pyne & Stucky. En una zona geografica donde la distribución de *L. cokeri* y de *L. graminifolia* son contíguas, especímenes que son morfológicamente intermedios entre las dos especies han sido colectados.

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INTRODUCTION

In preparation for a taxonomic study of *Liatris* Series Graminifoliae, herbarium material (GH, NCSC, NCU, NY, USCH) of the five species in the series was examined. A problem with the circumscription of *L. regimontis* (Small) Schumann was revealed. Most treatments (Godfrey 1948; Fernald 1950; Cronquist 1952, 1963, 1980) follow Gaiser's (1946) by recognizing *L. regimontis* as a widely distributed species (Atlantic Coastal Plain to western Piedmont, Va to Ga) which inhabits a variety of substrates. In contrast Ahles (in Radford et al. 1968) applies this name to plants only of the Carolina Fall-line sandhills as defined by Duke (1961). The plants from outside the sandhills region included in *L. regimontis* by the previous workers are included in *L. graminifolia* by Ahles.

Small (1898) based the original concept of *Lacinaria regimontis* [= *Liatris regimontis* (Small) Schumann] on his collections from King's Mountain, Cleveland County, NC. Alexander (in Small 1933) defines the range of this species as "outliers of the Blue Ridge in the Piedmont, also in adjacent provinces." It is, therefore, surprising that the majority of collections to which the name *Liatris regimontis* has been applied are plants from the Fall-line sandhills. If the species concept of Gaiser and subsequent workers is followed, then *L. regimontis* appears to include two distinct morphological types; one which occurs throughout the Fall-line sandhills and another which occurs in the western Piedmont of Virginia and North Carolina and the Piedmont and Coastal Plain of South Carolina and Georgia. If the species concept of Ahles is followed, then a morphologically more homogeneous species results, but this concept excludes the Cleveland County, NC type location from the species range. If, in fact, *L. regimontis sensu lato* comprises two morphological variants deserving of recognition, then the one from the sandhills must bear a name other than *L. regimontis*.

Most collections compatible with the type material of *Liatris regimontis* have previously been determined as *L. graminifolia* Willd. var. *smallii* (Britton) Fern. & Griscom. Cronquist (1980) lists this variety in synonymy under *L. regimontis*. Numerous collections from the Fall-line sandhills have been determined by other investigators as *L. regimontis* despite their morphological incompatibility with the type material.

Since the present study of *Liatris regimontis* is based largely on specimens determined as *L. graminifolia* var. *smallii*, it is necessary to demonstrate that the types of the two taxa are compatible and that these two names apply to the same plant. Accordingly, the purposes of this study are to (1) demonstrate that the names *Liatris regimontis* and *L. graminifolia* var. *smallii* apply to the same plant, (2) determine if material from the Fall-line sandhills is morphologically distinct from material of the Piedmont and

Coastal Plain portion of the range of *L. regimontis*, and (3) present the most appropriate taxonomic treatment. (Henceforth in this paper, unless otherwise indicated, the element of the Fall-line sandhills will be called the "sandhills plant;" the more widely distributed element of a western Piedmont and Coastal Plain distribution will be called *Liatris graminifolia* var. *smallii*).

MATERIALS AND METHODS

Collections of *Liatris regimontis* and *L. graminifolia* var. *smallii* obtained from G, NCSC, NCU, NY, and USCH were examined.

LIATRIS REGIMONTIS - L. GRAMINIFOLIA VAR. SMALLII COMPARISON — Data for principal components analysis (PCA) was obtained from the holotype and an isotype specimen of *L. regimontis* [NORTH CAROLINA. Cleveland Co.: King's Mt., 27 – 30 Aug 1894, *J. K. Small s.n.* (HOLOTYPE: NY!; ISOTYPE: NY!)], the holotype of *L. graminifolia* var. *smallii* {VIRGINIA. Smyth Co.: along Dickey Creek on Iron Mtn., 2900,' 8 Aug 1892, *J. K. Small s.n.* (HOLOTYPE:NY!)}, 22 specimens of *Liatris graminifolia* var. *smallii* from western Piedmont sites, 16 specimens of *L. graminifolia* var. *smallii* from Coastal Plain sites, and five specimens of *L. graminifolia* var. *graminifolia* (Table 1). The last taxon was included to provide outgroup comparison.

States of seventeen characters (Table 2) determined for each specimen constituted data set A. The OTU (specimen) X character matrix was standardized by characters and a character correlation matrix was derived from the standardized matrix. PCA was performed on this correlation matrix.

LIATRIS REGIMONTIS TYPE SPECIMENS - SANDHILLS PLANT COMPARISON — Univariate comparison of the holotype and an isotype of *Liatris regimontis* (see above) and 65 specimens of the sandhills plant was performed. Characters utilized were among those mentioned in Small's type description of *Lacinaria regimontis* (1898).

LIATRIS GRAMINIFOLIA VAR. SMALLII - SANDHILLS PLANT COMPARISON — A data set was compiled for 25 sandhills plant specimens, 22 *L. graminifolia* var. *smallii* specimens from western Piedmont sites, 16 *L. graminifolia* var. *smallii* specimens from Coastal Plain sites, the holotype of *L. graminifolia* var. *smallii*, the holotype and isotype of *L. regimontis*, and 5 specimens of *L. graminifolia* var. *graminifolia* included as outgroup representatives (Table 1). The full data set comprising 17 characters, data set B, and a subset of data comprising six characters (Table 2,), data set C, were each subjected to PCA which was performed as described above. Data set C comprised quantitative expressions of those characters included in the univariate comparison. Cluster analyses were performed on data sets B and C. Taxonomic resemblance between OTU's was measured using the chord distance equation (Pielou 1984) and Gower's coefficient of similarity (Gower 1971). The resulting distance matrices were subjected to UPGMA clustering (Sneath and Sokal 1973). Results for those analyses utilizing Gower's coefficient will be presented as phenograms.

TABLE 1. Group designation, geographic origin, collection number, and OTU number for specimens included in this study.

Group Designation[a]	Geographic origin (Co./State)	Collection No.	OTU
L. graminifolia			
var. *smallii*, WP[b]	Avery/NC	*Ahles & Duke 49602*	38
	Cleveland/NC[c]	*Small s.n.*	59
	Cleveland/NC[d]	*Small s.n.*	18
	Gaston/NC	*Fox 5426*	39
	Iredell/NC	*Veerhoff s.n.*	44
	Lincoln/NC	*Bell 15349*	42
	McDowell/NC	*Beaman 64*	47
	McDowell/NC	*Beaman 210*	48
	McDowell/NC	*Beaman 220*	34
	McDowell/NC	*Bell 4477*	32
	Mecklenberg/NC	*Ahles & Duke 50000*	45
	Rutherford/NC	*Fox 5273*	37
	Stokes/NC	*Godfrey & Fox 48575*	51
	Stokes/NC	*Radford 41403*	31
	Surry/NC	*Godfrey & Fox 50181*	35
	Transylvania/NC	*Bannister & Anderson 702*	52
	Transylvania/NC	*Cooper 2373*	33
	Transylvania/NC	*Godfrey & Fox 49919*	41
	Transylvania/NC	*Hardin 2222*	50
	Oconee/SC	*Powell & Patton s.n.*	18
	Oconee/SC	*Radford 17765*	49
	Pickens/SC	*Radford 16457*	36
	Union/SC	*Bell 10616*	46
	York/SC	*Ahles 34488*	43
	Smythe/VA[e]	*Small s.n.*	60
L. graminifolia var. *smallii*, CP[f]			
	Elbert/GA	*Coile 1384*	75
	Hart/GA	*McCarthy s.n.*	67
	Allendale/SC	*Bell 5220*	68
	Bamberg/SC	*Ahles 37615*	74
	Bamberg/SC	*Ahles 37634*	72
	Berkeley/SC	*Ahles 35525*	79
	Calhoun/SC	*Ahles 35362*	70
	Charleston/SC	*Ahles & Haesloop 38132*	80
	Colleton/SC	*Rayner 1840*	78
	Florence/SC	*Bartlett 2856*	69
	Hampton/SC	*Ahles & Bell 18274*	73

TABLE 1 (continued)

	Jasper/SC	*Bell 5117*	76
	Lexington/SC	*Hutto 199*	71
	Orangeburg/SC	*Ables 34949*	66
	Richland/SC	*Godfrey 50747*	40
	Williamsburg/SC	*Radford 3115*	77
Sandhills	Cumberland/NC	*Ables & Leisner 33484*	14
	Harnett/NC	*Fox & Whitford 1836*	9
	Harnett/NC	*Rock 661*	27
	Hoke/NC	*Ables 36348*	57
	Hoke/NC	*Ables 36491*	58
	Hoke/NC	*Duke R-3289*	6
	Hoke/NC	*Godfrey & Fox 50551*	54
	Montgomery/NC	*Radford 19636*	14
	Moore/NC	*Godfrey 50098*	56
	Moore/NC	*Duke Q-3355*	8
	Moore/NC	*Wicken s.n.*	46
	Richmond/NC	*Freeman 56768*	1
	Richmond/NC	*Radford 19324*	29
	Robeson/NC	*Fox 5568*	10
	Scotland/NC	*Duke 2507*	4
	Scotland/NC	*Duke 3240*	3
	Wayne/NC	*Bruton 406*	2
	Chesterfield/SC	*Bradley & Sears 3505*	30
	Chesterfield/SC	*Duke & Ables 2200*	5
	Darlington/SC	*Coker s.n.*	28
	Darlington/SC	*Smith 1019*	13
	Dillon/SC	*Ables 37096*	12
	Kershaw/SC	*Duke 2313*	16
	Kershaw/SC	*Duke Q-2936*	53
	Marlboro/SC	*Duke Q-3110*	7
Intermediate	Bladen/NC	*Ables 37366*	23
	Bladen/NC	*Crutchfield 5591*	25
	Columbus/NC	*Bell 15837*	22
	Columbus/NC	*Bell 15944*	21
	Cumberland/NC	*Ables 36528*	20
	Johnston/NC	*Godfrey & Fox 48703*	11
	Robeson/NC	*Britt 2583*	26
	Wayne/NC	*Radford 28836*	19
	Horry/SC	*Duke 0199*	24
L. graminifolia var. *graminifolia*	Chatham/NC	*Massey & Massey 2979*	65
	Pender/NC	*Ables 36171*	64
	Union/NC	*Ables 34012*	62
	Warren/NC	*Bozeman & Radford 11549*	61
	Washington/NC	*Radford 42375*	63

[a]Group designation at initiation of study.
[b]Western Piedmont.
[c]Holotype of *L. regimontis* (Small) Schumann.
[d]Isotype of *L. regimontis* (Small) Schumann.
[e]Holotype of *L. graminifolia* var. *smallii* (Britton) Fern. & Grisc.
[f]Coastal Plain.

Nine herbarium specimens appeared morphologically intermediate (Table 1) and could not be designated with confidence as either *Liatris graminifolia* var. *smallii* or the sandhills plant. Data from these specimens added to data sets B and C yielded data sets D and E, respectively. PCA was performed on both D and E.

RESULTS

LIATRIS REGIMONTIS - L. GRAMINIFOLIA VAR. SMALLII COMPARISON — The first axis of the PCA explained 24.1% of the data variation. The characters loading heavily on this axis pertained to head and flower size and head density along the inflorescence axis (Table 3). The second axis explained 16.0% of the data variation and was interpreted primarily as a phyllary shape axis (Table 3). Although somewhat distinguished by the second PCA axis, the PCA scores of the type specimens (OTU's 18, 59, 60) were relatively compatible (Fig. 1). In relation to the total array of PCA scores, the scores for the types were not centrally located; however, they were clearly not disparate. Although there was not a discernable discontinuity between PCA scores for western Piedmont and Coastal Plain

TABLE 2. Characters and character states used in the multivariate study.

PEDICEL:	1.	Pedicel length (mm)
HEADS:	2.	Number/3 cm inflorescence axis[a]
	3.	Orientation: 1, strongly divergent; 2, weakly divergent 3, strongly ascending
INVOLUCRE	4.	Height (mm)
	5.	Width (mm)[a]
PHYLLARIES:	6.	Outer phyllary planation: 1, flat; 2, cupped; 3, keeled[a]
	7.	Inner phyllary length (mm)
	8.	Inner phyllary width (mm)
	9.	Inner phyllary shape index: [length (mm) - distance from apex to point of greatest width]/ length (mm)[a]
	10.	Inner phyllary apex shape: 1, truncate; 2, obtuse; 3, acute; 4, acuminate
	11.	Inner phyllary apex reflexion: 1, none; 2, weak; 3, strong
	12.	Inner phyllary apex planation: 1, flat; 2, involute[a]
	13.	Extent of scarious margin on inner phyllary: 1, basal 2/3; 2, basal 2/3 but not around apex; 3, complete
FLOWERS:	14.	Number/head[a]
	15.	Corolla tube length (mm)
	16.	Pappus length (mm)
PUBESCENCE:	17.	Density on petioles, inflorescence bracts, and phyllaries: (Density was assessed on each part and the three assessments summed.): Character states for individual parts were 0, glabrous; 1, sparse; 2, moderate; 3, dense

[a]Included in data sets C and E.

TABLE 3. Character loadings with absolute values greater than 0.5 for the first two principal component axes.

Data Set	PCA Axis	Character	Loading
A	I	no. heads/3 cm	0.670
		involucre height	-0.736
		involucre width	-0.738
		phyllary length	-0.820
		corolla length	-0.805
		pappus length	-0.811
	II	inner phyllary apex shape	0.754
		extent scarious margin on phyllary	-0.604
B	I	no. heads/3 cm	-0.761
		involucre width	0.690
		inner phyllary apex shape	-0.691
		inner phyllary reflexion	-0.519
		no flowers/head	0.788
		outer phyllary planation	-0.722
		inner phyllary planation	-0.749
	II	Involucre height	0.683
		phyllary length	0.868
		corolla length	0.767
		pappus length	0.797
C	I	no. heads/3 cm	-0.782
		involucre width	0.742
		inner phyllary apex shape	-0.626
		no. flowers/head	0.843
		outer phyllary planation	-0.745
		inner phyllary planation	-0.779
	II	involucre width	0.506
		inner phyllary apex shape	0.662

specimens, material of these geographical ranges constituted two phases of the distribution of OTU's in two-dimensional space. PCA scores for the five outgroup OTU's were discontinuous with the body of scores for the 41 other OTU's.

LIATRIS REGIMONTIS TYPE SPECIMENS - SANDHILLS PLANT COMPARISON — The univariate comparison of the type specimens of *Liatris regimontis* with specimens of the sandhills plant suggested a morphological distinction between the two (Table 4).

LIATRIS GRAMINIFOLIA VAR. SMALLII - SANDHILLS PLANT COMPARISON — The first axis of the PCA performed on data set B explained 26.0% of the data variation. Characters loading heavily on this axis pertained to head size and density in the inflorescence and phyllary shape (Table 3). The

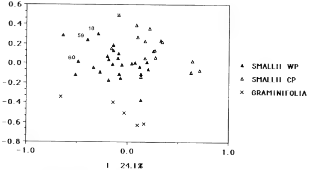

FIG. 1. PCA of data set A showing PCA scores of OTU's on axes I and II. OTU 18 = isotype of *Liatris regimontis* (Small) K. Sch.; 59 = holotype of *L. regimontis*; 60 = holotype of *L. graminifolia* var. *smallii*. (Britt.) Fern. & Grisc. WP = Western Piedmont; CP = Coastal Plain.

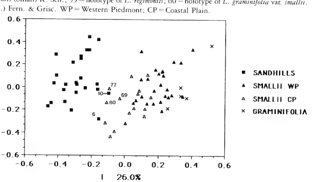

FIG. 2. PCA of data set B showing PCA scores of OTU's on axes I and II. Numbered OTU's are interpreted as intermediate between the sandhills plant and *Liatris graminifolia* var. *smallii*. OTU's are identified in Table 1. WP = Western Piedmont; CP = Coastal Plain.

second axis explained 15.6% of the data variation and was interpreted primarily as a head and flower length axis (Table 3). A discontinuity between the PCA scores for the sandhills plant and those for *Liatris graminifolia* var. *smallii* and the types of *L. regimontis* was evident along the first axis (Fig. 2). This discontinuity was greater than that between *L. graminifolia* var. *smallii* and the outgroup OTU's. This discontinuity was broached somewhat by two disparate specimens of the sandhills plant from

TABLE 4. Comparison of the holotype and isotype of *Liatris regimontis* with the sandhills plant.

Character	*Liatris regimontis*	Sandhills plant
Inflorescence	heads frequently widely spaced along inflorescence axis; not secund	heads closely spaced along inflorescence axis; frequently secund
Involucre shape	obconic	narrowly obconic
Inner phyllary apex	acute, not involute	acute to acuminate, involute
Outer phyllaries	cupped	strongly cupped to keeled
Flowers/head	9 – 12	4 – 9 (10)

Robeson (OTU 10) and Hoke (6) counties, NC, and three specimens of *L. graminifolia* var. *smallii* from Charleston (80), Florence (69), and Williamsburg (77) counties, SC.

The first axis of the PCA performed on data set C explained 57.1% of the data variation. Characters loading heavily on this axis pertained to head size and density and phyllary shape (Table 3). The second axis explained 15.6% of the variation and was interpreted as a phyllary shape and head size axis (Table 3). The discontinuity between the sandhills plant and *Liatris graminifolia* var. *smallii* plus the types of *L. regimontis* along axis one was approximately equal to that between the latter taxon and the outgroup OTU's (Fig. 3). The sandhills specimen from Robeson (OTU 10) County, NC, and the specimens of *L. graminifolia* var. *smallii* from Charleston (80), Florence (69), and Williamsburg (77) counties, SC, were, again, intermediate.

The cluster analysis performed on data set B indicated two major clusters; one composed of 24 sandhills plant OTU's and the other composed of 39 *Liatris graminifolia* var. *smallii* OTU's from both Piedmont and Coastal Plain sites including the holotype, the two type specimens of *L. regimontis*, the five outgroup OTU's, and one sandhills plant OTU (Fig. 4). The cluster analysis on data set C also indicated two major clusters; one comprised entirely of *L. graminifolia* var. *smallii* and outgroup OTU's and the other comprised of 25 sandhill plant OTU's plus three OTU's of *L. graminifolia* var. *smallii* from Coastal Plains sites (Fig. 5). Cluster analyses that utilized chord distances agreed closely with those presented here; the primary differences being the distances at which OTU's clustered with each other.

Of the nine specimens that initially appeared morphologically intermediate, specimens from Bladen (OTU's 23, 25) and Columbus (22)

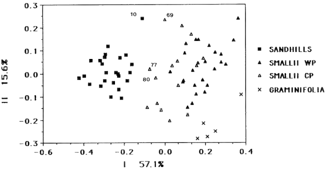

FIG. 3. PCA of data set C showing PCA scores of OTU's on axes I and II. Numbered OTU's are interpreted as intermediate between the sandhills plant and *Liatris graminifolia* var. *smallii*. OTU's are identified in Table 1. WP = Western Piedmont; CP = Coastal Plain.

counties, NC, and Horry (24) County, SC, were shown to be intermediate by PCA (Figs. 6 and 7). The specimens from Robeson (26) and Cumberland (20) County, NC, could, possibly, also be interpreted as intermediate. PCA indicated that the specimens from Johnston (11) and Wayne (19) counties, NC, were compatible with *L. graminifolia* var. *smallii*. The specimen from Williamsburg (77) County, SC, not initially felt to be intermediate and initially annotated as *L. graminifolia* var. *smallii*, was also intermediate according to PCA. Additional initially annotated specimens that could, possibly, be interpreted as intermediate include those from Florence (69) and Charleston (80) counties, SC.

DISCUSSION

LIATRIS REGIMONTIS - L. GRAMINIFOLIA VAR. SMALLII COMPARISON — The PCA showed that the type specimens of *Liatris regimontis* were reasonably congruent with the holotype of *L. graminifolia* var. *smallii* and that all three types were included within the range of variability collectively exhibited by the 38 other specimens of *L. graminifolia* var. *smallii*. These results suggested that *L. graminifolia* var. *smallii* and *L. regimontis* refer to the same plants. The use of specimens determined as *L. graminifolia* var. *smallii* in this study of the circumscription of *L. regimontis* was justified.

Although the Coastal Plain collections of *Liatris graminifolia* var. *smallii* appeared to be somewhat differentiated from the western Piedmont collections, these two aspects formed one continuum of variation. We recommend that these two regional elements not be taxonomically distinguished

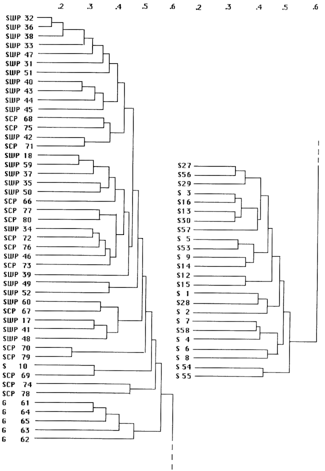

FIG. 4. Phenogram of cluster analysis of data set B. SWP = var. *smallii* of Western Piedmont; SCP = var. *smallii* of Coastal Plain; S = sandhills plant; G = var. *graminifolia* (outgroup). OTU's are identified in Table 1.

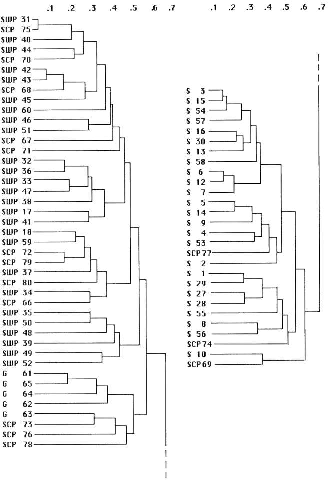

FIG. 5. Phenogram of cluster analysis of data set C. SWP = var. *smallii* of Western Piedmont; SCP = var. *smallii* of Coastal Plain; S = sandhills plant; G = var. *graminifolia* (outgroup). OTU's are identified in Table 1.

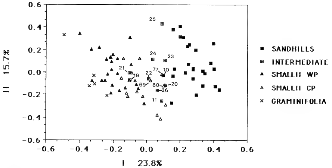

FIG. 6. PCA of data set D showing PCA scores of OTU's on axes I and II. OTU's are identified in Table 1. Intermediate = OTU's initially determined as intermediate between *Liatris graminifolia* var. *smallii* and the sandhills plant; WP = Western Piedmont; CP = Coastal Plain.

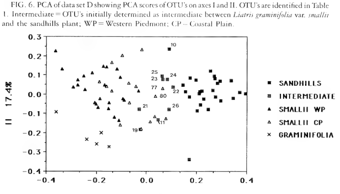

FIG. 7. PCA of data set E showing PCA scores of OTU's on axes I and II. OTU's are identified in Table 1. Intermediate = OTU's initially determined as intermediate between *Liatris graminifolia* var. *smallii* and the sandhills plant; WP = Western Piedmont; CP = Coastal Plain.

at this time and that future study of the relationships between the two is needed. Additionally, study of the distinction between *L. graminifolia* var. *smallii* and *L. graminifolia* var. *graminifolia* is warranted to determine if the former would most appropriately be recognized as a variety or as a species, *L. regimontis* (Small) Schumann.

Liatris regimontis TYPE SPECIMENS - SANDHILLS PLANT COMPARISON — Each character suggested a morphological discontinuity between the types of *Liatris regimontis* and the sandhills plant. Distinguishing the different involucre shapes and the cupped vs. keeled nature of the outer phyllaries exhibited by the two groups was strongly subjective. The characters that most objectively distinguished the two groups were the spacing of heads along the inflorescence axis, involute vs. non-involute nature of inner phyllary apices (Figs. 8 and 9) and number of flowers/head.

LIATRIS GRAMINIFOLIA VAR. SMALLII - SANDHILLS PLANT COMPARISON — The distinction between *Liatris graminifolia* var. *smallii* and the sandhills plant was equal to or greater than that between *L. graminifolia* var. *smallii* and the outgroup OTU's representing *L. graminifolia* var. *graminifolia*, according to the two PCA's. This distinction was also indicated by

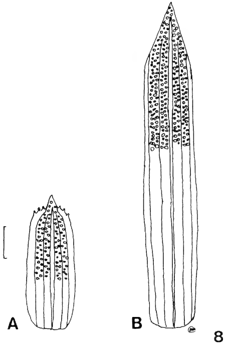

FIG. 8. An outer (A) and an inner (B) phyllary of the sandhills plant. Bar = 1mm.

the two cluster analyses. According to PCA, specimens from a continuous north-south geographical zone from Cumberland County, NC, to Williamsburg County, SC, were morphologically intermediate between *L. graminifolia* var. *smallii* and the sandhills plant (Fig. 10). All specimens which initially appeared intermediate prior to the analyses were included in the final PCA while only a sampling of those specimens that appeared typical for the sandhills plant and *L. graminifolia* var. *smallii* were included. In view of this "heavy sampling" of potential intermediates, it is our opinion that the relatively few OTU's that were shown by the numerical analyses to be truly intermediate do not obviate the overall discontinuity between the sandhills plant and *L. graminifolia* var. *smallii*.

Both PCA and cluster analyses suggested that the affinity of the sandhills plant is stronger with the Coastal Plain aspect of *Liatris graminifolia* var. *smallii* than with the western Piedmont aspect. If Gaiser (1946) was correct in suggesting that the widely distributed, morphologically variable *L. graminifolia* is the evolutionary ancestor to the other geographically more restricted, less variable taxa in series Graminifoliae, the results of the current study suggested that the sandhills taxon evolved from ances-

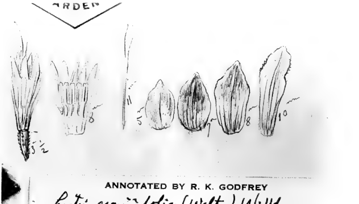

FIG. 9. Series of phyllaries, outer (shortest) to inner (longest), of *Liatris regimontis*. This is the drawing that is on the holotype of *L. regimontis* (Small) Schumann.

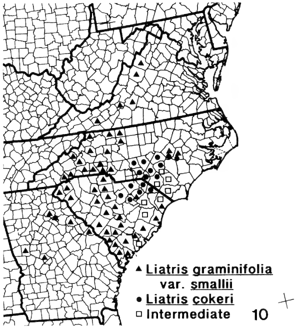

FIG. 10. Distributions of *Liatris cokeri*, *L. graminifolia* var. *smallii*, and intermediates between the two taxa.

tral *L. graminifolia* populations of the Coastal Plain. The current study does not provide an adequate basis for determining if the more likely ancestor is *L. graminifolia* var. *smallii* or *L. graminifolia* var. *graminifolia*, the latter variety common in the Coastal Plain of North Carolina, because so few specimens of the latter variety were included in the analyses. Investigations of the relationships of the sandhills plant with the two varieties are warranted. The intermediate specimens could indicate a zone of primary intergradation between the sandhills plant and its ancestral Coastal Plain populations (Fig. 10) or they could indicate hybridization between differentiated populations.

Our results show that the sandhills plant should be recognized as a species since it is morphologically distinct from plants representative of a species concept in which it has previously been included. We are not the first to recommend its taxonomic recognition. The label of an R. K. Godfrey collection of the sandhills plant (*Godfrey 50098*, Moore Co.: NC, 15 Sep 1949) states, "This is considered by Gaiser to be *L. regimontis* (Small) Schumann, but is considered by the collector to be an entirely different taxon." Godfrey annotated this and other specimens (NCSC) as *Liatris carinata* (Small) Coker. *Laciniaria carinata* Small (1903), the basionym of *Liatris carinata* (Small) Coker, has been lectotypified to a specimen of *Liatris secunda* Ell. (1822); therefore, *Liatris carinata* (Small) Coker is a synonym for *L. secunda* Ell. and is not available for the sandhills taxon (Pyne and Stucky 1990). A name for the sandhills species must be published.

NEW SPECIES OF *LIATRIS*

1. **Liatris cokeri** Pyne & Stucky, sp. nov.

Species nova similiter *L. regimontis* (Small) Schumann optimo distinguitur a capitulis approximatioribus, apices phyllariis intimis involutis, floribus paucioribus per capitulo. Species nova similiter *L. secunda* Ell. optimo distinguitur a caule glabrate, phyllariis carinatis, patenibus ad reflexis, involucro paulo brevior et corolla et pappo multo brevior.

Perennial herb; rootstock corm-like, globose, 0.8 − 3.0 cm wide. Stems 1 − 5 per corm, usually unbranched, frequently drooping or upright, glabrous, usually sparsely minutely glandular, 25 − 85 cm tall. Leaves linear, densely punctate on both surfaces, occasionally sparsely hirsute along midvein on either or both surfaces, margins irregularly ciliate near base or occasionally glabrous, (1.8) 2.0 − 4.8 (5.0) mm wide × 0.5 − 1.8 (2.0) dm long, length gradually reduced upwards. Inflorescence a spike or compact raceme; heads imbricate along rachis, frequently secund, sessile or on bracteate peduncles to 6.0 mm long, closely ascending or diverging particularly when heads secund. Involucres narrowly obconic, 4.8 − 10.5 mm long × 4.0 − 7.8 (8.0) mm wide at tips of phyllaries during anthesis; phyllaries imbricate in several series, punctate, scarious-margined, usually minutely ciliate or occasionally glabrous; inner phyllaries strongly acute to acuminate, apically involute and spreading to reflexed, 5.0 − 8.8 (9.0) mm long; outer phyllaries acute, strongly cupped to keeled. Flowers 4 − 9 (10) per head, corolla tube pink, glandular outside, pilose basally inside, 4.2 − 7.0 (7.5) mm long. Pappus barbellate, 4.0 − 7.0 mm long. Mature achenes obconic, 2.7 − 3.8 mm long, 0.8 − 1.2 mm wide at apex, angular in cross section, longitudinally ribbed, densely hirsute with ascending trichomes, gray to black.

TYPE: NORTH CAROLINA. Harnett Co.: 0.2 mi E jct. NC rt. 27 and co. rt. 1242 along NC 27 on S side road; sandy roadside and margin of longleaf pine/turkey oak/

wiregrass vegetation; 23 Sep 1989, *J.M. Stucky 511* (HOLOTYPE: NCU; ISOTYPES; GH, NCSC, NCU, NY, US, USCH).

This species is named in recognition of Dr. W. C. Coker who contributed significantly to the botany of the Carolinas and who included this species, calling it *Liatris carinata* (Small) Coker, in *The Plant Life of Hartsville, S.C.* (1912). Although the resolution of a lectotypification problem makes his combination incorrect for this species (Pyne and Stucky 1990), Dr. Coker should be recognized. As far as can be determined, the only vascular plant presently bearing the epithet *cokeri* is *Lycopus cokeri* Ahles.

As stems of *Liatris cokeri* grow longer and as heads mature and become heavier, the degree of drooping of the stems usually increases. On these drooping stems, the heads respond phototropically, causing the secund nature of the inflorescence. Due to its phenological basis, the secund inflorescence becomes more prevalent as the growing season progresses. The non-secund nature of an inflorescence should carry little diagnostic significance, particularly for specimens collected early in the growing season.

Liatris cokeri and *L. secunda* Ell. frequently form mixed populations in the Fall-line sandhills of the Carolinas and thus the species have often been confused. The basis of this confusion undoubtedly is their shared habitat and the secund inflorescence. Several characters do, however, distinguish *L. cokeri* from *L. secunda* in this area (Table 5).

KEY TO SPECIES OF *LIATRIS* OF THE CAROLINA
FALL-LINE SANDHILLS AND ADJACENT OUTER COASTAL PLAIN

1. Pappus plumose .... *L. squarrosa*
1. Pappus barbellate 2
   2. Middle and/or outer phyllaries squarrose; heads tending to be turned away from the axis, not secund .... *L. earlei*

TABLE 5. Distinctions between *Liatris cokeri* and *L. secunda*.

Character	*Liatris cokeri*	*Liatris secunda*
Stem pubescence	Lacking	Usually densely, minutely, hirsute basally
Involucre length	4.8 − 10.5 mm	8.8 − 12.2 mm
Phyllary keeling and reflexion	Outer frequently distinctly keeled; spreading to reflexed	Outer weakly keeled; appressed or barely spreading
Corolla tube length	4.2 − 7.0 (7.5) mm	7.8 − 9.0 mm
Inner corolla tube pubescence	Evident basally	Lacking or sparse
Corolla lobe length	1.5 − 3.0 mm	3.0 − 5.0 mm

2. Phyllaries appressed or spreading, not squarrose; heads ascending or, if turned away from the axis, secund 3
3. Inner corolla tube glabrous or nearly so 4
3. Inner corolla tube evidently hairy toward base 6
4. Inflorescence secund; involucre 8.8 − 12.2mm long; stem usually densely short pubescent basally, occasionally glabrous . . . . *L. secunda*
4. Inflorescence not secund; involucre 5.8 − 11.5mm long; stem glabrous or nearly so 5
5. Heads sessile; basal leaves >3.5mm wide . . . . *L. spicata*
5. Heads pedicellate; basal leaves <3.5mm wide . . . . *L. tenuifolia*
6. Inner phyllaries acute to acuminate, more or less spreading 7
6. Inner phyllaries obtuse to acute, appressed . . . . . . *L. graminifolia* var. *graminifolia*
7. Inner phyllary apices involute; flowers 4 − 10 per head . . . . *L. cokeri*
7. Inner phyllary apices not involute; flowers 8 − 12 per head . . . . *L. graminifolia* var. *smallii*

Liatris earlei (Greene) Schumann and *L. secunda* Elliott, recognized by Ahles (in Radford et al. 1968) are listed in synonymy under *L. squarrulosa* Michaux and *L. pauciflora* Pursh, respectively, by Cronquist (1980).

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LECTOTYPIFICATION OF *LACINIARIA CARINATA* (ASTERACEAE)[1]

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ABSTRACT

No type specimen was designated with the 1903 publication of *Laciniaria carinata* Small (= *Liatris carinata* [Small] Coker). The lectotypification of this name became necessary in order to evaluate its suitability of application to the sandhills blazing-star, which has passed in recent treatments of the genus as part of *Liatris regimontis* (Small) Schumann. Of four specimens obtained from NY which were annotated by Small as *La. carinata*, the one which best fits Small's initial 1903 description is a collection which is actually material compatible with *Liatris secunda* Elliott. This choice of a lectotype is made in accordance with the principle that the lectotype chosen should be the specimen which is most compatible with the author's description. This choice makes *Liatris carinata* a synonym for *Liatris secunda*, and necessitates the naming and description of the sandhills blazing-star as a *species novum*, *Liatris cokeri* Pyne & Stucky.

En la publicación de la descripción de *Laciniaria carinata* Small (= *Liatris carinata* [Small] Coker) en 1903 no fue designado ningún espécimen de tipo. Fue necesaria la lectotipificación de esta denominación para determinar si era adecuado aplicarla al "sandhills blazing-star" (estrella resplandeciente de las colinas arenosas). En los tratos recientes de este genus esta planta se ha considerado como parte de *Liatris regimontis* (Small) Schumann. De los cuatro especímenes recibidos del Herbario de Nueva York, que Small anotó como *La. carinata*, el que mejor corresponde a la descripción inicial de Small, en 1903, es una colecta que en realidad es compatible con *Liatris secunda* Elliott. La elección del presente lectotipo se hace de acuerdo con el principio de que el lectotipo elegido debe ser el espécimen que mejor corresponde a la descripción hecha por el autor. Esta elección hace que *Liatris carinata* sea un sinónimo de *Liatris secunda*, y hace necesaria la descripción y denominación de la sandhills blazing-star como una *species novum*, *Liatris cokeri* Pyne & Stucky.

We recently described a new species, *Liatris cokeri* Pyne & Stucky, endemic to the Fall-line sandhills (Duke 1961) of the Carolinas (Stucky and Pyne 1990). The common name "sandhills blazing star" is appropriate for these plants. *Liatris carinata* (Small) Coker, a 1912 combination based on Small's (1903) description of *Laciniaria carinata* Small, has previously been applied to this new species. The objectives of this article are to: 1) lectotypify *Laciniaria carinata* (= *Liatris carinata*); 2) explain the inapplicability

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of this name to the sandhills species; and 3) justify publishing a description of the "sandhills blazing star" as a new species, *Liatris cokeri*.

Laciniaria carinata appears in the main body of the text in Small (1903). He included three species of *Laciniaria* in his "List of genera and species published in this flora" at the end of the book, but *La. carinata* was not one of them. Since all standard nomenclatural references list Small's "Fl. South. U. S." as the place of original publication, one can only assume that Small simply overlooked inclusion of *La. carinata*. Alexander (in Small 1933) reduced *La. carinata* to synonymy under *La. secunda* (Elliott) Small, a species not included in previous editions of the Flora (Small 1903, 1913).

Coker (1912) lists "*Liatris carinata* (*Laciniaria carinata* Small). Sandy soil south of the lake." The label of a Coker collection (s.n., NCU 78491) bears, in Coker's hand, "Liatris, *Laciniaria carinata*, sandy soil south of lake

TABLE 1. Comparison of Small's description of *Laciniaria carinata* Small with the four specimens which could serve as the lectotype for this name.

Small's character state	A[a]	B	C	D
stem finely pubescent	glabrous	glabrous	glabrous	+
stem 7 – 11 dm tall	+	5.3	5.7	5.1(?)[b]
leaves rather few (?)[c]	(–)	(–)	(–)	(–)
blades narrowly linear	+	+	+	+
blades 2 – 8 cm long	+	+	+	+
blades glabrous	+	+	pubescent on midvein	+
blades acute	+	+	+	+
heads sessile	short peduncled	short peduncled	short peduncled	short peduncled
heads approximate, not crowded	crowded	crowded	+	crowded
heads 3 – 5 flowered	6 – 7	6 – 7	?[d]	+
involucres turbinate	+	+	+	+
involucres 8 – 10 mm high	+	+	7	+
bracts glabrous	ciliolate	ciliolate	ciliolate	+ to minutely ciliolate
bracts acute or somewhat acuminate	distinctly acuminate	distinctly acuminate	acute	+
bracts (outer) keeled	+	+	+	+
bracts (inner) scarious-margined	+	+	+	+
achenes 3 – 4 mm long	2 – 3	2 – 3	2.5 – 3	+
pappus plumose	barbellate	barbellate	barbellate	barbellate[e]

[a]our identifications: A&B = *Liatris cokeri*; C = *Liatris regimontis*; D = *Liatris secunda*
[b]stem apparently fragmentary. Total length cannot be determined.
[c]Small's meaning not clear, so assessements are of dubious value.
[d]heads incomplete; not possible to determine number of flowers per head.
[e]By today's standards, pappus of all specimens would be called barbellate; however, pappus bristles of specimen D longer than those of other specimens.

Hartsv., sep 6 – 11, Hartsville, S.C., W. C. Coker". The specimen is, without question, an individual of the sandhills blazing star.

Gaiser (1946) included *Laciniaria carinata* and *Liatris carinata* in synonymy under *Liatris regimontis* (Small) Schumann. Contrary to Alexander (in Small 1933) and Gaiser (loc. cit.), we have recognized the sandhills blazing star as a species morphologically distinct from both *Li. regimontis* and *Li. secunda* (Stucky and Pyne 1990). We had to consider using the name *Liatris carinata* for our species. R. K. Godfrey is a long-term researcher of the genus in the southeastern U. S. Herbarium specimens of the sandhills blazing star collected and determined by him as *Liatris carinata* have been observed (GH, NCSC, NCU, NY, TENN, US). Since Coker's name was based originally on Small's description (1903) and Small did not indicate any type material, the question of the correct application of the name depends on lectotypification of *Laciniaria carinata*.

Our request for Small's potential type material (NY) resulted in four herbarium specimens bearing Small's inscription "*Laciniaria carinata*" in his own hand. It was incumbent on us to choose a lectotype from this material in adherence to the intent of the International Code (Greuter 1988). The lectotype should be a specimen used by Small as the basis for his description (1903) and compatible with that description (Rollins 1972). The four specimens are identified and described below. Their significant character states are compared with the character states of *La. carinata* as stated in Small's description (1903) and summarized in Table 1.

A.) North Carolina. *M. Curtis s.n.* This sheet exhibits unambiguously the characteristic features of the Sandhills plant. Curtis' label says "*Liatris secunda* Ell.?"; it is inscribed by Small "*Lacinaria carinata* Small", and further annotated by R. K. Godfrey in 1950 as "*Liatris carinata* (Small) Coker." John Pruski (1986) has noted on the NY specimen "? A syntype of *L. carinata* Small."

B.) South Carolina. *M. Curtis s.n.* This sheet also exhibits the features of the Sandhills plants. Curtis' label applies an apparently unpublished name, *Liatris oxylepis*, to this plant. The inscriptions and annotations by Small and Godfrey are as in the sheet above; Pruski's comment is "? type of *L. carinata* Small?"

C.) Location indecipherable (South Carolina?). 12 Sep 1855, *L. Gibbes s.n.* Original determination (partially obliterated) "*L. gracilis* Ph." Annotated by Small "*Lacinaria carinata* Small;" by A. Cronquist "*L. regimontis* (Small) K. Schum. 1947;" and by R. K Godfrey in 1950 "*Liatris graminifolia* var. *smallii*." The specimen has poorly developed corolla tubes in the heads, making determination difficult.

D.) North Carolina. *A. Chapman s.n.* (for Southern Flora). Original determination "*Liatris pauciflora* Ph." This sheet was inscribed by Small "*Lacinaria carinata* Small", but he subsequently (without date) added " = *L. secunda*." Pruski's comments are "This sheet and 3 others labeled *Lacinaria carinata* Small [i.e. Curtis from NC, Curtis from SC, and a sheet from the Gibbes collection] deposited in NY are POSSIBLE TYPES of *L. carinata* Small, SE Fl. 1174, 1903. However, types not cited in Fl. SE 1903 on pages 1338 – 1339." This specimen exhibits the pubescent stem and larger corollas and heads associated with *L. secunda*.

Considered collectively, these four specimens demonstrated all of Small's character states with the exception of sessile heads and plumose pappi. No single specimen was in complete agreement with all elements of Small's description. However, specimen D showed more character states in agreement with the description than did the other three. The only character states of specimen D that unquestionably departed from Small's description were its short-peduncled and crowded heads. The other three specimens also disagreed with the description of the heads as sessile. The stem of specimen D was broken at the bottom and the length of the complete stem could not be determined from this fragment. The stems of specimens B and C, both shorter than the described stem length, were complete stems. Small's "stem finely pubescent" was clearly a reference to specimen D, the only one with pubescent stems. The pubescence is fine, and clearly present along the entire length of the stem. In addition, only specimen D agreed with both of Small's quantitative character states "heads 3 − 5 flowered" and "achenes 3 − 4 mm long." Specimens A and B, in contrast, have heads with 6 − 7 flowers, and achenes 2 − 3 mm long. Specimen C has achenes 2.5 − 3 mm long. The corolla tubes of its heads are poorly developed, and the number of flowers per head could not be determined. Additional evidence indicating Small's reliance on specimen D when he wrote his description is that it is the only one with a permanent slide of a dissected head in an attached envelope, indicating close inspection. The adhesive on the slide was brownish, indicating considerable age.

Small apparently wrote his description with all four specimens in hand; they all exhibit several character states included in the description. These include leaves rather few; leaf blades narrowly linear, acute, 2 − 8 cm long; involucres turbinate, 8 − 10 mm high; outer bracts keeled, and inner bracts scarious margined. The pappus character presents a problem; the description says "pappus plumose;" by today's standards, the pappus of all four would be called barbellate. The lateral pappus bristles of specimen D are longer than those of the other three specimens. Similarly, even though the description calls for "bracts glabrous," they appear to be ciliolate to some extent on all four. On specimen D, they are minutely ciliolate, and less so than on the other three specimens.

Of the four specimens available to us from which to choose, those we have designated A and B represent the "sandhills blazing-star." Specimen C is a specimen of *Liatris graminifolia* (Walter) Willd. var. *smallii* (Britton) Fern. & Griscom (= *L. regimontis*) Specimen D is *Liatris secunda* Elliott. The current requirements of the Code necessitate the choosing of a single specimen as lectotype which best fits the original description. In this case, it can be only specimen D. After this specimen was tentatively determined by us as *Liatris secunda*, an effort was made to compare it to original type material. As we found no type material at the Elliott Herbarium in Charleston, material labeled "*L. secunda* Elliott ex Herb. Elliott" was obtained from the Gray Herbarium (GH) and compared with the lectotype (specimen D). These two specimens evidently represent the same species, and agree with Elliott's description (1822).

Our conclusions are the following: 1) *Laciniaria carinata* (= *Liatris carinata*) is correctly lectotypified by material compatible with *Liatris secunda*; 2) *Laciniaria carinata* (= *Liatris carinata*) thereby becomes a later synomym for *Liatris secunda*, and is not available for the "sandhills blazing-star"; 3) a name for the "sandhills blazing-star" had not been effectively and validly published prior to our recent publication of it (Stucky and Pyne 1990).

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Book Reviews

Hunter, Carl G. 1989. Trees, Shrubs, and Vines of Arkansas. 207 pp, 311 color photographs. The Ozark Society Foundation, P. O. Box 3503, Little Rock, AR 72203.

This is a companion volume to "Wildflowers of Arkansas" published in 1984 with a second edition in 1988. None of the species published in that work are reproduced again and this expands the number of species treated in this manner for Arkansas. Except for the 325 plant species, subspecies, and varieties described of which 258 are illustrated with 311 color photographs, the rest of the book, Introduction etc., appears to be a repeat version of the "Wildflowers of Arkansas." A new preface and modifications to reflect the change of the nature of the contents has been incorporated as needed. My initial reaction was that I had seen this book before and thus, felt right at home with using it.

The quality of the color photographs is excellent and with the other aspects, it should be another award winning publication like the previous one.

Dunbar, Lin. 1989. Ferns of the Coastal Plain, their lore, legends and uses. 165 pp, 65 illustrations (line drawings) and some unnumbered habit and habitat pen and ink drawings by John Norton. University of South Carolina Press, Columbia, SC 29208. Paperback $11.95, Cloth $21.95. Contact: Lee Ellen Gaither (803) 777-5231; FAX (803) 777-0160.

This field guide also includes some of the folklore, legends, and uses of ferns that make it interesting reading as well as an identification manual. Dichotomous keys are absent but identification is based upon divisions of the frond and examination of the illustrations within those sections. This is an excellent book for the layman and its content should broaden even a pteridologist's perspective.

Marshall, Henry H. 1989. Pembina Hills flora. 83 pp. 3 photographs. Paper, $10.95 each plus $3.00 for postage and handling. Morden and District Museum, Inc., P. O. Box 728, Morden, Manitoba, Canada. R0G 1J0. Tele: 204/822-4150.

This flora is not merely a listing of the species but as the individual chapter titles indicate, it also can be considered an ecological study: Chapter 1. Isolated Floral Communities in the Pembina Hills; Chapter 2. Habitat and Floral Change; Chapter 3. Plant Interactions with Habitat and Living Organisms; Chapter 4. The Pathways of Life; Chapter 5. Pembina Flora Habitat Descriptions; Chapter 6. Pembina Flora Check List; Chapter 7. Botanical Notes; Chapter 8. Manitoba *Helianthus*. The author identifies and discusses the problems encountered and is a worthwhile book even for those not living in Canada since his discussions apply equally well to other areas.

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LEAF VENATION STUDIES IN INDIAN *SIDA* (MALVACEAE)

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ABSTRACT

In *Sida* L., the leaves are simple having serrate margins, except *S. schimperiana*, where the leaves have entire margins. The venation type is pinnate or actinodromous. The leaf shape, apex, base, number of areoles and the vein endings entering the areoles vary from species to species. The highest degree of vein order is resolved up to fifth degree. Vein endings exhibit brachytracheoids as well as tracheoids-in-aggregates.

INTRODUCTION

Recent studies on leaf architecture of dicotyledons by Hickey (1973, 1979) have created much interest and led to several investigations in this field. Many workers also concluded that the venation studies provide useful taxonomic clues in different taxa (Foster 1950, 1951; Tucker 1964; Banerji & Das 1972; Hickey 1973, 1979; Sehgal & Paliwal 1974; Prabhaker & Ramayya 1982; Samant & Shete 1987; Bhat et al. 1988). However, work on foliar venation in the Malvaceae is negligible (Hickey & Wolfe 1975; Bhat et al. 1988) and totally absent in *Sida*. Therefore, in the present investigation, nine taxa of *Sida* have been studied concerning the leaf morphology and venation patterns to fill in this void.

MATERIALS AND METHODS

The materials of *Sida* studied have been collected from different parts of India (Table 1). The mature leaves were first cleared in 50% sodium hypochlorite for 4 − 5 hours and later transferred to a supersaturated solution of chloral hydrate for a day. However, the dry leaves were boiled in 5% sodium hydroxide for 5 − 10 minutes before clearing by the above method. The leaves were stained in safranin and mounted in glycerin. The areole and veinlet frequencies/mm^2 were calculated from an average of 10 readings. The sizes of veins were calculated from the formula vw/lw × 100 (Hickey 1973). Terms to describe the venation and vein endings were

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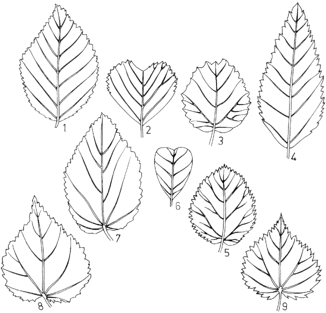
adopted from Hickey (1973), Hickey & Wolfe (1975) and those of tracheoids from Rao & Das (1979).

OBSERVATIONS

The leaves of *Sida* are simple, symmetrical with a range of leaf shapes from lanceolate, orbicular to obovate (Figs. 1 − 9). The apex also varies from acute, acuminate to obovate and emarginate (Figs. 1 − 9). Correspondingly, the leaf base varies from rounded, cuneate to obtuse and acute. The qualitative and quantitative features of leaf venation in the nine taxa of *Sida* are given in Table 1.

The venation patterns encountered in the present study are as follows: *S. rhombifolia* var. *rhombifolia*, *S. rhombifolia* var. *retusa*, *S. grewioides*, *S. acuta* and *S. spinosa* (Figs. 1 − 5) exhibit pinnate eucamptodromous type, but *S.*



FIGS. 1 − 9: 1. *S. rhombifolia* var. *rhombifolia*; 2. *S. rhombifolia* var. *retusa*; 3. *S. grewioides*; 4. *S. acuta*; 5. *S. spinosa*; 6. *S. schimperiana*; 7. *S. cordidolia*; 8. *S. mysorensis*; 9. *S. cordata*. All figures × 0.79.

TABLE 1. *Sida* species collected and studied.

S.L. No. Name of Species	Locality	Shape	Apex	Base	Margin	Texture	Predominate Tert. Vein origin Angle	Marginal Ultimate Venation	No. of 1° Veins	No. of 2° Veins	Angle range between 1° & 2°	Areoles/ mm²	No of Vein end-ings/mm²	Vein pattern
1. *S. acuta* Burm. f.	Hyderabad	Lanceo-late	Acute to acuminate	Rounded	Serrate	Charta-ceous	RR	Incomplete and looped	1	8	Lower pair obtuse, upper acute	88	40	Pinnate, eucamptodrom-ous
2. *S. cordata* Burm. f. Borss.	Hyderabad	Orbicu-lar	-do-	Cordate	-do-	-do-	-do-	-do-	5	8	Acute	20	6	Actinodrom-ous
3. *S. cordi-folia* L.	Hyderabad	Obovate	Obtuse	-do-	-do-	-do-	-do-	-do-	7	6	-do-	51	24	-do-
4. *S. grewioi-des* Guill. & Pers.	Auranga-bad	Ovate	Obtuse	Rounded	-do-	-do-	-do-	-do-	1	8	Lower second-aries more acute than upper pairs	52	24	Pinnate, eucamptodrom-ous
5. *S. mysorensis* W & A.	Bangal-ore	Ovate	Acute	Cordate	-do-	-do-	-do-	-do-	6	8	-do-	50	8	Actinodromous
6. *S. rhombifolia* var. *rhombi-folia* L.	New Delhi	Obovate-rounded, rhomboid elliptic	Acute to acuminate	Cuneate or rounded	-do-	-do-	RR/AR	Looped	1	6	-do-	36	12	Pinnate, eucamptodrom-ous
7. *S. rhombifolia* var. *retusa* L.	Chittoor, A.P.	Obovate linear	Emargi-nate	Acute	-do-	-do-	-do-	-do	1	8	-do-	19	6	-do-
8. *S. schimperi-ana* Hochst.	B.S.I. S. Circle	Obovate	-do-	-do-	entire	-do-	-do-	Looped and incomplete	1	4	-do-	132	74	Pinnate, brochidodro-mous
9. *S. spinosa* L.	Hydera-bad	Elliptic to ovate	Acute	Obtuse to truncate	Serrate	-do-	-do-	-do-	1	8	Acute	126	52	Pinnate, eucamptodrom-ous

schimperiana (Fig. 6) shows pinnate brochidodromous pattern. On the other hand, *S. cordifolia, S. mysorensis*, and *S. cordata* (Figs. 7−9) exhibit actinodromous perfect and basal condition.

In all the taxa studied, the venation is resolved up to quinternary (5°). For the sake of convenience, the observations are presented under different heads, as given below.

Major veins:

Primary veins (1°): The primary vein is the thickest, either occurring singly (in all pinnate taxa; Figs. 1−6) or four to seven in number (in all actinodromous taxa; Figs. 7−9). They run straight in all taxa. The size of the primary vein in all the taxa is weak ($< 1\%$)

Secondary veins (2°): They are the next smaller class of veins arising from the primary vein(s). The angle of divergence is at acute moderate angle (45°−60°). However, in *S. rhombifolia* var. *retusa, S. grewioides, S. acuta* and *S. schimperiana*, the lower secondaries are more acute than the upper ones. Further, the course is mostly straight, excepting in a few upper secondaries, where it is proximally curved.

Minor veins:

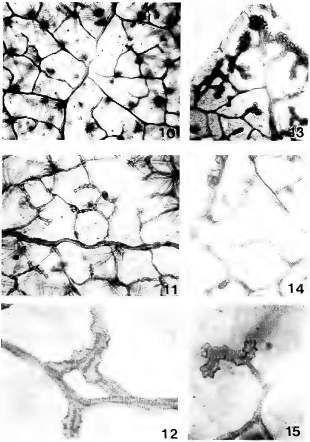
Tertiary veins (3°): They are at right or acute angles (RR & RA), percurrent and they run straight in their course.

Quaternary veins (4°): These veins form areoles in all the taxa studied (Fig. 10). The areoles are well developed and range from quadrangular to rounded in shape (Fig. 11). The number of areoles (per square millimeter) show a wide range and they vary from 19 (*S. rhombifolia* var. *retusa*) to 132 (*S. schimperiana*; Table 1). The course of quaternary veins is orthogonal (Figs. 10−11).

Quinternary veins (5°): These are the highest vein order resolved and they end up in the areoles as vein ending (Figs. 10−11). The vein endings are simple (both linear and curved; Fig. 12) and branched (once or twice; Fig. 13). The number of vein endings entering the areoles range between six (*S. cordata*) and 74 (*S. schimperiana*; per square millimeter; Table 1).

Tracheoids: They are the terminal points on the vein endings, and present either terminally or on the lateral sides. The tracheoids are either brachytracheoids or tracheoids-in-aggregates (Figs. 13 & 14). However, the tracheoids-in-aggregates are totally absent in *S. schimperiana*.

Bundle sheath: It is seen in all the nine taxa studied. They are present around all the degrees of veins in *S. rhombifolia* var. *retusa* and *S. grewioides*, but encircles only the minor veins in the remaining taxa.



FIGS. 10 – 15: 10. *S. cordifolia*: Quaternary veins forming the areoles, × 95; 11. *S. rhombifolia* var. *rhombifolia*: Well developed areoles ranging from quadrangular to rounded in shape, × 98; 12. *S. mysorensis*: An areole with simple, straight and linear vein endings, × 87; 13. *S. acuta*: Tracheoids-in-aggregates, confined to the margins, × 82; 14. *S. spinosa*: Brachytracheoids, × 82; 15. *S. cordata*: Gamma junction type of vein ending, × 89.

Sphaerocrystals: They are encountered only in *S. grewioides* and *S. schimperiana* and they line all the grades of veins.

Tooth architecture: It is studied in all the species except *S. schimperiana*, where the margin is entire. The teeth are compound, non-glandular with simple apical termination. The principal vein configuration of the tooth is a secondary vein in the bigger teeth. However, in actinodromous species the lateral primaries also enter the bigger teeth.

DISCUSSION

According to Hickey & Wolfe (1975), the leaves of Malvales are simple and venation is of actinodromous type (= Rectipalmatus type of Melville 1976). Recently, Bhat et al. (1988) working on Malvaceae (other than *Sida*) recorded actinodromous and pinnate types of venation. In the present study of *Sida* too, the venation is broadly assignable to actinodromous and pinnate categories.

According to Hickey & Wolfe (1975), the pinnate type might have evolved through the suppression of the lateral primaries of the actinodromous category in the Malvales. In this connection, it is interesting to note that in *S. rhombifolia* var. *rhombifolia*, *S. grewioides* and *S. spinosa* (Figs. 1, 3 & 5), some of the lower secondaries tend to be thicker than the others, but certainly distinct from the midrib. Thus, the above taxa may possibly form a connecting link between pinnate and actinodromous types in *Sida*.

Recently Samant & Shete (1987), working on *Cassia*, advocated a correlation between the plant habit and orders of venation. According to them, the herbs possess 2° veins as their highest vein order and the trees have $5-7^\circ$ as their highest order. In the present study, the highest vein order is uniformly 5° in all the taxa studied. Unlike the herbaceous *Cassia*, the situation in *Sida* is totally different as they are either herbs or undershrubs. Therefore, the present investigation does not favour any correlation between the plant habit and presence of particular order of venation.

As stated earlier, the highest venation order in *Sida* is resolved up to 5° which, however, differs from the observations made earlier in the Malvaceae (Bhat et al. 1988) where it is up to 6°.

Levin (1929) proposed the usage of areole number as a taxonomic tool. In the present investigation also, the number of areoles are found to be species specific (Table 1).

The vein endings in *Sida* are simple (linear & curved; Fig. 12) or branched (once or twice). Of the nine different types of vein endings proposed by Melville (1976), presently gamma type alone is observed (Fig. 15).

The termini of vein endings are either brachytracheoids (Fig. 14) or tracheoids-in-aggregates (Fig. 13). It has been suggested that the presence of tracheoids is an adaption to xeric conditions (Verghese 1969; Kakkar & Paliwal 1972; Sehgal & Paliwal 1974; Mohan & Inamdar 1984). Further, it is also suggested that they may provide mechanical support (Withner et al. 1974; Olatungi & Nengim 1980; Mohan & Inamdar 1984) or help in water retention (DeFraine 1912; Pant & Bhatnagar 1977). The present study also reveals the tracheoids, which may possibly help in the water retention potentialities of *Sida* occurring in dry habitats in India.

According to Bhat et al. (1988), the parenchymatous bundle sheath encloses only the primary and secondary veins in some species of the Malvaceae. In *Sida*, the bundle sheath is encountered on minor veins on all the taxa investigated. However, in *S. rhombifolia* var. *retusa* and *S. grewioides* they are encountered on all the degrees of veins.

The present study puts forth several characteristics of leaf architecture that are diagnostic and help in the identfiication of species.

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A NEW SPECIES OF *IBERVILLEA* (CUCURBITACEAE) FROM WESTERN MEXICO

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ABSTRACT

A new species of *Ibervillea* is described from western Mexico. *Ibervillea maxima* is most closely related to *I. hypoleuca* (Standl.) C. Jeffrey, but has a more robust stature and larger fruit.

Although there are problems with some of the names proposed for *Ibervillea*, study of recent collections by the authors, cultivation of plants from seed and subsequent review of herbarium material from Jalisco, Nayarit, and Sinaloa make necessary the addition of the following species:

Ibervillea maxima Lira & Kearns, sp. nov. (Fig. 1)

Ibervillea maxima Lira et Kearns, sp. nov. *I. hypoleuca* (Standl.) C. Jeffrey affinis, a qua fructu grandiore (13 − 15 cm longo, 6 cm lato), ellipsoideo, et pedunculo breviore crassioreque (ca. 10 mm diam.) differt; petala ca. 12-nervis.

Large climbing, deciduous, perennial and dioecious vine, with fleshy, branched, tuberous rootstocks. Stems perennial, 4 − 12 m long, soft-woody, terete, densely striose, becoming ± glaberous in age, with scattered lenticels. Tendrils simple, densely pubescent when young, glabrous and woody in age. Leaves broadly ovate-cordate to subreniform, slightly 3-lobed; lobes broad, obtuse; base cordate with wide sinuses; margins obscurely and sparsely denticulate; lamina ± indurate, 9.5 − 15 cm long, 12.5 − 20 cm wide; upper surface hispid-scabrous; lower surface very densely hispid-scabrous; petioles terete, pubescent, 3 − 7.5 cm long. Staminate inflorescences densely pubescent, of 4 − 10 flowers clustered in shortened racemes, appearing glomerate, with 1 − 2 flowers at anthesis at any one time; peduncle 12 − 18 mm long; pedicels 10 − 25 mm long; flowers salverform, pubescent, ± showy; hypanthium clyindric, slightly expanded in the throat, slightly bulbose at base, 11 − 18 mm long, 3 − 6 mm wide, with outer surface densely appressed-pubescent, with inner surface with scattered few-branched hairs; sepals 5, triangular, 1 − 1.5 mm long, densely pubescent; corolla yellow with a greenish center, 5-parted to near the base; lobes bifid and with undulate margins, ca. 12-nerved, densely pubescent, with inner surface and outer margin with yellow glandular hairs; stamens 3, free, narrowly oblong, straight, subsessile, dorsifixed, inserted near the perianth throat, $4-5$ mm long; anther glands present; pollen spherical, tricolporate, $40-50$ μm in diameter. Pistillate flowers solitary, similar to staminate; ovary ovoid-fusiform, $10-29$ mm long, $5-8$ mm wide in the middle, villous; hypanthium subcampanulate, 5 mm long, $4-5$ mm wide; sepals triangular, ca. 2 mm long. Fruit an elipsoidal, shortly-rostrate berry, $13-15$ cm long, ca. 6 cm wide, glabrous, smooth, at first dark green with linear arrays of white spots, at maturity turning bright orange, with a thick, fleshy pericarp; peduncle thick, ca. 1 cm long and 1 cm wide; seeds numerous, each surrounded by a bright red fleshy aril-like structure, pyriform, tumescent, $9-10$ mm long, $5-6$ mm wide, dark brown to reddish brown, smooth, with a conspicious tan-colored margin.

TYPE: cultivated in Austin, Texas, 1986–89, using seed from *Kearns & Kearns 390*, Nayarit, Mexico, along W side of Hwy 15 at km 39, 3.7 mi N of road to San Blas (Hwy 11), 140 m, 27 Mar 1986, *Kearns C-390* (staminate flowers) (HOLOTYPE: MEXU; ISOYTPES: TEX and to be distributed).

Additional collections examined: MEXICO. **Jalisco**: Mpio. Talpa de Allende, ca. 9 km SW of Talpa de Allende along road to Tomatlán, secondary vegetation, 1140 m, 15 Jul 1989, *Lira & Brunneau 871* (MEXU, TEX) (staminate flowers). **Nayarit**: ca. 8 mi E of San Blas along Hwy, tropical forest, 7 Nov 1961, *Gentry et al. 19479* (LL/TEX) (fruits); along Hwy 200, 8.8 mi N of turnoff to Compostela, 1000 m, 8 Sep 1985, *Kearns et al. 245* (TEX, MEXU) (fruits); along W side of Hwy 15 at km 39, 3.7 mi N of road to San Blas (Hwy 11), 140 m, 27 Mar 1986, *Kearns & Kearns 390* (MEXU, TEX) (fruits); along road to Tepic, 12 km N of Compostela, selva mediana, 910 m, 17 Jul 1989, *Lira & Brunneau 920* (MEXU, TEX) (staminate flowers). **Sinaloa**: near Colomos, foothills of the Sierra Madre, Jul 1897, *Rose 1659* (K) (staminate flowers); Mpio. Gpe. de Los Reyes. Cañada, selva mediana subcaducifolia, $700-900$ m, 14 Jun 1986, *Vega et al. 1910* (MEXU) (staminate flowers).

U.S.A. MICHIGAN. Washtenon Co.: Dixboro, grown from seed of *Dieterle 4182* (Jalisco, Mexico) at the Univ. of Mich. Botanical Garden, (K) (pistillate flowers).

Ibervillea maxima appears most closely related to *I. hypoleuca*, but is a larger, more robust species. The fruits of *I. maxima* are twice as large and elliptic rather than ovoid. Characters linking the two species include densely scabrous leaves, perennial stems with lenticels, and large fruits with thick pericarps. Because flowering specimens of *I. hypoleuca* are unknown, a comparison of the floral characters of the two species is not currently possible.

Jeffrey (1978), in transferring *Corallocarpus hypoleucus* Standl. to *Ibervillea*, noted the considerable variation in fruit shape and indumentum in the specimens he studied and hypothesized that possibly more than one

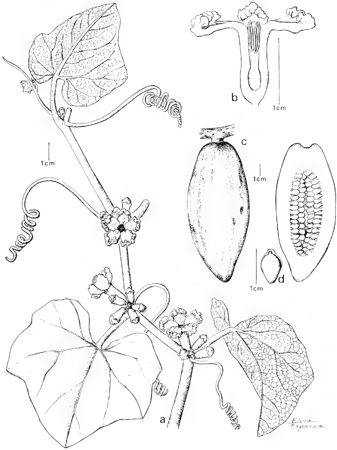

FIG. 1. *Ibervillea maxima*: a) aspect; b) longitudinal section of staminate flower; c) fruit (prior to maturity); d) seed. Illustration based on *Kearns and Kearns 390*, *Kearns C-390* and photographs of *Kearns and Kearns 390* (fruits).

species was represented. Included by Jeffrey in his list of *I. hypoleuca* are specimens of *I. maxima* collected by Gentry (# *19479*) and Rose (# *1659*). Other listed collections may also be *I. maxima*, but we have not had the opportunity to examine the specimens.

Ibervillea maxima can be found in the states of Jalisco, Nayarit, and Sinaloa, at elevations of 140 – 1140 m. The large vines climb high into the trees of the tropical deciduous and subdeciduous forest. During the dry season, the maturing fruits are easily seen among the leafless trees and vines. Although more recent collections are from roadside patches of vegetation, the current distribution appears to reflect land use (i.e., agricultural) patterns rather than evolved habitat preference. The perennial nature and growth habit of *I. maxima* imply that it would normally be a component of mature forests rather than disturbed habitats.

The seeds of *Ibervillea maxima* are dispersed during the dry season by birds which peck holes in the mature (orange) fruits to gain access to the seeds. The sweet red flesh covering the seeds is undoubtably digested while the seed passes through the bird's digestive tract without harm. Although *I. maxima* has a thick and sclerenchymatous seed coat, it does not need to be scarified and germinates quite easily.

The specific epithet was chosen as a reference to the size of the leaves, flowers and fruits, as well as the aspect of the plant, all of which are much larger than the other species of *Ibervillea*.

ACKNOWLEDGMENTS

We would like to thank Fernando Chiang, Patricia Davila, Alfonso Delgado, Francisco Gonzalez-Medrano, Hector Hernandez (MEXU), Charles Jeffrey (K), David Sutton (BM), Guy Nesom and Beryl Simpson (TEX) for helpful comments on the manuscript and on *Ibervillea*, in general. Elvia Esparza (Instituto de Biolog!a, UNAM) provided the illustration and Fernando Chiang helped with the Latin diagnosis. Thanks also to Anne Brunneau (Cornell) for assisting R. Lira in the field. A Tinker Fellowship from the Institute of Latin America Studies, Univ. of Texas, and a NSF doctoral dissertation research improvement grant (BSR86-01085) to D. Kearns helped to provide funds for collecting trips.

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GENTIANELLA CANOSOI (GENTIANACEAE), A NEW SPECIES FROM DURANGO, MEXICO

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ABSTRACT

A new species, ***Gentianella canosoi***, is described and illustrated from Durango, Mexico, where it is known from several collections.

KEY WORDS: *Gentianella*, Gentianaceae, Mexico.

The North American species of *Gentianella* were revised in a relatively recent treatment by Gillett (1957), but study of collections made since that time has shown there to be species not recognized in Gillett's study. A taxonomic synopsis of the whole genus in Mexico, which includes several other new species and a discussion of relationships, is being published nearly concurrently with the present study (Nesom, in prep.). The description of this species is presented separately to emphasize its distinctness and to honor Michael Canoso, Collections Manager of the Harvard University Herbaria. Mike has served with distinction for 39 years, and there could be but very few members of the taxonomic community who have not experienced his always friendly and competent asssistance or at least seen evidence, through his signature, of his activities.

GENTIANELLA CANOSOI Nesom & Turner, sp. nov. Fig. 1.

A speciebus Mexicis ceteris pedicellis ac tubis calycum dense prominenterque papillati-scabris bene distincta.

Taprooted annuals. Stems strictly erect, single from the base, 13 − 45 cm tall, often purple, young portions densely papillate-scabrous, smooth below or remaining slightly scabrous along the ridges. Leaves opposite, subclasping, not basally connate, spreading, 3-nerved, lanceolate, 15 − 35 mm long, 3 − 6 mm wide proximally, glabrous except for the minutely papillate-scabrous margins. Flowers mostly 3 − 5 in compact cymes, on pedicels 1 − 4 mm long, terminal on the primary stem and axillary branches arising mostly on the upper 2/3 of the stem; calyx prominently papillate-scabrous on the veins and lamina, most densely so on the veins, the tube 2.0 − 2.5 mm long, the 5 lobes linear-lanceolate, 3 − 4 mm long,

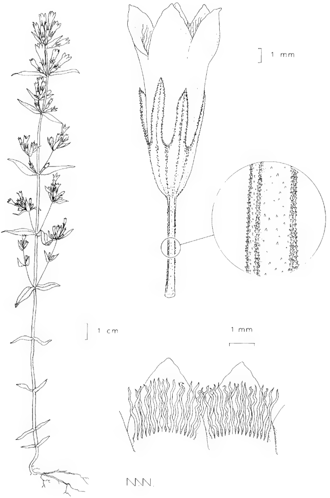

FIG. 1. Habit and details of *Gentianella canosoi*.

equal in length or nearly so, spreading at the apices; corollas yellowish-gold, drying yellow to purple, funnelform, the tube 8 – 10 mm long, with a ring of filaments inserted just below the mouth, the 5 lobes spreading-erect, 5 – 6 mm long, with attenuate apices; stamens epipetalous, the filaments narrowly winged basally, adnate to the tube for about half the tube length, the thecae 1 mm long, borne near the top of the tube. Ovaries 1-celled, with 2 persistent stigmas; mature fruits not observed.

South-central Durango; pine-oak woodlands, rich soil; ca. 2400 – 2650 m; Sep-Nov.

TYPE: MEXICO. DURANGO. Mpio. Pueblo Nuevo, vicinity of El Salto, pine woods, 4 Oct 1981, *S. González and S. Acevedo 2053* (HOLOTYPE: TEX!; ISOTYPE: GH!).

Additional specimens examined: MEXICO. **Durango.** Mpio. Pueblo Nuevo: 6 mi W of La Ciudad on Hwy 40, at Puerto de Buenos Aires, 7 Nov 1964, *Flyr 276* (TEX); 5 km SW of El Salto, 4 Oct 1981, *González and Acevedo 2033* (TEX); along Hwy 40 at the turnoff to La Campana, 3.2 mi W of Las Adjuntas and 14.7 mi W of El Salto, 26 Sep 1973, *Reveal 3458* (TEX, US).

Gentianella canosoi apparently is localized in the high-altitude pine woodlands in the area of El Salto, and all collections examined are convincingly consistent in their distinctive features. The new species differs from all other species of the genus in Mexico, and North America as well, in its upper stems, pedicels, and calyx tubes densely and prominently papillate-scabrous. With its fimbriate corolla tube, it is a member of series *Amarellae* (of *Gentianella* sect. *Amarella*, sensu Gillett 1957) and it appears to be most similar to *Gentianella amarella* subsp. *acuta* (Michx.) Gillett and another yet undescribed species from the Sierra Madre Occidental of Mexico (Nesom in prep.).

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O'Kennon, Lou Ellen and Robert. 1987. Texas wildflower portraits. 233 pp. 260 color photographs. $55.00 Cloth. Texas Monthly Press, Inc., P. O. Box 1569, Austin, TX 78767.

A beautifully illustrated book that would enhance any table top for browsing at any time.

Eleuterius, Lionel N. 1990. Tidal Marsh Plants. 160 pp, 7 × 10 color photographs, illustrations (line drawings of 200 species), bibliography, and index. Pelican Publishing Company, 1101 Monroe Street, P.O. Box 189, Gretna, LA 70053, (504/368-1175). Cloth (ISBN: 0-88289-795-0) $24.95.

This book represents many hours of work carried out over a period of twenty-two years. It illustrates 200 vascular plants found in salt marshes throughout the coastal area of southeastern United States. As a result this work will be useful to scientists, teachers, students, ecologists, etc. not only in the southeastern United States but in the New England States, of extreme South Florida, and of Texas.

The table of contents includes: preface; acknowledgments; introduction; use of the guide; scope of the guide; a general ecological description of tidal marshes; phenology; plant taxonomy: lower diagrams, inflorescence or fruit arrangement, kinds of leaves, identification of Monocotyledons and Dicotyledons, characteristics of the grasses (Poaceae), sedges (Cyperaceae), and rushes (Juncaceae); illustrations and descriptions of 200 species; color plates; glossary; literature cited; Latin-name index; common-name index.

Overall a very pleasant and interesting book.

A REVISION OF *PAXISTIMA* (CELASTRACEAE)

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ABSTRACT

Paxistima Raf. (Celastraceae), a North American genus of shrubs and subshrubs, has a confusing nomenclatural history. The genus name has four spellings in the literature. Although the name of the eastern species, *P. canbyi* Gray, is unequivocal, two specific epithets have been in use for the western species. In 1943, Wheeler concluded that *Paxistima* was the correct spelling of the genus, and that *myrtifolia* was the correct epithet for the western species. Wheeler combined several taxa into *Paxistima myrtifolia* (Nutt.) Wheeler, and indicated the possible existence of an uninvestigated (Mexican) taxon. After our review of the literature, the name of the western species is determined to be *P. myrsinites* (Pursh) Raf. Based on our numerical phenetic analyses, two species of *Paxistima*, *P. canbyi* and *P. myrsinites*, are recognized. We have clarified the holotypification of *P. canbyi*, and have selected a lectotype for *P. myrsinites*. A new subspecies, *Paxistima myrsinites* subsp. *mexicana* Navaro and Blackwell, is described herein.

INTRODUCTION

Paxistima Raf. is a small genus of Celastraceae interpreted as having from two to six species. A taxonomic synopsis of the genus was published in 1943 (Wheeler). The present study revises and augments Wheeler's nomenclatural and taxonomic treatment.

Paxistima is a North American genus of small evergreen shrubs or subshrubs with opposite leaves and small, perfect, 4-merous flowers on axillary pedicels. Within the Celastraceae *Paxistima* is the only capsule-fruited, 4-merous, 2-loculed genus in which the ovary is joined with the disk rather than sitting upon it.

The nomenclature of *Paxistima* has a confused past. This is especially so in regard to the type, *P. myrsinites*, which was first published by Pursh (1814) as "*Ilex? myrsinites*" based on specimens from the Lewis and Clark expedition of 1805-1806. Nuttall made the transfer of *Ilex myrsinites* to *Myginda* in 1818, as *Myginda myrtifolia*. As suggested by Wheeler (1943), Nuttall may have felt that "*myrtifolia*" was less similar to an existing epithet ("*myrsinoides*" HBK) within *Myginda* than was "*myrsinites*," and hence the superfluous alteration of the epithet. Regardless, Rafinesque (1818) in his "Review of Pursh's Flora of North America" wrote that he called *Ilex myrsinites*, "*Pachistima*," though he did not reference where he used the name. In 1819(a), in a review of Nuttall's work, Rafinesque stated

"The *Ilex myrsinites* of Pursh, is now called *Myginda myrtifolia* by N., but it belongs to neither genus; we deem it quite a peculiar genus, and call it *Pachistima*." Again in 1819(b) Rafinesque wrote that he placed *Ilex myrsinites* Pursh and *Myginda myrtifolia* Nuttall into a new genus which he called *Pachistima*. In none of his three early publications dealing with "*Pachistima*" (1818; 1819a,b) did Rafinesque include a description of his new genus, and so it has been considered (Wheeler 1943; Uttal 1986) to be a *nomen nudum*. It was approximately 20 years later when Rafinesque (1838) actually published the genus with a description; then he spelled it *Paxistima* (not *Pachistima*), and only then did he formally make the nomenclatural combination with *myrsinites*.

Also in 1838, Torrey and Gray (*A Flora of North America*) described the genus *Oreophila*, ascribing credit to Nuttall and transferring *Myginda myrtifolia* Nutt. (based on *Ilex myrsinites* Pursh) to *Oreophila*, as *O. myrtifolia*. However, the name *Oreophila* Nutt. ex T. & G. (Celastraceae) was preoccupied by *Oreophila* D. Don (1833), a genus in the Compositae. In 1840 Endlicher (in *Genera Plantarum*) recognized the genus *Oreophila* in the sense of Torrey and Gray (giving, inexplicably, sole credit to Nuttall); however, in his 1841 supplement, Endlicher reduced *Oreophila myrtifolia* to the synonymy of "Pachystima" (as spelled by Endlicher, not by Rafinesque). Meisner (1843) published an additional permutation of the spelling of the name *Pachistima*, as "*Pachystigma*." Since then, no new genera, generic synonyms, or additional spellings of the generic name have been published, although disagreement as to the generic spelling, as well as to which specific epithet to employ for the type species, has continued.

In 1878 Watson noted Rafinesque's 1818 publication in which Rafinesque used the spelling *Pachistima*. Watson also listed the 1838 publication, *Sylva Telluriana*, in which it was considered that Rafinesque validated the generic name but spelled it *Paxistima*. Watson, however, used the spelling *Pachystima*. In 1906 Piper employed the spelling *Pachistima* but referenced the wrong publication, *Flora Telluriana* instead of *Sylva Telluriana*. It was Wheeler's (1943) finding of the reference to *Sylva Telluriana* (Rafinesque, 1838) in Watson's (1878) work which led him to consider the correct spelling for the genus to be *Paxistima*.

As indicated, in his 1838 publication Rafinesque finally made the combination "*Paxistima myrsinites*." Rafinesque stated that he originally made the connection of the epithet *myrsinites* with *Paxistima* (or *Pachistima*) in 1817, but there is no evidence of this, and no reference cited. Regardless, Wheeler (1943) asserted, because Pursh provisionally published his name *Ilex? myrsinites*, i.e. with a question mark, that the original specific epithet, *myrsinites*, should not be accepted but rather that the epithet should be *myrtifolia* based on Nuttall's *Myginda myrtifolia*. Consequently, Wheeler employed the new combination *Paxistima myrtifolia* (Nutt.) Wheeler.

In addition to the original species, which we are calling *Paxistima myrsinites* (Pursh) Raf., four other species have been described. In 1873 Asa Gray published a new species endemic to limited areas of the eastern United States, "*Pachystima*" *canbyi*. This was based on plants collected from Giles County, Virginia in 1869 by William Canby, although originally discovered by him in 1868 (1858?, cf. Canby in Gray, 1873). *Paxistima canbyi* Gray continues to be recognized as a species, as does *P. myrsinites*.

In 1904 Edith Farr published a new species, "*Pachystima*" *macrophylla*, discovered in the Selkirk Mountains of British Columbia. In 1906 she published two additional species, *P. krautteri*, found in Siskiyou County, California and *P. schaefferi*, also found in the Selkirk Mountains. As for other taxa, two varieties of *Myginda myrtifolia* Nutt. were described by Hooker in 1840: Variety "alpha" *minor* corresponds with the putative type of *Ilex? myrsinites* (cf. Wheeler 1943); Wheeler believed that variety "beta" *major* corresponds with a second specimen from the Lewis and Clark expedition. Wheeler combined all of Farr's species and both of Hooker's varieties into "*Paxistima myrtifolia*," which he referred to as "a widespread and polymorphic species of the western United States and Canada." We agree with Wheeler's disposition of taxa considered synonyms; however, our interpretation of the nomenclature of the original species is different. We present in the Systematic Treatment, under *Orthography and Nomenclature*, the reasons that we consider *Paxistima myrsinites* to be the correct name.

In 1923 Standley made reference to a possible additional species of *Paxistima* growing in Mexico. He had seen only a single specimen but considered that it was indeed different from previously described species. Apparently, insufficient material was available to allow Wheeler (1943) to make an adequate determination of the putative Mexican taxon, although he alluded to its possible existence. A number of Mexican specimens have now accumulated in various herbaria in the United States and Mexico upon which a decision may be made as to the recognition of another taxon within *Paxistima*; this has been one focus of the present investigation.

MATERIALS AND METHODS

Approximately 1640 dried specimens of *Paxistima* were examined during this study. Specimens, including any types, were studied from the following herbaria (abbreviations after Holmgren, Keuken and Schofield 1981): A, ANSM, ARIZ, ASU, BHO, CAS, CM, DS, GH, IND, JEPS, KE, KNK, KY, LL, MSC, MU, MUHW, NCSC, NCU, ODU, OS, PH,

POM, RSA, TENN, TEX, UC, UNL, UNM, US, UT, WTU, WVA. Additionally, photographs of type specimens were made available during this study by the Academy of Natural Sciences of Philadelphia and by the Royal Botanical Gardens, Kew, England. From specimens studied, 140 were selected to represent the range of morphological variation within the genus, and a list of character state variation for 15 characters (those demonstrably variable among potential taxa) was established (Table 1) by careful comparison of these specimens. Each specimen was subsequently scored for each character, and numerical analyses were then performed using Statistical Analysis System (SAS) programs. Within SAS (version 5, 1985), both PRINCOMP, i.e. Principal Components Analysis (PCA) procedure, and FASTCLUS (which uses cluster seeding methodology, cf. Anderberg 1973) were employed, sequentially, in phenetic analysis to aid in the determination of the number and rank of the taxa which should be recognized. The linear composite variables (eigenvectors) which were outputted from PRINCOMP were inputted directly into FASTCLUS since, in contrast to at least some variables in the raw data, these eigenvectors (principal components) are uncorrelated with each other (SAS Institute 1985). The cubic clustering criterion (score indicative of optimal number of groupings, outputted from FASTCLUS) is most valid on large data sets (more than 100 OTU'S) in which uncorrelated variables are entered into the program. Keys, descriptions, distributional information, and complete synonomies are provided for taxa recognized. All specimens examined in the study are annotated. A card file containing the herbarium label information for each specimen is maintained in the Miami University Herbarium (MU).

NUMERICAL ANALYSIS AND DISCUSSION OF TAXA

As indicated, 15 characters (Table 1) were found to vary among the putative taxa of *Paxistima*. A substantial portion of this phenetic variation between taxa was extracted from the data set (based on the 15 characters) by principal components analysis (PRINCOMP procedure of SAS). The values (eigenvalues) of the first three principal components (first three eigenvectors) account for 57.8% of the total variance in the specimens (Table 2). Table 3 shows the first three components by character and the amount of variance. A scatter plot of OTUs (specimens) projected upon principal component one versus principal component two provides the greatest separation between taxa (Fig. 1); plots of other pairings of the first three components do not as clearly delineate the taxa. The character loadings of component one indicate that the characters primarily responsible for the variation (separation) observed in the taxa are blade length, blade

TABLE 1. Fifteen vegetative and floral characters used in Principal Components Analysis of *Paxistima*.

1. Adventitious roots: present/absent
2. Blade length
3. Blade width
4. Blade length from apex to widest point
5. Length of blade toothed
6. Petiole length
7. Blade teeth: pointed/rounded
8. Blade secondary veins below: evident/indistinct
9. Number of leaf pairs per unit length
10. Blade margin: revolute/not or subrevolute
11. Blade apical angle
12. Flowers: average number per nodal inflorescence
13. Length of central inflorescence axis
14. Calyx lobe length
15. Calyx lobe width

TABLE 2. Cumulative variance accounted for by the first eight principal components.

Principal component 1	0.371551
Principal component 2	0.486881
Principal component 3	0.577820
Principal component 4	0.651571
Principal component 5	0.718813
Principal component 6	0.772390
Principal component 7	0.822138
Principal component 8	0.862849

TABLE 3. The first three principal components (eigenvectors) and the amount of variance in each character.

	Eigenvectors		
Characters	1	2	3
1	0.198363	0.503841	0.048926
2	0.347826	0.301759	0.148375
3	0.384297	0.025179	0.014257
4	0.336087	0.212749	0.134065
5	0.360205	0.220944	0.079408
6	0.216563	0.001895	0.188342
7	0.261845	0.074394	0.043714
8	0.227593	0.170500	0.178999
9	0.317034	0.118163	0.140525
10	0.188620	0.249411	0.038666
11	0.196223	0.044555	0.176109
12	0.110797	0.173056	0.621414
13	0.005623	0.426972	0.506604
14	0.215398	0.284063	0.348118
15	0.220742	0.393276	0.255808

width, length of blade to its widest point, length of blade toothed and the number of leaf-pairs per cm per branch (see Table 1 and Table 3). In the second principal component, the presence/absence of adventitious roots and the length of the central inflorescence axis are most important.

Three more or less distinct groups can be recognized in the ordination produced by principal components analysis (Fig 1): one corresponds to *Paxistima canbyi*, the taxon endemic to areas of the central Appalachian Mountains and its foothills; another corresponds to *P. myrsinites*, a species widespread throughout the Rocky Mountains; a third is circumscribed by specimens, not previously studied together, collected in mountainous areas of northeastern Mexico. The range of these Mexican specimens is not contiguous with the range of the Rocky Mountain taxon. Although geographically disjunct, there is, however, some intergradation in morphology, and consequently overlap in the ordination, between specimens of *P. myrsinites* collected in the United States and the Mexican specimens. Therefore, we are designating the Mexican populations as a subspecies of *P. myrsinites* (following the concept of Du Rietz 1930), rather than recognizing them as distinct species. The Mexican populations constitute a significant geographic facies of *P. myrsinites*, and consequently subspecies rather than varietal rank seems appropriate (see Du Rietz). It is interesting that a (lesser) tendency toward intergradation also occurs between the Mexican populations and *P. canbyi*; possible interpretations of this observation will be discussed under Distribution and Geofloristic History.

The FASTCLUS program of SAS provided further insight into group structure within the genus *Paxistima*. FASTCLUS is a disjoint clustering (but non-tree producing) procedure which employs nearest centroid sorting, i.e. cluster seeding, techniques (Anderberg 1973); preassignment of number of groups is requisite to the procedure. We ran this procedure for one, two, three and six groups respectively — constituting all putative divisions previously recognized within *Paxistima*. The principal components analysis demonstrated that no more than two taxa, i.e. *P. canbyi* and *P. myrsinites*, are clearly distinct at the species level, although three groupings may be discerned from the analysis. When the principal components were entered into FASTCLUS, the most favorable clustering score (cubic clustering criterion value), indicative of the optimum number of clusters, suggested the existence of three groups as well. Hence, results of the FASTCLUS procedure support the recognition of two subspecies (*myrsinites* and *mexicana*) within *P. myrsinites*, as well as the existence of *P. canbyi*. Our delimitation of three taxa of *Paxistima* — *P. canbyi*, *P. myrsinites* subspecies *myrsinites* and *P. myrsinites* subspecies *mexicana* — is thus

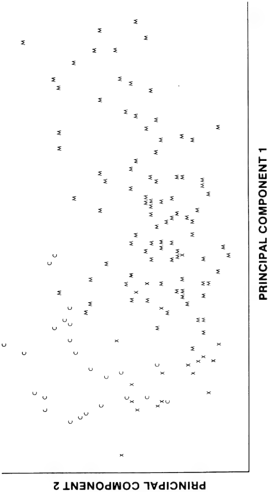

FIG. 1. Bivariate plot of first two principal components in morphological analysis of *Paxistima*. M = *P. Myrsinites* subsp. *myrsinites*, X = *P. myrsinites* subsp. *mexicana*, C = *P. canbyi*.

substantiated by the numerical phenetic analyses performed, i.e., when the results of both PRINCOMP and FASTCLUS are considered in consort.

If one examines the numerical data, the numerical analysis, the keys to taxa, and the descriptions, it will be apparent that all three taxa of *Paxistima* differ only by a number of seemingly minor characters, with overlapping character states. Although obviously debatable, if taken collectively, and considered in context of the disjunct nature of major super-groups of populations of *Paxistima*, we believe that the data (as analysed by computer) support the recognition (or continued recognition) of three taxa, as opposed to the submergence of all taxa into a single, fragmented, polymorphic species. Although the taxa of *Paxistima* are what we would term "statistical taxa," not distinguished by any one or a few infallible, totally clear-cut characters, the taxa are nonetheless rather readily recognized by their overall patterns when viewed on herbarium sheets, or in the field as we have seen them. As alluded to in the concluding section on Distribution and Geofloristic History, the taxa of *Paxistima* may well represent the now disjunct and somewhat divergent descendants of a single, wide-ranging, polymorphic ancestral species of the North American Arcto-Tertiary flora. Should all taxa survive, we would predict only a greater divergence of taxa through time, given their present geographic isolation and scant opportunity for gene exchange.

SYSTEMATIC TREATMENT

THE GENUS *PAXISTIMA*

PAXISTIMA Raf., Sylva Telluriana 42. 1838. (spelled *Pachistima* by Rafinesque, 1818, 1819a and b, a *nomen nudum*; *Pachystima* by Endlicher, 1841; and *Pachystigma* by Meisner, 1843). — TYPE: *Paxistima myrsinites* (Pursh) Rafinesque.

Oreophila Nutt. ex Torrey & Gray, A Flora of North America 1:258. 1838 (Celastraceae); non *Oreophila* D. Don, Trans. Linn. soc. of London 16:178. 1833 (Compositae). *Oreophila* T.& G. is thus a later homonym.

Low, evergreen, glabrous, much branched shrub or subshrub with subterranean rhizomes; adventitious roots often present on lower portions of stems; branches terete, with rough bark. Leaves simple, smooth, serrulate to crenulate (rarely subentire), coriaceous, opposite (decussate), short-petioled, with small caducous stipules. Flowers small, perfect, axillary, solitary or in simple dichasia (rarely fascicled or in compound dichasia); calyx lobes 4, imbricate, green, widely ovate, small; petals 4, maroon (occasionally green), trullate, longer than calyx lobes; stamens 4, inserted in the edge of a broad nectar disc, the anthers introrse, the filaments short, awl-shaped (occasionally longer and thread-like); ovary 2-loculed, superior but sunken in the disc; style short to obsolete; stigma capitate to linear-clavate (rarely obscurely 2-lobed). Fruit an oblong, 2-loculed capsule. Seeds 1 or 2, oblong, erect, enclosed in a membranaceous, white, cleft aril; endosperm fleshy. Flowers and fruits developing from early spring to early summer; flower buds formed the preceding summer, although some undergo anthesis prematurely (later in the season in which they are formed).

Orthography and Nomenclature: As noted by Wheeler (1943) and Uttal (1986), the spelling of the genus name should be *Paxistima*. Rafinesque provided no description in his early publications (1818; 1819a,b) when he spelled the name "*Pachistima*." His references variously to Pursh's and Nuttall's descriptions in these publications might appear to achieve validation by direct reference, but do not because neither Pursh nor Nuttall were attempting to describe new genera or sections of genera in this particular case (cf. Article 41.2, *International Code of Botanical Nomenclature*, Greuter et al. 1988). The first generic description or diagnosis legally attachable to the genus occurred in 1838 (*in situ* in *Silva Telluriana*) when Rafinesque employed the spelling *Paxistima*.

It is plausible that Rafinesque (1838) may have written the Greek "chi" or "χ" for the "ch" in *Pachistima* leading to an accidental change to the "x" (*Paxistima*) spelling; but this is only speculation and not justification for a change back to the "ch" spelling, although Merrill (1949) indicated "*Pachistima*" to be "universally accepted." Regarding meaning and gender, *Paxistima* may be a corruption of *pachys* (thick) and *stigma* (Genaust 1976). Since *stigma* is neuter, *Paxistima* could as well be interpreted as neuter. However, this again is difficult to prove, and consequently we are following Wheeler's (1943) apparent recognition of *Paxistima* as feminine.

Concerning the name of the original species, Pursh's (1814) inclusion of a question mark in *Ilex*(?) *myrsinites* does not invalidate the publication of the epithet *myrsinites*. Although Wheeler's (1943) interpretation of *I. myrsinites* as a provisional name may have been reasonable at the time, according to the present edition of the code the use of a question mark does not obviate publication when the author (Pursh) accepted the species, but merely expressed taxonomic doubt as to which genus it belonged (cf. Article 34.2, *International Code*). The valid combination *Paxistima myrsinites* was made by Rafinesque in 1838. The correct name and citation of the original species is thus *Paxistima myrsinites* (Pursh) Rafinesque (1838), not *Paxistima myrtifolia* (Nutt.) Wheeler (1943).

Species and Subspecies of *Paxistima*

A. Shrub or subshrub 20 to 100 cm high (typically not prostrate); leaves usually 1 − 2 pairs per cm of branch length; inflorescences averaging 6 − 10 per branch; western U.S., southwestern Canada, northeastern Mexico . . . 1) *P. myrsinites*

B. Shrub or subshrub $30-100$ cm high; leaves $1-2$ pairs per cm of branch length; blades lanceolate to obovate or oblanceolate, typically $11-27$ mm long; inflorescences averaging 10 per branch; western United States, southwestern Canada .... 1A. *P. myrsinites* subsp. *myrsinites*

B. Shrub or subshrub $20-45$ cm high; leaves $2(3-4)$ pairs per cm of branch length; blades lanceolate, typically $8-12$ mm long; inflorescences averaging 6 per branch; northeastern Mexico .... 1B. *P. myrsinites* subsp. *mexicana*

A. Subshrub (tending to be prostrate) $10-40$ cm high; leaves $2-4$ pairs per cm of branch length; inflorescences averaging 4 per branch; eastern United States .... 2) *P. canbyi*

1. Paxistima myrsinites (Pursh) Raf., Sylva Telluriana 42. 1838.

Shrub or subshrub, usually densely branched, 20 to 100 cm high; the lower portion of the stems sometimes prostrate; adventitious roots may be present. Leaves approximate, $1-2$ (occasionally $3-4$) pairs per cm; blades ovate (elliptic) to lanceolate (oblanceolate), (6-)8 − 27(-40) mm long, (3-)4 − 10(-15) mm wide; blade margins serrulate to crenulate (occasionally entire), revolute to subrevolute or not revolute (sometimes thickened when not revolute); teeth pointed or rounded, extending from apex to 1/3 to 4/5 of blade length; blade secondary veins indistinct below (occasionally evident); blade apex obtuse, apical angle $90° - 165°$; petioles (0.8-)1 − 2(-2.5) mm long. Inflorescence axillary or terminal, averaging $9.3(3-21)$ per branch, generally composed of 1 − 2(-3) flowers each; length of central or only inflorescence axis $2-4$ mm. Calyx lobes widely depressed-ovate to very widely ovate, slightly imbricate. Petals exceeding the calyx lobes, commonly maroon (those from buds from preceding season), occasionally green (those from buds from current season). Fruits $4-7$ mm long.

Two subspecies, *Paxistima myrsinites* subsp. *myrsinites* and *P. myrsinites* subsp. *mexicana*, are recognized within this species. The typification of *P. myrsinites* is discussed under the subspecies *P. myrsinites* subsp. *myrsinites*. *Paxistima myrsinites* subsp. *mexicana* is described as new.

1A. Paxistima myrsinites (Pursh) Raf. subsp. myrsinites.

Ilex? myrsinites Pursh, Fl. Amer. Sept., I. 119. 1814. — Lectotype: *Lewis s.n.*, 1806 (PH, photograph!; see typification, below).

Myginda myrtifolia Nutt., Gen. N. Amer. Pl. 109. 1818. — Type: same as *Ilex? myrsinites* Pursh. The spelling changed to *myrtifolia* by Nuttall, and hence the epithet *myrtifolia* is a superfluous name.

Myginda myrtifolia var. "alpha" *minor* Hooker, Fl. Bor.-Amer. 120 − 121. 1840. — Type: Apparently considered by Hooker to correspond to original material of *Ilex? myrsinites* Pursh.

Myginda myrtifolia var. "beta" *major* Hooker, Fl. Bor.-Amer. 120–121. 1840. — TYPE: *Douglas s.n.* as annotated by J. Ewan (K *s.n.*, photograph!).

Oreophila myrtifolia (Nutt.) Nutt. ex Torrey & Gray, Fl. N. Amer. I. 258–259. 1838–1843.

Pachystima macrophylla Farr, Trans. & Proc. Bot. Soc. Pennsylvania 1:421–422. 1904. — TYPE: *Farr s.n.* (PH 37408!, GH *s.n.*!).

Pachystima krautteri Farr, Ottawa Naturalist 20:108. 1906. — TYPE: *Krautter s.n.* (HOLOTYPE: PH 42752!).

Pachystima schaefferi Farr, Ottawa Naturalist 20:108. 1906. — TYPE: *Schaffer 512* (HOLOTYPE: PH s.n.!).

Paxistima myrtifolia (Nutt.) Wheeler, Amer. Midl. Naturalist 29:793–794. 1943.

Shrub (20-)30 – 100 cm high, the stems sometimes nearly prostrate; adventitious roots may be present. Leaves approximate, 1 – 2 pairs (rarely more) per cm of branch length; blades obovate to oblanceolate, occasionally ovate (or elliptic) to lanceolate (or narrowly elliptic), (9-)11 – 27(-40) mm long, 4 – 10(-15) mm wide; blade margins serrulate to crenulate (occasionally entire), revolute to subrevolute or not (sometimes thickened when not revolute); teeth pointed or rounded, extending from apex to 2/5 to 7/10 (occasionally 4/5) of blade length; blade secondary veins indistinct below (occasionally evident); blade apex obtuse, the apical angle (90°-) 105° – 165°; petioles generally (0.8-)1 – 2(-2.5) mm long. Inflorescences axillary or terminal, averaging 10(3 – 21) per branch, generally composed of (1-)2(-3) flowers each; length of central or only inflorescence axis (1.5-) 2 – 4(-8) mm. Calyx lobes depressed-ovate to very widely depressed ovate, slightly imbricate. Fruits 4 – 7 mm long.

Typification: No prior type was chosen for *Paxistima myrsinites* (i.e., subsp. *myrsinites*), as confirmed by Wheeler (1943). Two specimens (collected by Meriwether Lewis) were mentioned by Pursh (1814) in his description of *Ilex? myrsinites*, one from "near the Pacific Ocean," collected November 16, 1805, the other from "on the Rocky-mountain," collected June 16, 1806. The Lewis and Clark Herbarium at the Academy of Natural Sciences, Philadelphia, contains specimens so designated. An 1805 specimen is also in the herbarium of the Royal Botanic Garden, Kew, England. The Kew specimen is, however, part of a mixed collection (with a *Berberis* specimen) and is problematic as type material. The 1806 (Rocky Mountain) specimen (PH) seems preferable as the lectotype, and we so designate it.

Distribution: Variously known as mountain-lover, Oregon boxwood, myrtle pachistima, myrtle box-leaf and box-leaf, *Paxistima myrsinites* subsp. *myrsinites* is common in the mountain ranges of western North America at altitudes of 600 to 3350 meters. Its range extends from southern British Columbia and Alberta south into Arizona and New

Mexico. The flowers bloom from mid-March to mid-July. This subspecies is quite variable in vegetative morphology. Further investigation may reveal genetic or clinal bases for this polymorphism.

Representative specimens: CANADA: **Alberta**: Watertown Lakes Park, trail to Bertha Lake, 12 Jun 1925, *Malte and Watson 289* (WTU). **British Columbia**: Bear Creek Station, Selkirk Mountains, 25 May 1905, *Schaffer s.n.* (GH, PH, Type of *P. schaefferi*); Bear Creek Station, eastern slope Selkirk Mountains, 20 Aug 1904, *Farr s.n.(GH, PH, Isotype of P. macrophylla)*; Deer Park, Lower Arrow Lake, 4 Jun 1889, *Macoun 4058a* (MSC); Vancouver Island, Thetis Lake, four mi NW of Victoria, 15 May 1956, *Calder, Parmelee and Taylor 16363* (UC).

UNITED STATES: **Arizona**: **Apache Co.**: Lukachukai Mountains, wooded N slope, 1 Jun 1950, *Clark 15329* (UNM). **Cochise Co.**: Chiricauhua National Monument, Echo Park Trail, 15 Aug 1975, *Mason and McManus 3166* (ARIZ). Coconino Co.: Oak Creek Canyon, West Fork, 10 mi N of Sedona, West Fork trail #108, 23 Mar 1988, *Navaro s.n.* (MU). **California**: **Del Norte Co.**: Shelly Creek Canyon, 3 mi S of Old Monumental, 21 May 1937, *Parks and Parks 5646* (DS). **Humboldt Co.**: Trinity Summit, 2 mi E of Box Camp, 23 Jun 1942, *Tracy 17246* (UC). **Marin Co.**: Mt. Tamalpais, midway between Laurel Dell and Barth's Retreat, 16 Mar 1941, *Howell 16155* (CAS). **Shasta Co.**: northern Sierra Nevada, Hatchet Creek, E of Round Mountain, 18 Jul 1930, *Benson 2217* (POM). **Siskiyou Co.**: Black Butte, 15 Jul 1905, *Krautter s.n.* (PH, Holotype of *P. krautteri*); Black Butte, 15 Jul 1905, *Krautter s.n.* (PH, Isotype of *P. krautteri*). **Yuba Co.**: Willow Creek, near Camptonville, 6 Mar 1966, *Mott s.n.* (CAS). **Colorado**: **Garfield Co.**: Trappers' Lake, 30 Jul 1933, *Hermann 5503* (GH). **Grand Co.**: Routt National Forest, Gore Pass on Highway 84, 1 Aug 1962, *Porter and Porter 9187* (MSC). **Gunnison Co.**: old town of Gothic, E side of East River, 23 Jun 1952, *Barrell 43-52* (US). **Las Animas Co.**: above Whiskey Pass Rd., 6 mi W of Monument Lake campground, 18 Jun 1941, *Robbins s.n.* (ARIZ). **Montezuma Co.**: Mesa Verde National Park, rocky canyon below main lodge, 10 Jul 1941, *McVaugh s.n.* (UC). **Summit Co.**: 8 mi N of Silverthorne, Blue R. Valley, 22 Jun 1982, *Weber and Wittman 16214* (CM). **Idaho**: **Adams Co.**: SW slope of Smith Mountain, 10 Jul 1930, *Borell s.n.* (CAS). **Bear Lake Co.**: Bear Lake, Aug 1921, *Chamberlain s.n.* (DS). **Bonner Co.**: 5 mi W of Sand Point, slope above Clark's Fork River, 14 May 1936, *Hitchcock 2891* (WTU). **Clearwater Co.**: in brush at summit between Bovill and Elk River, 21 May 1949, *Cronquist 5781* (NCSC). **Idaho Co.**: Lolo Pass, 27 May 1938, *Barkley 2417* (POM). **Teton Co.**: 6 mi W of Driggs, Packsaddle Creek Canyon, 1 Jul 1968, *Muir s.n.* (POM). **Montana**: **Flathead Co.**: Rescue Creek and US 2, 28 Jun 1950, *Marshall 1176* (MSC). **Glacier Co.**: Glacier National Park, trail to Mount Brown lookout, 7 Jul 1939, *Bailey and Bailey 113* (TENN). **Powell Co.**: 2 mi NW of Woodworth School, Cottonwood Creek, 21 May 1933, *Hitchcock 1584* (POM). **New Mexico**: **Catron Co.**: Gila Primitive Area, 21 May 1937, *Sharp and Orr 332* (PH). **Grant Co.**: 5 mi N of Pinos Altos, mountain side above Cherry Creek, 24 Apr 1947, *McVaugh and Grant 8051* (GH). **Otero Co.**: Sacramento Mountains, Karr Canyon, about 1 mi W of N.M. highway 64, 10 Jul 1980, *Worthington 6192* (ARIZ). **Rio Arriba Co.**: Jemez Mountains, San Pedro Parks, 12 Jun 1964, *Martin, Smith and Schmitt 64-18* (UNM). **San Miguel Co.**: headwaters of the Rio Las Trampas, west of Spring Mountain, 21 Sept 1972, *Fosberg 54499* (POM). **Taos Co.**: 3 mi SE of Taos, Devisadero Peak, 7 Jun 1979, *Baker 1033* (NCU). **Oregon**: **Baker Co.**: near Cornucopia, Wallowa Mountains, Pine Creek, 30 Jun 1935, *Jones 7204* (UC). **Deschutes Co.**: 4 mi N of North Sister Mountains, near McKenzie Pass, 22 Jun 1939, *Hitchcock and Martin 4862* (POM). **Hood River Co.**: Mount Hood National Forest, near Sherwood

Forest Camp, 13 Aug 1933, *Jones 4198* (POM). **Lake Co.**: Gearhart Mountain region, 3 mi E of Finley Corral, 21 Jul 1932, *Applegate 7918* (CAS). **Josephine Co.**: Siskiyou Mountains, Steamboat Ranger Camp on Sturgis Creek, 5 Aug 1930, *Applegate 6597* (CAS). **Polk Co.**: 4 mi SW of Buell, bank along Mill Creek, 1 Jul 1930, *Peck 16204* (UC). **Utah**: **Box Elder Co.**: Raft River mountains, Clear Creek Canyon, 24 Jun 1947, *Preece 644* (UT). **Cache Co.**: W of Tony Grove Lake, rocky cliffs, 25 Aug 1950, *Thieret and Thieret 204* (GH). **Kane Co.**: Bryce Canyon National Park, one half mi E of Rainbow Point, 17 Jun 1957, *Buchanan 132* (UT). **Salt Lake Co.**: top of Clayton Peak, Big Cottonwood Canyon, 18 Jul 1960, *Cottam, Allan and Rowland 16491* (UT, CAS). **San Juan Co.**: canyon wall opposite Augusta Natural Bridge, 14 Sep 1939, *Cutler s.n.* (GH). **Washington Co.**: Zion National Park, Hidden Canyon, *Weights 9772* (UT). **Washington**: **Chelan Co.**: open woods near Merritt, 12 May 1934, *Jones 4754* (ARIZ). **Columbia Co.**: Blue Mountains, stream banks, 23 Jun 1897, *Horner s.n.* (GH). **Island Co.**: Whidby Island, Goose Rock, 21 May 1933, *Thompson 8940* (GH). **Lewis Co.**: Mount Ranier National Park, trail to Trump Park from Christine Falls, 3 Jul 1970, *Duffield 372* (MU). **Okanogan Co.**: near summit on Twisp cut-off, 27 May 1932, *Fiker 717* (DS). **Snohomish Co.**: 14 mi N of Seattle, Jun 1892, *Piper s.n.* (MSC). **Spokane Co.**: Mount Carleton, 21 Jul 1902, *Kreager 286* (WTU). **Wyoming**: **Fremont Co.**: along a small creek half way between Lander and South Pass City, 23 Jun 1939, *Craig and Craig 3575* (POM). **Teton Co.**: Teton Pass, 10 Jul 1959, *Porter and Porter 7902* (DS).

1B. Paxistima myrsinites (Pursh) Raf. subsp. mexicana Navaro & Blackwell, subsp. nov.

Differt a subsp. *myrsinites* statura parva, foliis coarctatioribus et parvis, et inflorescentiis paucioribus (6) per ramos.

Shrub or subshrub 20 − 45 cm high, the stems sometimes prostrate; adventitious roots may be present. Leaves approximate, 2 (occasionally 3 − 4) pairs per cm of branch length; blades lanceolate (6-)8 − 12(-15) mm long, (3-)4(-5) mm wide; blade margins crenulate (occasionally serrulate, rarely entire), revolute; teeth generally rounded (occasionally pointed), extending from apex to 1/3 to 3/5 (occasionally 3/4) of blade length; blade secondary veins indistinct below; blade apex obtuse, the apical angle generally 90°(-135°); petioles (0.8-)1(-2.5) mm long. Inflorescences axillary or terminal, averaging 6(3 − 9) per branch, generally composed of 1(-2) flowers each; length of central or only inflorescence axis (1.5-)2 − 4(-5) mm. Calyx lobes widely depressed-ovate to very widely ovate, slightly imbricate. Fruits 4 − 5 mm long.

Type: MEXICO. Coahuila. Municipality of Arteaga, La Siberia, Sierra de la Marta, 27 May 1982, *Villarreal 1678* (holotype: MU 134452; isotype: TEX *s.n.*).

Distribution: *Paxistima myrsinites* subsp. *mexicana* is apparently restricted to mountainous regions of three Mexican states: southeastern Coahuila, southern Nuevo Leon and southwestern Tamaulipas. It grows at altitudes of 2440 to 3500 meters on open hillsides or in forests of pine, fir and oak. The flowers may be found in bloom from late March to mid-July.

Representative specimens: MEXICO: Coahuila: municipality of Arteaga, La Siberia, 6 km SE of San Antonio de las Alazanas, 27 May 1982, *Villarreal 1678* (MU, TEX, Type of *P. myrsinites* subsp. *mexicana*); municipality of Arteaga, Puerto de la Siberia, 10 Oct 1970, *Marroquin 1994* (UNL); municipality of Arteaga, Sierra Madre Oriental, 26 Jul 1975, *Robert and Passini s.n.* (ANSM); 40 mi S of Saltillo, Sierra Madre, Jul 1880, *Palmer s.n.* (PH); 26 km NW of Fraile, 16 Jul 1941, *Stanford, Retherford and Northcraft 454* (CAS); Sierra de la Marta, 17 May 1981, *Poole 2324, Hinton and Nixon* (TEX). Nuevo Leon: municipality of Galeana, road to summit of Cerro Potosi, 12.5 mi from 18 de Marzo, 18 May 1982, *Dorr 2270 and Atkins* (TEX, ARIZ); municipality of Galeana, canyon below Las Canoas on Cerro Potosi, 20 Jul 1935 Mueller s.n. (GH); municipality of Galeana, *Sierra La Marta, 19 Apr 1981, Hinton 18158* (TEX); municipality of Zaragoza, El Salto, 29 May 1980, *Flores O. s.n.* (UNL). Tamaulipas: 20 km NE of Miquihuana, Cerro El Borrado, 2 Apr 1969, *Gonzales-Quintero 3855* (MSC); on E and S slopes of summit of Pena Nevada, 19 Jul 1949, *Stanford, Lauber and Taylor s.n.* (RSA).

2. PAXISTIMA CANBYI Gray, Proc. Amer. Acad. Arts 8:620. 1873. (spelled *Pachystima canbyi* by Gray — TYPE: 1869, *Canby s.n.* (HOLOTYPE: GH!; see typification, below).

Shrub or subshrub 10 − 40 cm high, tending to spread in vegetative clones; older portion of stems prostrate, the upper portion ascending; adventitious roots common on lower stem. Leaves closely approximate, 2 − 4 pairs (rarely more) per cm of branch length; blades narrowly elliptic to lanceolate, 11 − 22 mm long, 2.3 − 6.2 mm wide; blade margins serrulate to crenulate, strongly revolute; teeth pointed or rounded, extending from apex to 1/3 to 4/5 of blade length; blade secondary veins indistinct below; blade apex obtuse, the apical angle 105° − 120°; petioles (0.5-)1(-1.1) mm long. Inflorescences axillary or terminal, averaging 4(1 − 6) per branch, generally composed of 1 − 2(3) flowers each; length of central or only inflorescence axis (1-)2 − 6(-14) mm. Calyx lobes widely depressed-ovate to widely ovate, slightly imbricate. Petals exceeding the calyx lobes, commonly maroon (those from buds from preceding season), occasionally green (those from buds from current season). Fruits 4 mm long, rarely seen.

Typification: A specimen at the Gray Herbarium (collected by Canby in 1869) was annotated as the holotype by Vernon Bates in 1984. Asa Gray's 1873 description of *Paxistima canbyi* states, "Mr. Canby discovered the Alleghenian species in 1868, and obtained flowering specimens upon a second visit to the station in the spring of 1869." In actuality a small sterile specimen was collected by Canby in 1868 (1858?; cf. Canby in Gray, 1873). However, in regard to collection of specimens by Canby, Gray alluded only to those gathered in 1869 (these being flowering specimens, presumably from a single collection), and it was apparently these upon which Gray based his new species. Consequently, the May, 1869 collection by Canby (William Canby s.n.) from Giles County, Virginia is the type collection; the specimen at GH, annotated by Bates, is accepted as the holotype; an isotype is at US.

Distribution: *Paxistima canbyi*, variously called Canby's mountain-lover, cliff-green or rat-stripper, occurs very locally in the Appalachian Mountain region of the eastern United States; it is found on dry to moist, sunny to shaded, northwest to southwest facing, limestone bluffs and ravines in South-central Ohio and Pennsylvania through the Virginias into Kentucky, North Carolina and northern Tennessee. The North Carolina population is at an old nursery site and is considered to have been introduced (Hardin 1963). The presence of *P. canbyi* in North Carolina was, however, noticed as long ago as 1883 by Chapman, and *P. canbyi* is likely native to North Carolina. Endemic to a small number of areas in these states mentioned above, *P. canbyi* is listed in Category Two of plants of federal concern, i.e., more data needed to support listing as threatened or endangered (Ohio Division of Natural Areas and Preserves 1988). *Paxistima canbyi* typically flowers from late March into May, the flowers developing from buds formed during the preceding season. However,a small number of flowers may arise from buds of the current season; these may bloom during the summer.

Representative specimens: UNITED STATES: KENTUCKY: **Carter Co.**: Carter Caves, Devil's Backbone Ridge, 29 May 1986, *Navaro s.n.* (MU); Carter Caves, limestone cliff opposite entrance, 29 May 1986, *Navaro s.n.* (MU). **Pulaski Co.**: Tatesville, 1 mi S, Lake Cumberland, 10 May 1976, *Stephens s.n.* (TENN). OHIO: **Adams Co.**: Brush Creek Twp., Edge of Appalachia Preserve, 9 Apr 1987, *Navaro s.n.* (MU). **Highland Co.**: Brush Creek Twp., Ft. Hill St. Memorial Park, 1 Apr 1973, *Bourdo and Roberts 3294* (OS). NORTH CAROLINA: 1874, *Canby s.n.* (PH). PENNSYLVANIA: **Bedford CO.**: Cliff at Lutzville, 6 May 1950, *Henry and Buker s.n.* (CM); Juniata R. near Lutzville, 6 May 1950, *Krouse 97* (CM). TENNESSEE: **Hawkins Co.**: bluff above South Fork Holston River, Bays Mt. near Laurel Run Gorge, 21 Apr 1984, *Somers and Smith s.n.* (TENN). VIRGINIA: **Frederick Co.**: west of Middletown, above Cedar Creek, 20 Sep 1931, *Griscom and Hunnewell s.n.* (GH). **Giles Co.**: May 1869, *Canby s.n.* (GH, holotype). **Rockbridge Co.**: VMI post, above Maury R., 22 Apr 1963, *Gupton s.n.* (NCU). **Scott Co.**: Natural Tunnel, around the rim of tunnel, 17 May 1968, *James 9686* (NCU). **Wythe Co.**: near Wytheville, Jun 1875, *Shriver 483* (GH). WEST VIRGINIA: **Greenbriar Co.**: Chocolate Drop, limestone cliff facing Greenbriar R., 1 Aug 1931, *McNeill s.n.* (WVA). **Mercer Co.**: mouth of Brush Creek, 4 May 1976, *Grafton s.n.* (WVA). **Mineral Co.**: near Keyser, May 1936, *Chapman s.n.* (WVA).

DISTRIBUTION AND GEOFLORISTRIC HISTORY

The present distribution of *Paxistima* in North America (Fig. 2) is probably attributable to its presence in the temperate Arcto-Tertiary forests, and to subsequent geoclimatic restrictions upon these forests, i.e., orogenic activity, cooling/drying, glaciations. According to Chaney

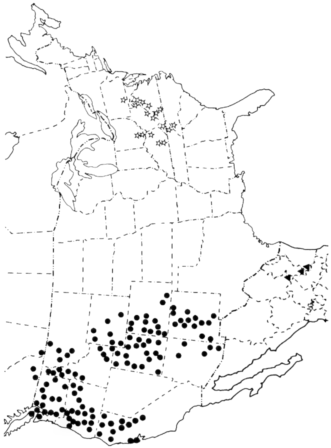

FIG. 2. Geographic distribution of *Paxistima* in North America. Star = *P. canbyi*, solid circle = *P. myrsinites* subsp. *myrsinites*, triangle = *P. myrsinites* subsp. *mexicana*.

(1947), "The Arcto-Tertiary Flora has survived in North America at middle latitudes in two main provinces, an eastern characterized by broad-leafed, deciduous trees, and a western characterized by conifers, broad-leafed evergreens, and broad-leafed deciduous trees and shrubs." The two species of *Paxistima*, *P. canbyi* and *P. myrsinites*, are indeed presently restricted, respectively, to parts of these two regions.

Additionally, the pattern and the restricted (localized) nature of the present distribution of *P. canbyi* have led some (e.g. Transeau 1941) to consider this distribution explainable by association with the former north-west-flowing, preglacial Teays River. However, populations generally lie outside the supposed Teays drainage *per se* (see Steeg 1946, for an account of the Teays drainage). On the other hand, several populations may be circumstantially related to the boundaries of the glacial lake (Lake Tight) formed by ice blockage of the Teays (Wolfe 1942; Braun 1950). The details of the explanation of the distribution of *P. canbyi* require further elucidation.

The origin and relationships of *Paxistima myrsinites* subspecies *mexicana* are worthy of conjecture. Although most similar to subspecies *myrsinites*, the variation of subspecies *mexicana* in the "morphological direction" of *P. canbyi* (Fig. 1) suggests that the Arcto-Tertiary antecedents of present day *Paxistima* perhaps constituted one transcontinental species complex which later became disjunct (developing more or less morphologically distinct entities) as a consequence of geoclimatic events, such as those mentioned previously. Subspecies *mexicana* may represent relic populations of the former *myrsinites-canbyi* complex, remaining in a refugium in the mountains of Northeast Mexico; it could also represent a third line of development from an ancestral species.

ACKNOWLEDGEMENTS

We wish to express our appreciation to the curators of those herbaria mentioned in the Materials and Methods section for loaning specimens utilized in this study. We also wish to thank Dan H. Nicolson for his helpful suggestions regarding orthography and nomenclature during the preparation of this manuscript. This research was funded in part by the Willard Sherman Turrell Herbarium Fund (MU) grants #72 and #85.

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Book Reviews

Blackwell, Will H. 1990. Poisonous and medicinal plants. 329 pp. Illus. Price unknown. Prentice-Hall, Inc., Englewood Cliffs, NJ 07632. Illustrations are by Thomas J. Cobbe with Chapter 5 (Poisonous and Medicinal Fungi) by Martha J. Powell.

The combination of medicinal and poisonous plants within the same volume is a natural one stemming from the beginning of man's knowledge of plants. Since poisons are medicinal and medicines are poisonous, it is merely the dosage and the sensitivity of an individual human being that determines the desired result. This is an excellent book for the classroom, reference, or just interesting reading.

Western, David and Mary Pearl (Editors). 1989. Conservation for the Twenty-first Century. 365 pp. Hardbound. $36.95. Oxford University Press, 2001 Evans Road, Cary, NC 27513.

The proceedings of the conference "Conservation 2100: A Fairfield Osborn Symposium" are published in this volume. Thirty-two contributors have published articles pertaining to the following topics: I. Tomorrow's World; II. The Biology of Conservation; III. Conservation Management; IV. Conservation Realities; V. An Agenda for the Future.

The text covers a broad spectrum of facts and ideas from an international and global viewpoint. It is recommended for all persons interested in any aspect of our future on this planet.

A TAXONOMIC COMPARISON OF *ARISTIDA TERNIPES* AND *ARISTIDA HAMULOSA* (GRAMINEAE)[1]

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ABSTRACT

The morphologic similarity of *Aristida ternipes* and *A. hamulosa* was assessed. All 29 measured variables exhibited considerable overlap in their ranges, and only eight of the 29 had correlations greater than 0.50. Multivariate (principle component and discriminant) analyses revealed a lack of phenetic patterning; only awn lengths distinguished the taxa. The two entities are recognized at the varietal level. The nomenclatural combination *A. ternipes* var. *hamulosa* (Henrard) Trent is made.

RESUMEN

Se evalus la similitud morfolsgica entre *Aristida ternipes* y *A. hamulosa*. Las 29 variables medidas mostraron considerable superposicisn, y solamente ocho de ellos dieron correlaciones mayores que 0.50. Un analisis multivariada revels una carencia de patrones feniticos; unicamente la longitud de las aristas sirvis para distinguir los taxa. Las dos entidades son reconocidas a nivel variedad. Se propone la combinacisn *A. ternipes* var. *hamulosa* (Henrard) Trent.

Two commonly encountered grasses in the southwestern United States are *Aristida ternipes* Cav. and *A. hamulosa* Henr. Both are common on dry, sandy plains and hills of low desert areas, and not infrequent at higher elevations in foothills and on mesa slopes. In general habit the two species are quite similar, with small basal tufts of foliage and large, stiff, widely spreading panicles. They differ most conspicuously in the development of their lateral awns, those of *A. ternipes* being very short (often hardly noticeable) and those of *A. hamulosa* being well-developed and obvious. Henrard (1927, p. 221) also called attention to the "curious" tuberculate lemmas of *A. hamulosa* when he described the species. The difference in awn lengths

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has traditionally placed the two species into separate sections of the genus: *A. ternipes* in the section *Streptachne*, and *A. hamulosa* in the section *Aristida* (*Chaetaria*) (Henrard 1929, 1932). However, the two species seem to be more similar than this classification would suggest.

Most North American botanists (Hitchcock and Chase 1951; Kearney and Peebles 1969; Beetle 1983) have accepted Hitchcock's (1924) and Henrard's (1926, 1928) treatment of *Aristida ternipes* and *A. hamulosa* as separate entities without evident relationship. Correll and Johnston (1970) suggested that *A. hamulosa* may be only a form of *A. divaricata*, but Gould (1951, 1975) called attention to the similarity of *A. hamulosa* with both *A. ternipes* and *A. divaricata*.

The purpose of this study was to evaluate the taxonomic relationship of *Aristida ternipes* and *A. hamulosa* by assessing the variability in morphological features and by testing the characters that traditionally have been used to separate them.

TABLE 1. Summary of acronyms and states for characters used in the statistical analysis of *Aristida ternipes* and *A. hamulosa*.

Character scored	Acronym	States
Culm height	CULMHT	Continuous
Blade width	BLADEW	Continuous
Blade conformation	BLADECON	0-flat 1-some involution 2-highly involute
Blade pubescence	BLADEPUB	0-glabrous 1-some pubescence 2-strongly pubescent
Collar pubescence	COLLPUB	0-glabrous 1-some pubescence 2-strongly pubescent
Ligule length	LIGULEL	Continuous
Panicle length	PANL	Continuous
Longest primary branch length	PRIBRNL	Continuous
Distance to first spikelet	SPKLTDIS	Continuous
First secondary branch length	SECBRNL	Continuous
Terminal primary branch length	TERMBRNL	Continuous
Lateral pedicel length	PEDL	Continuous
Maximum number of branches per node	BRNCHNUM	Continuous
Panicle branch spreading (Branching Index)	BRANINDX	ratio of spreading secondary and tertiary branches to the number of primary branches

Central awn length	CAWNL	Continuous
Lateral awn length	LATAWNL	Continuous
First glume length	FSTGLUML	Continuous
Second glume length	SECGLUML	Continuous
Glume pubescence	GLUMEPUB	0-glabrous 1-some pubescence 2-highly pubescent
Callus length	CALLUSL	Continuous
Floret length	FLORETL	Continuous
Width of lemma at widest point	LEMMAW	Continuous
Width of lemma at narrowest point	LEMMAN	Continuous
Lemma texture	LEMMATXT	0-smooth 1-tuberculate 2-scabrous
Awn column length	AWNCOLL	Continuous
Awn column twisting	COLLTW	0-no twisting 1-1 turn 2-2 or 3 turns 3-4 or more turns
Anther length	ANTHERL	Continuous
Palea length	PALEAL	Continuous
Elevation of collection site	ELEV	Continuous

MATERIALS AND METHODS

Field collections of *Aristida ternipes* and *A. hamulosa* were made from populations in Arizona, Colorado, New Mexico, Texas, and Chihuahua, Mexico; emphasis was placed on collecting all forms present in a population. The field collections were supplemented by herbarium material from throughout the range of the species, including California, Mexico, and Guatemala. From all material gathered, specimens were selected for study that represented the variability present in the two taxa as well as the geographic range of the species. A data set for morphometric analysis was compiled by scoring selected specimens (field and herbarium) for the features listed in Table 1. Only mature specimens were included in the analysis, determined by complete emergence of the panicle from the sheath. A total of 92 individuals were measured. A list of specimens examined may be requested from Allred.

The BMDP statistical package (Dixon 1981) was used for analysis. In addition to standard, descriptive statistics such as mean, range, standard deviation, and correlation coefficients for all variables, principal components analysis (PCA) was used to assess the morphological similarity or dissimilarity of the specimens (OTUs). Based on a variable by variable correlation matrix, the PCA plotted the OTUs along each component according to its phenetic similarity to each other OTU. Groups, or classifications of the OTUs, suggested by the PCA were then tested by stepwise discriminant analysis (SDA). SDA determined the potential for variables to cause disjunctions between two or more a priori groupings (in this case, those implied by PCA or those specified by a particular variable). A "grouping variable" segregated the OTUs into groups and the analysis determined if these groups were recognizable by the statistical relationships of the remaining variables. Output from SDA included the percentage of OTUs classified "correctly" or "incorrectly," that is, the percentage corresponding to the a priori groups. A high percentage of correctly classified OTUs indicated that the a priori classification was supported by the other variables. SDA was also used to test the importance or validity of certain variables in creating groups. Lateral awn length was used as the grouping variable, specifying two groups based on a cut-point value of 2.5 mm (those OTUs with lateral awns less than 2.5 mm were assigned to *ternipes*, those with lateral awns less greater than 2.5 mm were assigned to hamulosa). The SDA then determined if the resultant groups were supported statistically by the remaining variables.

RESULTS AND DISCUSSION

Morphometric Analysis. Correlation coefficients were calculated for all combinations of characters. All of the correlations greater than 0.50 were with continuous size variables (Table 2), but, the only variables that showed correlations higher than 0.80 were panicle and spikelet features related to specimen size: culm height with panicle length (0.86), primary branch length with panicle length (0.86), central awn length with lateral awn length (0.84), and first with second glume length (0.84). In general, as the size of the specimen increased, the size of the panicle also increased; likewise, the size of spikelet parts tended to increase or decrease in concert. It is noteworthy that lemma texture had no high correlations, eventhough Aristida hamulosa had been characterized by its prominent tubercles on the lemma (Henrard 1927).

The means and ranges of features with correlations higher than 0.50 were then compared between *Aristida ternipes* and *A. hamulosa* (Figure 1). The assignment of OTUs to one of the two taxa was based on lateral awn length because of its traditional importance in identification. OTUs with lateral awns longer than 2.5 mm were assigned to hamulosa, and those with shorter awns to *ternipes*. With the exception of the awn features, the ranges and standard deviations of every character overlapped extensively. Central awn length had overlapping ranges, but not standard deviations. Lateral awn lengths did not overlap because of the a priori assignment of

Fig. 1A.
Panicle Features

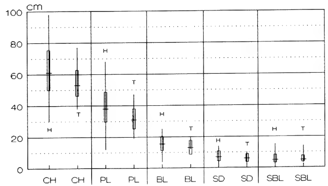

Fig. 1B.
Spikelet Features

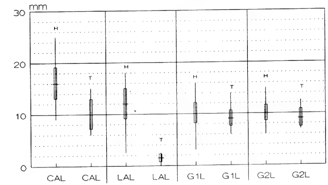

FIG. 1. Range, mean, and 1 one standard deviation for the correlated features of the data set for *Aristida ternipes* (T) and *A. hamulosa* (H). 1A. Panicle features, measured in cm. CH = culm height; PL = plant height; BL = primary branch length; SD = distance to first spikelet; SBL = secondary branch length. 1B. Spikelet features, measured in mm. CAL = central awn length; LAL = lateral awn length; G1L = first glume length; G2L = second glume length.

TABLE 2. Correlation coefficients greater than 0.500 of all variables for *Aristida hamulosa* and *A. ternipes* using all OTUs. Acronyms according to Table 1.

	CULMHT	PANL	PRIBRNL	CAWNL	FSTGLUML	SECGLUML
PANL	0.856	1.000	–	–	–	–
PRIBRNL	0.795	0.856	1.000	–	–	–
SPKLTDIS	0.643	0.635	0.749	–	–	–
SECBRNL	–	0.512	–	–	–	–
LATAWNL	–	–	–	0.835	–	–
SECGLUML	–	–	–	0.639	0.839	1.000
FLORETL	–	–	–	–	0.541	0.504
CALLUSL	–	–	–	–	–	0.526

the OTUs based on this feature. However, the range in lateral awn lengths varied continuously from *hamulosa* to *ternipes*.

The principal components analysis was conducted using the same set of correlated features. The placement of the OTUs along the first component (PCI) was correlated with over-all size features such as panicle length (0.93), longest primary branch length (0.92), culm height (0.91), and distance to the first spikelet on the branch (0.79). The second component (PCII) revealed differences in spikelet features, including second glume length (0.89), first glume length (0.86), and floret length (0.85). The third component (PCIII) emphasized lateral awn length (0.91) and central awn length (0.82). The three components accounted for 75 percent of the variability altogether.

The phenetic distribution of the OTUs along PCI and PCII, which were size and spikelet components, revealed no discernible separation of taxa, and those plots are not shown here. But a segregation of OTUs was achieved along the third component, based on awn lengths (Figure 2). To test the validity of a partition based on lateral awn length, a stepwise discriminant analysis was performed that used this character as the a priori grouping variable but not in calculating the discriminant function. The plot of the OTUs along the canonical variate (Figure 3A) indicated that two groups were distinguished; central awn length was the only variable used in calculation of the discriminant function. However, when both lateral and central awn lengths were removed from the analysis, an extensive intermingling of the OTUs resulted (Figure 3B), and the discriminant function assigned only 69% of the *hamulosa* OTUs and 60% of the *ternipes* OTUs to the "correct" a priori group.

The results of the statistical analyses indicated that 1) there was a nearly continuous range of morphologic variation from one taxon to the other, with extensive overlap in the ranges of individual variables; 2) two contiguous groups of OTUs were segregated based on awn lengths; and 3) no other basis existed, other than awn lengths, for distinguishing the groups.

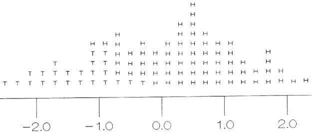

Fig. 2. Principal Component III

FIG. 2. Projection of *Aristida ternipes* (T) and *A. hamulosa* (H) OTUs along principal component III.

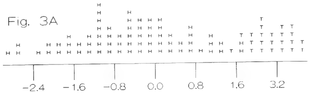

FIG. 3. Histograms of *Aristida ternipes* (T) and *A. hamulosa* (H) OTUs along the canonical variable of the discriminate analysis. The grouping variable was lateral awn length. 3A. Histogram when only lateral awn length was removed from the data set. 3B. Histogram when both lateral awn and central awn lengths were removed from the data set.

Other Observations. Field and herbarium studies yielded other important observations. Noted for the first time for both taxa was the consistent occurrence of long, weak hairs at the base of the blade above the ligule. Also characteristic were glabrous collars, an untwisted awn column, and anthers generally longer than 1.2 mm. These features distinguished the *hamulosa* and *ternipes* entities from the similar-appearing *A. divaricata* Willd. and *A. havardii* Vasey (commonly known as *A. barbata* Fourn.).

Both taxa were found in Texas, New Mexico, and Arizona and throughout most of Mexico. Only the *hamulosa* entity was found in southern California and southern Colorado, and extended as far south as Honduras, but specimens of *ternipes* were found from Nicaragua, Costa Rica, the Bahamas, Venezuela, and Columbia, where *hamulosa* was absent. When sympatric, the two often grew intermingled in the same apparent population and there were no noticeable differences in soil or microsite preferences. The *hamulosa* taxon has spread to slightly more temperate areas in California and Colorado, and *ternipes* perhaps represents a more subtropical form.

Specimens of *hamulosa* from California tended to be short in height, with correspondingly short primary panicle branches. The spikelets were also spaced somewhat closer together. The overall effect of these differences was a slightly more congested look to the panicle. California plants could not be distinguished from non-California plants on this basis, however, and numerous small plants with short branches were found within populations from other regions. *Aristida ternipes* was not found from California.

Commonly, branchlets and spikelets were appressed to the axis of the panicle branch (Figure 4A). However, forms with spreading to divaricate branchlets or pedicels were occasionally found in both taxa. This condition was always associated with pulvini in the axils of the branchlets and pedicels, causing them to spread outward from their axes (Figure 4B). The expression of the pulvini was measured by the branching index in the morphometric analysis and was not highly correlated with any other feature. Our field observations confirmed this: pulvini seemed to develop arbitrarily in many different populations and both spreading and appressed forms of *Aristida ternipes* and *A. hamulosa* were found in the same population. However, spreading forms transplanted to a greenhouse maintained this feature the following growing season, and pulvini did not appear to be a maturation phenomenon, but were observed in the inflorescences from the time they emerged from the sheath until senescence of the plant. The geographic distribution of the spreading forms was centered in the southwestern United States and northern Mexico, with few specimens found

FIG. 4. Spreading and appressed inflorescence forms. A. Inflorescence of a specimen of *Aristida hamulosa* showing the appressed form. B. Inflorescence of a specimen of *Aristida ternipes* showing the spreading form.

from California or southern Mexico. Spreading forms are likewise found in other species of *Aristida*, including *A. pansa*, *A. dissita*, *A. divaricata*, and *A. havardii*. The spreading form of *A. hamulosa*, in particular, may be confused with *A. havardii* or *A. divaricata*, but is distinguished by shorter anthers ($\leq$ 1 mm) and glabrous ligular region in the latter species.

Conclusions and Taxonomy. *Aristida ternipes* and *A. hamulosa* are nearly identical morphologically. Apart from the difference in lateral awn length, the two can scarcely be distinguished. Their over-all geographic distributions have considerable overlap, they are found in the same habitats and in intermingling populations, they both display a distinctive pubescence near the ligule, and they share a seemingly arbitrary expression of pulvini in the panicle. A chromosome level of $2n = 44$ has been reported for both taxa (Gould 1966, 1968; Stebbins & Love 1941). The recognition of two species based on differences in lateral awn length is unwarranted. Eventhough the two entities can be distinguished only by a single feature, suggesting forma status, we propose recognizing the variation in this complex at the varietal level. This is consistent with treatments of similar variation patterns in other Aristida species and with the widespread lack of sharp boundaries in general between taxa in many North American Aristida (Allred 1984a,b, 1985). Given the priority of *A. ternipes* in publication date, the correct classification of the *ternipes* and *hamulosa* entities would be within the single species *A. ternipes* with two varieties, var. *ternipes* and var. *hamulosa*. The necessary combination for the latter variety is effected below.

ARISTIDA TERNIPES Cav. var. **HAMULOSA** (Henrard) Trent, comb. nov. — BASIONYM: *Aristida hamulosa* Henrard, Med. Rijks. Herb. Leiden 54:219. 1926. TYPE: ARIZONA. Tucson, 30 Sep 1894, *J.W. Toumey s.n.*.

Salient features of the two varieties are compared below:

	var. *ternipes*	var. *hamulosa*
Lateral awn length	0 – 2.5 mm	(2.5)3.5 – 18 mm
Central awn length	5 – 15 mm	10 – 25 mm
Distribution	TX, NM, AZ, Mexico, C. Amer., S. Amer.	TX, NM, AZ, CO, CA, Mexico, Guatemala

ACKNOWLEDGMENTS

We are grateful to the curators of the following herbaria for their generous loans of specimens (acronyms according to Holmgren et al. 1981): AHUC, ANSM, ARIZ, ASU, COLO, ISC, JEPS, LL, NMC, NMCR, NY, OKL, RSA/POM, SD, SMU, SRSC, UNLV, US. Thanks also to two reviewers for their helpful and constructive criticism of the manuscript. David Lee Anderson assisted with the Spanish summary.

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CIRCUMSCRIPTION OF *AGARISTA BOLIVIENSIS* (ERICACEAE)

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ABSTRACT

Our understanding of the morphological variability of *Agarista boliviensis* is significantly expanded by an examination of a population in the Sierra de Zapla in the Province of Jujuy in extreme northwestern Argentina. The Sierra de Zapla plants may be distinguished from Bolivian populations of *A. boliviensis* by several features relating to the indumentum of stems and leaves, petiole and inflorescence lengths, and leaf margins. The taxonomic status of this population is discussed and a revised description for the species is provided. The pattern of variation of *Agarista boliviensis* is similar to that of the closely related *A. eucalyptoides*. The species also is compared with *A. paraguayensis*, the only other species of *Agarista* occurring in Argentina.

Agarista D. Don ex G. Don is a genus of 31 species occurring in both Africa (including Madagascar) and the Americas (Judd 1984; Gonzalez 1989). The genus is most diverse in South America, and is closely related to several genera in the Andromedeae (Ericaceae) such as *Craibiodendron* W. W. Smith, *Lyonia* Nutt., and *Pieris* D. Don (Judd 1979). The morphological variability of several species is still poorly known, and information regarding one of these, *A. boliviensis* (Sleumer) Judd, is reported herein.

Agarista boliviensis has been collected in the Sierra de Zapla in the province of Jujuy in extreme northwestern Argentina. It was first reported for the country by Legname (1978) and was listed in the Flora of this province by Cabrera (1983). All other populations of the species are located in central and southern Bolivia. The species occurs in mountainous areas from ca. 1200 to 2500 m altitude. In the Sierra de Zapla of Argentina it occurs in moist montane forests and is associated with *Podocarpus parlatorei, Alnus acuminata, Eupatorium* spp., and *Rubus* spp.

Available herbarium material of *A. boliviensis* from the Sierra de Zapla shows several differences from all known specimens of the species collected

SIDA 14(2):263–266. 1990.

in Bolivia, necessitating the following revised species description. As in Judd (1984), the term "pubescent" refers only to the presence of small, more or less whitish, unicellular, nonglandular hairs.

DESCRIPTION: Rhizomatous shrub or small tree to ca. 7 m tall. Twigs glabrous to moderately pubescent, reddish when young, with nonchambered to obscurely chambered pith; buds to ca. 1 mm long. Leaves alternate, reddish on young shoots; blade revolute in bud, ± flat at maturity, coriaceous, ovate, $2-7.5 \times 0.9-3.2$ cm, base cuneate to rounded and often slightly asymmetric, apex acuminate, margin entire and minutely undulate to smooth, more or less flat to very slightly revolute at extreme base; adaxial blade surface dark green and lustrous, glabrous or with a very few hairs, especially near margin, but very sparsely to moderately pubescent on midvein; abaxial blade surface glabrous, but very sparsely to moderately pubescent along midvein, with inconspicuous to conspicuous glandular dots along midvein; petiole (3.5-)$5-17$ mm long, slender and often flexuous. Inflorescences axillary racemes to $0.5-4$(-6) cm long; rachis moderately pubescent with whitish hairs; pedicels $4-9$ mm long, sparsely to moderately pubescent; bracteoles 2, opposite to alternate, from basal to within lower 1/3 of pedicel, narrowly triangular to linear (rarely ovate), to ca. 1.7 (rarely 8) mm long; floral bracts to ca. 1.5 mm long. Flowers 5-merous; calyx lobes triangular with acuminate apices, $0.9-2 \times 0.5-1.7$ mm, abaxial surface glabrous to moderately pubescent, articulated with pedicel, with ca. $1-1.5$ mm long projection between calyx and point of articulation; corolla cylindrical, $6-11 \times 2-5$ mm, abaxially glabrous (or sometimes with a very few unicellular hairs along the veins), white. Filaments $3.5-7$ mm long; anthers $1-1.2$ mm long. Ovary glabrous to moderately pubescent, especially near apex. Capsules subglobose to ovoid, $3-4.5 \times 4.3-7$ mm, placentae subapical; seeds $1.4-2.6$ mm long.

Specimens Examined: ARGENTINA. **Jujuy**: Departamento Capital, Cerro Zapla, Mina 9 de Octubre, Villamil 2936 (BBB, FLAS, NY); ibid., Villamil et al. 4311 (BBB, FLAS); Departamento Capital, Sierra de Zapla, Burkart et al. 30549 (FLAS [frag.], SI); Sierra de Zapla, Mina 9 de Octubre, Cabrera et al. 32009 (SI). BOLIVIA. **Chuquisaca**: Sucre, Alto de Aguas Blancas, Troll 1249 (B). **Cochabamba**: Rosal, below pumping station, Brooke 5702 (F, NY). **Potosi**: Charcas, San Pedro, Pasopaya, Anonymous 3400 (GH). **Santa Cruz**: Tres Cruces, Herzog 1634a (L). **Tarija**: lomas peladas, Alto de las Cañas, Troll 359 (B, M); Camino de Emborozú, La Mamora, Türpe et al. 4777 (BAA).

The very close relationship of the recent collections from the Sierra de Zapla in northwestern Argentina to those from central and southern Bolivia, i.e., typical *Agarista boliviensis*, is seen in the fact that plants from both regions share several characters: absence of multicellular gland-headed hairs; ovate leaves that are more or less flat at maturity, with slender and at least sometimes slightly flexuous petioles and acuminate apices; often short inflorescence axes that are moderately pubescent (with whitish hairs); white flowers with short calyx lobes; and capsules with subapical placentae (Judd 1984). The Sierra de Zapla population is the southernmost of the species. As is often the case in isolated peripherial populations (Mayr 1969), it is somewhat distinctive morphologically. Plants from this population usually can be differentiated from Bolivian plants by their sparsely to moderately pubescent twigs (vs. glabrous to sparsely pubescent); leaves with the midvein more or less moderately pubescent (vs. only very sparsely pubescent); petioles 3.5 – 10 mm long and not or only slightly flexuous (vs. 6 – 17 mm long and frequently flexuous); leaf margins entire and smooth to obscurely undulate (vs. usually entire and minutely undulate, but rarely only obscurely undulate); and inflorescences 0.5 – 4(-6) cm long (vs. 0.5 – 2.5 cm long). Some of the flowers on the Sierra de Zapla plants also have longer filaments (to 7 mm) than those seen in flowers of Bolivian plants (to 4.5 mm). The Sierra de Zapla plants have been illustrated by Cabrera (1983) and a typical Bolivian plant of *A. boliviensis* was pictured in Judd (1984).

Initially, we considered giving varietal rank to this distinctive population of *Agarista boliviensis* in the Sierra de Zapla. However, additional study of available material indicated that formal taxonomic recognition is unwarranted due to the degree of overlap in the presumed diagnostic characters, and because an extremely similar pattern of variation is shown by the closely related *A. eucalyptoides* (Chamisso & Schlechtendal) G. Don (see Judd 1984).

Agarista eucalyptoides is a widely distributed species of southern Brazil that shows variation in stem and leaf pubescence, degree of undulation of leaf margin, length and amount of flexuousness of the petiole, and inflorescence length (Judd 1984). It is, thus, not too surprising that additional collections of *A. boliviensis* have revealed extensive variability in these same features. *Agarista eucalyptoides* can easily be distinguished from *A. boliviensis* by its ovate to oblong leaves and the indumentum of its inflorescence axes, i.e., densely covered with ferrugineous hairs in *A. eucalyptoides* in contrast to moderately pubescent with whitish hairs in *A. boliviensis* (Judd 1984).

The only other species of *Agarista* occurring in Argentina is *A. paraguayensis* (Sleumer) Judd. This species grows in northeastern Argentina in Misiones province as well as several localities in Paraguay (Judd 1984). *Agarista boliviensis* differs from *A. paraguayensis* in several features: longer and occasionally slightly flexuous petioles, consistently acuminate leaf apices, leaves always lacking a dense indumentum on abaxial surface, consistent absence of multicellular gland-headed hairs, often shorter racemes, subapical placentae, and longer seeds. Although superficially similar, the two taxa probably are not closely related. Noteworthy in this regard, is the difference in placenta position in the two species, i.e., subapical in *A. boliviensis* and more or less central in *A. paraguayensis*.

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A NEW STATUS FOR *QUERCUS SHUMARDII* VAR. *ACERIFOLIA* (FAGACEAE)

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ABSTRACT

Quercus shumardii Buckl. var. *acerifolia* Palmer is elevated to species **Q. acerifolia**. It is restricted to the north-facing bluffs of Magazine Mountain, Logan County, Arkansas. A comparison of certain morphological features with *Q. shumardii sensu lato* is made.

Quercus shumardii Buckl. var. *acerifolia* Palmer (Maple-leaf Oak) was described in 1927 from specimens that E. J. Palmer collected in 1923 from Magazine Mountain, Arkansas. In the interim, no additional localities for this taxon have been discovered. It was included in the Report on Endangered and Threatened Plant Species of the United States (United States Fish and Wildlife Service 1975) in the category of Threatened species, and more recently in Category 2 (possible listing may be appropriate, but sufficient data not available to support listing now) of the Federal Register of Endangered and Threatened Wildlife and Plants (1985) by the United States Fish and Wildlife Service.

The single known locality for the Maple-leaf Oak occurs on land within the Ozark National Forest. The Ozark National Forest has issued a special use permit to Arkansas Department of Parks and Tourism for development of a state park on Magazine Mountain. Ownership of the land in the eventuality of park development will remain with the United States Forest Service. An Environmental Impact Study (EIS) to determine the feasibility of park development has been initiated and will be completed in 1991. Significant elements of flora and fauna on the mountain will be important factors in the selection of alternatives for park development in the EIS.

Quercus shumardii var. *acerifolia* is clearly related to typical *Q. shumardii*. *Quercus shumardii sensu lato* has also included other varieties such as *schneckii* (Britt.) Sarg. and *texana* Buckley *sensu* Trelease (= *Q. buckleyi* Nixon and Dorr). We have visited the type locality for var. *schneckii*) along the bottomland of the Wabash River in Illinois. The key morphological feature separating var. *shumardii* from var. *schneckii* is the shape of the acorn cupule (saucer-shape = var. *shumardii*; turbinate = var. *schneckii*). Trees with both types of acorn cupules occur at this locality. At this time, because the key morphological characteristic separating the two varieties and bottomland habitat (= var. *shumardii*) versus upland habitat (= var. *schneckii*) do not hold up, we do not recognize a distinction between these two taxa. Two other taxa, *Q. texana sensu* Dorr and Nixon (1985) (= *Q. nuttallii* Palmer) and possibly *Q. georgiana* M.A. Curtis make a part of the *Q. shumardii* complex. It is not the purpose of this paper to address the relationships of these taxa, although we are studying them for a later report.

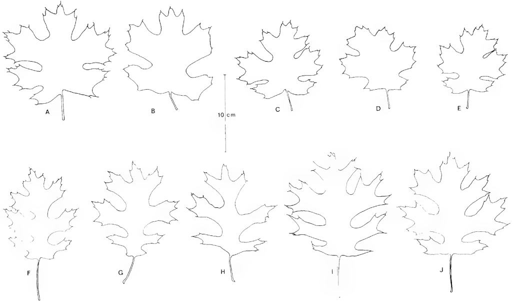
Stoynoff and Hess have accumulated data to warrant raising *Quercus shumardii* var. *acerifolia* to species status. Petzold and Kirchner (1864) were the first to use *Q. acerifolia*, but as a synonym of *Q. rubra* and without a description. Consequently, it was not a valid publication and *Q. acerifolia* is not a later homonym and available for the oak from Magazine Mountain. We are still in the process of gathering and analyzing data (especially from seedling stock), which will form the basis of comparative studies. Because of the impending EIS reviews, we believe it is important to propose the change in status now, rather than waiting for full confirmation. This may well be the most rare species of oak known and deserves very special preservation efforts and status.

QUERCUS **ACERIFOLIA** (Palmer) Stoynoff & Hess, stat. nov. — BASIONYM: *Quercus shumardii* Buckl. var. *acerifolia* Palmer, J. Arnold Arbor. 8:24–55. 1927, non *Quercus acerifolia* Petzold & Kirchner, nom. nud. Arbor. Muscav. p. 656. 1864. TYPE: UNITED STATES. ARKANSAS: Logan Co.: rocky (sandstone) top of Magazine Mountain, 8 Oct 1924, *Palmer 26434* (ISOTYPE: AA, MOR!).

Table 1 is a comparison of certain morphological features of *Quercus acerifolia* with its closest relative *Q. shumardii*. Maple-leaf Oak is a shrub or small tree to five (occasionally to 15) m tall. Typically, several ascending stems originate near the base at or below ground level. The leaves are broader than long and quite distinct from typical *Q. shumardii* leaves, which are longer than broad (Fig. 1). It has acorns (nuts only) that rarely are more than 17 mm long, 1/4 to 1/3 smaller than those of *Q. shumardii* (Fig. 2).

Quercus acerifolia grows on the north-facing bluffs of Magazine Mountain at an elevation of 2600 feet. There are two populations, one at Brown Spring and the other between 1.3 and 2.0 km west along the cliffs. They occur

FIG. 1. Leaf outlines of *Quercus acerifolia* and *Q. shumardii*. A–E. *Q. acerifolia* by Hess and Stoynoff from Magazine Mountain, Logan County, Arkansas. F–J. *Q. shumardii*. F. Clay Co., Illinois, *Hess and Stoynoff 6433*. G. Perry Co., Tennessee, *Hess and Stoynoff 6500*. H. Shenandoah Co., Virginia, *Hess 6514*. I. Union Co., Illinois, *Hess and Stoynoff 6436*. J. Izard Co., Arkansas, *Hess and Stoynoff 6440*.


A
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10 cm
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Table 1. Comparisons of certain morphological features of the *Quercus shumardii* complex.

Feature	*Q. acerifolia*	*Q. shumardii*
Habit	Shrub or small tree, 3 – 6 (-15) m tall, multiple stems	Tree, 15 – 30 (-40) m tall, single stem
Branch (yr 1)		
color	Brown	Brown
pubescence	Stellate, glabrescent	Stellate, glabrescent
Leaf		
habit	Wider than long	Longer than wide
length	7 – 14 cm	8 – 17 (-20) cm
width	8 – 15 (-18.5) cm	6 – 15 (-16) cm
length/width $\bar{x}$	0.81 (n = 39)	1.22 (n = 83)
# lobes	5 (-7)	5 – 7 (-9)
Bud		
color	Apex dark brown, lower scales tan, hyaline margins	Apex brown, lower scales tan, hyaline margins
pubescence	Glabrous	Glabrous
Acorn		
cupule		
depth	(2-) 3 – 5 (-6) mm	(4-) 6 – 12 mm
width	(12.4-) 14 – 17 (-18) mm	(16.5-) 18 – 26 (-28) mm
nut		
length	13 17 (-17.5) mm	(16-) 18 – 26 (-29) mm
Distribution	Logan Co., AR	US from PA s to FL, w to TX, OK, and KS.

mostly within 75 m of the 65 m high bluffs on level ground or, more commonly, on gentle slopes (in what would have been a savannah-like zone) and along the rocky rim.

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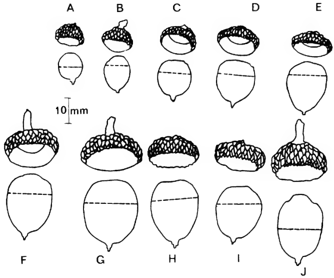

FIG. 2. Acorn nut and cupule outlines of *Quercus acerifolia* and *Q. shumardii*. A – E. *Q. acerifolia* collected by van der Linden and Hess from Logan Co., Arkansas. F – J. *Q. shumardii*. F – G. Beall Woods, Wabash Co., Illinois, *Hess and Stoynoff 6503*. H. Clay Co., Illinois, *Hess and Stoynoff s.n.* I. Shenandoah Co., Virginia, *Hess 6514*. J. Mississippi Co., Missouri, *Hess and Stoynoff 6509*.

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ANNOTATED CHECKLIST OF NEW MEXICAN CONVOLVULACEAE

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ABSTRACT

Specimens examined in 14 herbaria resulted in the identification of 25 species of Convolvulaceae for the state of New Mexico. The list includes three species not recorded in the recent state flora, and makes nomenclatural changes in five others to bring them in accord with current literature. A lectotype is chosen for *I. mexicana*.

RESUMEN

Un revision de las muestras de catorce herbarios ha resultado en la identificacion de veinticinco especies de Convolvulaceas para el estado de New Mexico. La lista incluye tres especies nuevemente reportados en el estado, y se realiza cambios de nomenclatura en cinco de las otras para ponerlas en acuerdo con la literatura moderna. Se selecciona un lectotipo para *Ipomoea mexicana*.

Although an updated flora of New Mexico was recently published (Martin and Hutchins 1981), there have been subsequent additions to the state (McDonald 1984; Spellenberg et al. 1986). More species are added as a result of studies of southwestern members of the family (Austin 1990b; in prep.). In addition, some of the names used by Martin and Hutchins (1981) are corrected.

In the following list, distribution data are provided for species on a county-by-county basis, and comments are made concerning the biogeographic relationships of each in the southwestern United States. Basically, the flora consists of species derived from three sources: the Great Plains, Mexico and Meso-America, and introduced weeds.

This list includes three species not included by Martin and Hutchins (1981), i.e., *Ipomoea dumetorum*, *I. plummerae* and *I. pubescens*, and changes five names used by the latter authors. Twenty-five species are now documented for the state. This number is similar to Arizona (30 species, Austin, unpubl.) but small compared with those found in Texas (58 species, Correll and Johnston 1970).

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KEY TO GENERA

1. Leaf bases obtuse to acute.
   2. Styles 2; stigmas 2, globose; leaves elliptic to lanceolate or ovate-lanceolate; flowers salverform, 0.5 − 0.65 cm long . . . . *Cressa*
   2. Styles 2; stigmas 4, linear to club-shaped; leaves ovate to almost linear; flowers rotate, funnelform or salverform, 5 − 22 mm long . . . . *Evolvulus*
1. Leaf bases truncate, cordate to hastate.
   3. Leaves reniform; flowers mostly green, less than 1 cm wide . . . . *Dichondra*
   3. Leaves variable, but not reniform; flowers white or colored other than green, mostly over 1 cm wide.
      4. Flowers white, with or without tinges of lavender to pink on limb.
         5. Calyx usually enclosed by 2 foliaceous bracts (not in *C. longipes*); corolla funnelform, 3 − 6 cm long; stigmas oblong, flattened . . *Calystegia*
         5. Calyx not enclosed, the bracts scalelike; corolla either campanulate, broadly funnelform, funnelform or salverform, (0.5-)1 − 3 cm long; stigmas subulate . . . . *Convolvulus*
      4. Flowers lavender, blue, red or white with a purple to purple-red throat . . . . *Ipomoea*

KEY TO *CALYSTEGIA*

1. Leaf bases markedly 2-angled; calyx 15 − 30 mm long . . . . . . *C. sepium* ssp. *angulata*
1. Leaf bases cordate to subsagittate, the lobes rounded; calyx 10 − 12 mm long . . . . *C. macounii*

CALYSTEGIA R. Brown HEDGE BINDWEED

1. CALYSTEGIA MACOUNII (Greene) Brummitt, Ann. Missouri Bot. Gard. 52: 215. 1965. — TYPE: CANADA. SASKATCHEWAN: Assiniboia, Milk River, Aug 1895, *Macounn* (not seen).

   Calystegia interior House, Bull. Torrey Bot. Club 32: 140. 1905. — TYPE: COLORADO: ca. Ft. Collins, 19 Jun 1896, *Crandell 1625* (NY!).

Apparently rare in New Mexico, this basically Great Plains species extends south into this state. Although the taxonomy of our native taxa is complex, the group has been discussed by Brummitt (1980).

Specimen examined. **San Miguel Co.**: Las Vegas, Soldier's Camp, 14 Jun 1927, *Bro. Arsene 18720* (US).

2. CALYSTEGIA SEPIUM (L.) R. Br. ssp. ANGULATA Brummitt, Kew Bull. 35(2):328. 1980. — TYPE: IDAHO. CANYON CO.: *Macbride 318* (NY!). *Calystegia sepium* (L.) R. Br. var. *angulata* (Brummitt) N. Holmgren in A. Cronquist et al., Intermountain Fl. Vasc. Pl. Intermountain West, U.S.A. 4:77. 1984.

This North American subspecies reaches its limits in the southwestern United States. Numerous people have misinterpeted this taxon, and the recent Utah flora (Welsh et al. 1987) records it under *Calystegia sepium* with the incorrect statement that it is an introduced European plant. These plants are easily confused with the Great Plains taxon *C. sylvatica* spp. *fraterniflora* (Mackenzie & Bush) Brummitt, as was done by Tryon (1939), Correll and Correll (1972) and Lehr (1978).

Representative specimens examined. **Colfax Co.**: *Clarke 16131* (UNM). **Dona Ana Co.**: 19 Jul 1902, *Metcalfe s.n.* (ARIZ, NMC); *Wooton & Standley 3353* (ARIZ, NMC). **Rio Arriba Co.**: Jul 1859, *Newberry s.n.* (US). **San Juan Co.**: *Standley 7031* (US). **San Miguel Co.**: Jul 1881, *Vasey s.n.* (NY).

KEY TO *CONVOLVULUS*

1. Leaves almost as broad as long; calyx 3 – 5 mm long; perennials from deep creeping root, forming large patches . . . . *C. arvensis*
1. Leaves usually much longer than broad; calyx 6 – 12 mm long; perennials from taproot, sometimes divided at apex but not forming large, creeping patches . . . . *C. equitans*

CONVOLVULUS L. Bindweed

3. Convolvulus arvensis L., Sp. Pl. 153. 1753. — Type: SWEDEN: specimen *218.1* (LINN, microfiche!).

This European introduction has become one of the most widely distributed members of the family in North America. It is a problem weed in cotton and corn fields.

Representative specimens examined. **Bernalillo Co.**: 16 Jul 1945, *Reed s.n.* (UNM). **Catron Co.**: in 1964, *James s.n.* (UNM). **Chaves Co.**: *Bohrer 1975* (ARIZ). **Colfax Co.**: 13 Jun 1979, *Higgins and Campbell s.n.* (UNM). **Curry Co.**: 1 Oct 1907, *Liebret s.n.* (NMC). **Dona Ana Co.**: *Anderson 13* (NMC). **Eddy Co.**: 18 May 1940, *Hershey s.n.* (NMC). **Grant Co.**: *Hess 2065* (ARIZ). **Guadalupe Co.**: *Tschaikowsky 146* (ARIZ). **Hidalgo Co.**: *Castetter 10691* (UNM). **Lea Co.**: *Pearce 2675* (ARIZ). **Lincoln Co.**: *Hutchins 3505* (UNM). **McKinley Co.**: *Nelson 7341* (UNM). **Otero Co.**: 24 May 1970, *Todsen s.n.* (NMC). **Quay Co.**: *Waldrop 37* (UNM). **Rio Arriba Co.**: *Baker 530* (ARIZ). **Roosevelt Co.**: *Castetter 10720* (UNM). **San Juan Co.**: *Levin 408* (ARIZ). **San Miguel Co.**: 20 Jul 1965, *Broeske s.n.* (UNM). **Sandoval Co.**: *Nelson 7342* (UNM). **Santa Fe Co.**: *Bartlett 63* (NMC). **Sierra Co.**: *Metcalfe 1186* (NMC, NY, UC). **Soccoro Co.**: *Moeller 277* (NMC). **Taos Co.**: *Castetter 10689* (UNM). **Torrance Co.**: *Bedker 1042* (UNM). **Valencia Co.**: *Riffle 1216* (UNM).

4. Convolvulus equitans Bentham, Pl. Hartweg. 16. 1839. — Type: MEXICO: *Hartweg 98* (K? not seen).

Convolvulus incanus sensu auct., non Vahl.

This tropical American species reaches its northern limit in Arizona, Utah, New Mexico and Texas.

Representative specimens examined: **Catron Co.**: *Mulford 516* (NY). **Chaves Co.**: *Earle & Earle 248* (NMC, NY, UC). **Colfax Co.**: *Griffiths 5537* (US). **De Baca Co.**: *Dunn 1955* (UNM). **Dona Ana Co.**: 18 May 1936, *Hershey s.n.* (NMC). **Eddy Co.**: 3 Aug 1909, *Wooton s.n.* (NMC). **Grant Co.**: 22 Jun 1906, *Wooton s.n.* (NMC). **Guadalupe Co.**: *Clark 7344* (UNM). **Harding Co.**: *Ward et al. 81-244* (NMC). **Hidalgo Co.**: *Cazier 405* (ASU); *Spellenberg & Spellenberg 3825* (ASU, TEX, NMC, NY). **Lincoln Co.**: *Locke et al. G11-40*

(ASU). **Luna Co.**: *Hershey 2043* (NMC). **Otero Co.**: *Fletcher and Haggren 600* (UNM). **Quay Co.**: *Castetter 10690* (UNM). **San Miguel Co.**: 1899, *Cockerell & Porter s.n.* (NMC). **Sandoval Co.**: *Plowman and Kilham AP295* (GH). **Sierra Co.**: *Spellenberg & Todsen 2539* (NMC, NY). **Soccoro Co.**: *Fleetwood 10* (NMC). **Union Co.**: 23 Sep 1907, *Hanson s.n.* (NMC).

Ward (1984) recorded the chromosome numbers of this species, based on his Harding County collection, as n = 12.

CRESSA ALKALI WEED

5. CRESSA TRUXILLENSIS Humboldt, Bonpland and Kunth, Nov. Gen. Sp. Pl. 3:93. 1819. — TYPE: PERU: Trujillo, *Humboldt & Bonpland 3727* (MICROFICHE: B!; ISOTYPE: F!). *Cressa cretica* L. var. *truxillensis* (H.B.& K.) Choisy in DeCandolle, Prodr. 9:440. 1845.

   Cressa depressa Goodding, Bot. Gaz. 37:58. 1904. — TYPE: NEVADA: *Goodding 726* (UC!).

   Cressa insularis House, Bull. Torrey Bot. Club 33:315. 1906. — TYPE: MEXICO: Revillagigedo Isls, *Barkelew 252* (US!, UC!).

   Cressa erecta Rydberg, Bull. Torrey Bot. Club 40:466. 1913. — TYPE: UTAH: *Garrett 870* (NY!).

   Cressa minima Heller, Muhlenbergia 8:140. 1913. — TYPE: NEVADA: *Heller and Kennedy 8663a* (NY!). *Cressa truxillensis* H.B.& K. var. *minima* (Heller) Munz, Aliso 4:96. 1958.

   Cressa pumila Heller, Muhlenbergia 8:142. tab. 17. 1913. nomen nudum.

   Cressa vallicola Heller, Muhlenbergia 8: 140. tab. 17. 1913. — TYPE: CALIFORNIA: *Heller 8936a* UC!).

   Cressa truxillensis H.B.& K. var. *vallicola* (Heller) Munz, Aliso 4:96. 1958.

Throughout the North American range of this species (e and s California and se Oregon, e to Utah, w parts of Texas and Oklahoma) there is considerable variation that appears to be of minor taxonomic importance (cf. Austin 1990b). No New Mexican populations are thought to be worthy of a varietal name at this time. For example, plants which are erect have been typically referred to *C. truxillensis*; those which are prostrate are referred to *C. depressa* Goodding. Both of these growth forms have been found growing in the same stand (Arizona: Yuma Co.: *Austin and Austin 7586* ASU). Although the plants are locally common in coastal Sonora, they are infrequent to rare in Arizona, New Mexico and Texas.

Representative specimens studied: **Bernalillo Co.**: *Dittmer and Clark 7361* (UNM). **Chaves Co.**: *Waterfall 4313* (ARIZ). **Dona Ana Co.**: 12 Jun 1892, *Wooton s.n.* (NMC). **Eddy Co.**: *Castetter 10683* (UNM). **Otero Co.**: 16 May 1936, *Hershey s.n.* (NMC). **Soccoro Co.**: *Castetter s.n.* (UNM 10619).

KEY TO *DICHONDRA*

1. Plants with appressed, whitish or canescent pubescence; pedicels 4 – 6 mm long, recurved near their attachment to the stolon .... *D. argentea*

1. Plants not whitish or canescent; pedicels 5 – 13(-26) mm long, recurved near the calyx . . . . *D. brachypoda*

DICHONDRA Forster PENNYWORT

6. DICHONDRA ARGENTEA Willd., Hort. Berol. 297. t. 81.1806. — TYPE: COLOMBIA: Tolima near Honda, *Bonpland* (B?).

These plants often grow on southwestern-facing rocky ridges in Dona Ana and Luna Counties. Although plants may be locally common, the species is infrequent in the state. The species occurs in New Mexico, Texas, and was found once in Arizona in 1931 (*Harrison 8256* ARIZ). In Mexico it occurs from Chihuahua south to Chiapas; also found in Central and South America.

Representative specimens studied: **De Baca Co.**: 23 Oct 1904, *Wooton s.n.* (NMC); 25 Jun 1894, *Wooton s.n.* (NMC). **Dona Ana Co.**: *Austin & Austin 7637* (ASU). **Grant Co.**: *Knight 2725* (UNM). **Harding Co.**: *Wooton s.n.* (UNM 18050). **Luna Co.**: *Goodding 3189* (NMC).

7. DICHONDRA BRACHYPODA Wooton and Standley, Contr. U.S. Nat. Herb. 16:160. 1913. — TYPE: NEW MEXICO. DONA ANA CO.: Organ Mountains, Filmore Canyon, 23 Sep 1906, *Wooton & Standley s.n.* (US!).

This species of the Mexican-U.S. border is known from Arizona, New Mexico and Texas. In Mexico it has been found from Chihuahua to Oaxaca.

Representative specimens studied: **De Baca Co.**: 1890, *Wooton s.n.* (US). **Eddy Co.**: 31 Jul 1909, *Wooton s.n.* (NMC). **Grant Co.**: *Barneby 2541* (NY). **Hidalgo Co.**: *Spellenberg & Repass 5318* (NMC, NY); *Spellenberg & Spellenberg 6318* (NMC, NY). **Sierra Co.**: *Metcalfe 1377* (GH, NMC, NY, UC).

KEY TO *EVOLVULUS*

1. Peduncle developed, longer or shorter than the subtending leaves.
    2. Sepals densely pilose, 2 – 2.5 mm long; corolla (5-) 7 – 10 mm wide; leaves elliptic, ovate or oblong to lanceolate; stems with appressed-pilose and long spreading trichomes . . . . *E. alsinoides*
    2. Sepals pilose to tomentose, 3 – 3.5 mm long; corolla (10-)12 – 22 mm wide; leaves lanceolate to linear-lanceolate; stems appressed pilose to tomentose, rarely with spreading trichomes . . . . *E. laetus*
1. Peduncle absent or extremely short, always shorter than subtending leaves.
    3. Sepals lanceolate to narrow-lanceolate, 4 – 5 mm long, spreading pilose . . . . *E. nuttallianus*
    3. Sepals oblong-lanceolate, 3 – 5 mm long, appressed-pilose . . . . *E. sericeus*

EVOLVULUS L.

8. EVOLVULUS ALSINOIDES L. var. ANGUSTIFOLIA Torr., Bot. Mex. Bound. 150. 1858. — TYPE: TEXAS. BREWSTER CO.: near the Grand Canyon of the Rio Grande, August, *Parry* (not found in CM, GH, ISC, MO, NY, PH, US or YU).

Evolvulus alsinoides L. var. *acapulcensis* (Willd.) van Ooststroom, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 14:34. 1934. — TYPE: MEXICO. GUERRERO: near Acapulco, *Willdenow 6128* (B).

This species is pantropical, and has been divided into a large number of varieties. The variety that occurs in Arizona, New Mexico, Texas and Mexico is var. *angustifolia* Torrey (cf. Austin 1990a). Nearby in Texas is the var. *hirticaulis* Torrey. While this Sonoran Desert variety seems to be rare in New Mexico, it is frequent in southern Arizona.

Representative specimens studied: **Dona Ana Co.**: *Todsen 700802-3* (NMC). **Hidalgo Co.**: *Castetter s.n.* (UNM 16459). **Luna Co.**: *Barneby 2485* (NY).

9. EVOLVULUS LAETUS Gray, Proc. Amer. Acad. Arts 17:228. 1882. — TYPE: ARIZONA: 1881, *Pringle* (F!, GH!, US!). *Evolvulus arizonicus* Gray var. *laetus* (Gray) van Ooststroom, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 14:76. 1934.

Evolvulus arizonicus Gray, Syn. Fl. N. Amer. 2, 1:218. 1886. — TYPE: MEXICO. SONORA: sandy prairies, Sep 1857, *Thurber 1023* (GH!); see Austin (1990a) on complexities of typification.

Martin & Hutchins (1981: 1557) separated these two named varieties on the basis of stem and leaf pubescence: short and appressed in var. *arizonicus*, and both short-appressed and long and spreading in var. *laetus*. These traits do not allow separation of the named taxa across the geographic range of the species (cf. Austin 1990a).

Representative specimens studied: **Dona Ana Co.**: 19 Jul 1901, *Wooton s.n.* (NMC). **Grant Co.**: *Moore 103* (ARIZ). **Hidalgo Co.**: *Spellenberg & Repass 5387* (NMC).

10. EVOLVULUS NUTTALLIANUS Roem. and Schult., Syst. Veg. 6:198. 1820. — TYPE: not seen.

Evolvulus pilosus Nutt., Gen. N. Amer. Pl. 1:174. 1818, nom. illegit. — TYPE: on the banks of the Missouri, *Nuttall* (not found).

Evolvulus oreophilus Greene, Leafl. Bot. Observ. and Crit. 1:151. 1903 – 1906. — TYPE: NEW MEXICO. SIERRA CO.: *Metcalfe 1228* (NMC!, NY!, UC!, US!).

Perry (1939) originally pointed out that the Roemer & Schultes name has priority over the Nuttall name. This is a Great Plains species that reaches its limits in the southwestern United States.

Representative specimens studied: **Chaves Co.**: *Higgins 9155* (NY). **Colfax Co.**: *Standley 6291* (US). **Dona Ana Co.**: *Wooton 128* (NMC, UC). **Eddy Co.**: 1 Aug 1909, *Wooton s.n.* (NMC). **Grant Co.**: *Metcalfe s.n.* (UNM 18728). **Guadalupe Co.**: *Tschaikowsky 333* (ARIZ). **Harding Co.**: *Spellenberg et al. 6041* (NMC, NY). **Hidalgo Co.**: *Moeller & Anderson 451* (NMC). **Lea Co.**: *Marley et al. 1458* (UNM). **Lincoln Co.**: *Gordon and Dunn 882* (UNM). **Luna Co.**: *Worthington 13709* (NY). **Otero Co.**: *Fletcher and Haggren 644* (UNM). **Quay Co.**: collector unknown *7358* (UNM); *Eggleston 20121* (GH). **Roosevelt**

Co.: 17 Aug 1909, *Wooton s.n.* (NMC). **San Juan Co.**: *Losure 350* (ARIZ). **San Miguel Co.**: *Broeke M06* (UNM). **Sandoval Co.**: *Castetter 7364* (UNM). **Santa Fe Co.**: *McKinley 84* (UNM). **Sierra Co.**: *Todsen 55267* (NMC). **Soccoro Co.**: *Herrick 711* (NMC). **Union Co.**: *Bartlett 234* (NMC).

Some specimens of this species and *E. sericeus* are difficult to separate. Sepal pubescence and shape will usually allow their separation.

11. EVOLVULUS SERICEUS Swartz, Prodr. Veg. Ind. Occ. 55. 1788. — TYPE: JAMAICA: *Swartz* (M, S).

Evolvulus wilcoxiana House, Bull. Torrey Bot. Club 33:315. 1906. — TYPE: ARIZONA: *Wilcox 96* (US!).

Evolvulus sericeus var. *discolor* (Benth.) Gray, Syn. Fl. N. Amer. 2, 1: 436. 1886. — TYPE: MEXICO: between Lagos (Jalisco) and Aguascalientes (Aguascalientes), *Hartweg 20* (K, L, P).

Martin & Hutchins (1981: 1557) separate these two taxa on the single basis of leaf pubescence: upper surface pubescent in var. *sericeous*; upper leaf surface glabrate and green in var. *discolor*. Both forms may be found within the same population of the plants, thus only one taxon seems worthy of recognition. (cf. Austin 1982). This is a tropical American species that reaches its northern limits in the United States, in Arizona, New Mexico, Texas, Georgia and also Florida.

Representative specimens studied: **Catron Co.**: *Shelton 115* (NY). **Curry Co.**: *Clark s.n.* (UNM 5990). **Dona Ana Co.**: 29 Aug 1894, *Wooton s.n.* (NMC). **Eddy Co.**: *Marley s.n.* (GH, UNM 74839). **Grant Co.**: *Metcalfe 100* (GH, NMC, NY, UC). **Hidalgo Co.**: *Moir 109* (NMC). **Luna Co.**: *Castetter 10692* (UNM). **Otero Co.**: *Meents & Moir 20* (NMC). **Roosevelt Co.**: *Castetter 10693* (UNM). **San Miguel Co.**: *Cockerell s.n.* in 1899 (NMC). **Sierra Co.**: *Metcalfe 1259* (NMC, NY). **Soccoro Co.**: *Higgins 7719* (NMC).

KEY TO *IPOMOEA*

1. Leaves pedatisect, less often sagittate.
   2. Flowers salverform, 3.5 – 10 cm long, nocturnal or diurnal. . . . . *I. tenuiloba*
   2. Flowers funnelform, mostly less than 3 cm long, diurnal.
      3. Sepals hirsute; corolla 2.5 – 3 cm long . . . . *I. leptotoma*
      3. Sepals glabrous or muricate; corolla 1 – 3 cm long.
         4. Calyx glabrous; corolla 1 – 1.5 cm long. . . . . *I. costellata*
         4. Calyx muricate-tuberculate; corolla 2 – 3 cm long.
            5. Sepals 5 – 6 mm long; peduncle plus pedicel about 5 – 10 (-14) mm long; tuber elongate . . . . *I. capillacea*
            5. Sepals 7 – 9 mm long; peduncles plus pedicels about 14 – 18 (-22) mm long; tuber globose to subglobose . . . . *I. plummerae*
1. Leaves simple to lobed or toothed, often cordate.
   6. Erect herbs . . . . *I. leptophylla*
   6. Climbing to trailing vines.
      7. Corollas 2 – 2.6 cm long, scarlet, orange or yellow . . . . *I. cristulata*
      7. Corollas 4 – 15 cm long, lavender to white or purple.

8. Pedicels and peduncles glabrous or with appressed small trichomes.
   9. Sepals triangular . . . . *I. cardiophylla*
   9. Sepals ovate . . . . *I. dumetorum*
8. Pedicels and peduncles with spreading, ascending or reflexed trichomes.
   10. Sepal apices acute to obtuse.
      11. Sepals 8 – 15 mm long, ovate-lanceolate to elliptic and rounded at the base; corolla 2.5 – 4.3 (-5.0) cm long . . *I. purpurea*
      11. Sepals 15 – 28 mm long, ovate-attenuate to lanceolate-attenuate and truncate at the base; corolla 4 – 8 cm long . . . . *I. pubescens*
   10. Sepal apices acuminate to long-acuminate.
      12. Sepals 9 – 12 mm long, linear-attenuate and not conspicuously dilated at the base; corolla 1.6 – 2.5 cm long . . . . *I. barbatisepala*
      12. Sepals 12 – 28 mm long, lanceolate to ovate-lanceolate, conspicuously dilated at the base; corolla 2 – 10 cm long.
         13. Sepals 12 – 24 mm long, lanceolate; corolla 2.0 – 3.7 (-4.5) cm long; annual . . . . *I. hederacea*
         13. Sepals 15 – 28 mm long, ovate-lanceolate to narrowly lanceolate; corolla 6 – 10 cm long; perennial . . . . *I. lindheimeri*

IPOMOEA L. Morning Glory

12. Ipomoea barbatisepala Gray, Syn. Fl. N. Amer. 2, 1:212. 1886. — Type: TEXAS: *Wright 507* (GH!, US!).

Some specimens are difficult to separate from the closely allied *I. hederacea* Jacq. The latter species, however, was originally endemic to the southeastern U.S., while *I. barbatisepala* is a Mexican species on the margin of its range in Arizona, New Mexico and Texas.

Representative specimen studied: **Eddy Co.**: *Clark s.n.* (UNM 4877). **Luna Co.**: *Todsen 164* (NMC).

13. Ipomoea capillacea (H.B. & K.) G. Don, Gen. Syst. 4:267. 1838. — Type: COLOMBIA: *Bonpland* (microfiche!).

Ipomoea muricata Cav., Icones Pl. 5:52. pl. 478. f. 2. 1794, non L. (1763), non Jacq. (1789).

This is an American species ranging from Arizona and New Mexico through Mexico and Central America to South America.

Representative specimens studied: **Catron Co.**: *Fletcher 820* (UNM). **Grant Co.**: *Rusby 301* (NY). **Lincoln Co.**: *Earle & Earle 492* (NY). **Sierra Co.**: *Knight 2199* (UNM).

14. Ipomoea cardiophylla Gray, Syn. Fl. N. Amer. 2, 1:213. 1886. — Type: TEXAS: *Wright 1314* (GH!).

The type was collected in Texas (Hudspeth Co., Hueco Mts., E of El Paso. 13 Oct 1849) where it was rediscovered by McDonald (1982). This species was most recently relocated by Ms. Katie Skaggs, naturalist on the A. B. Cox Nature Conservancy land in the Organ Mountains near Las Cruces. The species is easily confused with *I. parasitica* (H.B.K.) G. Don and *I. tricolor* Cav. of Mexico, Meso-America and South America.

Representative specimens studied: **Dona Ana Co.**: 28 Sep 1902, *Wooton s.n.* (NMC); 28 Sep 1980, *Worthington 6655* (TEX), 11 Oct 1980, *6746* (TEX); 23 Oct 1975, *Von Loh 687* (UNM). **Grant Co.**: *Zimmerman and Zimmerman 2006* (SNM fide McDonald 1982: 261).

15. Ipomoea costellata Torr., Bot. Mex. Bound. 149. 1859. — Type: TEXAS: *Wright 505* (GH!, US!).

Ipomoea futilis A. Nelson, Univ. Wyoming Publ. Sci. 1(3):65. 1924. — Type: ARIZONA: *Hanson 1016* (RS).

This annual desert species is similar to and undoubtedly related to *I. leptotoma*. It occurs in Arizona, New Mexico and Mexico (Baja California, Chihuahua, and Sonora, south to Chiapas and Veracruz).

Representative specimens studied: **Bernalillo Co.**: *Wagner 515* (UNM). **Catron Co.**: *Hutchins 9151* (UNM). **Chaves Co.**: *Earle & Earle 331* (NMC, NY). **Dona Ana Co.**: 28 Sep 1902, *Wooton s.n.* (ARIZ, NMC). **Grant Co.**: *Spellenberg et al. 8270* (NMC, NY, TEX). **Hidalgo Co.**: *Spellenberg & Spellenberg 3852* (NMC, NY, TEX). **Lincoln Co.**: *Hutchins 2590* (UNM). **Luna Co.**: *Worthington 13742* (NY). **San Miguel Co.**: *Hill 12258* (GH). **Soccoro Co.**: *Metcalfe 766* (ARIZ, NMC).

16. Ipomoea cristulata H. Hall., Med. Rijksherb. Leiden 46:20. 1922. — Type: MEXICO: based on syntypes including *Bourgeau 1061* (G-DC!). A nom. nov. for *Quamoclit gracilis* H. Hall, Bull. Herb. Boiss. 7:416. 1899.

Ipomoea coccinea auct., non L.

Martin & Hutchins (1981: 1560), Wooten & Standley (1915), Tidestrom & Kittell (1942), Kearney & Peebles (1951) and Shreve & Wiggins (1964) have applied two incorrect names to these populations: *I. coccinea* var. *coccinea* and *I. coccinea* var. *hederifolia*. In fact, these populations represent *Ipomoea cristulata*, a largely Mexican (Baja California, Chihuahua, and Sonora south to Michoacan and San Luis Potosi) xerophyte that extends northward into Arizona, New Mexico, Texas and into the Great Plains. *Ipomoea cristulata* is easily distinguished from the other two taxa, which are best considered species, by its sepals which are 3 – 4 mm long, and (when in fruit) by reflexed peduncles. The other two species have smaller sepals and erect fruits. *Ipomoea coccinea* L. is a southeastern United States endemic; *I. hederifolia* is a tropical American species now widely spread and naturalized in the wet tropics of the world.

Ward (1984) reported the Hidalgo County collection with a chromosome number of $n = 15$.

Representative specimens studied: **Catron Co.**: *Hutchins 9843* (UNM). **Dona Ana Co.**: 16 Aug 1895, *Wooton s.n.* (NMC). **Grant Co.**: *Beckworth 150* (DES). **Hidalgo Co.**: *Spellenberg 3834* (NMC). **Lincoln Co.**: 16 Aug 1899, *Turner s.n.* (NMC). **Rio Arriba Co.**: *Castetter 10686* (UNM). **San Miguel Co.**: *Standley 5272* (NMC). **Sandoval Co.**: *Yarnell 128* (UNM). **Santa Fe Co.**: *Bartlett 65* (NMC). **Sierra Co.**: 27 Jul 1904, *Metcalfe s.n.* (NMC). **Soccoro Co.**: *Metcalfe 825* (NMC). **Torrance Co.**: *Fletcher 5612* (UNM). **Valencia Co.**: *McCallum 619* (UNM).

17. Ipomoea dumetorum Willd. ex Roem. & Schult., Syst. Veg. 4:789. 1819. — Type: COLOMBIA or ECUADOR: without locality (B).

Martin & Hutchins (1981) do not include this in their flora. This Mexican, Meso-American and South American species was identified and relocated by McDonald (1982, 1984) in New Mexico and Texas.

McDonald (1984) cites specimens in addition to those listed here.

Dona Ana Co.: Organ Mts., *McDonald 140* TEX, not seen). **Lincoln Co.**: White Mountains, alt. 7400 ft, 25 Aug 1907, *Wooton & Standley s.n.* (NMC, US); White Mts., alt. 2500 m., *Wooton 630* (MO, not seen).

Because the species has been so rarely collected in the U.S.A., additional specimens will be cited. TEXAS. Jeff Davis Co.: Mt. Livermore, alt. 2700 m., *Warnock 23068* (SR, not seen); Davis Mts., Madera Canyon, near Livermore, *Hinckley s.n.* (ARIZ).

18. Ipomoea hederacea Jacq., Collect. Bot. 1:124. 1786. — Type: Based on Dillenius, Hort. Elth. t. 80, fig. 92 (plate selected as lectotype by Verdcourt, 1957).

Ipomoea desertorum House, Ann. N.Y. Acad. Sci. 18:203. 1908. — Type: ARIZONA: *Thornber 29* (ARIZ!, NY!).

Ipomoea hirsutula authors, pro parte, non Jacq. f. (1811).

Martin & Hutchins (1981: 1560) separate both their *I. hederacea* and *I. hirsutula* from *I. purpurea* on the basis of leaf lobing. If the plants have entire leaves they are placed in *I. purpurea*. If there are leaf lobes, they key to either of the other two species. Leaf lobing will not separate these plants under any circumstances (Elmore 1986); only characteristics of the sepals will separate them. The correct citation is *I. hederacea* Jacq. because Jacquin proposed the name as a new species, not a transfer of a Linnaean name (cf. Austin 1986a). While the species is a common weed in cotton fields in Arizona, it may be rare in New Mexico. At least, it is seldom collected since I found only two collections.

Specimens studied: **Hidalgo Co.**: 20 Aug 1955, *Castetter 11350* (UNM). **Luna Co.**: 30 Aug 1895, *Mulford 1088* (NY).

19. IPOMOEA LEPTOPHYLLA Torrey in Fremont, First Rept. 94. 1845. — TYPE: forks of the upper Platte to Laramie River, *Fremont* (HOLOTYPE: US!; PROBABLE ISOTYPE: NY!).

I consider this Great Plains species an indicator of where prairies formerly existed in New Mexico. It reaches its southwestern limit in New Mexico.

Representative specimens studied: **Chaves Co.**: *Wagner and Manthey 979* (UNM). **Colfax Co.**: *Griffiths 2323* (US). **Curry Co.**: 18 Aug 1909, *Wooton s.n.* (NMC). **De Baca Co.**: *Higgins 8659* (NY). **Dona Ana Co.**: *Castetter 7375* (UNM). **Eddy Co.**: *Spellenberg & Repass 5255* (NMC). **Harding Co.**: *Van Devender 84-377* (ARIZ). **Hidalgo Co.**: *herb. Chapman s.n.* (NY). **Quay Co.**: 29 Jul 1942, *Suggs s.n.* (NMC). **Rio Arriba Co.**: *Perdue 6128* (US). **Roosevelt Co.**: *Secor 61* (TEX). **San Miguel Co.**: *Crutchfield 417* (TEX). **Sandoval Co.**: 2 Sep 1936, *Hershey s.n.* (NMC). **Santa Fe Co.**: *Hitchcock et al. 4188* (UC). **Torrance Co.**: *Castetter 7372* (UNM). **Union Co.**: *Bartlett 250* (NMC).

20. IPOMOEA LEPTOTOMA Torr., Bot. Mex. Bound. 150. 1859. — TYPE: MEXICO. SONORA: *Thurber 977* (GH!).

Ipomoea leptotoma var. *wootonii* Kelso, Rhodora 39:151. 1937. — TYPE: ARIZONA: 10 Sep 1914, *Wooton s.n.* (US!).

This northern Mexican species is frequent in parts of Arizona, but apparently rare in New Mexico.

Specimens studied: **Curry Co.**: *Whitehouse s.n.* (TEX). **Hidalgo Co.**: *Castetter 9509* (UNM).

21. IPOMOEA LINDHEIMERI Gray, Syn. Fl. N. Amer. 2, 1:210. 1886. — TYPE: TEXAS: *Wright 508* (GH!, US!).

This Mexican-U.S. border species is known from Texas, New Mexico and Arizona as well as Coahuila and Chihuahua in Mexico.

Representative specimens studied: **Dona Ana Co.**: 19 Sep 1976, *Todsen s.n.* (NMC). **Eddy Co.**: 4 Aug 1905, *Wooton s.n.* (NMC); *Starr & Starr 81* (ARIZ). **Otero Co.**: *Gordon and Norris 552* (UNM). **County Unknown**: *Wright 1612* (NY).

22. IPOMOEA PLUMMERAE Gray, Syn. Fl. N. Amer. 2, 1: suppl. 434. 1886. — TYPE: ARIZONA: *Lemmon 2839* (GH!).

Ipomoea cuneifolia Gray, Proc. Amer. Acad. Arts 19:90. 1883, non Meisner (1869). — TYPE: ARIZONA: *Lemmon 2839* (F!, GH!, US!). *Ipomoea egregia* House, Torreya 6:124. 1906, nom. nov. for *I. cuneifolia* Gray.

The species was not recorded for the state by Wooton and Standley (1915), nor Martin & Hutchins (1981), although it was included with a query in Tidestrom and Kittell (1941). This is a Mexican (Coahuila, Chihuahua, Sonora) species reaching its northern limits in Arizona and New Mexico.

Representative specimens studied: **Catron Co.**: *Fletcher 2762* (UNM). **Grant Co.**: *Spellenberg et al. 5864* (NMC). **Lincoln Co.**: 5 Aug 1897, *Wooton s.n.* (NMC); *Wooton 627* (NY). **Otero Co.**: 8 Aug 1899, *Wooton s.n.* (NMC). **San Miguel Co.**: in 1899, *Cockerell & Porter s.n.* (NMC). **Sierra Co.**: 24 Aug 1969, *Todsen s.n.* (NMC). **Soccoro Co.**: *Metcalfe 271* (GH, NMC).

23. IPOMOEA PUBESCENS Lam., Encycl. Meth. Bot. 1:265. 1791. — TYPE: America, collector unknown (K!).

Ipomoea heterophylla Ortega, Hort. Matr. Dec. 1:9. 1800. — TYPE: MEXICO: not seen.
Ipomoea lindheimeri Gray var. *subintegra* House, Ann. N.Y. Acad. Sci. 18:196. 1908. — TYPE: ARIZONA: *Lemmon 2835* (GH!, UC!).

This species was not included by Martin and Hutchins (1981) although they had specimens of it misidentified as *I. lindheimeri* in the UNM herbarium. This is a widespread American species that reaches its northern limit in the southwestern United States.

Representative specimens studied: **Dona Ana Co.**: *Knight 3415* (UNM). **Eddy Co.**: *Bailey 721* (US). **Hidalgo Co.**: collector unknown 7367 (UNM). **Luna Co.**: *Spellenberg & Spellenberg 6626* (NMC).

24. IPOMOEA PURPUREA (L.) Roth, Bot. Abh. 27. 1787. — TYPE: U.S.A. Dillenius, Hort. Elth. t. 84, fig. 97. 1732 (LECTOTYPE: chosen by Verdcourt 1963!).

Ipomoea hirsutula Jacquin f., Eclog. Pl. Rar. 1:63. t. 44. 1811. — TYPE: no specimen found, (LECTOTYPE: the plate chosen by Austin 1990).

Ipomoea mexicana Gray, Syn. Fl. N. Amer. 2(1): 210. 1886. — TYPE: NEW MEXICO AND ARIZONA. Based on syntypes. Since no lectotype has been chosen (House 1908), the following is here designated.

"N. Mex. 1851–52." *C. Wright 1612* (LECTOTYPE: GH); on same sheet is: Arizona. Cochise Co.: Ft. Huachuca, 1882. *Lemmon 2838* (GH!). Since both collections were probably on the sheet when Gray published the binomial, he surely examined both. He cited, however, only the collection by Wright; thus, it is chosen as lectotype.

Gray also cited a collection by Fendler which is in the GH as a sheet containing two collections: New Mexico. Plantae Nova-Mexicanae. 1847. *Fendler 662* (GH!); Arizona. w/o loc. 1878, *Dr. Loud 152-A* (GH!). Gray also cited a collection by Thurber which has not been located in GH.

The key in Martin & Hutchins will cause the user to place the entire-leaved specimens of *I. purpurea* here and the lobed-leaved specimens into *I. hirsutula*; here they are treated synonymously. This species is now pantropical because of cultivation, but it was undoubtedly originally Mexican. It occurs in Arizona, New Mexico, and Texas and has been introduced and/or escaped in the Great Plains, the southeastern United States and the northeastern United States.

Representative specimens studied: **Bernalillo Co.**: *Wagner 519* (UNM). **Catron Co.**: *Hutchins 9121* (UNM). **Chaves Co.**: *Earle 256* (TEX, NY). **Dona Ana Co.**: *Worthington*

6635 (TEX). **Eddy Co.**: *Higgins 9233* (NY). **Grant Co.**: *Barkley 14710* (TEX). **Guadalupe Co.**: *Tschaikowsky 387* (ARIZ). **Harding Co.**: *Fletcher and Martin 5768* (UNM). **Hidalgo Co.**: *Spellenberg & Spellenberg 3905* (ASU, NMC, NY). **Lincoln Co.**: *Wooton & Standley 3631* (NMC). **Luna Co.**: *Spellenberg & Spellenberg 6221* (NMC, NY). **Otero Co.**: *Ward & Soreng 81-534* (NMC). **San Miguel Co.**: *Standley 4946* (NMC, NY). **Sandoval Co.**: *Dixon 4-348* (UNM). **Santa Fe Co.**: *Bartlett 64* (NMC). **Soccoro Co.**: 19 Aug 1900, *Wooton s.n.* (NMC). **Torrance Co.**: *Bedkey 1542* (UNM).

25. Ipomoea tenuiloba Torr., Bot. Mex. Bound. 148. 1859. — Type: TEXAS: *Bigelow* (US!).

Ipomoea lemmoni Gray, Proc. Amer. Acad. Sci. 19:20. 1883. — Type: ARIZONA: *Lemmon 2840* (GH!, US!). *Ipomoea tenuiloba* Torrey var. *lemmonii* (Gray) Yatskievych & Mason, Madrono 31:102. 1984.

Since both varieties and intermediates occur in New Mexico, and they have been completely discussed by Yatskievych & Mason (1984), they will not be discussed in detail here.

Representative specimens studied: **Eddy Co.**: 2 Aug 1909, *Wooton s.n.* (NMC). **Grant Co.**: *Wagner 3444* (UNM). **Hidalgo Co.**: 15 Sep 1980, *Todsen s.n.* (NMC).

EXCLUDED SPECIES

Ipomoea longifolia Benth.

The range given by Martin & Hutchins (1981: 1562) includes the range of *I. shumardiana* (Torrey) Shinners, a Great Plains species that is distinct. There is one specimen of *I. leptophylla* (*Winhoff 508* ASU) misidentified as *I. longifolia*. *Ipomoea longifolia* has not been verified for any part of the United States except southeastern Arizona (cf. Austin 1986b).

Calystegia pubescens Lindl.

The species has been collected once (Santa Fe Co.: 10 Jun 1925, *Bro. Benedict 128* US) from a garden. It was undoubtedly cultivated as the species is cultivated farther north in the Great Plains.

Ipomoea alba L.

There is a specimen collected in 1949 in Albuquerque (*Castetter 7334* UNM). Although the sheet does not indicate that the specimen was cultivated, this was almost certainly the case. The species typically grows in swamps and other wetlands farther south in the tropics. Indeed, the species is now pantropical in the wet tropics because it has been introduced and cultivated from the New World.

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DELETIONS AND RESTORATIONS IN THE FLORA OF SOUTHERN FLORIDA

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ABSTRACT

The species listed in the *Annotated Checklist of the Vascular Plants of Collier, Dade, and Monroe counties, Florida* (1965) as occurring in the three southernmost counties of Florida have been compared with those species included in *A Flora of Tropical Florida* (1971, 1976) and with the known flora of the area. Corrections are made by deletion of 62 species and six families reported to occur in South Florida, restoration of 18 species and one family once reported but later omitted, and assignment of 23 names that should have been included in synonymy in the later publication.

The vascular flora of Florida is a fascinating one, varied and exotic beyond that of any other state in eastern North America. The abundance and novelty of this flora, and the economic and aesthetic interest in it by a rapidly expanding human population, has made welcome those too-few efforts to describe or merely to enumerate its plants.

It is inevitable, given the demand for studies of the state's flora, the paucity of experienced floristic botanists in the area, and the pressures upon them to make their information available, that preliminary listings and tentative identifications will be placed in print. Lack of time either in the field or in the herbarium, lack of access to literature or authoritatively named specimens, or lack of adequate understanding of the biological realities that keep plant distribution from being a random and wholly unpredictable event, all have doubtless contributed to the publication of errors. Such errors, once unequivocally placed in print, gain a life of their own, being copied and recopied with ever increasing verisimilitude, and are suppressed only with great difficulty.

No writer dealing with technical minutiae can be free of all error, and in most circumstances later commentators are perhaps best advised to make corrections gently by stating the facts accurately without specific mention of aberrant views. We do feel an obligation, however, where the general topic (plant identification and distribution in the state of Florida) is so intimately tied to our professional experience and knowledge, and particularly where one of us by implication is responsible for the statements made,

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to document as clearly as we can, errors in this field with the hope that such documentation will inhibit their repetition in later publications.

In 1965 the Fairchild Tropical Garden and the University of Miami Press released an *Annotated Checklist of the Vascular Plants of Collier, Dade, and Monroe counties, Florida*. Its authorship was given as Dr. Olga Lakela, University of South Florida, Tampa, and Dr. Frank C. Craighead, of the Everglades National Park and Fairchild Tropical Garden. This listing was welcomed in southern Florida and served as a standardized tabulation of the flora of these three counties until superceded by Robert W. Long & Olga Lakela's *A Flora of Tropical Florida*, University of Miami Press, 1971. The *Annotated Checklist* contained 1,470 species of ferns, gymnosperms, monocotyledons, and dicotyledons, and for most gave the habitats, the counties, and in many cases the exact areas from which specimens had supposedly been collected or reported. Documentation was stated to be based on the herbaria of the Everglades National Park, the University of Miami, the University of South Florida, and on previously published records.

In what remains as an inexplicable misunderstanding, the present second author's name was listed, following that of Dr. Lakela, as co-author. He was not. This publication was not his doing, and he did not request nor anticipate that his name be so credited. He did give of his time and information to Dr. Lakela during her trips to southern Florida, and he did give her free access to the herbarium of the Everglades National Park, of which he was then curator and to which he had largely contributed. It must be attributed to the generosity of Dr. Lakela that she so acknowledged this help. But it has left him in the uncomfortable position of being considered responsible for errors that he had no part in making, and even further of being aware that his tentative identifications, never intended to be presented as definitive, are the source at least in part of statements in the *Annotated Checklist* that are patently false and denigrate the scholarship of its authors.[1]

[1]My friend and co-author, Dr. Frank Cooper Craighead, died 15 May 1982. After his retirement as a U.S.D.A. entomologist, "Craig" became the unofficial but highly respected botanist of the Everglades National Park. His enthusiastic and perceptive field studies in this second career produced a number of botanical publications including *Orchids and Other Air Plants of the Everglades National Park* (1963) and *Trees of South Florida* (1971).

Craig was not a man of mild temper. It was at his urging that I began this compilation in the early 1970s. Encouragement was also received from George N. Avery, a meticulous collector and field observer of the flora of southern Florida. But with the loss through death of those persons immediately concerned (Robert William Long, 21 July 1976; Olga Korhonen Lakela, 17 May 1980; George Newton Avery, ca. 12 July 1983), other tasks took precedence.

Now, with a resurgence of interest in the plants of Florida, and with state-wide floristic projects actively underway in Tallahassee, Gainesville, Tampa, and Miami, it seems time to make these notes available. — D.B.W.

The inadequacies of this preliminary annotated listing were apparent, and the authors of *A Flora of Tropical Florida* clearly attempted exculpation by disregarding this earlier production. Nowhere in the 962 pages of their 1971 book, neither in the list of "selected" references nor at any other appropriate point, is there mention that six years earlier one of them had authored a treatment of the plant species of the identical geographic area.

But this earlier annotated listing cannot so simply be ignored. Copies of it abound, and are regularly cited by authors interested in the flora of southern Florida (Al-Shehbaz 1985; Austin 1980; Miasek 1978; Miller 1971a, 1971b; Poppleton et al. 1977; Rogers 1984, 1985; Spongberg 1978; Webster 1967; etc.). Further, a peculiar stylistic feature of the *Flora* has left the earlier *Annotated Checklist* still its essential companion. This is the practice of *A Flora of Tropical Florida*, apparently unique in recent North American local floras, of omitting almost all exact statements of distribution in the treated area for almost all species. The *Annotated Checklist*, although its distributional information may not be detailed to the degree desired, at least goes well beyond the larger book in specifying the counties from which collections have been seen or reports cited.

This disregard of the earlier *Annotated Checklist* by the authors of *A Flora of Tropical Florida* has left in a botanical limbo the names that appeared in the listing but not in the later book. A contemporary reviewer (Gillis 1973) noted that such names exist and suggested that it is an obligation of floristic writers to account for previous names recorded (and previously unchallenged) for the area they treat.

We support this policy most strongly. It seems particularly appropriate that an author who is aware of an error in his own work be the one to call attention to his earlier erroneous statement, thus most effectively removing doubt as to its invalidity. But when a previous author has not taken the opportunity to do so, the mantle of responsibility falls more broadly on the botanical community, and those with information that might prevent error by a still later generation of writers would themselves appear obligated to make correction. It is in this spirit that we have undertaken the present task.

The following listing is intended to be comprehensive *only* of the 103 names that appear in the 1965 *Annotated Checklist* that cannot be accounted for (in one way or another) in the 1971 *A Flora of Tropical Florida* or in its essentially identical 1976 "new edition." Additional names used in the *Annotated Checklist*, perhaps two to three times as many as in the following list, are not used for species in the later publication but are recorded as synonyms under a name accepted in the *Flora* or are otherwise unambiguously traceable.

The vanished names may be accounted for in one of three ways. First, and most numerous, are those species reported on the basis of misidentifications, where the error appears to have been detected and the species was correctly deleted from the later *Flora*. Sixty-two such species have been noted by us, and had the *Flora* contained the customary accounting of excluded species, these names would have been disposed of in that publication.[2]

These names constitute somewhat over 4.2% of the species enumerated by the *Annotated Checklist*. They include the sole representatives in South Florida (here defined, as in the two publications under discussion, as limited to Collier, Dade, and Monroe counties) of eighteen genera and six families (Araliaceae, Marsileaceae, Nyssaceae, Punicaceae, Sparganiaceae, Zosteraceae).

It must be made clear that additional species are included in the *Annotated Checklist* which we do not believe occur in South Florida. Our own understanding of their ranges casts immediate doubt on the inclusion of such species as *Cakile edentula*, *Carya floridana*, *Hypericum galioides*, *Juniperus silicicola*, *Oxalis stricta* (= *O. cymosa*), *Polygonum persicaria*, *Prunella vulgaris*, *Sabatia campanulata*, and *Vinca minor*, some of which we are not aware occur in Florida, much less in the southernmost counties covered by the *Flora*. But each of these names is included in the *Flora* (some with qualifications), and thus their tabulation falls outside the present scope of our study.[3]

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[2] It is worth comment that there is no standardized way of handling species that are reported for the area under study but are believed inappropriate for inclusion. Three exemplary floras demonstrate this diversity of treatment. Deam (*Flora of Indiana* 1940) gathered his 707 excluded species into a single appendix. Steyermark (*Flora of Missouri* 1963) listed his excluded species at the end of each genus. Voss (*Michigan Flora* 1972, 1985) inserted his excluded species in the text of the species with which they were most related.

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[3] As with the names recorded in the *Annotated Checklist*, the presence of a name in *A Flora of Tropical Florida* does not consistently reflect the presence of that species in the flora of southern Florida. Persons who give only cursory review of this strange publication cannot appreciate the large number of species listed therein that actually are unknown in South Florida, either as herbarium collections or as modern-day populations.

The following names, together with the names listed in the above text, are offered as a partial tabulation of species included in *A Flora of Tropical Florida* that appear not to be known in the flora of South Florida: *Acanthospermum australe*, *Amaranthus cannabinus*, *Amoracia aquatica*, *Asimina speciosa*, *Asplenium platyneuron*, *Bacopa cyclophylla*, *Bignonia capreolata*, *Brassica kaber*, *Cenchrus longispinus*, *Chloris neglecta*, *Chrysopsis (Heterotheca) floridana*, *Eleocharis vivipara*, *Eragrostis simplex* (= *E. cumingii*), *Flaveria floridana*, *Fuirena longa*, *Gelsemium sempervirens*, *Gentiana pennelliana*, *Juncus trigonocarpus*, *Lagerstroemia indica*, *Lemna perpusilla*, *Leptochloa filiformis*, *Linaria floridana*, *Liquidambar styraciflua*, *Lobelia floridana*, *Lycopodium carolinianum*, *Najas flexilis*, *Nyssa sylvatica* (s.l.), *Oncidium bahamense*, *Oxalis violacea*, *Petalostemon pinnatum*, *Pinus palustris*, *Polygonella fimbriata*, *Polygonum hirsutum*, *Rhexia nashii*, *Rhynchospora inundata*, *Rubus cuneifolius*, *Sagittaria kurziana*, *Salsola kali*, *Selaginella apoda*, *Setaria glauca*, *Silene antirrhina*, *Stipa avenacioides*, *Suaeda maritima*, *Tradescantia ohiensis*, *Tragiola (Gratiola) pilosa*, *Typha angustifolia*, *Valeriana scandens*, *Zannichellia palustris*.

A second category of vanished names is composed of the species that were reported in the *Annotated Checklist* but were not retained by the *Flora* even though the species is known in South Florida or may reasonably be assumed to have existed there in the recent past. Considerable latitude is required in the assignment of a species to a flora, for at the poorly documented end of the scale one or more specimens may exist yet there be little doubt that the species is no longer present in a living state. Such quasi-components of a flora are perhaps best handled in the form of a note, with the species left unnumbered or in some way or other given a secondary or tentative status.

We have found eighteen species and one family (Zingiberaceae) which we believe to be proper inclusions in the flora of South Florida that should not have been dropped by the *Flora*. Six of these, for nomenclatural or other reasons, require names different from those used in the *Annotated Checklist*.

Finally, a third category of vanished names is simply a tabulation of synonyms that the *Flora* has failed to assign to an accepted species. These names are retained in the present listing since the inconsequentiality of this correction is of course not apparent to the person attempting to trace a name from the *Annotated Checklist* to the appropriate treatment in the *Flora*. We have considered twenty-three names worthy of comment.

We have listed these vanished names in alphabetic order, rather than in the sequence originally used, as an aid to rapid checking. Data as to habitat and range given in the *Annotated Checklist* are here repeated in quotes, except for those names that should have been treated as synonyms by the *Flora*. The use of "C," "D," or "M" in these quoted passages is the code used in the *Annotated Checklist* in reporting species as present in the counties of Collier, Dade, and Monroe. Habitat and range data as given for those species that we believe should be deleted from the flora of South Florida are of course considered erroneous.

ADIANTUM CAPILLUS-VENERIS. "Moist hammocks, solution holes, CDM." This fern is not known south of Hernando County (Correll 1938; Wherry 1964; FLAS; USF). DELETE SPECIES.

ALOCASIA INDICA. "Homestead, D." This (or *A. macrorrhiza* (L.) G. Don) is perhaps cultivated as a rare novelty, but is not known by us as an escape. DELETE SPECIES and the genus *Alocasia*.

ALOE VERA. This name does not appear as a synonym under *Aloe barbadensis* Mill., by which name the species is treated in the *Flora* (p. 281). Dates of publication of these two names, however, indicate the correct name is *Aloe vera* (L.) Burm. f.[4]

ARALIA SPINOSA. "Hammocks, D." The *Flora* (p. 659) qualified the earlier report with "apparently not well established in south Fla." No Dade County specimens have been located, and the species apparently does not extend south of Polk County (FLAS, USF). DELETE SPECIES, the genus *Aralia*, and the Araliaceae.

BRACHIARIA PLANTAGINEA. "Moist ground, D." This Brazilian grass has now escaped at several places in Florida, but no collections have been seen south of Palm Beach County (FLAS). *Brachiaria subquadripara* (Trin.) Hitchc. is a frequent escape in South Florida and was treated in the *Flora* (p. 168); it was not recorded in the *Annotated Checklist*, and the presumption is that the earlier name was based on a misidentification. DELETE SPECIES.

CAKILE LANCEOLATA. "Coastal beaches, DM." Our understanding of *Cakile* is that it is represented in South Florida by two entities, both subspecies of *C. lanceolata*: ssp. *lanceolata*, and ssp. *fusiformis* (Greene) Rodman (Rodman 1974; FLAS; USF). The *Annotated Checklist* has these two (the second in the form of an unpublished combination attributed to J. P. Patman), but has also *C. edentula* (Bigel.) Hook., a northern species that we have not seen south of St. Johns and St. Lucie counties (Rodman 1974; FLAS). The *Flora* (p. 431) recorded *C. edentula* (with a note that it is only "presumably" in its area), and *C. fusiformis*; the *Flora* should have retained both *C. lanceolata* and *C. fusiformis*, either as two species or as lesser entities of *C. lanceolata*, the prior name. RESTORE *Cakile lanceolata* (Willd.) O. E. Schulz.

CAPSICUM FRUTESCENS. "Hammocks, CDM." Recent workers generally treat this species as distinct from *Capsicum annuum* L. (cf. Smith & Heiser 1951; Heiser & Pickersgill 1969; contra, Shinners 1956). The common native species in South Florida is *C. frutescens*, and was correctly so recorded in the *Annotated Checklist*. Occasional plants of *C. annuum* L. var. *aviculare* (Dierb.) D'Arcy & Eshbaugh (1973) occur, perhaps as escapes, throughout Florida and could appropriately have been included in the checklist; the *Flora* (p. 759) reported only this species, as *C. annuum* var. *minimum* (Mill.) Heiser. RESTORE *Capsicum frutescens* L.

CASSIA CORYMBOSA. "Homestead, D." This shrub is restricted in cultivation to central and north Florida (Isely 1975). We do not believe it escapes even within this northern range. DELETE SPECIES.

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[4]This plant was first described by Linnaeus in 1753, as *Aloe perfoliata* var. *vera*. Linnaeus' varietal epithet was transferred to specific level by Burman in 1768, while Miller, also in 1768, independently described the species as *A. barbadensis*. Following the analysis of Reynolds (1966) that the name *Aloe barbadensis* Mill. antedated *Aloe vera* (L.) Burm. f., Miller's name has obtained wide use. But more precise dating of the relevant publications (Stafleu 1967) indicates that the appropriate portion of Burman's *Flora Indica* appeared "Mar-Apr (ante 6)," while Miller's *The Gardeners Dictionary* was published 16 April. *Aloe vera* would thus appear to be the prior name by a minimum of ten days (Newton 1979).

CAYAPONIA RACEMOSA. "Hammocks, Everglade Keys, D." This habitat and location data would appear taken directly from Small (1933) which in turn is based upon early collections from Dade County (*Small & Carter 792* in 1903, NY; *Small & Wilson 1593* in 1904, NY; *Small & Carter 2722* in 1906, NY). Although the *Flora* cautioned (p. 816), "No recent collections of this species from south Fla. have been seen, and it may no longer be in our area," it was found again in 1976 (Castellow Hammock Park, Dade County, *Avery 486*, FLAS, FTG). Small's identification, however, was in error, and has been corrected by R. P. Wunderlin. RESTORE (replace with) *Cayaponia americana* (Lam.) Cogn. in DC.

CEANOTHUS AMERICANUS. "Drier sites - C." We have not seen this species south of Polk County, and Brizicky (1964b) was not willing to extend its range south of "northern Florida." The *Flora* (p. 582) recorded the species only as a note, remarking that it "...may occur locally in our area. However, we have seen no specimens from south Fla." DELETE SPECIES and the genus *Ceanothus*.

CHAMAESYCE CHIOGENES. Burch (1965) has considered this name as synonymous with *C. blodgettii* (Engelm. ex Hitchc.) Small.

CHAMAESYCE CORDIFOLIA. "Sand dunes, CDM." Correctly interpreted, this is a northern species. Burch (1965) did not record it south of Highlands and Lee counties. DELETE SPECIES.

CHAMAESYCE GEMELLA. Burch (1965) treated this as synonymous with *C. opthalmica* (Pers.) Burch.

CHAMAESYCE GLOMERIFERA. Burch (1965) considered this as synonymous with *C. hypericifolia* (L.) Millsp.

CHAMAESYCE MATHEWSII. Burch (1965) included this with *C. maculata* (L.) Small.

CHAMAESYCE MOSIERI. Burch (1965) treated this within *C. garberi* (Engelm. ex Chapm.) Small.

CHRYSOPSIS MICROCEPHALA. "CDM." We fully agree with Small (1933), Dress (1975), and Semple et al. (1980) that *Chrysopsis*, *Pityopsis*, and *Heterotheca* merit separate generic recognition. Dress (1953) included this entity within the typical variety of *Pityopsis* (*Chrysopsis*) *graminifolia*, assigning it a range in Florida south only to Bradford and Flagler counties, while Semple & Bowers (1985) interpreted it as within var. *tenuifolia* which they extend to southern Florida. Although the *Flora* (p. 855) could perhaps have placed this in synonymy under its *Heterotheca graminifolia* var. *graminifolia*, one might best avoid use of the name. DELETE SPECIES.

CHRYSOPSIS NERVOSA. "Pineland, CDM." Although viewed by Semple & Bowers (1985) as a variety of *Pityopsis graminifolia*, we support Dress (1975) in retaining *P. nervosa* at specific rank. This species is common in South Florida and is perhaps what the *Flora* (p. 855) intended by its *Heterotheca graminifolia* var. *tracyi*. RESTORE (replace with) *Pityopsis nervosa* (Willd.) Dress.

CIENFUEGOSIA HETEROPHYLLA. This species was excluded from Florida (Fryxell 1969), our plant now being known as *C. yucatanensis* Millsp. The *Flora* (p. 593) treated these species correctly but did not clearly indicate the previous assumption that they were identical.

CLERODENDRON FRAGRANS. The plant intended by the *Annotated Checklist* is widely cultivated in Florida and occasionally escapes. We are in agreement with Moldenke (1980) that this name should be placed in the synonymy of *Clerodendrum philippinum* Schauer, by the *Flora* (p. 737).

CLUSIA FLAVA. "Not seen recently, hammocks, Key West, M." Wood & Adams (1976) have pointed out the reports of this tropical species for Florida are unsubstantiated, the specimens so labeled being *C. rosea* Jacq. DELETE SPECIES.

Cyperus inflexus. Horvat (1941) and other workers have considered this a synonym of *Cyperus aristatus* Rottb.

Cyperus pseudovegetus. "Low ground, CD." This species is one of several closely related to *C. virens* Michx. They were well understood by McGivney (1938). We have not seen collections south of northern Florida. The present report should probably be referred to either *C. distinctus* Steud. or *C. surinamensis* Rottb., both common in South Florida and correctly cited by the *Flora*. DELETE SPECIES.

Desmodium ciliare. "Cutler Ridge, D." This species is predominately northern and is rare south of Alachua County. It is, however, in Dade County, as documented by recent collections (*Atwater* in 1958, FLAS; *Avery 486* in 1968, FLAS). It should not have been deleted by the *Flora*. RESTORE *Desmodium ciliare* (Muhl. ex Willd.) DC.

Desmodium lineatum. "Homestead, D." This species is largely northern, with only a few collections seen by us south of Alachua County. In Dade County we know of it only as a collection from a "scarified lot, Homestead" (*Hawkins 41* in 1927, FLAS). We have no reason to believe that this specimen was the source for the above report, but it provides sufficient verification. RESTORE *Desmodium lineatum* DC.

Digitaria diversiflora. "Old fields and roadsides, CDM." Swallen (1963) has distinguished this tropical species, found in Dade and Monroe counties, from *D. ciliaris* (Retz.) Koel. (= *D. ascendens* (HBK.) Henr.). Swallen's name, however, was not the earliest. RESTORE (replace with) *Digitaria bicornis* Roem. & Schult. ex Loud.

Digitaria filiformis. "D." This species is largely northern; we have seen no collections from peninsular Florida. South Florida collections are probably to be referred to *D. villosa* (Walt.) Pers. DELETE SPECIES.

Dolichos hosei. "Agr. Exp. Sta. Homestead, D." This species is perhaps better known as *Vigna hosei* (Craib) Back. It has been introduced into Florida on an experimental basis, as a possible ground cover. It is not known to escape. DELETE SPECIES.

Eleocharis albida. "Wet soils, D." This distinct species is known in Dade County, with several recent collections (*Gillis 10865* in 1971, FLAS; *Avery 1196* in 1972, FLAS). It should not have been deleted by the *Flora*. RESTORE *Eleocharis albida* Torr.

Eleocharis equisetoides. "Wet gladeland, solution holes." This species is not known south of Lake County (Ward & Leigh 1975). South Florida collections probably should be referred to *Eleocharis interstincta* (Vahl) R. & S.; this species was not reported in the *Annotated Checklist* but correctly does appear in the *Flora* (p. 219). DELETE SPECIES.

Elephantopus tomentosus. "Pineland dryer sites, CDM." James (1959) and Ward (1975) have described this species as not extending closer to South Florida than Leon and Wakulla counties. The only South Florida representative of this genus is *E. elatus* Bertol. The earlier error was corrected, but not explained, in the *Flora* (p. 877). DELETE SPECIES.

Erlangea incana. "D." The report of this species is from Moldenke (1944). He flatly stated it to be in cultivation. We do not know otherwise. DELETE SPECIES and the genus *Erlangea*.

Fimbristylis harperi. Ward (1968) and Kral (1971) have treated this name as included with *Fimbristylis caroliniana* (Lam.) Fern. It should have been so indicated by the *Flora* (p. 216).

Furcraea macrophylla. "D." The *Flora* (p. 290) treated this species only as a note, remarking it "may persist" from cultivation. It is rarely if ever cultivated and there appear to be no reports, nor documenting specimens, of its persistence. We see no need to retain such an insubstantial supposition even as a note. DELETE SPECIES.

Galactia brachypoda. "Miami, D." This name is based on A. W. Chapman collections from the vicinity of the Apalachicola River, northwestern Florida. Although Rogers (1949) maintained it as a species, it seems more probably an aberrant form of the northern *Galactia erecta* (Walt.) Vail. A Dade County collection cited by Rogers (dry rocky soil, Miami, *Hood 71863* in 1912, FLAS) is apparently an atypical *G. volubilis* (L.) Britt. This last species may be what was intended by the above report. DELETE SPECIES.

Grewia populifolia. "Fantastic gardens, South Miami, D." This species is now becoming frequently cultivated in South and Central Florida but is not known to escape. DELETE SPECIES and the genus *Grewia*.

Hymenocallis caymanensis. Recent authors (Adams 1972; Correll & Correll 1982) consistently place this name in synonymy under *Hymenocallis latifolia* (Mill.) Roem.

Jatropha manihot. "CDM." Rogers (1963) has treated this plant, the manioc or cassava, as *Manihot esculenta* Crantz. The *Flora* (p. 536) accepted this name but failed to give its synonym. This frost-sensitive species is very sparingly grown on the Florida keys and in Dade County, but we do not believe it persists outside of cultivation. The only basis for its inclusion by Small (1933) and the *Flora* appears to be a 1904 collection by J. K. Small reported by Webster (1967), from what was likely a cultivated source. DELETE SPECIES (and *Manihot esculenta*).

Kalanchoe crenata. "Waste places — CDM." The *Flora* was of two minds as to the inclusion of this species. It was treated as a note (p. 438), with the statement, "in disturbed sites and hammocks....no specimens, however, have been seen recently." This is not one of the more vigorous species, and we are unaware that it ever escapes. DELETE SPECIES.

Kallstroemia intermedia. "Florida Keys, M." Porter (1969) assigned this name to the synonymy of *Kallstroemia parviflora* Norton, a species not known to occur in Florida. Our representative of this genus is *K. maxima* (L.) Hook. & Arn. DELETE SPECIES.

Lachnanthes tinctoria. This name should have appeared in the *Flora* as a synonym of *Lachnanthes caroliniana* (Lam.) Dandy. It does appear in place of the correct name in the legend for the *Flora*'s plate of the species (p. 292).

Languas speciosa. "Cult. — D." This species is better known as *Alpinia zerumbet*. It was collected in Addison Hammock, Dade County, as early as 1915 (FLAS) and has since been found repeatedly as an escape in the south and central parts of the state. RESTORE (replace with) *Alpinia zerumbet* (Pers.) Burtt & R. M. Sm., and Zingiberaceae.

Lemna minima. "Canals, D." Daubs (1965) recognized a species under this name, although he used it for plants occurring no closer to Florida than Texas. His specimens, however, conform to *Lemna minor* L., a species rare in Florida and unknown south of Glades County (Landolt 1986). We suspect the *Annotated Checklist* may have had the very similar *L. obscura* (Austin) Daubs, which is common. DELETE SPECIES.

Lemna valdiviana. "Stagnant pools, C." Peninsular Florida is appropriate for the reported range of this species. D. W. Hall has informed us he has seen collections of it from Collier and Dade counties, and E. Landolt has provided us an unpublished map showing its presence in Collier County. RESTORE *Lemna valdiviana* Phil.

Limnobium spongia. "Shallow waters, C." This distinctive aquatic is rare south of Polk and St. Johns counties, but we have seen a specimen from Collier County (*Atwater M-137* in 1959, FLAS). RESTORE *Limnobium spongia* (Bosc) Steud.

Lochnera minor. "Wasteland — CDM." The *Flora* (p. 701) retreated to a note that this species (*Vinca minor* L.) "...is widely cultivated and has been collected as an escape in Palm Beach County. It may also occur locally in our area." Even this more modest distribution does not accord with our observation that this northern species cannot be cultivated successfully in peninsular Florida. DELETE SPECIES (and *Vinca minor*) and the genus *Lochnera*.

LORINSERIA AREOLATA. "Open hammocks, CDM." We have not seen specimens of this fern south of Glades County, although Correll (1938) reported a Lee County collection. DELETE SPECIES and the genus *Lorinseria*.

LUDWIGIA INTERMEDIA. This combination, as published in the *Annotated Checklist*, is illegitimate. Its basionym, *Isnardia intermedia* Small & Alexander, was treated by Munz (1965) with *Ludwigia repens* Forst.

LUDWIGIA PALUSTRIS. "Fresh water, CDM." We have seen this species south to Charlotte and Lee counties (FLAS), but not farther. It is easily confused with *Ludwigia repens* Forst., which is common in southern Florida. DELETE SPECIES.

LUDWIGIA SPATHULIFOLIA. "Low ground, D." This plant is related to *L. curtissii* Chapm. with which it has hesitantly been combined by a recent monographer (Peng 1989). Since its type locality is near Perrine, Dade County, the name should have been addressed by the *Flora*. Pending a further judgment as to its status, RESTORE *Ludwigia spathulifolia* Small.

MACADAMIA TERNIFOLIA. "Spice and Fruit Park, Homestead D." This tree is occasionally cultivated in Florida, but does not escape. DELETE SPECIES and the genus *Macadamia*.

MAMMEA AMERICANA. "Canal edge, Tamiami Trail, D." This tree is infrequently cultivated, and is tender. The *Flora* (p. 609) believed it "probably is not established." Its report as an escape was based upon Moldenke (1944). Without further indication of its persistence, we believe it best excluded from our flora. DELETE SPECIES and the genus *Mammea*.

MARSILEA VESTITA. "D." Old reports of this fern ally from "Orange Beach," Dade County, were based on a collection (*Underwood* 66 in 1891, PH) from Orange Bend, Lake County (Ward & Hall 1976). In this century it has been known in Florida only in Franklin, Hillsborough, Sarasota, and Seminole counties. DELETE SPECIES, the genus *Marsilea*, and the Marsileaceae.

NYSSA SYLVATICA VAR. BIFLORA. "Swamps, C." We have not seen the swamp tupelo (for which we prefer *N. biflora* Walt.) south of Glades County. (The typical black tupelo does not extend south of Alachua County.) There appears to be no previous report from Collier County. Monachino & Leonard (1959) called attention to a specimen labeled as from Lignum Vitae Key, Monroe County (*Small & Britton* in 1919, NY), but H. K. Rickett (pers. comm., 1966) was unable to relocate the specimen. The *Flora* (p. 648) noted the Lignum Vitae Key collection, but remarked, "No recent collections have been seen, and its occurrence in our area is doubtful." DELETE SPECIES, the genus *Nyssa*, and the Nyssaceae.

A series of specimens attributed to Lignum Vitae Key and distributed to the University of South Florida and perhaps elsewhere is unquestionably in gross error as to its origin. In each case the label is a standard printed form, headed "New York Botanical Garden, with the cooperation of Mr. Charles Deering, Exploration of the Florida Keys, Tropical Florida." The labels further bear in print, "Hammock, Lignum Vitae Key, Monroe County. Collectors J. K. Small, N. L. Britton, December 13, 1919." Further data, in blue ink, is in the hand of J. K. Small. In each case the known range of the species mounted on the sheet and named on the label is completely at variance with the stated source on Lignum Vitae Key.

Two striking examples of this mis-labeled series of specimens are *Gentiana pennelliana* Fern. and *Juncus trigonocarpus* Steud. The gentian was reported in the *Flora* (p. 697) without details but with the suggestion that the species may no longer be present in the area. The basis for this report was an excellent sheet (USF 17005) of six flowering plants labeled in Small's hand, "Gentiana" and correctly annotated by R. W. Long as *Gentiana pennelliana* Fern. That species, however, is a tightly restricted pine flatwoods endemic known only from six counties in West Florida (Wakulla to Walton) and well documented by Clausen

(1941) and Pringle (1967). It is difficult to believe it could survive as a disjunct native or be adventive in the tropical hammock of Lignum Vitae Key.

Similarly, *Juncus trigonocarpus* was reported by the *Flora* (p. 280) as "Hammock, Lignum Vitae Key...rare," the report being based on a sheet (USF) bearing three plants, with the same printed heading and hand-labeled "Juncus." This species belongs to the same acid-soil coastal plain flora as the *Gentiana*; it is known in Florida only from west of Franklin County (FLAS, FSU, USF), although northward it extends into the Carolinas. Again, the habitat of this species is grossly different from that of Lignum Vitae Key.

The full history of what appears to be a set of spurious 1919 Lignum Vitae Key collections has not been traced. Since Small did not refer to these would-be striking range extensions in his later publications, it is clear that he did not accept them as the labels would now appear to read. The USF specimens were obtained by Mr. George Cooley from the New York Botanical Garden, in unmounted form, in the early 1960s. They would appear to have been part of a "rich collection," referred to by Monachino & Leonard (1959) that for many years had lain in storage at NY, but no information is at hand as to how many other erroneously labeled specimens were acquired by USF, if any, or how widely dispersed they may be in other herbaria. It is apparent that species with less sharply restricted North Florida ranges may more readily pass as acceptably small non-disjunct range extensions. At the least, a caveat is in order as to the acceptance of South Florida ranges based on 1919 Small & Britton collections from Lignum Vitae Key.

Oenothera mollissima. "Drier soils, CDM." Small (1933) reported this South American species (as *Raimannia mollissima*) to occur from Florida to Texas, a claim that has been disregarded by North American workers (Munz 1965; Correll & Johnston 1970). The Florida plants, at least, are not of that species, but have been suggested by P. H. Raven (pers. comm., 1978) to represent *Oenothera humifusa* or *O. humifusa* — *O. laciniata* hybrids. DELETE SPECIES.

Oryza sativa. "Anhinga Trail, Taylor Slough, D." A perennial, awned rice, "Red Rice," now commonly treated as distinct from *Oryza sativa* L., has been known for some years to be well established in the vicinity of Taylor Slough, Everglades National Park, and is represented by specimens (*Atwater GS-174* in 1959, FLAS; *Craighead* in 1961, FLAS). RESTORE (replace with) *Oryza rufipogon* Griff.

Panicum condensum. This species was obscurely recorded by the *Flora* (p. 189) as a variety of *Panicum agrostoides* Spreng., a species better known (Voss 1966) as *P. rigidulum* Bosc ex Nees.

Panicum consanguineum. "Pinelands, CDM." Freckmann (1967) retained this entity at the level of species and reported it south to central Florida. Specimens we have seen support this range. It is very close to, and in fact appears to intergrade with, *P. angustifolium* Ell., a frequent South Florida species. DELETE SPECIES.

Panicum geminatum. This distinctive grass was retained in the *Flora* (p. 176) as *Paspalidium geminatum* (Forssk.) Stapf in Prain, but without indicative synonymy. Gould (1968) and other recent workers have supported this generic segregation.

Panicum longifolium. "Low ground, wet pineland, DM." This name is now usually placed in synonymy under *Panicum rigidulum* Bosc ex Nees. Though this grass is somewhat aggressive and is widespread to the north, we have not seen it south of Okeechobee County. DELETE SPECIES.

Paspalum difforme. "Pinelands, D." We know this plant (as a synonym of *P. floridanum* Michx. var. *floridanum*) south only to Flagler and Marion counties. Specimens bearing this name from Dade County have been misidentified *Paspalum floridanum* var. *glabratum* Engelm. ex Vasey (= *P. giganteum* Baldw. ex Vasey). DELETE SPECIES.

PHYSALIS TURBINATA. "Pineland, D." Even after the work of Menzel (1951) and Waterfall (1958, 1968) we remain in doubt as to the correct names of the Florida species of *Physalis* section *Pubescentes*. More commentary is needed than is appropriate here. Our present interpretation is that the *Flora* (p. 754) was correct in describing this species as hairy and with a fruiting calyx up to 4 cm. long; many specimens bearing this name are the near-glabrous, smaller-fruited *P. cordata* Mill. (= *P. pubescens* L. var *glabra* (Michx.) Waterfall). We have, however, seen no specimens of true *P. turbinata* Medic. from Florida. DELETE SPECIES.

PIPER OTOPHYLLUM. "Mangrove belt, Jamaica, CDM." Adams (1972) considered this name synonymous with *Piper fadyenii* C. DC. in DC., a montane endemic of Jamaica. It disappeared from the *Flora*, apparently recognized as a gross misidentification. DELETE SPECIES and the genus *Piper*.

POINSETTIA DENTATA. "Pinelands, D." Neither Burch (1966) nor we are able to cite collections of this species from Florida. DELETE SPECIES.

POLYGONELLA MYRIOPHYLLA. "Sand scrub, C." The *Flora* (p. 375) did not refer to the earlier Collier County report, but noted this species "has been found in Dade County." Horton (1963) knew it only as an endemic of central Florida (Highlands County and northward), and we have been unable to locate documenting specimens south of that area. DELETE SPECIES.

POTAMOGETON FLUITANS. "Long Pine Key, DC." This name is now usually considered a synonym of *Potamogeton nodosus* Poir. in Lam. which in our experience is not found south of western Florida. Confusion with the widespread *P. illinoensis* Morong is suggested. DELETE SPECIES.

PUNICA GRANATUM. "Waste places, old fields - D." Although this shrub, as Small (1933) stated, does persist around old homesites, it has only very sparingly been cultivated in southern Florida and apparently has never been documented there as an escape. DELETE SPECIES, the genus *Punica*, and the Punicaceae.

RHACOMA CROSSOPETALUM. This name should properly have been listed by the *Flora* (p. 568) as a synonym under *Crossopetalum rhacoma* Crantz (Brizicky 1964a).

RHAPIDOPHYLLUM HYSTRIX. "D." We believe this palm does not range south of Hardee and Highlands counties (FLAS, USF). DELETE SPECIES and the genus *Rhapidophyllum*.

RHYNCHOSPORA EDISONIANA. Gale (1944) treated this as synonymous with *Rhynchospora microcarpa* Baldw. ex Gray.

RHYNCHOSPORA FERNALDII. "Coastal beaches, C." Gale (1944) reported this species only south to Lee County, and the *Flora* (p. 231) deleted it without reference to the unequivocal statement in the *Annotated Checklist*. However, collections from Collier County do exist (*Craighead* in 1956, FLAS; Sandy excavation, Marco Island. *Atwater* in 1958, FLAS). RESTORE *Rhynchospora fernaldii* Gale.

RHYNCHOSPORA HARVEYI. "Glades, D." This coastal plain species is admitted to the flora of Florida only on the basis of a few northern collections (Leon Co., FSU; Duval Co., FLAS). It is unknown in the peninsula. DELETE SPECIES.

RUELLIA NUDIFLORA. "Pinelands, D." R. W. Long was a student of *Ruellia* but did not discuss the distribution of this species. It apparently is restricted to Texas and northern Mexico and had not previously been reported for Florida. It was omitted, without comment, by the *Flora* (p. 786.) DELETE SPECIES.

SAGITTARIA FALCATA. "C." The nearest location at which this species is known to occur is in Franklin County, western Florida (FLAS). DELETE SPECIES.

SALVIA MUTABILIS. We assume this combination is a *lapsus calami* for the common *Hyptis mutabilis* (A. Rich.) Briq.

SCHOENOLIRION ALBIFLORUM. Although this name may originally have been applied to the more northern *Schoenolirion croceum* (Michx.) Wood (Sherman 1969), it has long been used for *S. elliottii* Gray, under which the *Flora* (p. 283) might have placed it in synonymy.

SCHRANKIA ANGUSTISILIQUA. Probably only *Schrankia microphylla* (Dryand.) Macbr. occurs in the South Florida area (Isely 1973; FLAS; contra, Beard 1964, who cited Broward and Dade County specimens as *S. uncinata* Willd.). Isely (1973) considered *S. angustisiliqua* to be a "phase" of *S. microphylla*, within which the *Flora* (p. 454) should have placed this name in synonymy.

SCLERIA SETACEA. Core (1936) originally held this taxon distinct from *Scleria reticularis* Michx., but Fairey (1967), working under Core's direction, treated it as var. *pubescens* Britt. The above name should have been given by the *Flora* (p. 237) as a synonym.

SISYRINCHIUM MIAMIENSE. "D." The type of this taxon is a collection from Miami (*Pollard & Collins 264* in 1898, NY), and thus the name should not have been disregarded by the *Flora* (p. 298). Although this plant can be interpreted to fall within a rather inclusive interpretation of the East Coast and Bahamian *Sisyrinchium arenicola* Bicknell, the South Florida population appears to merit specific rank (Ward & Gillis 1975). RESTORE *Sisyrinchium miamiense* Bicknell.

SMILAX LANCEOLATA. "Hammocks, CDM." This name is a synonym of *Smilax smallii* Morong. The species, however, is not known south of Highlands County (Duncan 1967; FLAS) DELETE SPECIES.

SOLANUM NIGRUM. "Good soil, CDM." Although this Eurasian species has been reported in Dade County (D'Arcy 1974), recent workers (Heiser et al. 1979; Ogg et al. 1981; Schilling 1981) place all related South Florida materials in *S. americanum* Mill. (including *S. nodiflorum* Jacq.) or *S. pseudogracile* Heiser. DELETE SPECIES.

SPARGANIUM AMERICANUM. "Swampy shores, CDM." This distinctive plant is not known in Florida south of Highlands County, either by Beal (1960) or by us (FLAS, FSU, FTG, USF). DELETE SPECIES, the genus *Sparganium*, and the Sparganiaceae.

SPARTINA CYNOSUROIDES. "Saltwater beaches, low tidal lands, CDM." We have seen no records of this grass south of Duval County. DELETE SPECIES.

SPERMACOCE TENUIOR. "Pinelands, CDM." Long (1970) chose to treat *Spermacoce floridana* as a variety of *S. tenuior* L. In the *Flora* (p. 806) the typical variety was excluded from South Florida. This conforms with our experience, although the differences between these two taxa seem of specific magnitude. ADD *S. floridana* Urban[5] to the South Florida flora, and DELETE SPECIES reported above.

STENOCARPUS SINUATUS. "Coral Gables - D." This tree is cultivated occasionally in central and southern Florida, but there is no evidence that it escapes. DELETE SPECIES and the genus *Stenocarpus*.

STYLISMA AQUATICA. "In clearing floor of hammock, D." This species was attributed to South Florida by Moldenke (1944). Myint (1966) noted the reported range to southern Florida had been based upon misidentified specimens, mostly of *Stylisma villosa* (Nash) House, and that *S. aquatica* was not found south of the Apalachicola River in West Florida. DELETE SPECIES.

THELYPTERIS DENTATA. "Moist hammocks, CD." We have seen specimens of this species from Collier County (*Scull* in 1937, FLAS; *Avery 2071* in 1969, FLAS), as well as a

[5]*Spermacoce floridana* Urban dates from 15 Aug 1913 (*Symbolae Antillanae* 7:550, published on this date according to Carroll & Sutton 1965), while *S. keyensis* Small appears to be later. The preface of Small, *Flora of the Florida Keys*, 1913, was dated 11 Aug 1913, but the publication was recorded in the 28 Nov 1914 *Index to American Botanical Literature* (Bull. Torrey Bot. Club 41:575). Since the *Index* was monthly, *Flora of the Florida Keys* would seem not to have been available until after Oct 1914.

"volunteer in slat house," Dade Co. (FLAS). It had been deleted by the *Flora*. RESTORE *Thelypteris dentata* (Forssk.) E. St. John.

THELYPTERIS PATENS. "Moist hammocks, CDM." Neither Wherry (1964), Smith (1971b), nor recent field botanists in South Florida have been able to expand state records of this species beyond the single 1905 Dade County collection discussed by R. St. John (in Small 1938). We concur with the *Flora* (p. 101) that this species is highly unlikely to remain a member of our flora. DELETE SPECIES.

THELYPTERIS SERRA. "D." St. John (in Small 1938), in his report of this species for the state, recognized that the original specimens from Dade County were not wholly typical of the species as known in the West Indies. Wherry (1964) and Smith (1971a) have pointed out that, indeed, the Florida collections so named fall within the morphological limits of *Thelypteris augescens* (Link) Munz & Johnst. DELETE SPECIES.

THELYPTERIS TETRAGONA. "Moist hammocks, CD." This species is not known south of Marion and Hernando counties (FLAS, USF). DELETE SPECIES.

THELYPTERIS ULIGINOSA. The *Flora* (p. 100) omitted this name as a synonym of *Thelypteris torresiana* (Gaud.) Alston.

THERMOPSIS MOLLIS. "Pineland, hammocks, CDM." Wilbur (1963) reported this piedmont legume south only to northern Georgia. No conflicting specimens have been seen. DELETE SPECIES and the genus *Thermopsis*.

VERNONIA SCABERRIMA. "Sandy pineland, CDM." Jones (1964) failed to find this taxon, which he treated as *Vernonia angustifolia* Michx. var *scaberrima* (Nutt.) Gray, outside of South Carolina and eastern Georgia. DELETE SPECIES.

VICIA FLORIDANA. "Margins, hammocks, CD." This legume, although common in northern and central Florida, apparently does not occur south of Desoto County (FLAS, USF). DELETE SPECIES.

VIGNA UNGUICULATA. "Waste places, CD." This plant is frequently cultivated, but we know it as an escape only on Sanibel Island, Lee County (FLAS). DELETE SPECIES.

WALTHERIA AMERICANA. The *Flora* (p. 604) failed to give this name as a synonym under *Waltheria indica* L.

WAREA CUNEIFOLIA. "D." Channell & James (1964) have reemphasized the earlier interpretation of this species as known only from Liberty and Gadsden counties, West Florida. Dade County material would be the related but distinct *Warea carteri* Small. DELETE SPECIES.

WASHINGTONIA FILIFERA. "CDM." The vast majority of Florida individuals of this genus are the gracefully slender *Washingtonia robusta* Wendl. *Washingtonia filifera* is cultivated only with rarity in Florida, and we are unable to find evidence that it escapes. DELETE SPECIES.

WEBSTERIA SUBMERSA. "Submersed aquatic, C." This plant is better known as *Websteria confervoides* (Poir.) Hooper (= *Scirpus confervoides* Poir. in Lam.). It is rare in Florida, and we have seen no specimens from south of Lake and Highlands counties. Inclusion of this species in South Florida is based upon specimens from Collier County so annotated by H. K. Svenson (FLAS, FSU, USF); the plants, however, are submersed forms of the common *Eleocharis baldwinii* (Torr.) Chapman. DELETE SPECIES and the genus *Websteria*.

WOLFFIA COLUMBIANA. "Canals, D." The *Flora* (p. 254) omitted this genus. Yet this species is frequent in Florida and D. W. Hall, recently a student of the Lemnaceae, reports to us that he has seen a Dade County collection (*Stimpson 738*, FSU). RESTORE *Wolffia columbiana* Karst.

XYRIS BALDWINIANA. "C." Kral (1966) did not find this species south of Marion County. We are unable to contradict him. DELETE SPECIES.

ZAMIA INTEGRIFOLIA. "Pinelands, CDM." The *Flora* (p. 108) reported the common

Florida species of this genus to be *Zamia pumila* L., a name initially applied to plants from Hispaniola but extended by Eckenwalder (1980) to all members of the genus in the West Indies and Florida. The Florida representatives, though undoubtedly "founder effect" selections from this Caribbean complex, seem sufficiently uniform to merit taxonomic recognition (Hardin 1971; Ward 1979). Aiton's *Zamia integrifolia*, though earlier, is nomenclaturally superfluous and thus illegitimate. RESTORE (replace with) *Z. floridana* A. DC.

ZOSTERA MARINA. "CDM." This marine species ranges from Beaufort, North Carolina (Den Hartog 1970), north into the arctic seas. It is completely unknown in Florida. DELETE SPECIES, the genus *Zostera*, and Zosteraceae.

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DOCUMENTED CHROMOSOME NUMBERS 1990: 1. MISCELLANEOUS NORTH AMERICAN VASCULAR PLANTS

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The following meiotic chromosome counts are documented by specimens deposited in Herbarium of Arizona State University (ASU). Previously uncounted taxa are represented by an asterisk (*). A double asterisk (**) indicates a new number for the species.

METHODS

Flower buds were collected in developmental series from plants growing in native habitats. Buds were killed and fixed in chloroform, ethanol, and glacial acetic acid (6:3:1 v/v) or ethanol and glacial acetic acid (3:1 v/v), transferred to 70% ethanol after 24 hrs, and refrigerated. Anthers were squashed in iron/acetocarmine and mounted in Hoyer's medium (Beeks 1955).

Percentage positive pollen stainability was determined for the three *Penstemon* individuals for which chromosome counts were obtained. Pollen was taken from closed anthers of herbarium specimens and stained in aniline-blue lactophenol for 48 hrs (Maneval 1936). A minimum of 500 pollen grains per individual were scored. Percentage of staining, normal-size grains is indicated in parentheses after the chromosome number in the results below.

ANACARDIACEAE

*Rhus aromatica Aiton var. pilosissima (Engl.) Shinners. $n = 15$. — Arizona. Yavapai Co.: NW side of Prescott, Arrowhead Dr, *Parfitt 3898 & Roberts*.

Sida 14(2):305 – 308. 1990.

APOCYNACEAE

Amsonia tomentosa Torr. & Frem. var. **tomentosa**. $n = 11$. — Arizona. Mohave Co.: jct. of Signal Rd & Alamo Rd NNW of Alamo Lake, *Parfitt 4181 & Christy.*

***Cycladenia humilus** Benth. $n = 7$. — Utah. Grand Co.: Castle Valley, red clay slopes below Parriot Mesa, *Anderson 86-51*.

ASTERACEAE

Berlandiera lyrata A. Gray var. **monocephala** B. L. Turner. $n = 15$. Chihuahua. Rte 14, near La Junta, *Pinkava 13334, 13339, McGill, Reeves & Nash*.

Chaenactis stevioides Hook. & Arn. $n = 5$. — Arizona. Apache Co.: Navajo Reservation, Hwy 12 ca. 5.7 mi NW of jct with Hwy 13, just N of Tsedadhotsosi (a tiny mesa), *Reeves 8273 & Parfitt*.

***Cirsium drummondii** Torr. & Gray × C. **wheeleri** (A.Gray) Petrak. $n = 16$. — Arizona. Apache Co.: Alpine Campground, 5 mi N of Alpine, *Landrum 5249 & Landrum*.

***Helenium arizonicum** Blake. $n = 15 + 1B$. — Arizona. Coconino Co.: AZ 260, near turnoff to Willow Springs Lake, T11N R14E S31, *Parfitt 3845 & Rickel*.

Machaeranthera grindelioides (Nutt.) Shinners. $n = 4$. — Nevada. White Pine Co.: 38 mi W of Ely Cemetery, US 50, *Parfitt 3817 & Roberts*.

Machaeranthera asteroides (Torr.) Greene var. **glandulosa** B.L.Turner. $n = 4$. — Arizona. Yavapai Co.: Antelope Hills Golf Course, US 89, Prescott, *Fillipi 3*.

Stephanomeria exigua Nutt. var. **exigua**. $n = 8$. — Baja California Norte. 22.9 mi S of San Vicente, *Pinkava 11110, McGill, Hensel, & MacIntyre*.

Stephanomeria pauciflora (Torr.) A. Nels. $n = 8$. — Arizona. Pinal Co.: 37.4 mi NW of Oracle Junction, *Pinkava 10993, Lehto & Hensel*.

BORAGINCEAE

****Lithospermum incisum** Lehm. $n = 14$. — Arizona. Apache Co.: Navajo Reservation. SW slopes of Chuska Mts., ca. 3.2 mi NE of Tsaile, 36° 19′ 20″ N, 109° 10′ 10″ W, *Reeves 8302 & Parfitt*.

BRASSICACEAE

***Pennellia longifolia** (Benth.) Rollins. $n = 8$. — Arizona.

Apache Co.: ca. 6 air mi E of Mt Baldy Peak, T6N R27E S14, *Parfitt 3852 & Rickel.*

CACTACEAE

Opuntia repens Bello. $n = 11$. — Puerto Rico. ca. 4.4 mi SE of Boqueron along PR 303, *Keil 16512.*

CUCURBITACEAE

*__Marah gilensis__ Greene. $n = 15$. — Arizona. Maricopa Co.: ca. 2.5 mi N of Sunflower, T6N R9E S4, *Parfitt 3731 & Bricker.*

ERICACEAE

*__Arctostaphylos pringlei__ Parry. $n = 13$. — Arizona. Yavapai Co.: 1.1 mi E of Crown King, *Parfitt 3746, Bricker & Eggers.*

FABACEAE

*__Psoralea mephitica__ S. Wats. $n = 11$. — Arizona. Maricopa Co.: ca. 11 mi S of Sunflower, T4N R8E S2, *Parfitt 3732 & Bricker.*

Vicia pulchella Kunth. $n = 7$. — Arizona. Apache Co.: White Mtns, 2.7 mi NE of jct Forest Service Rds 117 & 117a, near Carnero Lake, T8N R27E S6, *Parfitt 3874 & Rickel.*

LAMIACEAE

Mentha arvensis L. var. **villosa** (Benth.) S. R. Stewart. $n = 48$. — Arizona. Coconino Co.: AZ 260, near turnoff to Willow Springs Lake, T11N R14E S31, *Parfitt 3848 & Rickel.*

RUTACEAE

*__Thamnosma montana__ Torr. & Gray. $n = 10$. — California. San Bernardino Co.: N side of Clark Mt, T17N R13E S15, *Parfitt 3586 & Baker.*

SCROPHULARIACEAE

*__Keckiella antirrhinoides__ (Benth.) Straw ssp. **microphylla** (Gray) Straw. $n = 8$. — Arizona. Maricopa Co.: 12.7 mi S of Sunflower, *Parfitt 3725 & Bricker.*

Orthocarpus luteus Nutt. $n = 14$. — Arizona. Apache Co.: ca. 6 air miles E of Mt. Baldy Peak, T6N R27E S14, *Parfitt 3854 & Rickel.*

Penstemon eatonii Gray ssp. **eatonii**. $n = 8$ (97.4%). — Arizona. Maricopa Co.: cult., 924 W. Watson Dr, Tempe, *Parfitt 3603.*

Penstemon pseudospectabilis Jones var. **connatifolius** (A. Nels.)

Keck. $n = 8$ (60.0%). — ARIZONA. Maricopa Co.: cult., 924 W. Watson Dr, Tempe, *Parfitt 3601*.

*PENSTEMON EATONII ssp. EATONII × P. PSEUDOSPECTABILIS var. CONNATIFOLIUS (F1 hybrid, a volunteer resulting from natural pollination). $n = 8$ (36.2%). — ARIZONA. Maricopa Co.: cult., 924 W. Watson Dr, Tempe, *Parfitt 3602*.

ROSACEAE

Correction. The following was erroneously reported as *Rhus ovata* (*Parfitt et al. 1985*):

PRUNUS ILLICIFOLIA (Nutt.) Walp. $n = 15$. California. San Diego Co.: 117.2 mi W of Yuma, AZ, at jct. of CA 94 & I-8, *Gallagher 82-9*.

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NOTES

A NOTE CONCERNING THE TYPIFICATION OF TWO PLANTS DESCRIBED FROM TEXAS — In a recent revision of the genus *Callirhoe* Nuttall (Malvaceae) (Dorr 1990), a paratype (*Lindheimer 681*) was chosen as the lectotype for *C. leiocarpa* R. Martin since the holotype (*C. D. Marsh s.n.*), which had been deposited at NA, was missing and presumed lost. However, the holotype has been found since at US (D. Nicolson, pers. comm.). Evidently, in 1953 the herbaceous material at NA was transferred to US and the Marsh specimen was misfiled under *Malva* L. The revision of *Callirhoe* (Dorr 1990, p. 40) should be corrected as follows:

CALLIRHOE LEIOCARPA R. Martin, J. Wash. Acad. Sci. 28(3):108. 1938 ("*Callirhoë*"). — TYPE: UNITED STATES. TEXAS: Kinney Co.: Spofford, 4 Apr 1908, *C. D. Marsh s.n.* (HOLOTYPE: US-2133209 ex NA-8099!).

When Dorr and Barnett (1986) sought to clarify the identity of *Nephropetalum* Robinson & Greenman (Sterculiaceae) they concluded that the genus was synonymous with *Ayenia* L. (Sterculiaceae) and that the sole species, *N. pringlei* Robinson and Greenman, was conspecific with *A. limitaris* Cristóbal. They were unable to locate the type of *N. pringlei*, which presumably was deposited at GH. Consequently they designated an isotype at VT as lectotype. After Dorr & Barnett (1986) published this lectotype, C. Cristóbal informed the curator of GH that the holotype of *N. pringlei* was filed under *Triumfetta* L. (Tiliaceae) (W. Kittredge, pers. comm.). Cristóbal concurred with our taxonomic assessment and *N. pringlei* remains a synonym of *A. limitaris*. However, the typification of the former name is now:

NEPHROPETALUM PRINGLEI Robinson & Greenman, Bot. Gaz. (Crawfordsville) 22: 168. 1896. — TYPE: UNITED STATES. TEXAS. Hidalgo Co.: Hidalgo, woodlands, 3 Aug 1888, *Pringle 2272* (HOLOTYPE: GH!; ISOTYPE: VT!).

— *Laurence J. Dorr, New York Botanical Garden, Bronx, NY 10458-5126, U.S.A.*

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MONTIA LINEARIS (PORTULACACEAE), NEW TO MISSISSIPPI — While examining a shipment of exchange specimens that the junior author had sent to MICH in 1989, the senior author and A. A. Reznicek (MICH) noticed that two specimens determined as *Claytonia virginica* looked odd. In a later communication, the junior author noted that he also thought that the specimens looked a little strange for *C. virginica*, but thought that their appearance might be attributed to the use of herbicides along roadsides where they were found.

The presence of white rather than dark-veined pink petals ruled out *C. virginica* immediately. The combination of fibrous roots and alternate cauline leaves excluded the plants from the genus *Claytonia*, suggesting instead that they belonged in the genus *Montia*. Comparison with the MICH holdings of *Montia* revealed that the Mississippi collections were specimens of *Montia linearis* (Dougl. ex Hook.) Greene, narrow-leaved montia, a native western species found at lower elevations from British Columbia south to California and eastward to southwestern Saskatchewan, Montana, and Utah (Hitchcock & Cronquist 1973, Scoggan 1978). These determinations were subsequently confirmed by Walter A. Kelley of Mesa State College, Grand Junction, Colorado.

Montia linearis is known from the following collections:

MISSISSIPPI: **Coahoma Co.**: between highway and old railroad tracks, along US 49W between Tutwiler and Rome, T25N,R3W,S36,SE½, 4 May 1988, *Bryson 7483* (SWSL) & *7572* (MICH, SWSL). **Panola Co.**: wet area N of MS Hwy 6, 11.4 mi W of Batesville, T9S,R9W,S20, 4 May 1988, *Bryson 7553* (SWSL). **Quitman Co.**: wet area along MS Hwy 3, S of Marks, 4 May 1988, *Bryson 7537* (SWSL). **Sunflower Co.**: wet area along US 49W, 5 mi N of Drew, T23N,R3W,S4, NE¼, 4 May 1988, *Bryson 7544* (SWSL). **Tallahatchie Co.**: wet area, W side of US 49W, 1 mi S of Tutwiler, T25N,R2W,S31,NW¼, 4 May 1988, *Bryson 7458* (IBE, SWSL); roadside park, jct. of US 49E & 49W, S of Tutwiler, 4 May 1988, *Bryson 7500* (MICH, SWSL); 11 Apr 1990, *Bryson & Newton 8775 & 8783* (CLEMS, DUR, FLAS, GA, IBE, MESA, MICH, MMNS, MO, NCU, NLU, NY, OSC, SMU, SWSL, TAES, TENN, UARK, UC, VDB, VSC, and WTU).

This is the first report of the genus *Montia* in the Southeastern United States. Its occurrence along roadsides in five counties strongly suggests an introduction from an unknown source, possibly the first such occurrence outside of its native range. It may have arrived via a railroad source since all but the Panola County site are within ¼ mi of Illinois Central Gulf trackage abandoned in the 1980's.

The largest of these populations is at the roadside park just south of Tutwiler. The plants here occur in open areas or under widely scattered *Quercus nigra* and *Q. phellos* on poorly drained, heavy clay and/or on well drained, sandy, loam soils. Within the park, *M. linearis* is colonial much like populations of *Claytonia*, ranging from a few plants to several thousands over areas of less than one square meter or up to 30 m^2 in size.

Since we have no information on when the species may have first arrived, it is likely that either other specimens may exist in herbaria, likewise assumed to be *Claytonia virginica*, or that it has been overlooked. From the habitat range of these collections, *M.* linearis may be expected in other locations within the Mississippi-Yazoo Delta Region along roadsides or in cemeteries, roadside parks, and even lawns. — *Richard K. Rabeler, University of Michigan Herbarium, North University Building, Ann Arbor, MI 48109-1057, U.S.A. and Charles T. Bryson, USDA-ARS, Southern Weed Science Laboratory, Stoneville, MS 38776, U.S.A.*

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CAREX COMOSA (CYPERACEAE), NEW TO MISSISSIPPI. — *Carex comosa* Boott is a large, conspicuous sedge that inhabits low, wet, non-acid soils (Mackenzie 1935). It occurs from southeastern Canada to Minnesota, generally southward to central peninsular Florida and west to Texas, and in the west from California to Washington, eastward to Idaho (Steyermark 1968, Godfrey and Wooten 1979). It is disjunct in central Mexico (Hermann 1974). However, the nearest known record to Mississippi is from Crittenden County, Arkansas which is adjacent to and across the Mississippi River from Mississippi and Tennessee (Smith 1978). Despite searches for this species, especially by the senior author during the past decade, *C. comosa* had not been found within the boundaries of Mississippi.

While on a collecting trip, *C. comosa* was found growing at an oxbow lake in Coahoma County located in the Yazoo-Mississippi Delta Region. Similar oxbow lakes are scattered throughout the Yazoo-Mississippi Delta Region.

Specimens collected: MISSISSIPPI. Coahoma Co.: 5.6 mi (9 km) N on US 49 from its jct. with MS 3, E side of US 49, Home Cypress Hunting Club Lake, NE Dublin; E of US 49, Sec. 34, T26N, R3W, 15 May 1990, *Bryson 9858* & *S.* & *G. Jones* (ctb, private collection of Charles T. Bryson, DSC, GA, IBE, MICH, MMNS, NLU, SWSL, TENN, UARK, VDB, VSC, WARM); *S.* & *G. Jones 4719* & *Bryson* (ASTC, SMU, SWT, TAES, TEX, US).

The habitat is an open oxbow lake (cypress slough) with scattered bald cypress trees (*Taxodium distichum*) growing in the lake. The area adjacent to the oxbow is cleared farmland with brownish loamy clay soil, alluvium (Qa) of the Tutwiler formation within the Delta Region (Holocene, Quaternary) (Bicker 1969). *Carex comosa* was found frequently growing on bald cypress stumps and logs in close association with *C. decomposita*, and less frequently growing along the bank's edge. Other associated taxa were *Ludwigia* sp., *Bidens* sp., and *Lemna* sp.

Due to the large population size of more than 50 clumps and the large cespitose clumps, the authors believe that *C. comosa* has been established at this location for many years and is not a recent introduction. Subsequent searches in potential habitat in Coahoma County and surrounding counties in northwestern Mississippi by the senior author during 1990 failed to locate additional populations of *C. comosa*. This record is approximately 62 miles (100 km) southeast from the nearest station in Arkansas.

We thank Gretchen D. Jones for her assistance in the field and for editorial comments. We also acknowledge Richard Carter (VSC), David Castaner (WARM), A. A. Reznicek (MICH), and J. K. Wipff (TAES) for helpful suggestions. — *Charles T. Bryson, USDA, ARS, Southern Weed Science Laboratory (SWSL), Stoneville, MS 38776, U.S.A. and Stanley D. Jones, S. M. Tracy Herbarium (TAES), Department of Range Science, Texas A&M University, College Station, TX 77843, U.S.A.*

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STEYERMARK, J. A. 1963. Flora of Missouri. The Iowa State University Press, Ames, p. 373–74.

CHLORIS INFLATA (POACEAE) NEW TO LOUISIANA — Recent collections from Louisiana have yielded a specimen of *Chloris inflata* Link. Despite an extensive distribution throughout the tropical and subtropical regions of the Old WORLD and New World, there have been few collections of *Chloris inflata* from the continental United States. Prior to the collection reported herein the only confirmed collections of this taxon were from Bexar County, Texas (*W.A. Silveus 6413*, US) and Cameron and Hidalgo counties in extreme southern Texas (Correll and Johnston 1970; Gould 1975). A range map dot shown for Mississippi in a paper by Anderson (1974) could not be verified. Allen (1980) did not report it for Louisiana. Considering the widespread distribution of this species in the Caribbean and Bahamas, it is highly likely that this taxon will be found elsewhere in the southern United States in the near future. The collection data are:

LOUISIANA. **Orleans Parish**: on the shoulder between Leake Ave. and the tracks of the Illinois Central RR, opposite the U.S. Army Corps of Engineers facility, 7 Aug 1989, *John Macgregor 892* (UNO).

—*John R. Macgregor, Department of Biological Sciences, University of New Orleans, New Orleans, LA 70148, U.S.A. and Charles M. Allen, Division of Sciences, Louisiana State University at Eunice, Eunice, LA 70535, U.S.A.*

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PLANTAE ALPINAE NOVAE MEXICANAE: *SEDUM CHRYSICAULUM* (CRASSULACEAE)

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ABSTRACT

Recent explorations of the alpine-subalpine floras of northeastern Mexico have revealed several new species of *Sedum*. The most widespread of these, here described as **S. chrysicaulum**, approaches most closely *S. parvum* ssp. *nanifolium*, but is easily distinguished from the latter by persistent, pale yellow-green, dorsally sulcate leaves, petals 5.0 – 7.5 mm long, and a preference for habitats above timberline.

RESUMEN

Exploraciones recientes de las floras alpinas en el nordeste de México han dado luz a varias especies nuevas de *Sedum*. La especie mas ampliamente distribuida, **S. chrysicaulum**, aquí descrita, asemeja a *S. parvum* ssp. *nanifolium*, con la cual se distingue por hojas persistentes, verde-amarillentas pálidas, sulcadas en la superficie adaxial, pétalos 5.0 – 7.5 mm de largo, y por prefencia de habitats arriba de los límites arboreos.

Sedum chrysicaulum McDonald, sp. nov. (Fig. 1)

A *Sedo parvo* Hemsl. ssp. *nanifolio* (Frod.) Clausen caulibus infernis herbaceis foliis ellipsoideis dorsaliter sulcatis 5 – 6 mm longis petalis 5 – 7 mm longis et folliculis 4 – 5 mm longis differt.

Herbs perennial, cespitose, 3 – 7 cm tall, 2 – 20 cm wide, glabrous. Stems branching from base, ascending, 5 – 9 cm long, 1 – 2 mm in diam at maturity, yellow-green, glabrous, smooth; internodes somewhat longer in basal portions, 0.5 – 9.0 mm long; nodes occasionally rooting; roots fibrous. Leaves simple, sessile, narrowly ellipsoid, dorsally sulcate (flattened upon drying), 5 – 7 (-10) mm long, 2 – 3 mm wide, light green or rarely orangish, with occasional red spots, glabrous. Inflorescence in terminal, congested cincinni; flowers 2 – 8; sepals 5, broadly lanceolate, 4 – 5 mm long, 1.5 – 2.0 mm wide at base, pale green, coriaceous, glabrous; petals 5, erect, narrowly elliptic or lanceolate, 5 – 8 mm long, 2.0 – 2.5 mm wide medially, ca. 2 mm wide at base, yellow with occasional red-pigmented dots or longitudinal striations, glabrous; stamens 10, 5 – 6 mm long, terete, attenuate, ca. 0.5 mm wide in diam at base, filiform at apex, yellow; anthers ovoid, basally cordate, yellow; carpels 5, 6 – 8 mm long, 1.2 – 1.5 mm wide at base, yellow, glabrous. Fruit con-

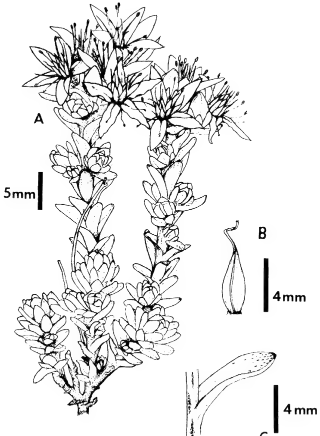

FIG. 1. Illustration of *Sedum chrysicaulum*. A. Growth habit. B. Mature follicle. C. Mature stem and leaf; note the red striations on the stem, and the red punctae on the blade.

sisting of 5 erect, free follicles, narrowly ellipsoid, 7 − 9 mm long, ca. 2 mm wide at base, often red-pigmented, glabrous, suture ca. 5 mm long, the style persistent, forming an attenuate apex ca. 2 mm long; seeds ca. 10, narrowly ellipsoid, 0.7 − 1.0 mm long, ca. 0.4 mm wide, brown, glossy, densely papillate.

TYPE: MEXICO. NUEVO LEON: Mpio. Rayones, summit of Sierra La Marta, eastern ridge-top in subalpine vegetation, ca. 3650 m, 24 Aug 1989, *McDonald & Mayfield 2556* (HOLOTYPE: TEX; ISOTYPES: MEXU, NY, UAT).

Specimens examined: MEXICO. **Coahuila**: Mpio. Arteaga, summit of Sierra La Viga, 3700 m, 22 Aug 1986, *McDonald 2099* (TEX); 24 Oct 1984, *McDonald & Gomez 1157* (TEX, UAT); Mpio. Arteaga, summit of Sierra La Marta, 3600 − 3700 m, 31 Aug 1980, *Hinton et al. 17977* (TEX); 4 Aug 1980, *Hinton et al. 17919* (TEX); 25 Oct 1984, *McDonald & Gomez 1242* (TEX); 22 Aug 1986, *McDonald 2136* (TEX). **Nuevo Leon**: Mpio. Galeana, summit of Cerro Potosí, 3700 m, 19 Jun 1966, *Gilbert 9* (TEX); 23 Aug 1984, *Lavin 4787* (TEX); 14 Oct 1970, *Hinton et al. 17303* (TEX); Mpio. Zaragoza, Sierra Peña Nevada, N of Picacho de San Onofre, 30 Nov 1984, *McDonald & Gomez 1298* (MEXU, TEX, UAT).

Three species of *Sedum* in the alpine-subalpine vegetation of northeastern Mexico have yellow flowers and relatively short leaves (<6 mm), suggesting close relationships with *S. parvum* Hemsl. (*sensu lato*; Clausen 1978, 1979, 1981). Beaman & Andresen (1966) adopted the latter epithet for all of the *Sedum* collections from the alpine flora of Cerro Potosi, Nuevo Leon, despite the morphological and ecological distinctiveness of these populations in relation to the type population of *S. parvum* Hemsl. ssp. *parvum* from warm and semiarid regions near the city of San Luis Potosí (Clausen 1979). All three of the above-mentioned alpine stoneworts appear to be undescribed (McDonald 1990), but two must await formal recognition pending a critical study of the entire complex (Nesom, in prep). The most distinctive and widespread of these, occurring in all seven timberline refugia studied by McDonald (1990; Fig. 2), most closely approaches in morphology the low-elevational *S. parvum* Hemsl. ssp. *nanifolium* (Frod.) R. Clausen. *Sedum chrysicaulum*, here described, shares the following features with *S. parvum* ssp. *nanifolium*: smooth stems, flattened and/or sulcate leaves that often bear distinctive red markings, and yellow flowers. *Sedum parvum* ssp. *nanifolium* is distinguishable from *S. chrysicaulum*, however, by green or reddish, basally lignescent stems that often branch distally, flattened leaves, ovate to broadly elliptical, 2.5 − 3.5 mm long, generally deciduous at the base of stems and congested in apical regions of the stems, petals 4 − 5 mm long, and follicles 2 − 3 mm long. This and other subspecies of *S. parvum* recognized by Clausen (1978, 1979, 1981) generally occur in relatively arid, chaparral vegetation or pine-oak associations of northeastern Mexico and western Texas (Clausen 1978).

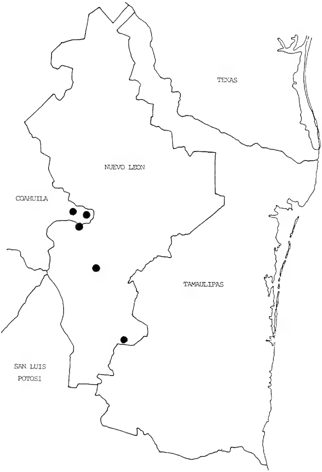

FIG. 2. Known distribution of *S. chrysicaulum*.

In contrast, *S. chrysicaulum* has herbaceous, light yellow-green stems that branch mostly from the base, leaves narrowly elliptic, dorsally sulcate (a feature commonly obscured by desiccation), 5 − 6 mm long, persistent and dispersed relatively evenly along stems, petals 5.0 − 7.5 mm long and follicles 4 − 5 mm long (Fig. 1). *Sedum chrysicaulum* generally occurs from 3400 − 3700 m in timberline and alpine vegetation of northeastern Mexico (Coahuila, Nuevo Leon, Tamaulipas; Fig. 2) as an associate of subalpine vegetation dominated by the genera *Arracacia* Bancr., *Castilleja* Mutis, *Erysimum* L., *Penstemon* Schmid., and *Senecio* L., and stunted individuals of *Pinus culminicola* Andresen & Beaman and *Pinus hartwegii* Benth. (McDonald 1990). Plants of *S. chrysicaulum* flower and fruit from June to October.

ACKNOWLEDGEMENTS

The author gratefully acknowledges support from the World Nature Association that financed an expedition to collect the type specimen. Dr. Guy Nesom shared his views on the relationships of the new taxon, and suggested the specific epithet.

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BOOK REVIEWS

MAYES, VERNON O. AND BARBARA BAYLESS LACY. 1989. **Nanise' A Navajo Herbal. One hundred plants from the Navajo Reservation.** Navajo Community College Press, Tsaile, Arizona.

An interesting text on the common plants found on the Navajo Indian Reservagion in the "Four Corners Area" of Arizona, Utah, Colorado and New Mexico, a 25,000 square mile area. Each plant is presented with an illustration, scientific name and pronouncation guide, the derivation and the Navajo name. Each plant is briefly described and its association with other plants is briefly mentioned. The Navajo uses of the plant is also described followed by references from the ethnobotany literature. An interesting book from an unusual region of the United States. John E. Ubelaker.

KINDSCHER, KELLY. 1987. **Edible Wild Plants of the Prairie. An Ethnobotanical Guide.** The University Press of Kansas, Lawrence, Kansas 66045. Paper.

An introductory text that introduces wildflower enthusiasts to the value of numerous native and introduced plants of the Great Plains. The text resulted from an 80 day walk across Kansas and eastern Colorado by the author. Presented are line illustrations of common plants, Indians names for the plants, followed by a brief description and habitat. A substantial section involves the food uses of the plants as well as food mythology and beliefs by the American Indians. The book is well written and enjoyable to read. *John E. Ubelaker.*

STUBBENDIECK, JAMES AND ELVERNE C. CONARD. 1989. **Common Legumes of the Great Plains, An Illustrated Guide.** Illustrated by Bellamy Parks Jansen. University of Nebraska Press, 901 N. 17th St., Lincoln, NE 68588-0520. Hardbound $35.00. 330 pp.

An illustrated manual treating 107 species in detail common to the Great Plains. This includes full page illustrations accompanying the text of each taxon. The text contains a species description, synonymy, agronomic and wildlife data, food, medicinal, and other uses by American Indians and pioneers. Dichotomous keys are provided from the family level down to the species treated within each genus when there are more than one per genus. The excellent diagrammatic illustrations greatly enhance this publication. wfm

A NATURAL INTERGENERIC HYBRID IN THE $x = 6$ GROUP OF THE ASTEREAE (ASTERACEAE)

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ABSTRACT

A single plant found west of Zacatepec, Puebla, Mexico, is recognized as a hybrid between members of two $x = 6$ genera of Astereae based on intermediacy of characters and reduced fertility. The plant is regarded as *Xanthocephalum humile* (Kunth) Benth. × *Isocoma* (*Haplopappus*) *veneta* (Kunth) E. Greene. The existence of this and two other natural hybrids of similar origin supports the hypothesis that the genera of Astereae having $x = 6$ are more closely related to one another than any is to genera having other base chromosome numbers, but should not be interpreted as evidence for uniting the genera.

KEY WORDS: Asteraceae, Astereae, *Haplopappus*, *Isocoma*, *Xanthocephalum*, hybrid, Mexico.

RESUMEN

Una planta encontrada al oeste de Zacatepec, Puebla, México ha sido reconocida como un híbrido entre dos $x = 6$ géneros de Astereae basado en fertilidad reducida y caracteres intermedios. La planta es considerada *Xanthocephalum humile* (Kunth) Benth. × *Isocoma* (*Haplopappus*) *veneta* (Kunth) E. Greene. La existencia de éste y otros dos híbridos de origen natural sostiene la hipotesis de que los géneros de Astereae que tienen $x = 6$ están más cercanamente relacionados unos a otros que cualquiera de éstos con otros géneros con diferentes números cromosomicos base, no obstante ésto no debe ser interpretado como evidencia para unir los géneros.

Found west of Zacatepec, Puebla, Mexico was a single plant, *Hartman & Funk 4127*, 19 Aug 1976 (**RM** and **TEX**), which has the following combination of features unlike that of any plant previously known to science:

Sprawling perennial herb; stems longitudinally ridged, 15 – 25 cm long, reddish-brown to purple, densely villous, less so with age, the internodes 2 – 12 mm long. **Leaves** alternate, often with fascicles of secondary leaves in axils, lanceolate to linear-lanceolate or occasionally linear, 15 – 30 mm long, 1 – 5 mm wide, the apex mucronate, the base gradually tapered, the margins with 1 − 3 (-4) salient, mucronate teeth per side, often not paired, the adaxial surface sparsely to moderately villous, pitted on drying, the veins obscure, less so on the slightly paler abaxial surface. **Capitulescence** a terminal, corymbose cluster of 4 − 8 heads; peduncles 5-30 mm long, bracteate, the bracts linear to scale-like, densely villous, sparsely so with age. **Heads** radiate, 7 − 8 mm high and 14 − 18 mm wide in flower, 7 − 9.5 mm high in fruit (pressed material); involucres hemispheric, 5 − 6 mm high, 7 − 9.5 mm wide, the phyllaries in 3 − 4 (-5) series, imbricate, oblong to narrowly oblanceolate, appressed, 1 − 5 mm long, the lower portion thickened, stramineous, the upper 1/2 − 1/4 herbaceous, the apex mucronate; receptacles flat to slightly convex, alveolate, the alveolae rimmed by scales 0.2 − 0.5 mm long. **Ray florets** hermaphroditic (Fig. 1A), 12 − 15; corolla yellow, the tube 1.7 − 2 mm long, 0.3 − 0.4 mm in diameter, moderately to densely villous (Fig. 1A), the lamina broadly oblong to elliptic, 5 − 6.5 mm long, 1.8 − 2.2 mm wide, with 4 nerves, the lobes irregular, 0.1 − 0.5 mm long; anthers 3 − 4, not well developed; style branches 1.3 − 1.5 mm long, either linear and appearing stigmatic throughout or with deltate appendages; achene oblong to obovoid, 1.9 − 2.2 mm long, tan, antrorsely pubescent; pappus bristles somewhat unequal, 1.5 − 2.5 mm long, tan. **Disc florets** hermaphroditic, 32 − 40; corolla yellow, goblet-shaped, the tube 2.5 − 2.7 mm long, 0.3 − 0.4 mm in diameter, sparsely villous, the throat 1.2 − 1.5 mm long, 0.8 − 0.9 mm in diameter, glabrous, the lobes narrowly triangular, 0.5 − 0.7 mm long, glabrous; anthers 5, functional; style branches 1 − 1.2 mm long with deltate appendages; achene obovoid, 2.8 − 3 mm long, tan, antrorsely pubescent; pappus bristles unequal, 2 − 4 mm long, tan. Mexico: Puebla: salt flat (elev. ca. 2300 m), ca. 4.8 km WNW of Zacatepec on hwy 136. With *Xanthocephalum humile*, scattered individuals of *Isocoma veneta*, and species of *Erigeron*, *Suaeda*, *Atriplex*, *Bouteloua*, and *Distichlis* in the immediate vicinity.

There are two possible explanations for the differences between this plant and known species: either it is a new species, or it is a hybrid between related but distinct taxa. Based on the data given below, we believe the latter to be the case.

The plant was found with *Xanthocephalum humile* (Kunth) Benth. and *Isocoma veneta* (Kunth) E. Greene [= *Haplopappus venetus* (Kunth) S. F. Blake], two species of a group of genera of the Astereae that several authors have considered to be related. The bases for this assessment are the common base chromosome number of $x = 6$ and shared morphological characters including goblet-shaped disk corollas (first noted by Jackson 1966), deltate style-branch appendages on the disk florets, and rectangular epidermal cells on the adaxial surface of the ray corolla, as shown in Figure 1C (Hartman 1990; Hartman et al. 1987; Lane 1980, 1982; Lane & Hartman 1984, 1985; Lane et al. 1987) among other features (De Jong & Beaman 1963; Keil & Stuessy 1977). In addition, many members of the group grow in saline or alkaline habitats (Robinson 1893; Steyermark 1937; Turner 1972; Mayes 1976; Watson 1977; Lane 1983). Further, Jackson (1966), Jackson & Dimas (1981), and Venugopalan (1966) have reported experimental hybrids between some of the species belonging to this group

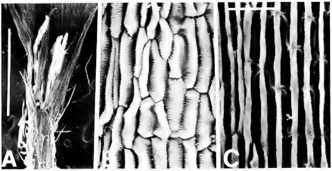

FIG. 1. Scanning electron micrographs of ray florets (scale for A = 1 mm, scale for B and C = 50 μm). A. Tube and lower portion of lamina of a ray floret from *Hartman & Funk 4127* (RM) showing the poorly developed anthers (light colored) in proximity to two rudimentary adaxial lobes (dark colored) and the villose tube. B. Adaxial epidermis of the lamina of a floret shown in Fig. 1A. C. Adaxial epidermis of the lamina of a ray floret of *Xanthocephalum humile* (*Lane 2395*, TEX), showing an epidermal pattern typical of all members of the $x = 6$ genera of Astereae. Specimens were prepared and photographed as described by Lane (1982).

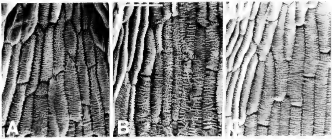

FIG. 2. Scanning electron micrographs of adaxial surfaces of lobes of disk corollas (scale = 50 μm for all). A. *Xanthocephalum humile* (*Lane 2395*, TEX). B. *Hartman & Funk 4127* (RM). C. *Isocoma veneta* (*Hartman 3830*, TEX). Specimens were prepared and photographed as described by Lane (1982). The epidermal pattern shown is typical of all members of the $n = 6$ genera of Astereae.

of genera; Lane (1980, 1983) found two natural interspecific hybrids in *Xanthocephalum*.

Hartman & Funk 4127 shares a number of features with both of the parental species proposed here. The epidermal cells of the adaxial surface of the disk corolla lobes are identical to those of both *X. humile* and *I. veneta* (Figs. 2A-C), the disk corollas are goblet-shaped, the disk style-branch appendages are deltate, and the plant was found in a saline habitat. However, while the pollen stainability of both species is 98% or greater (Jackson & Dimas 1981; Lane 1980; see Table 1), that of the putative hybrid is only 51.4% (205 of 399 observed grains were stained in lactophenol cotton-blue). Further, only 11 of 19 (57.9%) expanded achenes contained embryos. These indications of reduction in fertility are similar to those found in the natural and artificial hybrids mentioned above (Jackson 1966; Jackson & Dimas 1981; Lane 1980, 1983).

As indicated in Table 1, *Hartman & Funk 4127* has young stems, peduncles, capitula, involucres, and phyllaries like those of *X. humile*, but capitulescence, receptacles, achenes, and pappus similar to *I. veneta*. In all the other features listed in Table 1 and shown in Figure 3, the specimen is intermediate between the two taxa (e.g., habit, leaves, floret numbers, features of the style branch appendages, and achene lengths).

The most striking features of this plant are found in the "ray" florets (Fig. 1A), which have densely villous tubes, unusually deep sinuses, and adaxial epidermal cells (Fig. 1B) quite unlike those of *X. humile* (*I. veneta* is eradiate) shown in Figure 1C. These florets, unlike the ray florets of "good" taxa of the Astereae, contain stamens (although rudimentary) and the style-branch appendages in some of the florets resemble more closely those of disk florets. The same phenomena occur in another natural radiate-eradiate hybrid between *Machaeranthera restiformis* B. Turner and *M. gypsophila* B. Turner (Turner & Sanderson 1971; Turner 1973). These anomalous "ray florets" appear to be highly modified disk florets (pers. obs. of the authors). Jackson & Dimas (1981), who experimentally hybridized *I. veneta* with *Haplopappus aureus* A. Gray (a radiate species with $n = 6$), found that the presence or absence of ray florets is a single-gene character (see also Gottlieb 1984), although length of the lamina when ray florets are present is apparently quantitatively inherited. Our observations suggest that length as well as other features of the lamina are polygenically controlled and that some genes involved in disk floret structure can be "turned on" by the allele for presence of ray florets. These hypotheses await testing.

Recently, Guy Nesom brought to our attention two additional putative hybrids. The first (*G. Castillo C. & M. Vazquez 3063*, TEX) was collected in the same area (Mexico: Puebla: road from Zacatepec to El Carmen at

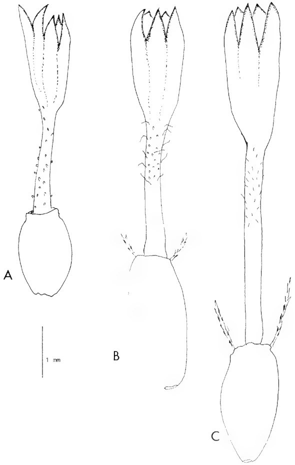

FIG. 3. Line drawings of disk florets, showing goblet-shaped corollas (scale bar as indicated). A. *Xanthocephalum humile* (*Lane 2395*, TEX). B. *Hartman & Funk 4127* (RM). C. *Isocoma veneta* (*Hartman 3830*, TEX). Achene pubescence of *Hartman & Funk 4127* and *Isocoma veneta* is not shown, and only a few of the pappus bristles are depicted.

border with Tlaxcala, 12 Jan 1984). It agrees in general with the description of *Hartman & Funk 4127* in most morphological features except the leaves are smaller, 10 − 20 mm long. Interestingly, the ray corollas exhibit one of the following conditions with respect to the adaxial petals: both are suppressed as in a normal floret, one or both is present but reduced in size, both are united into a narrow lamina 1/2 − 4/5 as long as the abaxial one, or one or both is present as a lateral lobe of the abaxial lamina. The second (*H.H. Iltis, A. Jose, & A. Lasseigne 802*; TEX) was collected approximately 140 km WNW of the site for *Hartman & Funk 4127* (Mexico: Mexico: on

TABLE 1. Comparison of *Xanthocephalum humile* (data from Lane 1980, 1983), *Hartman and Funk 4127* (data from the specimen), and *Isocoma veneta* (data compiled from Hall 1928 pp. 223 − 224, Jackson & Dimas 1981, and personal observation of *Hartman 3830*).

	Xanthocephalum humile	*Hartman & Funk 4127*	*Isocoma veneta*
HABIT	prostrate, perennial herb	sprawling, perennial herb	shrub
YOUNG STEMS	reddish to purple, villous	reddish to purple, villous	green, glabrous to puberulent
LEAVES	linear to narrowly obovate-spatulate	lanceolate to linear-lanceolate	oblanceolate to spatulate-oblong
MARGIN	usually entire	1 − 3 salient teeth/side	2 − 5 salient teeth/side
CAPITULA	solitary	4 − 8, pedunculate, in corymbose clusters	4 − 8, ± sessile, in corymbose clusters
PEDUNCLES	villous, bracteate	villous, bracteate	pubescent but not villous, ebracteate
INVOLUCRES	hemispheric	hemispheric	broadly turbinate
HEIGHT	4.3 − 6.4 mm	5 − 6 mm	5 − 8 mm
WIDTH	5.7 − 6.9 mm	7 − 9.5 mm	4 − 6 mm
PHYLLARIES	not resinous	not resinous	resinous
RECEPTACLES	reticulate, scales none	alveolate, alveolae rimmed by scales	alveolate, alveolae rimmed by scales
RAY FLORETS	14 − 32, pistillate	12 − 15, hermaphroditic (anthers rudimentary)	0
COROLLA TUBES	trichomes glandular and uniseriate	densely villous	———
DISK FLORETS	29 − 46 (80)	32 − 40	15 − 25 (30)
COROLLA			
LENGTH	2.9 − 4.6 mm	4 5.7 mm	5 − 7 mm
COROLLA TUBES	trichomes glandular	trichomes glandular and uniseriate	glabrous or trichomes sparse, uniseriate
STYLE-BRANCH			
APPENDAGES	papillae elongate, attenuate	papillae elongate, rounded	papillae short, rounded
ACHENES	glabrous, golden brown	sparsely silky-villous, tan	densely silky-villous, light tan
LENGTH	1 − 2.4 mm	1.9 − 3 mm	1.8 − 4 mm
PAPPUS	none or low scaly crown	bristles	bristles
LENGTH	0	1.5 − 4 mm	3 − 6 mm
POLLEN			
STAINABILITY	99.2%	51.4%	98%

former bed of Lago Texcoco at kilometer post 7, WSW of Texcoco, 10 Jan 1978). It fits closely the description of *Hartman & Funk 4127* except the plant is older and most of the pubescence has been lost and the ray corolla is shorter (tube 2.5 − 3 mm long; lamina 2.7 − 3 mm long) and either has a narrow, adaxial lamina nearly equalling the abaxial one or is normal in this respect. Both of these putative hybrids were found to have developed embryos in only 10% of the expanded achenes (1 of 10; limited number available). Pollen stainability was also much lower in these specimens than in *Hartman & Funk 3027*; *Castillo and Vasquez 3063* had 28.1% stainable pollen (307 of 1090 grains observed), and *Iltis et al. 802* only 13.9% (145 of 1042 grains observed).

Jackson's (1966) hypothesis that taxa of Astereae having goblet-shaped disk corollas are related has certainly been supported by his and others' more recent work, including the present paper. However, if *Haplopappus phyllocephalus* DC., *H. annuus* (Rydb.) Cory, and *H. aureus* (the "phyllocephalus group" of Hartman 1976, 1990) were to be placed in *Isocoma* (*Haplopappus* sect. *Isocoma* sensu Hall 1928) based on the hybrids reported by Jackson & Dimas (1981), then *Xanthocephalum* sensu Lane (1983) should also be accrued, based on the *Xanthocephalum humile* X *Isocoma* (*Haplopappus*) *veneta* hybrid reported here. There are strong morphological and chloroplast DNA restriction site data (D. Morgan, Y. Suh, B. Simpson, M. Lane, unpubl. data) that suggest that the monotypic *Stephanodoria* (Robinson 1892) is very closely allied with *Isocoma* and *Xanthocephalum*. Further, *Xanthocephalum* is clearly related to *Grindelia* (including *Prionopsis*, Morgan, Suh, Simpson, Lane, unpubl. data) to which *Olivaea* (De Jong & Beaman 1963) is also allied (Lane 1982).

Although the experimental and natural hybrids and other data discussed here certainly do indicate relationship of these taxa, we believe that the "lumping" of the several genera, before the detailed morphological and DNA-systematic investigations currently underway (Nesom et al. 1990; Lane, unpubl. data; Y. Suh and B. Simpson, pers. comm.) are completed, would result in a very large genus that would be not only systematically uninformative but also a nomenclatural nightmare. If all were joined to Hall's (1928) *Haplopappus* (in which case the generic name would be *Xanthocephalum* based on priority) as has been suggested by some workers, then it would follow that yet other genera of Astereae should also be united with it. Ultimately, the collapse of most if not all of the tribe into one or a very few genera would result. Such a situation would obscure rather than clarify the phylogeny of the Astereae; for this reason we continue to recognize distinct genera, even though their members may occasionally hybridize.

ACKNOWLEDGMENTS

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BOOK REVIEWS

KARI, PRISCILLA RUSSELL. 1987. Tanaina Plantlore: Dena'ina K'et'una. 2nd Edition, Revised. Alaska National History Association. Paperback $9.95 plus $2.00 postage & handling. 205 pp.

The ethnobotanical publication of the Dena'ina Indians of south central Alaska is well illustrated with colored plates of people and plants. Part I contains the background of the culture and environment in relation to the usage of plants. Part II treats individual plant species that are grouped mostly according to the habit of the plant. Gymnosperms, monocots, dicots, ferns, mosses, lichens, fungi, and algae have been utilized in some respect by this culture. One item that caught my interest was the following statement: There is a story... of a giant artist's fungus [*Ganoderma* or similar appearing]...said to have been about a quarter of a mile wide..." and I thought my foot and a half long (18 inches) specimen was large (*Mahler* 9983). An excellent book well worth the price. wfm

JOHNSON, FRAN HOLMAN. 1990. "The Gift of the Wild Things": The Life of Caroline Dorman. The Center for Louisiana Studies, P.O. Box 40831. University of Southwestern Louisiana, Lafayette, LA 70504-0831. Hardbound, Price Unknown. 166 pp.

A biography of one of Louisiana's most prominent personalities is most welcome. Although I never met her, Dr. Lloyd Shinners knew her and talked about some of her botanical pursuits. I was not disappointed when I read it as I found a reference to Dr. Shinners and his comment regarding Caroline Dorman. Her life was a pioneering one, ahead of her time. For me, it was a review of the past issues that have now surfaced and are actively part of everyone's life. wfm

DUKE, JAMES A. 1989. Ginseng: A Concise Handbook. Reference Publications, Inc., 218 St. Clair River Drive, Box 344, Algonae, MI 48001. Hardbound $39.95. 273 pp.

This book is a must for anyone interested in ginseng. The text evaluates the past scientific studies in a non-technical style that is captivating reading. The topics covered in the chapters are taxonomy, history, Siberian ginseng: *Eleutherococcus*, carrots and ginseng, root booster, other herbal teas, chemistry, pharmacology, immunology, other pests, agroecology, economics, law and an appendix on population biology. The chapter on pathogens was contributed by Melodie Putnam. The title could just as easily have been "A Comprehensive Handbook." wfm

MORPHOLOGICAL CHARACTERS AS INDICATORS OF RUBBER CONTENT IN GUAYULE (*PARTHENIUM ARGENTATUM* — COMPOSITAE)

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ABSTRACT

Five distinct morphological groups were identified in a cultivated guayule stand at the Texas Agricultural Experiment Station Guayule Research Site near Fort Stockton, Texas. These groups were delineated according to growth habit, and leaf and inflorescence morphology. Mean rubber content was higher in Groups II, III, and V, which possessed more typical *Parthenium argentatum* morphological characters than in Groups I and IV. The latter groups are apparently products of the natural hybridization between guayule and mariola. Selection for superior rubber-yielding shrubs should be concentrated in Groups II, III, and V.

RESUMEN

Cinco diferentes grupos morfólogicos fueron identificados en un puesto de guayule cultivado en la Estacion del Estudioń de Guayule de la Estacioń Experimental de Agricultura de Texas. Estos grupos fueron delineados de acuerdo con lo alto y el diámetro del palio, características de la hoja, y la morfología del pedunclo. El alto contenido de hule ocurrió en los Grupos II, III, y V los cuales poseen el típico *Parthenium argentatum* de caractéres morfológicos. Los Grupos I y IV, productos de la hybridación natural entre el guayule y la mariola, producieron menos hule. La selección de arbustos que produscan hule superior deberá concentrarse en Grupos II, III, y V.

INTRODUCTION

The world supply of natural rubber comes from the tropical*Hevea brasiliensis* (Willd. ex A. Juss) Muell. Agr., and the United States imports almost one billion dollars worth annually from tropical Asia. Guayule (*Parthenium argentatum* Gray) is the most promising source of domestic rubber which can be successfully grown in the southwestern United States.

Guayule, a profusely branched shrub with small gray-green leaves, usually attains a height of 0.3 to 1 m (Correll and Johnston 1979). Native stands of this semidesert shrub occur in the Trans Pecos area of southwest Texas and northcentral Mexico at elevations of 700 to 2,000 m (Lloyd 1911). Guayule persists within a wide range of climatic tolerances where annual precipitation averages 25 to 38 cm and occurs primarily in late

Sida 14(3):331–338. 1991.

spring and early fall. Temperatures may vary from -23°C to 49°C (Foster and Moore 1987).

Lloyd (1911) described certain guayule biotypes growing in native stands in Mexico. Many of the plants had the mariola (*P. incanum* H.B.K.) growth form which is quite distinctive and easily identifiable. Rollins (1950) reported the existence of numerous biotypes of *P. argentatum* which differed widely in cultural characteristics, physiological behavior, and morphology. The differences were often traceable to the effects induced by interspecific hybridization between guayule and mariola.

Mehta et al. (1979) described different morphological forms of guayule collected from native guayule populations in Mexico. However, only three distinct types were delineated, and plant growth habit was not considered. Morphological and biochemical data indicated the presence of mariola genes in two groups, which correlated with an increase in leaf trichome length and a decrease in rubber content. The authors emphasized that high rubber-bearing plants in native stands could be selected by analyzing trichome morphology. Tipton and Gregg (1982) stated that since most native guayule was tetraploid and reproduced by facultative apomixis, seed collections based on leaf and inflorescence morphology should represent the germplasm originally selected.

The commercialization of guayule depends, in part, on the development of higher rubber-bearing shrubs through germplasm selection and plant breeding. Previous studies have yielded little definitive information on the interdependence of plant morphology and growth habit, and rubber content. The objectives of this research were to survey a 4 ha cultivated guayule stand established from seed collected from native Mexican populations and: (1) group the shrubs according to growth habit, and leaf and inflorescence morphology; (2) identify shrubs with rubber contents of at least 10%; and (3) determine if morphological characters were reliable indicators of rubber content.

MATERIALS AND METHODS

The study was conducted at the Texas Agricultural Experiment Station (TAES) Guayule Research Site located approximately 20 km west of Fort Stockton, Pecos County, Texas. The Firestone Tire and Rubber Company established about 80 ha of guayule in 1978, and leased it to TAES in 1983. Research was conducted in a 4 ha guayule stand established in 1981. The plants were grown in a greenhouse from seed collected at random in native guayule populations in Mexico, and transplanted into the field as eight-week-old seedlings. In addition to natural precipitation, the area received 13 cm of water annually by sprinkler irrigation.

Soil on the research area was a Delnorte very gravelly loam (loamy-skeletal, mixed, thermic family of shallow Typic Paleorthids) (Rives 1980). These are calcareous, light colored, very gravelly soils with indurated caliche within 50 cm of the surface.

The research area was surveyed in July 1986 and guayule shrubs were categorized into five distinct morphological groups based on growth habit, leaf shape and number of teeth, and branching of the peduncle. Fifty plants of each group were randomly selected and marked. Shrub height and two canopy diameter measurements were recorded. Ten leaves and peduncles were randomly collected from each plant, placed in a plant press, and returned to the laboratory. Terminology used in describing leaf characters follows Radford et al. (1974). The leaf shape and number of teeth on each margin, leaf length, and leaf width were recorded. Each peduncle was measured and the number of branches denoted.

In March 1987 and 1988, one branch from each shrub was harvested for resin and rubber analyses. The branches were air dried, defoliated and ground in a Fitzmill Comminutor with a 2.36 mm screen. Resin and rubber contents were determined according to the procedure outlined by Black et al. (1983).

Average plant height and canopy diameter, leaf length and width, and peduncle length are reported as the mean $\pm$ standard error. Resin and rubber values were analyzed by analysis of variance and the means were separated by Tukey's Studentized Range (HSD) Test ($\alpha = 0.05$).

RESULTS

Guayule plants in the five morphological groups varied considerably in growth habit (Fig. 1). The dense, intricately branched canopies of shrubs in Group I contained fine, tapered, smaller diameter stems similar to Group IV. Stems merged gradually into a peduncle, which branched two to three times. The branches were about the same length as the peduncle (Fig. 2). Leaves in Group I were smaller than other groups (Table 1). Leaf shape was usually oblanceolate to obovate, and the margins were coarsely toothed with two to four teeth (Fig. 2). Group I shrubs consistently produced lower rubber contents than Groups II, III, and IV (Table 2).

Group II shrubs were the tallest, reaching a mean height of 48 cm (Table 1). The canopies were open with minimal branching, and stem diameter was greater than in other groups. Unlike plants in Groups I and IV, there was an abrupt termination of the stem at the base of the peduncle. The naked peduncle generally branched once (rarely two times) with the branches extended beyond the peduncle (Fig. 2). Rubber content was significantly greater in Group II shrubs, and ranged from 7.2 to 13.1% in 1987 and from 6.2 to 12.0% in 1988.

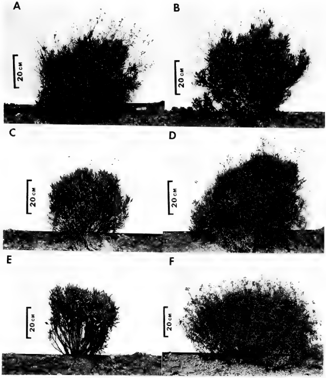

FIG. 1. Growth habit of guayule plants in (A) Group I, (B) Group II, (C) Group III, (D) Group IV, (E) GroupV, and (F) mariola.

Group III shrubs followed a low growth habit and resembled Group I in height and canopy diameter (Table 1). However, in Group III, the diverging system of larger branches resulted in a symmetrical, closely branched canopy, not the interwoven system as in Groups I and IV. Like Group II, the peduncle usually branched once (Fig. 2), the branch extended beyond the peduncle, and the distinction between stem and peduncle was abrupt. Leaves were intermediate in size compared to the other groups, and leaf shape and margin characteristics matched those in Groups II and V.

TABLE 1. Morphological characteristics of guayule shrubs within five morphological groups.

	Shrub		*Peduncle*		*Leaf*	
Group	*Height*	*Diameter*	*Length*	*Branches*	*Length*	*Width*
	(cm)		(cm)		(cm)	
I	39 ± 0.9[1]	54 ± 1.3	15.4 ± 0.1	2-3	3.5 ± 0.03	1.1 ± 0.01
II	48 ± 0.9	57 ± 1.2	14.0 ± 0.1	0-2	5.1 ± 0.04	1.2 ± 0.02
III	39 ± 0.8	52 ± 1.2	13.4 ± 0.1	0-1	4.5 ± 0.03	0.9 ± 0.01
IV	43 ± 0.7	64 ± 1.6	15.6 ± 0.1	2-3	4.5 ± 0.04	0.9 ± 0.01
V	46 ± 1.1	42 ± 1.2	14.8 ± 0.1	0-1	5.6 ± 0.04	1.0 ± 0.01

[1] Mean ± standard error.

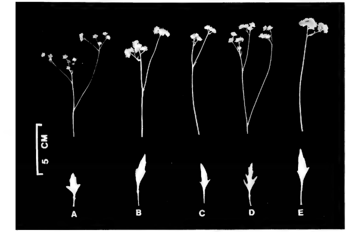

FIG. 2. Leaf and peduncle morphology in (A) Group I, (B) Group II, (C) Group III, (D) Group IV, and (E) Group V.

Canopy characteristics of Group IV shrubs were similar to Group I and included: (1) close, interwoven network of stems, (2) fine, tapered, small diameter stems, and (3) gradual transition of stem to peduncle. Leaf size was comparable to Group III; however, leaf shape was narrowly elliptic to elliptic (Table 1).

The growth habit and branching characteristics in Group V were similar to Group II (Fig. 1): plants were erect with an average height of 46 cm (Table 1); canopies were open with minimal branching; and stems terminated abruptly at the base of the peduncle. Corresponding to Groups II and III, the peduncle generally branched only once with the branch extending above the peduncle. Mean rubber content of Groups II, III, and V was significantly greater than Groups I and IV (Table 2).

DISCUSSION

Lloyd (1911) stated that the monopodial growth of the guayule seedling was terminated by the development of the first inflorescence and followed by the rapid growth of several of the uppermost branches. The growth of these branches was also ended by the formation of an inflorescence. Thus, a constantly divaricating system of stems was produced, which resulted in a symmetrical, closely branched shrub. Through the failure of some branches to develop, irregular forms were often observed and attained a greater height than the symmetrical plants. Groups II and V were readily discernable in the field, and included upright, erect shrubs with less rebranching than other groups. Plants in Group III were low-growing with the symmetrical, closely branched growth habit.

As guayule leaves mature, they are characterized by a single tooth located near the middle of one margin (Lloyd 1911). Subsequently, a tooth appears on each margin, and a second pair can develop about halfway between the original two and the apex. The guayule stem, unlike mariola, terminates abruptly at the base of the peduncle, and the peduncles generally branch only once near the tip. The morphology of Groups II, III, and V was similar to these typical *P. argentatum* characters: (1) one to two teeth on either leaf margin, (2) peduncle branching one or two times with the branch extending beyond the peduncle, and (3) stems terminating abruptly at the base of the peduncle.

TABLE 2. Average resin and rubber content of guayule shrubs within five morphological groups harvested in March 1987 and 1988.

	Resin Content				*Rubber Content*			
	1987		*1988*		*1987*		*1988*	
Group	*Mean*	*Range*	*Mean*	*Range*	*Mean*	*Range*	*Mean*	*Range*
	(%)				(%)			
I	8.0b[1]	5.9-10.4	7.9b	5.4-12.2	5.5c	3.6-8.5	4.5e	1.9-8.0
II	8.2ab	5.5-11.1	8.1b	5.3-10.8	10.5a	7.2-13.1	9.4a	6.2-12.0
III	6.2c	4.6-9.4	6.3c	4.9-9.3	8.8b	5.0-11.3	8.7b	4.6-12.0
IV	8.4a	7.2-9.8	8.8a	6.8-10.6	6.1c	4.1-8.1	6.0d	3.7-7.9
V	7.9b	4.6-9.8	8.1b	5.1-11.0	8.8b	4.2-12.9	7.6c	3.1-11.8

[1] Means within columns followed by the same letter are not significantly different ($\alpha = 0.05$).

Groups I and IV, with dense, profusely-branched canopies, exhibited the mariola manner of growth, and apparently resulted from the introgression between guayule and mariola. Mariola stems, like guayule, terminate in an inflorescence, but are more slender and support short branches or spurs which are more numerous (Lloyd 1911). This manner of growth results in a close interweaving of stems, in striking contrast to guayule. Leaf morphology in Groups I and IV was intermediate between that of guayule and mariola. Leaves were oblanceolate/obovate and narrowly elliptic/elliptic in shape, and not the lanceolate/ovate shape typified by Groups II, III, and V. Morphology of the peduncle in the two groups resembled that of mariola. The peduncles usually branched two to three times and the branches were about the same length as the peduncle.

Results of this study confirm that guayule plants with morphology similar to *P. argentatum* (Groups II, III, and V) produced the highest rubber content. Selection should be concentrated in these groups with rubber contents of over 10%. Shrubs with the erect growth habit consistently yielded the greatest rubber content among the five groups. Shrubs with leaf and inflorescence morphology and growth habit similar to mariola should be avoided when screening plants for high rubber-bearing potential.

ACKNOWLEDGEMENTS

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CLASSIFICATION AND SYSTEMATICS OF EASTERN NORTH AMERICAN *VITIS* L. (VITACEAE) NORTH OF MEXICO

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ABSTRACT

Eastern North American *Vitis*, north of Mexico, as circumscribed here consists of two subgenera: *Vitis* and *Muscadinia* (Planchon) Rehder. Subgenus *Muscadinia* consists of a single species with two varieties. Subgenus *Vitis* is further divided into five series. Series *Aestivales* and *Cinerescentes* both consist of a single species, the former with three varieties and the latter with four varieties. Series *Cordifoliae*, *Labruscae* and *Ripariae* each contain three species. Three taxa previously recognized as species are regarded as hybrids: *V.* × *champinii*, *V.* × *doaniana*, *V.* × *novae-angliae*. Keys, descriptions, synonomies and typifications are included.

INTRODUCTION

The genus *Vitis* in North America has long been considered difficult from a systematic standpoint and has been largely ignored by North American systematists since the 1930's. The major classifications of North American *Vitis* (Planchon 1887, Munson 1909, Bailey 1934) are discordant in defining species and subgeneric groupings (Barrett et al. 1969), with the latter two treatments being the most widely accepted (Comeaux 1984). Galet (1967) proposed a monograph of the worldwide genus, but his treatment of the North American species is a compilation of the taxa listed by Munson and Bailey with a few minor revisions. The subgeneric groupings proposed by Galet sharply contrast with those proposed by Munson (1909) and Bailey (1934). Indeed, several authors have stated a need for a thorough taxonomic and nomenclatural revision of North American *Vitis* (Brizicky 1965, Radford et al. 1968, McGregor 1986).

Comeaux (1984) represents the most recent classification of North American *Vitis* and is based on Munson's (1909) treatment. However, Comeaux (1984) studied in detail only those taxa native to North Carolina, with the remainder of his classification being derived from a general review of previous literature. Comeaux's (1984) classification was also never published, but rather a different classification was followed by Comeaux et al. in 1987. Several other recent studies have also provided information of im-

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port to the systematics of North American *Vitis*, either through the use of experimental studies or as taxonomic treatments of portions of the genus (Barrett et al. 1969, Comeaux 1987a, 1987b, Duncan 1975, Matthews 1960, Moore 1985, 1987, 1988, 1989, Moore and Giannasi 1987). Thus, renewed interest in *Vitis* systematics has resulted in a foundation upon which a modern classification of North American *Vitis* can be structured.

The classification presented here is the result of a revisionary study that employed phenetic analyses of both morphological and foliar flavonoid data as well as extensive field work (Moore 1990). This study, however, excludes the members of series *Occidentales* Munson sensu Munson (1909) and Comeaux (1984) (distributed largely west of the Rocky Mountains) as well as four Mexican and South American members of series *Cinerescentes* and one Mexican member of subgenus *Muscadinia* (sensu Comeaux 1984). The proposed classification is in general agreement with Comeaux's (1984) treatment, but several nomenclatural changes are proposed.

MATERIALS AND METHODS

Herbarium specimens were borrowed from ALU, AUA, BH, BM, C, CM, CU, F, FLAS, FSU, GH, IND, KY, MICH, MINN, MO, MOR, NA, NCU, NHA, NLU, NO, NY, OKL, OKLA, OS, PH, SA, SMU, SRSC, TENN, TEX, TTC, UARK, UNA, UNM, US, USF, VDB, VT, WIS, WVA (acronyms according to Holmgren et al. 1981). All taxa were observed and collected in the field during various trips from 1984 – 1989. These specimens, along with those housed at GA, were studied during the course of research.

The method by which nodal diaphragm measurements were taken in this study is necessary of brief discussion. In several previous treatments of the genus (e.g., Steyermark 1963; Duncan 1975), the width of nodal diaphragms was used to discriminate between taxa. However, in many such treatments, no indication is given concerning the age of wood from which diaphragm measurements were taken. In wood one year old or older, the nodal diaphragms are frequently wider than in sections made from the current years growth. In this present study, all diaphragm measurements were made from current years growth. Also, measurements were made using a dissecting microscope equipped with an ocular micrometer.

In using the following keys to assist in the identification of the native grapes, emphasis must be placed on the use of combinations of characters, as a single character is frequently insufficient. The morphological variation in the native grapes is considerable, but when several characters are considered, correct identifications can be achieved with little difficulty.

VITIS L. Sp. Pl. 2:230. 1753. — LECTOTYPE: *V. vinifera* L., LINN (as IDC microfiche!).

Deciduous woody vines or viny shrubs climbing by tendrils. Bark exfoliating in strips, lenticels inconspicuous or absent (subgenus *Vitis*) or adherent with prominent lenticels (subgenus *Muscadinia*). Pith brown, interrupted by nodal diaphragms (subgenus *Vitis*) or continuous through nodes (subgenus *Muscadinia*). Tendrils bifid to trifid (subgenus *Vitis*) or unbranched (subgenus *Muscadinia*), present opposite only two consecutive nodes or at three to many consecutive nodes (*V. labrusca*, *V.* × *novae-angliae*). Branchlets of the season terete to angled, glabrous to densely pubescent. Leaves petiolate, blades simple, lobed or unlobed, palmately veined, cordate to orbicular or reniform, toothed to merely scalloped, often mucronate, bases cordate to less often truncate, glabrous to sparsely or densely pubescent beneath, glabrous to slightly pubescent above. Stipules caducous, 0.5 − 7 mm long, promptly deciduous. Growing tips glabrous to densely pubescent. Inflorescence thyrsoid-paniculate, present opposite only two consecutive nodes or at three to many consecutive nodes (*V. labrusca*, *V.* × *novae-angliae*). Flowers pedicellate, functionally unisexual; plants polygamodioecious. Calyx minute, fused into a collar at the base of the flower, essentially absent. Corolla of 5 (3 − 9) apically united petals, 1 − 3 mm long, separating basally at anthesis and falling from the plant as a unit. Stamens 5 (3 − 9), filaments erect in staminate flowers, 2 − 7 mm long, reflexed to less commonly absent in pistillate flowers; anthers dorsifixed, valvate, introrse, ca. 0.5 mm long. Nectariferous intrastaminal disc of five more or less separate glands alternating with the stamens. Pistil 1, 0.5 − 2 mm long, ovary 2 (3 − 4)-locular, each locule with two ovules; style very short; stigma capitate. Fruit a pulpy 1 − 4 seeded berry. Seeds obovoid to pyriform, 3 − 8 mm long, the ventral surface with two longitudinal grooves on either side of the attached funiculus (raphe), the dorsal surface with a groove running its length, becoming wider toward the center, forming a circular structure (chalaza) that is either sunken or raised.

Considered in this treatment are 12 species and 9 varieties, distributed throughout the United States and Canada, largely east of the Rocky Mountains. Three hybrid taxa are also found in eastern North America.

KEY TO THE SUBGENERA AND SERIES

1. Tendrils simple; bark adherent with prominent lenticels; pith continuous through nodes . . . . Subgenus *Muscadinia*
1. Tendrils bifid to trifid; bark shedding, the lenticels inconspicuous; pith interrupted by diaphragms at nodes . . . . 2 (Subgenus *Vitis*)

2. Leaves glaucous beneath; nodes often glaucous . . . . Series *Aestivales*
2. Leaves not glaucous beneath; nodes not glaucous 3
   3. Branchlets of the season angled, pubescent with arachnoid or hirtellous trichomes, or both, varying to glabrate; mature 3 or 4 seeded berries less than 8 mm in diameter; nodes frequently banded with red pigmentation . . . . Series *Cinerescentes*
   3. Branchlets of the season more or less terete, glabrous or pubescent; mature 3 or 4 seeded berries usually greater than 8 mm in diameter; nodes usually not banded with red pigmentation 4
      4. Leaves heavily arachnoid pubescent beneath, concealing the leaf undersurface but not always the veins; mature fruits greater than 12 mm in diameter . . . . Series *Labruscae*
      4. Leaves glabrous to slightly arachnoid pubescent beneath, not concealing the intervein area of the underleaf surface; mature berries less than 12 mm in diameter 5
         5. Growing tips more or less enveloped by enlarging, unfolding leaves; stipules large, usually greater than 3 mm long; nodal diaphragms usually less than 1 mm in diameter . . . . . . Series *Ripariae*
         5. Growing tips not enveloped by enlarging, unfolding leaves; stipules small, usually less than 3 mm long; nodal diaphragms usually greater than 1 mm in diameter . . Series *Cordifoliae*

ARTIFICIAL KEY TO SPECIES AND HYBRIDS

1. Tendrils simple; bark adherent with prominent lenticels; pith continuous through nodes . . . . *V. rotundifolia*
1. Tendrils bifid to trifid; bark shredding, the lenticels inconspicuous; pith interrupted by nodal diaphragms 2
   2. Mature leaves glaucous beneath; nodes often glaucous . . . . *V. aestivalis*
   2. Mature leaves not glaucous beneath; nodes not glaucous 3
      3. Tendrils or inflorescences present at three to many consecutive nodes 4
         4. Leaves densely pubescent beneath, concealing the leaf undersurface but not always the veins; nodal diaphragms usually greater than 1 mm in diameter . . . . *V. labrusca*
         4. Leaves slightly to moderately pubescent beneath, the leaf undersurface visible on mature leaves; nodal diaphragms usually less than 1 mm in diameter . . . . *V.* × *novae-angliae*
      3. Tendrils or inflorescences present at only two consecutive nodes 5
         5. Leaves densely pubescent beneath, concealing the leaf undersurfaces but not always the veins; fruits greater than 12 mm in diameter 6
            6. Stipules greater than 1 mm long; leaves frequently concavely folded . . . . *V. mustangensis*
            6. Stipules less than 1 mm long; leaves not concavely folded . . . . *V. shuttleworthii*
         5. Leaves glabrous to moderately pubescent beneath, the intervein area of leaf undersurfaces visible on mature leaves; fruits less or greater than 12 mm in diameter 7

7. Leaves reniform, glabrous beneath at maturity; tendrils absent or present only opposite the uppermost nodes ..... *V. rupestris*
7. Leaves cordate to cordate ovate, glabrous to pubescent beneath at maturity, tendrils present opposite most nodes 8
    8. Nodal diaphragms less than 1 mm wide, usually less than 0.5 mm wide; growing tips enveloped by enlarging, unfolding leaves 9
        9. Growing tips slightly to densely pubescent; branchlets of the season slightly to densely arachnoid pubescent; inflorescences usually less than 8 cm long .... *V. acerifolia*
        9. Growing tips glabrous to slightly pubescent; branchlets of the season usually lacking arachnoid pubescence; inflorescences usually greater than 8 cm long .... *V. riparia*
    8. Nodal diaphragms greater than 1 mm wide; growing tips not enveloped by enlarging, unfolding leaves 10
        10. Branchlets of the season angled, arachnoid and/or hirtellous pubescent, varying to glabrate; mature 3 or 4 seeded berries less than 8 mm in diameter; nodes frequently banded with red pigmentation .... *V. cinerea*
        10. Branchlets of the season more or less terete, glabrous or arachnoid pubescent; mature 3 or 4 seeded berries usually greater than 8 mm in diameter; nodes usually not banded with red pigmentation 11
            11. Mature 3 or 4 seeded berries greater than 12 mm in diameter; leaves arachnoid pubescent beneath 12
                12. Leaves moderately to heavily arachnoid pubescent beneath, also with hirtellous trichomes along the veins; fruits glaucous .... *V. × doaniana*
                12. Leaves only slightly arachnoid pubescent beneath and lacking hirtellous trichomes; fruits not glaucous .... *V. × champinii*
            11. Mature 3 or 4 seeded berries less than 12 mm in diameter; leaves usually lacking arachnoid pubescence beneath 13
                13. Nodal diaphragms greater than 2.5 mm wide; leaf apices usually long acuminate; branchlets of the season with a purplish red cast .... *V. palmata*
                13. Nodal diaphragms less than 2.5 mm wide; leaf apices usually acute to short acuminate; branchlets of the season gray to green or brown or with purplish pigmentation only on one side of the branchlet 14
                    14. Berries usually with lenticels; infructescences with less than 12 berries; growing tips slightly to densely pubescent; leaf blades usually less than 8 cm

long; branchlets of the season usually slightly arachnoid pubescent . . . . *V. monticola*

14. Berries without lenticels; infructescences with more than 12 berries; growing tips glabrous to slightly pubescent; leaf blades usually greater than 9 cm long; branchlets of the season glabrous . . . . *V. vulpina*

Subgenus **MUSCADINIA** (Planchon) Rehder, Man. Cult. Trees 601. 1927. Section *Muscadinia* Planchon, DC Monogr. Phan. 5:323. 1887. Genus *Muscadinia* (Planchon) Small, Fl. SE U.S. 756. 1903. — Type species: *V. rotundifolia* Michaux.

Vitis rotundifolia Michaux, Fl. Bor.-Amer. 2:231. 1803.

High climbing vine, branchlets of the season terete to slightly angled. Bark of younger woody stems with evident lenticels, that of older stems tight, not exfoliating, that of still older stems exfoliating in plates, pith brown, continuous through nodes, diaphragm absent. Tendrils unbranched, a tendril or inflorescence present at only 2 consecutive nodes, nodes not glaucous, but often banded with red pigmentation. Very young, rapidly growing stems and leaf surfaces usually with thin, loose, grayish arachnoid pubescence or with dense, rusty, arachnoid pubescence at the nodes of the stems and pinkish on leaf surfaces, the pubescence eventually deciduous. Leaves with petioles mostly as long as the blades, glabrous to glabrate; blades cordiform to nearly reniform, very rarely lobed; margins crenate to dentate, apices very short acuminate; upper surface of mature leaves glabrous and lustrous, lower surface not glaucous, but glabrous or pubescent with few to many hirtellous trichomes along the veins and in their axils; stipules $1-2$ mm long. Panicles $3-8$ cm long, rarely longer, usually more or less globose in outline, infructescences with less than 25 berries (or pedicels); 3 or 4 seeded berries $8-25$ mm in diameter, generally black or purplish, occasionally bronze when ripe, glaucescent, with tan, circular lenticels present on the skin. Seeds brown, oval to ellipsoidal, $5-8$ mm long.

Inhabiting a very wide variety of sites, both upland and well drained and lowland and poorly drained, including intermittently flooded bottomlands. (DE to KY, s IN, MO, generally southward to FL, e OK and e TX). Flowering in late April to May; fruit ripening in late July to September.

The two varieties of this species can be distinguished morphologically based on the following key:

1. Mature fruits greater than 12 mm in diameter; infructescences usually with less than 12 berries; leaf blades usually more than 5 cm in length . . . . *V. rotundifolia* var. *rotundifolia*

1. Mature fruits less than 12 mm in diameter; infructescences with more than 12 berries; leaf blades often less than 5 cm long . . . . . *V. rotundifolia* var. *munsoniana*

VITIS ROTUNDIFOLIA Michaux var. ROTUNDIFOLIA. *V. muscadinia* Raf., Amer. Man. Grape Vines 16–17. 1830. *Muscadinia rotundifolia* (Michaux) Small, Fl. SE U.S. 757. 1903. — TYPE: a Virginia ad Floridum (LECTOTYPE, here designated: microfiche IDC Michaux, no. 122, photo 20! P). — SYNTYPE: microfiche IDC Michaux, no. 123, photo 1! (P).

Leaves generally larger than in variety *munsoniana*, fruits greater than 12 mm in diameter and infructescences with less than 12 berries. Inhabiting a wide variety of sites, both upland and well drained and lowland and poorly drained. (DE to KY, s IN, MO, generally southward to FL, e OK and e TX). Flowering in late April to May, fruit ripening in late July to September.

Representative specimens examined: ARKANSAS. Hempstead Co.: *Palmer 6839* (GH). GEORGIA. Brooks Co.: *Moore 790* (GA); Clarke Co.: *Moore 1011* (GA). FLORIDA. Franklin Co.: *Moore 814* (GA); Gilchrist Co.: *Moore 407* (GA); Jackson Co.: *Knight 675* (FSU). NORTH CAROLINA. Davie Co.: *Moore 249* (GA). OKLAHOMA. LeFlore Co.: *Palmer 20589* (GH). SOUTH CAROLINA. Berkeley Co.: *Wiegand & Manning 1955* (GH). TEXAS. Newton Co.: *Lundell 11870* (TX).

VITIS ROTUNDIFOLIA Michaux var. MUNSONIANA (Simpson ex Munson) M.O. Moore, comb. nov. — BASIONYM: *V. munsoniana* Simpson ex Munson, Proc. Soc. Promot. Agric. Sci. 8:59. 1887. *Muscadinia munsoniana* (Simpson ex Munson) Small, Fl. SE U.S. 757. 1903. — TYPE. FLORIDA. MANATEE CO.: collected along Manatee River, 1883, 1885, 1887, *J.H. Simpson*, cultivated Munson vineyard, Denison, Texas 1890 (LECTOTYPE, here designated: PH!). — SYNTYPE: (PH!).

Similar to var. *rotundifolia*, but usually with smaller leaves, fruits less than 12 mm in diameter and infructescences with more than 12 berries. Inhabiting a wide variety of sites, but usually found on drier soils. (FL, s GA, s AL). Flowers and fruits virtually all year in peninsular Florida, but in more northern locations flowering in late April to May; fruit ripening late July to September.

Representative specimens examined: FLORIDA. Collier Co.: *Moore 764* (GA); *Moore 759* (GA). Duval Co.: *Curtis 4818* (US). Franklin Co.: *Moore 815* (GA). Highlands Co.: *Skean 2144* (GA). Lake Co.: *Moore 401* (GA); *Judd 2453B* (FLAS). Monroe Co.: *Bailey 314* (BH); *Moore 769* (GA). Putnam Co.: *Moore 746* (GA).

Subgenus VITIS, Series AESTIVALES Planchon, in DC Monogr. Phan. 5:323. 1887. — TYPE SPECIES: *V. aestivalis* Michaux.

VITIS AESTIVALIS Michaux, Fl. Bor.-Amer. 2:230. 1803.

High climbing vine, branchlets of the season terete, tomentose, arachnoid floccose or glabrous. Bark exfoliating in shreds on mature stems, lenticels absent or inconspicuous, pith brown, interrupted by diaphragms at the nodes, diaphragms $1-4$ mm thick. Tendrils bifurcate, a tendril or inflorescence present at only 2 consecutive nodes, nodes glaucous or not glaucous, not banded with red pigmentation. Leaves with petioles about as long as the blades, glabrate to pubescent; blades cordiform to orbicular, unlobed to 3-shouldered or $3-5$ lobed, often deeply so, when lobed the lobes mostly acute, the sinuses rounded to acute; margins crenate to dentate; upper surface of mature leaves glabrous to puberulent, lower surface glaucous with varying degrees of arachnoid, floccose pubescence, when heavy the glaucescence somewhat obscured, the pubescence whitish to more commonly rusty, hirtellous trichomes also occasionally present along the veins and as tufts in the vein axils; stipules $1-4$ mm long. Panicles $7-20$ cm long, usually narrowly triangular in outline, infructescences usually with more than 25 berries (or pedicels); 3 or 4 seeded berries $8-20$ mm in diameter, black, glaucous, without lenticels. Seeds tan to brown, pyriform, $3-8$ mm long.

Generally found on well drained sites, woodlands of various mixtures, woodland borders, thickets, fence and hedge rows, scrub, stabilized dunes, less often along stream or river banks, rarely in floodplains or lowland woods. (Throughout eastern North America and southern Canada). Flowering in April to June; fruit ripening in July to September.

This species is frequently confused with *V. cinerea*. However, the glaucous leaf undersurfaces, more heavily glaucous, larger berries, terete less evenly pubescent branchlets, preference for well drained, drier habitats and earlier blooming period distinguishes *V. aestivalis* from *V. cinerea*.

The three varieties of this species can be distinguished morphologically based on the following key:

1. Branchlets of the season heavily arachnoid pubescent; mature 3 or 4 seeded berries usually greater than 14 mm in diameter; stipules usually less than 1.5 mm long . . . . *V. aestivalis* var. *lincecumii*
1. Branchlets of the season slightly to moderately arachnoid pubescent, or glabrous; mature 3 or 4 seeded berries usually less than 14 mm in diameter; stipules usually greater than 1.5 mm long 2
   2. Mature 3 or 4 seeded berries less than 9 mm in diameter; mature leaves glabrous to glabrate beneath; nodes usually glaucous; nodal diaphragms usually less than 2 mm in diameter . . . . *V. aestivalis* var. *bicolor*
   2. Mature 3 or 4 seeded berries greater than 9 mm in diameter; mature leaves slightly to heavily arachnoid pubescent beneath; nodes usually not glaucous; nodal diaphragms usually greater than 2 mm in diameter . . . . *V. aestivalis* var. *aestivalis*

Vitis aestivalis Michaux var. **aestivalis**. *V. labrusca* var. *aestivalis* (Michaux) Regel, Act. Hort. Petrop. 2:396. 1873. *V. vinifera* var. *aestivalis* (Michaux) Kunze, Rev. Gen. Pl. 1:132. 1891. — Type: in sylvestris, a Pensylvania ad Carolinum (Lectotype, here designated: microfiche IDC Michaux, no. 122, photo 17! P). — Syntype: microfiche IDC Michaux, no. 122, photo 18! (P).

V. aestivalis var. *sinuata* Pursh, Fl. Amer. Sept. 1:169. 1814. *V. sinuata* (Pursh) G. Don, Gen. Hist. 1:711. 1831. — Syntypes: not seen.

V. araneosus LeConte, Proc. Acad. Nat. Sci. Philadelphia 6:272. 1853. — Type: GEORGIA. On the banks of the Oconee at Athens, 14 Sep 1850, *John LeConte s.n.* (lectotype, here designated: PH!; isolectotype: PH!). Syntypes: (PH!).

V. lincecumii Buckley var. *glauca* Munson, U.S.D.A. Div. Pomol. Bull. No. 3: 7, 12. 1890. *V. lincecumii* var. *lactea* Small, Fl. SE U.S. 755, 1334. 1903. — Type: TEXAS. North Texas, 26 May 1890, *Munson s.n.* (holotype: PH!).

V. simpsonii Munson, U.S.D.A. Div. Pomol. Bull. No. 3:12. 1890, non 1887, *nom. illeg. V. smalliana* Bailey, Gentes Herb. 3:207 – 209. 1934. *V. aestivalis* ssp. *smalliana* (Bailey) Rogers, Proc. Florida State Hort. Soc. 92:289. 1979, *nom. illeg. V. aestivalis* var. *smalliana* (Bailey) Comeaux, Sida 12:286. 1987. — Type: FLORIDA. Manatee Co.: collected originally from Manatee County, n.d., *J.H. Simpson s.n.* cultivated Denison, Texas, 25 May 1890 (lectotype, here designated: PH!; isolectotypes: MO!).

V. rufotomentosa Small, Fl. SE U.S. 756, 1334. 1903. — Type: FLORIDA. Lake Co.: vicinity of Lake Eustis, 16 – 30 Apr 1894, *Nash 525* (holotype: NY!; isotypes: US!, PH!).

V. gigas Fennel, J. Wash. Acad. Sci. 30:15 – 19. 1940. – Type: FLORIDA. Sebastian River, 20 Jul 1938, *J.L. Fennel 713* (holotype: US!; 2 sheets, 1 of fruiting branch, 1 of growing tip).

Leaf undersurfaces with varying degrees of arachnoid pubescence, moderately to somewhat heavily glaucous, nodes usually not glaucous, nodal diaphragms usually greater than 2 mm wide, mature 3 or 4 seeded berries 9 – 14 mm in diameter. Found in well drained sites, woodlands, woodland borders, thickets, fence and hedge rows, scrub, stabilized dunes, less often along stream or river banks and floodplains and lowland woods. (Piedmont, Coastal Plain, Mountains, Interior Low Plateau, Central Lowlands, coastal MA to se IA, MO, e OK, e TX to FL). Flowering in April to June, fruit ripening in July to September.

Representative specimens examined: FLORIDA. Hamilton Co.: *Moore 379* (GA). Hampton Co.: *Moore 360* (GA). Wakulla Co.: *Moore 403* (GA). GEORGIA. Decatur Co.: *Moore 805* (GA). Montgomery Co.: *Moore 346* (GA). INDIANA. Martin Co.: *Moore 1056* (GA). MISSOURI. Howell Co.: *Moore 1027* (GA). TENNESSEE. Carter Co.: *Moore 250* (GA). TEXAS. Rusk Co.: *Moore 930* (GA). VIRGINIA. Nelson Co.: *Moore 834* (GA).

Vitis aestivalis Michaux var. **bicolor** Deam, Shrubs Indiana 207. 1924. *V. argentifolia* Munson, Proc. Soc. Promot. Agric. Sci. 8:59. 1887. *V. aestivalis* var. *argentifolia* (Munson) Fernald, Rhodora 38:428. 1936. — Neotype, here designated: WEST VIRGINIA. Nicholas Co.: W side of US 19, 1.7 mi S of the

Braxton Co. line, 12.3 mi N of jct. with WV 55, 25 Aug 1987, *Michael O. Moore 886* (GA!). — SYNTYPES: not found.

Similar to var. *aestivalis*, but with leaf undersurfaces glabrous to glabrate and heavily glaucous beneath, nodes usually glaucous, nodal diaphragms only 1 − 2 mm wide, mature 3 or 4 seeded berries 8 − 9 mm in diameter.

Inhabiting a wide variety of well drained sites, woodlands of various mixtures, woodland borders, thickets, fence and hedge rows and scrub. (Blue Ridge, Ridge and Valley, Appalachian Plateau, n GA and n AL generally north to Canada). Flowering in late May to June; fruit ripening in July to September.

Previously known as *V. aestivalis* var. *argentifolia*, Fernald (1936), stated that the name var. *bicolor* cannot be used because this taxon is not the *V. bicolor* of LeConte and because var. *bicolor* was never published. However, Deam (1924) did treat this taxon as *V. aestivalis* var. *bicolor*, attributing the combination to Britton and Brown. Britton and Brown never made this combination, but rather listed *V. bicolor* in synonymy under *V. aestivalis*. LeConte's *V. bicolor* is a dubious name that cannot be associated with any currently recognized taxon. Deam (1924) did give a good description of this taxon including characters that distinguish it from *V. aestivalis* var. *aestivalis* and thus did feel that it should be treated as a variety of *V. aestivalis*. It can thus be concluded that Deam's use of the name *V. aestivalis* var. *bicolor* is a valid publication which has priority over Fernald's (1936) name *V. aestivalis* var. *argentifolia*.

Representative specimens examined: CONNECTICUT. Hartford Co.: *Moore 851* (GA). GEORGIA. Rabun Co.: *Owen 201* (AUA). ILLINOIS. Tazwell Co.: *Chase 3467* (MIN). KENTUCKY. Bell Co.: *McFarland 3619* (BH). NORTH CAROLINA. Avery Co. *Moore 254* (GA). OHIO. Ashtabula Co.: *Tandy 1741* (OS). PENNSYLVANIA. Northampton Co.: *Adams 4128* (GH). VIRGINIA. Patrick Co.: *Moore 232* (GA). WEST VIRGINIA. Nicholas Co.: *Moore 886* (GA). WISCONSIN. Columbia Co.: *Allen s.n.* (MIN).

VITIS AESTIVALIS var. LINCECUMII (Buckley) Munson, Proc. Amer. Pomol. Soc. 20:97. 1886. *V. lincecumii* Buckley, Proc. Acad. Nat. Sci. Philadelphia 62: 451. 1861. — TYPE: TEXAS. Eastern Texas, 1861, *S.B. Buckley s.n.* (HOLOTYPE: US!).

Similar to var. *aestivalis*, but with branchlets of the season more or less densely tomentose, nodal diaphragms generally less than 2 mm wide, leaves more frequently deeply 3 to 5 lobed, berries that are generally larger than 14 mm in diameter and are heavily glaucous, and larger seeds, 7 − 8 mm. *Vitis aestivalis* var. *lincecumii* also has an earlier time of anthesis than var. *aestivalis* and is more drought resistant.

Inhabiting well drained sites, woodlands of various mixtures, woodland borders, thickets, fence and hedge rows and scrub. (TX, east of the Trinity

River, c TX east of Austin, w LA). Flowering in April, fruit ripening June to September.

In the original publication of this name (Buckley 1861), the specific epithet was spelled "*linsecomii*", but the holotype has the name spelled "*lincecumii*" in Buckley's handwriting. Munson (1909) determined that this taxon was named after Dr. Gideon Lincecum, and speculated that the spelling "*linsecomii*" probably came through as an error of the typesetter. Thus, in accordance with article 73.1 of the International Code of Botanical Nomenclature, the spelling of this name should be corrected to "*lincecumii*."

Representative specimens examined: LOUISIANA. Bienville Parish. *Moore 664* (GA). TEXAS. Cherokee Co.: *Moore 931* (GA). Henderson Co.: *Lundell & Lundell 9569* (SMU). Leon Co.: *Moore 936* (GA). Milam Co.: *Moore 680* (GA). Morris Co.: *Correll & Correll 12445* (SMU); *Correll & Correll 25469* (NY). Rusk Co.: *Cory 56465* (SMU). Smith Co.: *Shinners 15094* (SMU). Wood Co.: *Holmes 3917* (NLU).

Subgenus **VITIS**, Series **CINERESCENTES** Planchon, in DC Monogr. Phan. 5:323. 1887. — Type species: *V. cinerea* (Engelm. in Gray) Engelm. ex Millardet.

Vitis cinerea (Engelm. in Gray) Engelm. ex Millardet, Mem. Soc. Sci. Phys. Nat. Bordeaux 2(3):319 – 330. 1880.

High climbing vine in floodplains and lowland woods, along stream banks, pond margins and fence rows. Branchlets slightly to distinctly angled (the angling often difficult to see with the unaided eye), branchlets of the season covered with dense, short, straight (hirtellous) trichomes and/or thin to dense arachnoid pubescence, varying to glabrate. Bark exfoliating in shreds on mature stems, lenticels absent or inconspicuous, pith brown, interrupted by diaphragms at nodes, diaphragms 1.5 to 3.5 mm thick. Tendrils bifurcate to trifurcate, a tendril or inflorescence present at only 2 consecutive nodes, nodes of branchlets of the season often banded with red pigmentation, nodes not glaucous. Leaves with petioles about as long as the blades, puberulent to pubescent with hirtellous trichomes, thin arachnoid pubescence commonly present as well; blades cordiform, unlobed to 3-shouldered, occasionally 3-lobed, the apex acute to more commonly acuminate; margins crenate to dentate; upper surface of mature leaves glabrous to pubescent, lower surface not glaucous, slightly to moderately arachnoid pubescent, varying to glabrous, the pubescence mostly whitish; hirtellous trichomes also commonly present along the veins and as small tufts in the vein axils; stipules 1 – 3 mm long. Panicles 10 – 25 cm long, usually broadly triangular in outline, infructescences usually with more than 25 berries (or pedicels); 3 or 4 seeded berries 4 – 8 mm in diameter, black, with little or no glaucescence, lenticels absent. Seeds brown, obovoid, $2-4$ mm long.

Usually found in moist habitats. (s IN to s PA, south to FL, west to TX, north to OK, KN, MO and IL). Flowering in late May to June; fruit ripening in July to October. This species is frequently confused with *V. aestivalis*. See the discussion provided under *V. aestivalis*.

In recent treatments of the genus (e.g., Radford *et al.* 1968; Godfrey and Wooten 1981), the author citation for *V. cinerea* is given as Engelm. ex Millardet. Still other treatments (e.g., Steyermark 1963; McGregor 1986) cite only Engelm. as the author citation. Gandhi and Brown (1989), however, use the following: *V. cinerea* (Engelm.) Engelm. ex Millardet and discuss the reasoning for their citation of authorship. Since this taxon was first published as a variety of *V. aestivalis* in Gray's Manual (1867), with the name being attributed to and the description provided by Engelmann, it is clear that the initial citation should be *V. aestivalis* var. *cinerea* Engelm. in Gray. Millardet was the first to elevate this taxon to the species level, also attributing the name to Engelmann but providing a description not given by Engelmann. Thus, the correct citation is clearly *V. cinerea* (Engelm. in Gray) Engelm. ex Millardet. To eliminate Gray's name from the author citation also eliminates the author of the original publication in which the name appeared from the citation, making it quite difficult to trace the nomenclatural history of this taxon.

The four varieties of this species can be distinguished morphologically based on the following key:

1. Berries moderately to heavily glaucous; leaf blades glabrous to glabrate, usually less than 10 cm long; central Texas . . . . *V. cinerea* var. *helleri*
1. Berries only slightly to not glaucous; leaf blades pubescent, varying to glabrate, usually more than 10 cm long; e Texas east and northward 2
   2. Branchlets of the season sparsely to densely hirtellous pubescent, often with arachnoid pubescence as well; leaf undersurfaces usually more or less uniformly hirtellous pubescent on veins . . . . *V. cinerea* var. *cinerea*
   2. Branchlets of the season without evident hirtellous trichomes (if present, then concealed by arachnoid pubescence); leaf undersurfaces usually without hirtellous trichomes, or, when present, only very sparsely so 3
      3. Branchlets slightly to densely arachnoid pubescent; nodes usually not banded with red pigmentation; leaves slightly to densely arachnoid pubescent beneath; Coastal Plain . . . . *V. cinerea* var. *floridana*
      3. Branchlets glabrate to only slightly arachnoid pubescent; nodes usually banded with red pigmentation; leaves glabrous to very slightly arachnoid pubescent beneath; Piedmont and Mountains . . . . *V. cinerea* var. *baileyana*

VITIS CINEREA (Engelm. in Gray) Engelm. ex Millardet var. CINEREA. *V. aestivalis* var. *cinerea* Engelm. in Gray, Manual ed. 5:676. 1867. — TYPE: ILLINOIS. The Engelmann farm, Sep 1867, *G. Engelmann s.n.* (LECTOTYPE, here designated: MO!; ISOLECTOTYPE: MO!). — SYNTYPE: (MO!).

V. cinerea var. *canescens* (Engelm.) Bailey ex Gray, Syn. Fl. N. Amer. 1(2):425. 1897. *V. aestivalis* var. *canescens* Engelm., Amer. Naturalist 2:321. 1869. — TYPE: Mississippi Valley (HOLOTYPE: GH!).

Branchlets of the season covered with short, straight hirtellous trichomes, occasionally with arachnoid trichomes as well. Leaf undersurfaces are moderately arachnoid and/or hirtellous pubescent. Inhabiting floodplains, lowland woods, ponds and stream margins. Native to the rich bottomlands of the Mississippi basin. (s IA, s IL, s IN south to e KN, e OK, e TX east to a few scattered localities in AL and panhandle FL). Flowering in late May to June, fruit ripening in July to October.

Representative specimens examined: ALABAMA. Lowndes Co.: *Moore 734* (GA). ARKANSAS. Ashley Co.: *Moore 349* (GA). Marion Co.: *Moore 300* (GA). ILLINOIS. Richland Co.: *Moore 1053* (GA); Schuyler Co.: *Moore 1047* (GA). KENTUCKY. Hickman Co.: *Moore 284* (GA). LOUISIANA. Bossier Parish. *Moore 335* (GA). MISSISSIPPI. Lowndes Co.: *Moore 344* (GA). OKLAHOMA. Pottawatomie Co.: *Moore 982* (GA). TENNESSEE. Lake Co.: *Moore 278* (GA).

VITIS CINEREA (Engelm. in Gray) Engelm. ex Millardet var. FLORIDANA Munson, U.S.D.A. Div. Pomol. Bull. No. 3:12. 1890. *V. simpsonii* Munson, Proc. Soc. Promot. Agric. Sci. 8:59. 1887. *V. austrina* Small, Fl. SE U.S. 755. 1903. — TYPE: FLORIDA. MANATEE CO.: originally from Manatee River, *J.H. Simpson s.n.*, cultivated in vineyard of T.V. Munson, 1890 (LECTOTYPE, here designated: MO!; ISOLECTOTYPE: MO!). — SYNTYPES: (BH!, PH!).

V. sola Bailey, Gentes Herb. 3:203. 1934. *V. aestivalis* ssp. *sola* (Bailey) Rogers, Proc. Florida State Hort. Soc. 92:289. 1979, *nom. illeg.* — TYPE: FLORIDA. Swamp near Jacksonville, 20 Sep 1894, *A.H. Curtiss 4791* (LECTOTYPE, here designated: NY!, as photo BH!; ISOLECTOTYPE: NY!). — PARATYPES: (MO!, as photo BH!).

V. aestivalis ssp. *divergens* Rogers, Proc. Florida State Hort. Soc. 92:289. 1979, *nom. illeg.*

Similar in general appearance to *V. cinerea* var. *cinerea* but differs from var. *cinerea* by having branchlets that are arachnoid pubescent, often densely so, and generally lacking the dense hirtellous pubescence characteristic of *V. cinerea* var. *cinerea*. The leaf undersurfaces of *V. cinerea* var. *floridana* also tend to be more densely arachnoid pubescent than is common in *V. cinerea* var. *cinerea*. Common in floodplains, lowland woods, stream and pond margins. (Coastal Plain of VA, SC, NC, GA, FL, AL and MS). Flowering in late May to June; fruit ripening in July to October. This variety is frequently confused with *V. aestivalis*. See the discussion provided under *V. aestivalis*.

Comeaux and Fantz (1987) provide a discussion of the somewhat convoluted nomenclatural history of this taxon.

Representative specimens examined: ALABAMA. Lowndes Co.: *Moore 732* (GA). FLORIDA. Collier Co.: *Moore 763* (GA). Gadsden Co.: *Moore 804* (GA). Jefferson Co.: *Moore 391*, (GA). Taylor Co.: *Moore 402* (GA). Walton Co.: *Moore 202* (GA). GEORGIA. Early Co.: *Moore 261* (GA). Randolph Co.: *Moore 268* (GA). Telfair Co.: *Moore 382* (GA). Wilkinson Co.: *Moore 381* (GA).

VITIS CINEREA (Engelm. in Gray) Engelm. ex Millardet var. BAILEYANA (Munson) Comeaux, Castanea 52(3):212−213. 1987. *V. virginiana* Munson, U.S.D.A. Div. Pomol. Bull. No. 3:3, 14. 1890, *nom. illeg. V. baileyana* Munson, Leaflet, 20 Jun 1893. — TYPE: VIRGINIA. ROANOKE CO.: Mountain valleys, southwest Virginia, 1890, *J.G. Wertz s.n.* (LECTOTYPE, here designated: PH!; ISOLECTOTYPE: MO!).

Similar in general appearance to *V. cinerea* var. *floridana*, but differing in having branchlets of the season glabrous to glabrate, nodes usually banded with red pigmentation and lower leaf surfaces glabrous to glabrate. Inhabiting a variety of habitats but more common in moist soils, floodplains, lowland woods, stream and pond margins. (Piedmont and Mountains, GA and AL to se IN, s OH and s PA). This taxon intergrades into *V. cinerea* var. *floridana* along the fall line between the Piedmont and Coastal Plain in AL, GA, NC, SC and VA.

Representative specimens examined: GEORGIA. Clarke Co.: *Moore 171* (GA); *Moore 190* (GA); *Moore 194* (GA); Jones Co.: *Moore 259* (GA). NORTH CAROLINA. Stokes Co.: *Moore 238* (GA). Yadkin Co.: *Moore 241* (GA). SOUTH CAROLINA. Spartanburg Co.: *Moore 819* (GA). TENNESSEE. Lawrence Co.: *Sharpe et al. 9700* (TENN). VIRGINIA. Albemarle Co.: *Massey 4579* (BH). Roanoke Co.: *Wertz s.n.* (MO).

VITIS CINEREA (Engelm. in Gray) Engelm. ex Millardet var. HELLERI (Bailey) M.O. Moore, comb. nov. — BASIONYM: *V. cordifolia* var. *helleri* Bailey, Gray's Syn. Fl. N. Amer. 1:424. 1897. *V. helleri* (Bailey) Small, Fl. SE U.S. 754:1334. 1903. TYPE: TEXAS. KERR CO.: 1600−2000 ft, 14−21 May 1894, *Heller 1750* (LECTOTYPE, here designated: BH!; ISOLECTOTYPES: BH!, as photos BH!).

V. berlandieri Planchon, Compt. Rend. Hebd. Seances Acad. Sci. 91:425. 1880. *V. cinerea* var. *berlandieri* (Planchon) Comeaux, Proc. Texas Grape Growers Assoc., 1986. 1987, *nom. illeg.* — TYPE: NEW MEXICO and TEXAS, 1834, *Berlandier 2412* (HOLOTYPE: PH!).

Similar in appearance to *V. cinerea* var. *cinerea*, but differing by having berries that are moderately to heavily glaucous, branchlets of the season that generally lack hirtellous pubescence and are not as prominently angled, and leaf blades that are usually less than 10 cm long with undersurfaces that are only sparsely hirtellous pubescent (or glabrate). Inhabiting a variety of moist habitats, floodplains, lowland woods, stream and pond margins. (TX, most common on the Edwards Plateau, but also found in the Cross Timbers and Prairies and the Blackland Prairies). This variety intergrades with *V. cinerea* var. *cinerea* southwest of the Brazos River (Comeaux, 1987a).

Comeaux (1987a) combined this taxon with *V. cinerea* as *V. cinerea* var. *berlandieri* (Planchon) Comeaux. However, in doing so, no clear indication of the basionym was given as is required under article 33.2 of the International Code of Botanical Nomenclature and thus the name was not validly published. Nevertheless, the name "var. *helleri*" is the oldest varietal name attributable to this taxon and therefore must be used if this taxon is recognized at the varietal level and if *V. cordifolia* var. *helleri* is considered as a synonym of it. Gandhi and Brown (1989), however, did not accept Comeaux's treatment and preferred recognizing this taxon as a distinct species. Present evidence justifies the treatment of this taxon as a variety of *V. cinerea*.

Representative specimens examined: TEXAS. Bandera Co.: *Moore 683* (GA). Coryell Co.: *Moore 943* (GA); *Moore 944* (GA). Kendall Co.: *Moore 682* (GA). Kerr Co.: *Correll & Johnston 17231* (TEX). Real Co.: *Moore 691* (GA); *Cory 19088* (GH). Travis Co.: *Ripperton & Barkley 14522C* (OKL). Uvalde Co.: *Moore 958* (GA); *Moore 689* (GA).

Subgenus **VITIS**, Series **CORDIFOLIAE** Munson, U.S.D.A. Div. Pomol. Bull. No. 3:7. 1890. — TYPE SPECIES: *Vitis cordifolia* Michaux (= *V. vulpina* L.).

VITIS VULPINA L., Sp. Pl. 203. 1753. — TYPE: VIRGINIA (HOLOTYPE: LINN as IDC microfiche, no. 281.7!).

V. cordifolia Michaux, Fl. Bor.-Amer. 2:231. 1803. LECTOTYPE, here designated: as microfiche IDC Michaux, no. 123, photo 3! (P). — SYNTYPE: as microfiche IDC Michaux, no. 123, photo 4! (P).

V. pullaria LeConte, Proc. Acad. Nat. Sci. Philadelphia 6:273. 1853. — TYPE: VIRGINIA. Norfolk, n.d., *John LeConte s.n.* (LECTOTYPE, here designated: PH!; ISOLECTOTYPE: PH!).

V. cordifolia var. *foetida* Engelm., Amer. Naturalist 2:231. 1869. — SYNTYPES: not found.

V. cordifolia var. *sempervirens* Munson, Rev. Vitic. 5:165. 1896. *V. illex* Bailey, Gent. Herb. 3:217. 1934. — TYPE: FLORIDA. MANATEE CO.: originally from south Florida, cultivated in vineyard of T.V. Munson, 10 May 1890 (LECTOTYPE, here designated: BH!). — SYNTYPES: (BH!).

High climbing vine, branchlets of the season slightly angled when very young but becoming terete, very young stems and emerging leaves glabrous to sparsely arachnoid pubescent. Bark exfoliating in shreds on mature stems, lenticels absent or inconspicuous, pith brown, interrupted by nodal diaphragms, diaphragms 1 − 2.5 mm thick. Tendrils bifurcate, a tendril or inflorescence present at 2 consecutive nodes only, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about as long as the blades, sparsely to moderately pubescent with hirtellous trichomes or glabrous; blades cordiform, often 3-shouldered to shallowly 3-lobed, deeply lobed only on ground shoots; margins irregularly dentate-serrate, bases typically cordate, apices acute to short acuminate; upper surface of mature leaves typically glabrous to very sparsely hirtellous pubescent, often lustrous, lower surface not glaucous, typically green, with short, straight hirtellous pubescence along the veins and in their axils, varying to more or less glabrous, rarely with very sparse arachnoid pubescence; stipules $1.5-3$ mm long. Panicles $9-19$ cm long, usually narrowly triangular in general outline, infructescences typically with more than 25 berries (or pedicels); 3 or 4 seeded berries $8-12$ mm in diameter, black, very slightly, or more typically, not at all glaucous, lenticels absent; seeds dark brown, ovoid, $3-5$ mm long.

In upland, well-drained woodlands of various mixtures, woodland borders, fence and hedge rows, thickets, less commonly in floodplains or lowland woods (se NY to MO and e KN, generally southward to peninsular FL and nc TX). Flowering in May; fruit ripening July to August.

Representative specimens examined: ARKANSAS. Marion Co.: *Moore 301* (GA). FLORIDA. Dixie Co.: *Moore 317* (GA); Gadsden Co.: *Moore 798* (GA). ILLINOIS. Shelby Co.: *Moore 1050* (GA). MISSOURI. Howard Co.: *Moore 1033* (GA). NORTH CAROLINA. Brunswick Co.: *Moore 374* (GA). OKLAHOMA. McCurtain Co.: *Moore 716* (GA). TENNESSEE. Carter Co.: *Moore 251* (GA); Rutherford Co.: *Moore 273* (GA). VIRGINIA. *Moore 835* Nelson Co.: (GA).

Vitis palmata Vahl, Symb. Bot. 3:42 – 43. 1794. — Type: VIRGINIA: in Virginiana, n.d., no collector (lectotype, here designated: C!). — Syntype: (C!).

V. rubra Michaux ex Planchon, in DC Monogr. Phan. 5:344. 1887. — Lectotype, here designated: as microfiche IDC Michaux, no. 123, photo 2! (P). — Syntype: as microfiche IDC Michaux, no. 123, photo 5! (P).

Relatively slender, high climbing vine, the branchlets of the season subterete and usually entirely dark crimson or purplish-red until mature, upon maturity the branches then of a reddish-brown to chestnut color, glabrous to very thinly arachnoid. Bark exfoliating in shreds on mature stems, pith brown, interrupted by nodal diaphragms, diaphragms $2.5-4$ mm thick. Tendrils bifurcate, red-pigmented when young, a tendril or inflorescence present at only 2 consecutive nodes, nodes not glaucous. Leaves with slender petioles that are somewhat shorter than the blades, glabrous to puberulent; blades generally cordiform, commonly deeply 3 (5) lobed, the lobes attenuate acuminate, sinuses acute to rounded; margins dentate-serrate; upper surface of mature leaves glabrous, lower surface not glaucous, glabrous or pubescent with only hirtellous trichomes along the veins and in their axils; stipules $1.5 - 3$ mm long. Panicles $6 - 18$ cm long, usually narrowly triangular in outline, infructescences usually with more than 25 berries; 3 or 4 seeded berries $8 - 10$ mm in diameter, bluish-black to black, with very little or no glaucescence, lenticels absent. Seeds dark brown, globose, $4 - 7$ mm long, nearly filling the berry.

River banks and alluvial floodplain woodlands (IL and IN south to MO, TX, wc AL, c panhandle of FL). Flowers the latest of all native species, mid to late June; fruit ripening late July to October.

Representative specimens examined: ALABAMA. Hale Co.: *Glenboski 49* (UNA). FLORIDA. Gadsden Co.: *Moore 797* (GA); *Moore 802* (GA). INDIANA. Knox Co.: *Deam 24145* (US). Posey Co.: *Tryon 4256* (US); *Deam 39930* (GH). LOUISIANA. Ouchita Parish: *Thieret 20841* (FSU); *Smith 458* (TENN). MISSISSIPPI. LeFlore Co.: *Moore 347* (GA). Neshoba Co.: *Smith 883* (FSU).

Vitis monticola Buckley, Proc. Acad. Nat. Sci. Philadelphia 62:450. 1861. *V. aestivalis* var. *monticola* (Buckley) Engelm., Amer. Naturalist 2:321. 1869. — Type: TEXAS. Hays Co.: Crescit in Texas, n.d., *B. Buckley s.n.* (lectotype, here designated: US!). — Syntype: (PH!).

High climbing vine, branchlets of the season angled when young but becoming terete at maturity, young stems and leaves slightly to moderately arachnoid pubescent. Bark exfoliating in shreds on mature stems, lenticels absent or inconspicuous, pith brown, interrupted by nodal diaphragms, diaphragms $1 - 2.5$ mm thick. Tendrils bifurcate, a tendril or inflorescence present at only two consecutive nodes, nodes not glaucous, usually not banded with red pigmentation (but occasionally the red-banding present). Leaves with petioles about half as long as the blade, sparsely to moderately pubescent with arachnoid trichomes, glabrate at maturity; blades cordiform, often 3-shouldered to shallowly 3-lobed; margins irregularly dentate-serrate, bases typically cordate, apices acute to short acuminate (occasionally long acuminate); upper surface of mature leaves typically glabrous, usually lustrous, lower surface not glaucous, typically green, glabrous to sparsely hirtellous pubescent; stipules $1.5 - 3$ (-4) mm long. Panicles $3 - 7$ cm long, usually globose in general outline, infructescences typically with less than 25 berries (or pedicels); 3 or 4 seeded berries $8 - 10$ mm in diameter, black, very slightly, or more typically, not at all glaucous, lenticels usually present. Seeds dark brown, ovoid, $5 - 7$ mm long.

In upland, well-drained habitats of various mixtures. Endemic to the Edwards Plateau in sc TX. Flowering in May, fruit ripening July to August.

Representative specimens examined: TEXAS. Bandera Co.: *Moore 935* (GA). Bexar Co.: *Clare 641* (BH). Blanco Co.: *Whitehouse 546* (NY). Comal Co.: *Palmer 12181* (GH-A). Kendall Co.: *Palmer 13651* (GH). Kerr Co.: *Moore 962* (GA); *Cory 24043* (BH). Llano Co.: *Ramsey s.n.* (NY). Real Co.: *Cory 42700* (TEX); *Cory 42701* (GH).

Subgenus **VITIS**, Series **LABRUSCAE** Planchon, in DC Monogr. Phan. 5:323. 1887. — Type species: *Vitis labrusca* L.

Vitis labrusca L., Sp. Pl. 202. 1753. — Type: America Septentrionali (lectotype, here designated: LINN, as IDC microfiche no. 81.5!). — Syntype: LINN, as IDC microfiche no. 281.6!.

V. labrusca var. *labruscoides* Eaton, Man. Bot. 496. 1818. — Syntypes: not seen.

V. labrusca var. *alba* Prince, Treatise on the Vine 181. 1830. *V. labrusca* forma *alba* (Prince) Fernald, Rhodora 41:431. 1941. — Syntypes: not seen.

V. labrusca var. *rosea* Prince, Treatise on the Vine 182. 1830. — Syntypes: not seen.

V. labrusca var. *subedentata* Fernald, Rhodora 42:462–463. 1940. — Type: VIRGINIA. Charles City Co.: swampy thickets southeast of Charles City, 22 Aug 1939, *M. Fernald and B. Long 11074* (holotype: GH!; isotypes: GH! NY! PH! US!).

High climbing vine, branchlets of the season obscurely angled when young, becoming terete at maturity, young stems and leaves densely tomentose, occasionally with spinose pubescence with glandular tips. Bark exfoliating in shreds on mature stems, lenticels inconspicuous or absent, pith brown, interrupted by nodal diaphragms, diaphragms 0.5 – 2.5 mm wide. Tendrils bifurcate to occasionally trifurcate, continuous, a tendril or inflorescence present opposite virtually every node, occasionally absent opposite lowermost nodes, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about as long as the blades, thinly arachnoid pubescent to glabrous; blades cordiform, often 3-shouldered; margins crenate to crenate-dentate, bases typically cordate, apices usually acute; upper surfaces of mature leaves glabrous to slightly pubescent, dull, lower surface not glaucous, typically whitish to yellowish due to dense arachnoid tomentum which obscures the leaf undersurface but not the veins; stipules 2 – 4 mm long. Panicles 6 – 14 cm long, usually globose to cylindrical in general outline; infructescences usually with less than 25 berries, occasionally with less than 12. Berries greater than 12 mm in diameter, black, very slightly, or more typically, not at all glaucous, lenticels absent. Seeds brown, obcordate, 5 – 8 mm long.

Inhabiting a very wide variety of sites, both upland and well drained and lowland and poorly drained, including intermittently flooded bottomlands (ME, NH and VT south to n GA, n AL, n MS, north to ne AR, se MO, e IL and s MI). Flowering in May to June, fruit ripening in September to October.

Representative specimens examined: GEORGIA. Rabun Co.: *Jones 23662* (GA). INDIANA. Porter Co.: *Deam 29810* (IND). MAINE. Oxford Co.: *Moore 855* (GA). PENNSYLVANIA. Fayette Co.: *Moore 881* (GA). Pike Co.: *Moore 846* (GA). TENNESSEE. Cooke Co.: *Hunnewell 14254* (GH). VIRGINIA. Carroll Co.: *Moore 231* (GA); Carroll Co.: *Moore 245* (GA). Nelson Co.: *Moore 836* (GA). Norfolk Co.: *Moore 378* (GA).

Vitis shuttleworthii House, Amer. Midl. Naturalist 7:129. 1921. *V. coriacea* Shuttlew. ex Planchon, in DC Monogr. Phan. 5:345. 1887, *nom. illeg.*, non Miq. 1863. *V. candicans* var. *coriacea* (Shuttlew. ex Planchon) Bailey ex Gray, Syn. Fl. N. Amer. 1:429. 1897. Type: FLORIDA. borders of the Manatee River, Jun 1845, *Rugel 111* (holotype: BM!).

Moderately high climbing vigorous vine, branchlets of the season oval to terete, densely tomentose when young, becoming more thinly tomentose with age. Bark exfoliating in shreds on 2 year old stems, lenticels absent or inconspicuous, pith brown, interrupted by diaphragms at nodes, diaphragms typically 2.5 – 6 mm thick but frequently continuing halfway into the internode. Tendrils bifurcate to trifurcate, a tendril or inflorescence present opposite only 2 consecutive nodes, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about half to three quarters the length of the blade, densely tomentose; blades broadly cordate to nearly reniform, typically unlobed but varying to 3-shouldered or, less often, deeply 3 – 5 lobed, when lobed the lobes acute and the sinuses rounded; margins with shallow, broad scalloped, obtuse teeth, typically nearly entire, leaf bases cordate to truncate; upper surface of mature leaves floccose to glabrous, lower surface not glaucous but densely and evenly covered with white to rusty tomentum, typically concealing the leaf undersurface but not always the veins; stipules minute, less than 1 mm long, promptly deciduous. Panicles 4 – 10 cm long, the rachis arachnoid floccose, usually broadly short triangular in outline, infructescences with less than 25 berries, occasionally with less than 12. Berries large, greater than 12 mm in diameter, dark red to purple-black, with little or no glaucescence, lenticels absent. Seeds dark brown, ovoid to rounded, 5 – 6 mm long.

Generally found in woodlands of various mixtures, woodland borders, thickets and lowland woods in peninsular FL (endemic to peninsular FL). Flowering in early April to early May, fruit ripening in June to August.

Representative specimens examined: FLORIDA. Citrus Co.: *Moore 776* (GA). Charlotte Co.: *Moore 753* (GA). Collier Co.: *Moore 760* (GA). DeSoto Co.: *Moore 752* (GA). Glades Co.: *Moore 749* (GA). Hardee Co.: *Moore 322* (GA). Hillsborough Co.: *Pardue s.n.* (USF). Manatee Co.: *Moore 786* (GA). Sarasota Co.: *Moore 787* (GA); *Moore 788* (GA).

VITIS MUSTANGENSIS Buckley, Proc. Acad. Nat. Sci. Philadelphia 62:451. 1861. — TYPE: TEXAS. Near Austin, Apr 1860, *S.B. Buckley s.n.* (LECTOTYPE, here designated: PH!). — SYNTYPE: (US!).

High climbing vigorous vine, branchlets of the season oval to terete, densely tomentose when young, becoming more thinly tomentose with age. Bark exfoliating in shreds on 2 year old stems, lenticels absent or inconspicuous, pith brown, interrupted by diaphragms at nodes, diaphragms 1.5 – 3 mm thick. Tendrils bifurcate to trifurcate, a tendril or inflorescence present opposite only 2 consecutive nodes, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about half to three quarters the length of the blade, densely tomentose; blades broadly cordate to nearly reniform, usually concavely folded, typically unlobed but varying to 3-shouldered or deeply 3 – 5 lobed, when lobed the lobes acute and the sinuses rounded; margins with shallow, broad scalloped, obtuse teeth, typically nearly entire, leaf bases cordate to truncate; upper surface of mature leaves floccose to glabrous, lower surface not glaucous but densely and evenly covered with white to rusty tomentum, typically concealing the leaf undersurface but not always the veins; stipules 1.5 – 4 mm long, promptly deciduous. Panicles 4 – 10 cm long, the rachis arachnoid floccose, usually broadly short triangular in outline, infructescences with less than 25 berries, occasionally with less than 12. Berries large, greater than 12 mm in diameter, black to less commonly dark red, with little or no glaucescence, lenticels absent. Seeds dark brown, ovoid to rounded, 6 – 7 mm long.

Generally found in woodlands of various mixtures, woodland borders, thickets and lowland woods (e TX and extreme w LA north to s OK, with one disjunct population in Wilcox County, AL). Flowering in late May to early June, fruit ripening in August to September.

In several early publications (e.g., Munson 1909; Bailey 1934), this species was known as *V. candicans* Engelm. ex Gray. Engelmann and Gray published this name in 1850, but the description of this taxon was quite vague, stating only that "Under the name of *V. candicans* (n.sp.) Engelm. ined., I have from Lindheimer, as also from Mr. Wright, Texan specimens of what appears to be a variety of *V. californica* Benth., with the leaves somewhat less dentate and more densely tomentose underneath". Additionally, it is not at all clear how Gray is treating the above description, as he did not list it as a new species, but rather included it under what appears to be the description of a new variety of *V. aestivalis*. However, Gray did not give this apparent new variety a name but only states "var. *tomento albo, nec fulvo*. Shady banks of streams, New Braunfels. Climbing high trees. Berries the size of peas, in large bunches, black; the taste vinous and pleasant. Flowers very odorous." Thus, the name *V. candicans* must be considered ambiguous, making the name *V. mustangensis* the valid and legitimate one for this species.

Representative specimens examined: ALABAMA. Wilcox Co.: *Moore 728* (GA). OKLAHOMA. Marshall Co.: *Goodman 5858* (GH). TEXAS. Anderson Co.: *Moore 932* (GA). Comal Co.: *Moore 687* (GA). Gonzales Co.: *Webster & Wilbur 2977* (SMU). Grayson Co.: *Moore 713* (GA). Hays Co.: *Moore 686* (GA). Leon Co.: *Moore 935* (GA). Llano Co.: *Moore 964* (GA). Mason Co.: *Moore 693* (GA).

Subgenus **VITIS**, Series **RIPARIAE** Munson, U.S.D.A. Div. Pomol. Bull. No. 3:7. 1890. — Type species: *V. riparia* Michaux.

Vitis acerifolia Raf., Amer. Man. Grape Vines 14. 1830. — Neotype, here designated: TEXAS. Wilbarger Co.: growing along Beaver Creek on US 283, S of Vernon, in a rest area 1.5 mi S of jct. with Farm Road 1763, 13 Jun 1986, *Moore 700* (GA!; isoneotypes: PH!, US!). — Syntypes: not found.

V. longii Prince, Treatise on the Vine 184. 1830. — Syntypes: not seen.

V. solonis Hort. Berol. ex Planchon, Vignes Amer. 119. 1875. *V. cordifolia* var. *solonis* (Hort. Berol. ex Planch) Planchon, Vignes Amer. 118. 1875. — Syntypes: not found.

V. nuevo-mexicana Lemmon ex Munson, Trans. Amer. Hort. Soc. 3:132. 1885. — Syntypes: not found.

V. solonis var. *microsperma* Munson, Rev. Vitic. 3:158. 1895. *V. longii* var. *microsperma* (Munson) Bailey ex Gray, Syn. Fl. N. Amer. 1:423. 1897. — Syntypes: not found.

Typically a stocky, erect, shrubby, much branched low to moderately high climbing vine, branchlets of the season slightly angled when young but becoming terete, very young stems and leaves whitish arachnoid pubescent, mature stems glabrous to arachnoid pubescent. Bark closely persistent for several years, then shredding in thin plates, lenticels absent or inconspicuous, pith brown, interrupted by nodal diaphragms, diaphragms usually less than 1.0 mm wide. Tendrils bifurcate, a tendril or inflorescence present at only two consecutive nodes, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about half as long as the blades, often partially conduplicately folded, typically moderately to thinly arachnoid pubescent to glabrate; blades broadly cordate, often 3-shouldered to shallowly 3-lobed; margins sharply dentate-serrate, bases typically broadly cordate, apices typically short acuminate; upper surface of mature leaves slightly arachnoid pubescent to glabrate, lower surface not glaucous, slightly arachnoid pubescent but also with sparse hirtellous pubescence along the veins, varying to glabrate; stipules $3-6$ mm long. Panicles $5-9$ cm long, compact, globose in general outline, infructescences typically short pedunculate, making the clusters appear almost sessile, typically with greater than 25 berries, but occasionally with only 12 to 25; 3 or 4 seeded berries 8 − 12 mm in diameter, black, heavily glaucous, lenticels absent. Seeds reddish-brown, pyriform, 5 − 6 mm long.

Inhabiting moist to slightly drier sites, river banks and alluvial flood-plain woodlands, but also along hedge rows and fence rows (nc TX, ne NM, se CO, sw KN, w OK). Flowering in April to May, fruit ripening in July to August.

In earlier treatments of the genus, (e.g., Munson 1909; Bailey 1934), this species was known as *V. longii* Prince. Since both *V. acerifolia* and *V. longii* were published in 1830, Bailey (1934) stated that he could not choose between the two names and that both descriptions were equally good. Since Prince had the species in fruit, while Rafinesque apparently did not, and since the name "*longii*" had been used for many years, Bailey decided to continue using that name. However, Rehder (1946) later determined that Rafinesque's publication was dated May, 1830 in the preface while the copyright date of Prince's publication was September, 1830. Thus, the name "*acerifolia*" has priority over the name "*longii*."

Representative specimens examined: OKLAHOMA. Custer Co.: *Moore 708* (GA). Dewey Co.: *Nelson 6095* (OKL). Grady Co.: *Moore 978* (GA). Harmon Co.: *Moore 701* (GA). Washita Co.: *Moore 707* (GA). Woodward Co.: *Moore 702* (GA). TEXAS. Collingsworth Co.: *Moore 697* (GA). Donley Co.: *Moore 698* (GA). Hemphill Co.: *Cory 16224* (BH). Wilbarger Co.: *Moore 700* (GA).

Vitis riparia Michaux, Fl. Bor.-Amer. 2:231. 1803. *V. cordifolia* var. *vulpina*, (L.) Eaton, Man. Bot. 497. 1818. *V. cordifolia* var. *riparia* (Michaux) Gray, Manual ed. 5:113. 1867. *V. vulpina* ssp. *riparia* (Michaux) Clausen, Cornell Univ. Agric. Exp. Sta. Mem. 298:8. 1949. — Type: ad ripas et in insulis fluviorum Ohio, Mississippi, etc. (holotype: as microfiche, IDC Michaux no. 122, photo 19, bottom specimen! P).

V. riparia var. *praecox* Engelm. ex Bailey, Amer. Garden 14:353. 1893. — Syntypes: not found.

V. vulpina var. *syrticola* Fernald and Weigand, Rhodora 25:212. 1923. *V. riparia* var. *syrticola* (Fernald and Weigand) Fernald, Rhodora 41:431. 1931. — Type: NEW YORK. Oswego Co.: Selkirk, sand dunes overlying Silurian shales and schists by Lake Ontario, 23 Aug 1922, *Fernald, Weigand and Eames 14388* (holotype: GH!; isotype: GH!).

Moderate to high climbing vine, branchlets of the season terete, young stems and leaves glabrous to slightly hirtellous pubescent (varying to slightly arachnoid pubescent in some Louisiana specimens). Bark exfoliating in shreds on mature stems, lenticels absent or inconspicuous, pith brown, interrupted by nodal diaphragms, diaphragms usually less than 0.5 mm wide. Tendrils bifurcate, a tendril or inflorescence present at only two consecutive nodes, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about half as long as the blades, slightly to moderately hirtellous pubescent; blades cordiform, 3-shouldered to shallowly 3-lobed, margins sharply dentate-serrate, bases typically cordate, apices typically short acuminate; upper surface of mature leaves glabrous, often light yellowish-green, lower surface not glaucous, typically green and with hirtellous trichomes along the veins and in their axils, varying to glabrate; stipules 3 – 5 mm long. Panicles 7 – 12 cm long, usually narrowly triangular in general outline, infructescences typically with more than 25 berries; 3 or 4 seeded berries 8 – 12 mm in diameter, black, heavily glaucous, lenticels absent. Seeds dark brown, pyriform, 5 – 6 mm long.

Inhabiting a wide variety of habitats but preferring moist soils, stream banks, pond margins, alluvial woodlands but also on roadsides, hedge rows and fence rows (s New Brunswick west to se Saskatchewan, south to n VA, w TN, n MS, LA, e TX, north to e KN, e NB, e SD and e ND. Also reported from the Pacific Northwest). Flowering in April to June, fruit ripening in August to September.

Representative specimens examined: ARKANSAS. Miller Co.: *Moore 724* (GA). IOWA. Davis Co.: *Moore 1041* (GA). Van Buren Co.: *Moore 1042* (GA). MISSOURI. Pettis Co.: *Moore 1035* (GA). NEW YORK. Herkimer Co.: *Moore 870* (GA). Schuyler Co.: *Moore 875* (GA). Sullivan Co.: *Moore 847* (GA). Warren Co.: *Moore 869* (GA). VERMONT. Addison Co.: *Moore 868* (GA). Caledonia Co.: *Moore 865* (GA).

Vitis rupestris Scheele, Linnaea 21:591. 1848. — Neotype, here designated: MISSOURI. Dent Co.: all around gravel bed deposits covering large area around Meramec River Headwaters, T33N, R4W, sect. 14, 2 mi SE of Max, 10 Aug 1936, *J. A. Steyermark 12842* (MO!). — Syntypes: not found.

V. rupestris var. *dissecta* Eggert ex Bailey in Gray, Syn. Fl. N. Amer. 1:422. 1897. *V. rupestris* forma *dissecta* (Eggert ex Bailey in Gray) Fernald, Rhodora 41:431. 1941. — Type: MISSOURI. Jefferson Co.: brooks on hillsides, 22 May 1892, *Eggert s.n.* (lectotype, here designated: NY!; isolectotypes: F!, US!).

Sprawling to low climbing, much branched vine, branchlets of the season slightly angled but becoming terete at maturity, very young stems and leaves glabrous or slightly hirtellous pubescent. Bark persistent for the first several years, then shredding in plates, lenticels absent or inconspicuous, pith brown, interrupted by nodal diaphragms, diaphragms less than 1 mm wide. Tendrils bifurcate, commonly present only opposite the uppermost nodes and then only at two consecutive nodes, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about half as long as the blades, glabrous to slightly hirtellous pubescent; blades typically reniform, conduplicately folded, particularly when young, often 3-shouldered, rarely shallowly 3-lobed; margins dentate-serrate, bases typically truncate to broadly cordate, apices acute to short acuminate; upper surface of mature leaves typically glabrous, often lustrous, lower surface not glaucous, typically green and glabrous, occasionally with sparse hirtellous pubescence along the veins and in their axils; stipules $3-6.5$ mm long. Panicles $4-7$ cm long, usually globose in general outline, infructescences typically with less than 25 berries, occasionally with less than 12; 3 or 4 seeded berries $8-12$ mm in diameter, black, slightly glaucous, lenticels absent. Seeds light brown, ovoid, $5-6$ mm long.

Herbarium records indicate that this species was once distributed from south central Texas, through northern Arkansas, Missouri, northern Tennessee, Kentucky and northern West Virginia and northwestern Maryland to southwestern Pennsylvania. It has apparently been extirpated from many of these regions and is now only found along calcareous, gravelly banks, river bottoms, stream beds and washes in south central Missouri and extreme northern Arkansas. Flowering in April to May, fruit ripening in August to September. It is a critical species as it is important in viticulture as a rootstock.

Representative specimens examined: MARYLAND. Montgomery Co.: *Steele s.n.* (NY). MISSOURI. Oregon Co.: *Palmer & Steyermark 41716* (MO). Phelps Co.: *Eggert s.n.* (BH). Iron Co.: *Palmer 18103* (GH). PENNSYLVANIA. Lane Co.: *Porter s.n.* (NY). OKLAHOMA. Comanche Co.: *Demaree 13141* (GH). TENNESSEE. Davidson Co.: *Gattinger 460A* (GH). TEXAS. Johnson Co.: *Reverchon s.n.* (SMU). Tarrant Co.: *Ruth 368* (US). Tom Green Co.: *Tweedy 134* (US).

HYBRIDS

Vitis × champinii Planchon (*pro. sp.*), Vigne Amer. 6:22. 1882. — Neotype, here designated: TEXAS. Grayson Co.: originally from Llano County, cultivated Denison, Texas, Munson vineyard, 25 Apr 1890, *F.M. Ramsey s.n.* (NY!; isoneotype: MO!) — Syntypes: not found.

High climbing vine, branchlets of the season somewhat angled when young, becoming terete when mature, young stems and leaves arachnoid pubescent, becoming glabrate with age. Bark tardily exfoliating in shreds, lenticels absent or inconspicuous, pith brown, interrupted by nodal diaphragms, diaphragms $1.5-2.5$ mm thick. Tendrils bifurcate, rarely trifurcate, a tendril or inflorescence present at only two consecutive nodes, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about half as long as the blade, thinly arachnoid pubescent to less commonly glabrous; blades cordate to occasionally nearly reniform, often 3-shouldered to very shallowly 3-lobed, occasionally partially conduplicate; margins crenate to slightly serrate, bases typically cordate, apices acute to short acuminate; upper surface of mature leaves typically glabrous, often lustrous, lower surface not glaucous, typically green, thinly arachnoid pubescent to glabrate; stipules 2.0 − 5.5 mm long. Panicles 3 − 7 cm long, usually globose in general outline, infructescences usually with less than 25 berries (or pedicels); 3 or 4 seeded berries greater than 12 mm in diameter, black, very slightly, or more typically, not at all glaucous, lenticels absent. Seeds brown, ovoid, 5 − 6 mm long.

Inhabiting well drained calcareous soils in sc Texas, on and adjacent to the Edwards Plateau. Flowering in April to May, fruit ripening in July to August. Interpreted here as a hybrid between *V. mustangensis* and *V. rupestris*, Comeaux (pers. comm.), however, presently feels that the origin of this taxon may be more complicated. It is now rare in nature (Comeaux, 1987b).

Representative specimens examined: NORTH CAROLINA. *Williams 63*, cultivated, Wake Co. (BH). TEXAS. Burnet Co.: Biltmore Herbarium 14842 (US). Bell Co.: *W.B. Munson s.n.* (BH). Travis Co.: *Munson s.n.* (MO). Southwestern Texas, *Munson s.n.*, (US). Originally from Coryell County, *Moore 1062*, (GA). Cultivated, Denison, *Munson s.n.*, (BH); cultivated, Denison, *Munson s.n.*, (MOR). Originally from Llano County, *Munson s.n.*, (MO). No collector, no number, no location (29 May 1896) (BH).

Vitis × **doaniana** Munson ex Viala (*pro. sp.*), Mission Vitic. Amér. 101. 1889. — Type: TEXAS. Wilbarger Co.: Wilbarger County, 1886, cultivated in the Munson vineyard, Denison, 24 Apr 1890, *T.V. Munson s.n.* (lectotype, here designated: NY!). Syntypes: (CU! BH! FLAS! US!).

High climbing vine, but shrubby and sprawling without support, branchlets of the season terete when mature, young stems and leaves densely tomentose. Bark tardily exfoliating in shreds, lenticels absent or inconspicuous, pith brown, interrupted by nodal diaphragms, diaphragms 1 − 2 mm thick. Tendrils bifurcate to occasionally trifurcate, a tendril or inflorescence present at only two consecutive nodes, nodes not glaucous, not banded with red pigmentation. Leaves with petioles about half as long as the blades, thinly arachnoid pubescent; blades cordate, often 3-shouldered to shallowly 3-lobed; margins crenate to crenate-serrate, bases typically cordate, apices acute to short acuminate; upper surface of mature leaves slightly to moderately arachnoid pubescent, lower surface not glaucous, typically dull green, slightly to moderately arachnoid pubescent; stipules 3 − 6 mm long. Panicles 4 − 10 cm long, usually globose to short triangular in outline, infructescences with less than 25 berries (or pedicels); 3 or 4 seeded berries greater than 12 mm in diameter, black, heavily glaucous, lenticels absent. Seeds dark brown, ovoid, 6 − 7 mm long.

Inhabiting well-drained, drier soils in sand hills, plains and timber regions (n TX to s OK). Flowering in April to May, fruit ripening in July to August. A hybrid between *V. mustangensis* and *V. acerifolia*, once more common in nature than it is at present, that was named for Judge J. Doan of Wilbarger County, Texas, who manufactured wine from the berries of this species. The town of Doans in Wilbarger County is named after Judge Doan where populations of this hybrid can still be found.

Representative specimens examined: MASSACHUSETTS. cultivated, Arnold Arboretum, *Palmer s.n.*, (MOR). NEW YORK. Ontario Co.: cultivated, *Bean 668* (BH). OKLAHOMA. Tillman Co.: *Moore 975* (GA). TEXAS. Wilbarger Co.: *Moore 974* (GA); *Munson s.n.* (NY). Cultivated, Denison, 6 May 1891 *Munson s.n.* (BH); cultivated, Denison, Aug 1891 *Munson s.n.* (BH); cultivated Denison, *Munson s.n.* (BH); cultivated Denison, originally from Wilbarger Co.: 24 Apr 1890 *Munson s.n.* (BH); cultivated, Denison, 7 Aug 1895 *Munson s.n.* (BH).

Vitis × novae-angliae Fernald (*pro. sp.*), Rhodora 19:146. 1917. — Type: MAINE. Penobscot Co.: thicket by river, Orono, 27 Jun 1906, *M.L. Fernald s.n.* (lectotype, here designated: GH!; isolectotypes: GH! NY! PH!). — Syntype: (GH!). — Paratypes: (GH!, PH!).

High climbing vine, branchlets of the season terete at maturity, young stems and leaves densely tomentose. Bark exfoliating in shreds on mature stems, lenticels inconspicuous or absent, pith brown, interrupted by nodal diaphragms, diaphragms $0.3-1.1$ mm thick. Tendrils bifurcate, continuous, a tendril or inflorescence present at three to several consecutive nodes, but frequently not present opposite all nodes as in *V. labrusca*, nodes not glaucous, not banded with red pigmentation. Leaves with petioles one half to nearly as long as the blades, sparsely arachnoid pubescent to glabrate; blades cordiform, often 3-shouldered; margins crenate to irregularly dentate-serrate, bases typically cordate, apices acute to short acuminate; upper surface of mature leaves typically glabrous, lower surface not glaucous, typically green when mature, more or less densely arachnoid pubescent on young but expanded leaves, only slightly arachnoid pubescent on fully mature leaves; stipules $2.5-6.0$ mm long. Panicles $7-13$ cm long, usually triangular in general outline, infructescences typically with more than 25 berries, but occasionally with only 12 to 25; 3 or 4 seeded berries greater than 12 mm in diameter, black, slightly glaucous, lenticels absent. Seeds brown, $6-8$ mm long.

Thickets, largely alluvial, as well as roadsides, pond and stream margins, and fence and hedge rows (s ME south to n PA and n NJ). Flowering in June, fruit ripening in August to September. A hybrid between *V. labrusca* and *V. riparia* that is common in the New England region.

Representative specimens examined: MAINE. Franklin Co.: *Moore 852* (GA); *Knowlton s.n.* (USF). Waldo Co.: *Seymour 30055* (VT). MASSACHUSETTS. Middlesex Co.: *Smith s.n.* (MO). Essex Co.: *Williams s.n.* (GH). NEW HAMPSHIRE. Belknap Co.: *Moore 859* (GA). Cheshire Co.: *Batchelder s.n.* (PH). Merrimack Co.: *Moore 856* (GA); *Moore 858* (GA). PENNSYLVANIA. Lackawanna Co.: *Glowenke 8343* (PH).

Nomina nuda et dubiosa

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V. digitata Raf., Amer. Man. Grape Vines 9. 1830.
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V. ursina Raf., Amer. Man. Grape Vines 8. 1830.
V. verrucosa Raf., Amer. Man. Grape Vines 17. 1830.

Excluded species found in North America north of Mexico.

V. arizonica Engelm. (var. *arizonica* and var. *glabra* Munson)
V. californica Bentham
V. girdiana Munson

ACKNOWLEDGEMENTS

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This book is patterned to a large extent on their previous one, "The potatoes of Argentina, Brazil, Paraguay and Uruguay—a biosystematic study." It is fortunate that their studies continued and such a definitive treatment is now available for Bolivia.

The text is divided into 2 parts: I. General and II. Detailed Taxonomy. In Part I., chapters include: 1. Introduction; 2. The Breeding Value of Bolivian Potatoes; 3. Cytogenetics and Crossability; 4. Species Concepts and Evolutionary Relationships; 5. Phytogeography and Ecology; 6. Potato exploration in Bolivia; 7. Taxonomic Methods used in this book; 8. Classification of the genus *Solanum*. In Part II., the taxa are grouped in seven series with keys to the species, descriptions, affinities, localities, ranges of distribution, habitats, taxonomic notes, cytology, natural hybrids, artificial hybrids, and breeding value comments of each taxon with accompanying plates of diagrammatic illustrations of the species and distribution maps. It was of special interest to note the discussion on Dr. Donovan Correll's collections in Chapter 6 since he was associated for 2 years with our herbarium. This publication exudes quality throughout. wfm

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COOK, CYNTHIA C. AND MIKAEL GRUT. 1989. Agroforestry in Sub-Saharan Africa, A Farmer's Perspective. World Bank Technical Paper No. 112, The World Bank, Publications Dept., J2152, 1818 H Street, N.W., Washington, DC 20433. Order Stock £11389. $7.95 paper (8.5 x 11). 104 pp.

"This study reviews agroforestry practices in Sub-Saharan Africa as seen from the farmer's perspective. Agroforestry, broadly defined as the integration of trees and shrubs in farming systems, offers one of the most promising technological options for reversing soil degradation, restoring tree cover, and improving agricultural productivity in Africa. The literature on agroforestry was reviewed in order to identify a limited number of successful experiences for further field study. Seven case studies were then conducted by an interdisciplinary team, covering indigenous and innovative systems found in the highlands of East Africa, the semi-arid zone, and the humid lowlands of West Africa [from first paragraph of Abstract]." wfm

HARD GRASS (*SCLEROCHLOA DURA*, POACEAE) IN THE UNITED STATES

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ABSTRACT

The introduction and spread of *Sclerochloa dura* (Poaceae) in the United States are traced. Included is a detailed description of the species.

On 26 April 1928 a grass was collected along a roadside between Salt Lake City and Ogden, Utah. The collector, C.W. Fallass (misspelled "Fallas" in several publications), unable to identify it, sent a specimen to the Smithsonian Institution. Eventually the grass was described as a new genus and species, *Crassipes annuus*, by Swallen (1931), said by him to be most closely related to the European *Oreochloa* Link and to be near the North American *Orcuttia* Vasey.

In the early 1930s, several collections of this grass from Colorado, Utah, and Washington were distributed under the name *C. annuus*. Fallass' grass was, however, not one "generically distinct from any previously known" (Swallen 1931). In the first *Manual of the grasses of the United States* (Hitchcock 1935), it found its rightful place as a synonym of the European *Sclerochloa dura* (L.) Beauv. (Fig. 1), the plant's correct name.

The earliest U.S. collection of *S. dura* that we have seen was made "about the wool mill" in Yonkers, New York state, in 1895 (*Bicknell s.n.*, 5 May 1895, NY); the species has apparently not been found again in New York. Thirty-three years later, in 1928, the grass was collected in Utah for the first time. The additional states from which we have seen specimens of hard grass — and the dates of the earliest collections of it known to us from these states — are Colorado, 1931; Idaho and Washington, 1932; California, 1935; Oregon, 1937; Texas, 1944; Kansas, 1961; Missouri, 1972 (first reported by Ladd [1983]); Oklahoma, 1973 (first reported by Goodman [1974]); Arkansas, 1976; Georgia and Nebraska, 1982;

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Sida 14(3):369 – 376. 1991.

Tennessee, 1985 (first reported by Freckmann [1988]); Maryland, 1986 (first reported by Hill [1988]); Mississippi, 1987; and Ohio, 1990. Data with many of these early collections mentioned that the grass occurred in abundance.

The species was recorded from Louisiana in 1977 (MacRoberts 1977); the collection, though, is actually a depauperate specimen of *Eleusine indica* (Allen 1980). The documented distribution of *S. dura* in the United States is shown in Figure 2.

We have noted reports of the introduction of *S. dura* into Argentina (Rugolo de Agrasar 1980) and Australia (New South Wales, South Australia, and Victoria) (Watson and Dallwitz 1980).

In the United States this grass is, we suggest, under-collected and under-reported. We saw several herbarium specimens of it misidentified as *Poa annua*, a species that hard grass superficially resembles; because of this similarity, *S. dura* is probably ignored in at least some places where it occurs.

It is also certainly under-noticed. For example, on one occasion we spoke with two university botanists, asking them if *S. dura* was on their campus. They checked the Hitchcock *Manual* (Hitchcock 1950) and then searched their campus for the grass; they reported to us that they were unable to find it. A few days later they telephoned with a revision of their report: *S. dura* was in fact the dominant weedy grass in the lawn around their building. Apparently they did not expect it to be a major constituent of a lawn; they had been searching for isolated clumps. We believe that *S. dura* is overlooked elsewhere, too.

Two U.S. weed books that include *S. dura* — Dennis (1980) and Gaines and Swan (1972) — describe the grass as a "lawn pest" and a "nuisance in lawns." Being typically more or less prostrate, it can escape being mowed. One means of spread of hard grass is possibly via grass seed or, more likely, sod.

Other habitats include campsites, roadsides, golf courses, and especially the most disturbed areas in playgrounds and athletic fields. We suspect that the grass may move from athletic field to athletic field on the cleats of ballplayers' shoes. It can obviously endure severe trampling and can outcompete even *Matricaria matricarioides*, *Poa annua*, and other weeds of these harsh habitats. Ladd (1983) mentioned *Androsace occidentalis*, *Draba brachycarpa*, *Holosteum umbellatum*, *Lepidium virginicum*, and *Veronica arvensis* as other associates. Patzke and Korneck (1982) described a "Sclerochloo-Polygonetum avicularis" community in much disturbed habitats in West Germany (Hessen) in which the associates included *Capsella bursa-pastoris*,

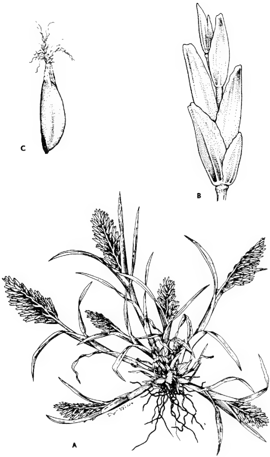

FIG. 1. *Sclerochloa dura*. A, plant, × 2/3. B, spikelet, × 7 1/2. C, caryopsis, × 10 1/2.

Lolium perenne, *Matricaria discoidea*, *Poa angustifolia*, *P. annua*, *Polygonum arenastrum*, *Stellaria media*, and *Veronica hederifolia*.

The specimens of *S. dura* we have seen were collected from late winter ("February," Texas) to early summer (20 July, Washington), but mostly from mid April to early June. Green during the first part of the growing season, the plants eventually become light yellow-brown. At this time they are easiest to locate, as areas infested by the species change color. Yellow-brown ballfields are a common sight where the species is dominant. The plants often persist, unshattered and dead, until mid July (at least in Oklahoma and Utah, where most of our observations of growing plants were made). Seed dispersal is often accomplished, we believe, through disturbance of these dried plants. The dispersal units may consist of one or more florets, one or more spikelets, irregular pieces of inflorescence, more or less intact inflorescences, or even entire culms or plants.

Like many grasses, *S. dura* has had a tortured nomenclatural history. It was originally described by Linnaeus (Linnaeus 1753) as *Cynosurus durus*. Thereafter, Scopoli (1772) included it in *Poa*; Villars (1787), in *Festuca*; and Lamarck (1791), in *Eleusine*. Beauvois (1812) established the genus *Sclerochloa* to accommodate the species. There, except for a transfer to *Sesleria* by Kunth (1829), it has rested ever since.

The chromosome number of *S. dura* was reported by Stace (1980) as $2n = 14$ and by Tsvelev (1983) as $x = 7$.

A second species of *Sclerochloa*, *S. woronowii* (Hack.) Tsvelev, originally described as a species of *Scleropoa* in 1912, is known from Syria, Iraq, the Caucasus, and Afghanistan (Bor 1968).

The description of *S. dura* below is based mainly on our study of many herbarium specimens of this species; figures in brackets are literature data we could not confirm. We offer it as a supplement to descriptions of the species we have seen (Bor 1968, 1970; Clayton & Renvoise 1986; Cope 1982; Cronquist et al. 1977; Gould 1975; Gould & Shaw 1983; Hegi 1906; Hitchcock 1935, 1950; Ladd 1983; Maire 1955; Roshevits 1980; Rugolo de Agrasar 1980; Stace 1980; Swallen 1931; Tsvelev 1983; Watson & Dallwitz 1980, 1988). Rosengurtt et al. include data on lipids in the central endosperm of *S. dura*; Watson & Dallwitz (1988), data on anatomy (see also Dallwitz [1980] and Watson et al. [1986]).

SCLEROCHLOA DURA (L.) Beauv., Ess. Agrost. 98. 1812.

Cynosurus durus L., Sp. Pl. ed. 1:72. 1753.
Poa dura (L.) Scop., Fl. Carn. 1:70. 1772.
Festuca dura (L.) Vill., Hist. Pl. Dauph. 2: 94. 1787.
Eleusine dura (L.) Lam., Tab. Encycl. Méth. Bot. 1:203. 1791.
Sesleria dura (L.) Kunth, Rév. Gram. 1:110. 1829.
Crassipes annuus Swallen, Amer. J. Bot. 18:684. 1931.

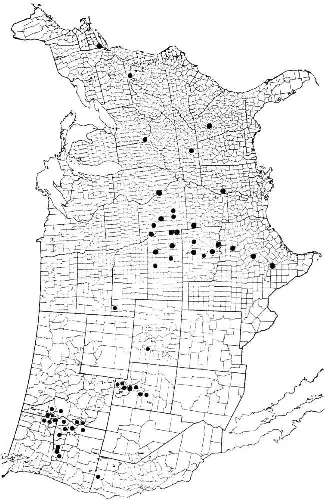

FIG. 2. *Sclerochloa dura*. Documented distribution by county in the United States.

Annual. Plants often matted, occasionally solitary, green but becoming stramineous in age. **CULMS** generally prostrate or procumbent to ascending but sometimes erect, branched, 2 − 18(30) cm tall though mostly less than 15 cm, many from tillering at basal nodes, the nodes glabrous, the internodes glabrous, solid or hollow with narrow lumen, more or less flattened. **LEAVES** basal and cauline, strongly overlapping toward base, usually overtopping inflorescences, the junction of sheath and blade not well defined; *sheaths* closed and tubular in lower 1/4 to 1/2, open above, more or less rounded on lower leaves, rounded to keeled on upper leaves, longer than internodes, glabrous, the margins conspicuously and broadly hyaline, the upper sheaths often inflated; *auricles* absent; *ligules* membranous, broadly triangular, (0.3) 0.75 − 2 (3.3) [3.5] mm long, glabrous, the margin entire to more or less lacerate, the apex acute; *collars* pale white to yellowish white, glabrous; *blades* flat or folded, (0.15) 0.5 − 5 (7) cm long, 1 − 4 mm wide, glabrous above and below or scaberulous on midrib, the apex boat-shaped, the margins entire or scaberulous. **INFLORESCENCE** oblong to broadly elliptic, 1 − 4 [5] cm long, 0.5 − 2 [4] cm wide, often partially enclosed in the upper leaf sheath(s), the spikelets overlapping on short, thick pedicels (or nearly sessile) arranged along one side of a more or less zig-zag rachis; middle (and sometimes lower) nodes bearing short branches with 2 − 5 spikelets, spikelets solitary at upper (and usually lower) nodes, rarely with all nodes bearing only single spikelets; no general mode of disarticulation (see text above). **SPIKELETS** narrowly oblong, laterally compressed, (3.4)5 − 12 mm long; *florets* (2)3 − 4(7), upper one or two sterile, the first floret more or less sessile, remaining florets on rachilla joints 1 − 3.5 mm long and ca. 0.5 mm wide; *glumes* weakly dorsally compressed, both shorter than first lemma, awnless, chartaceous, glabrous, the apices blunt or emarginate, the margins broadly hyaline; first glume lanceolate to narrowly oblong, 1.4 − 3(3.7) mm long, nerves (1) 3 (5); second glume oblong to elliptic, longer than first glume, 2.6 − 5.4 (6.2) mm long, nerves (3 or 5) 7 (9); *lemmas* awnless, oblong to narrowly lanceolate, laterally compressed, (3.4) 4.5 − 5.8 (7) mm long in first floret, (0.4) 1 − 4.5 (5.9) mm long in remaining florets, chartaceous-indurate, glabrous or scaberulous on midnerve toward apex, incompletely and irregularly (5) 7 − 9 nerved, the nerves parallel, the apex obtuse, the margins broadly hyaline; *paleas* dorsally compressed, ca. 0.5 − 1.5 mm shorter than to equalling the lemma, 2-nerved, glabrous or, in upper half of keels, scaberulous, the keels slightly winged in upper 1/2; apex blunt to variously lobed or notched; margins broadly hyaline. **STAMENS** 3, anthers 0.8 − 1.3 [1.5] mm long. **LODICULES** 2, broadly oblong to oval, 0.75 − 2 mm long, clawed at base, the apex entire to somewhat lacerate, the margins entire. **CARYOPSES** yellowish brown, narrowly lanceolate in outline, 2.1 − 3.5 mm long, 0.8 − 1.4 mm wide, rugulose, weakly trigonous, beaked by remnants of persistent styles/stigmas.

ACKNOWLEDGEMENTS

We acknowledge aid from John R. Baird, Jeremy Bruhl, Douglas Ladd, Clive Stace, and Kathleen Stewart. The illustration of *S. dura* is the work of Paul W. Nelson. Herbaria from which we borrowed specimens of *S. dura* are ARIZ, CAS, CHSC, CINC, COLO, DAO, DS, F, FLAS, GH, HSC, ID, ILL, ISC, KANU, KNK, KSC, LL, MICH, MIN, MO, MONT, MU, ND, NLU, NY, OKL, OKLA, OMA, OSC, PENN, PH, RMS, SDC, SMS, SMU, TAES, TENN, TEX, UARK, UBC, UC, UCM, UMO, US, USF, UTC, VDB, WARM, WILLU, WIN, WIS, WS, WTU, and WVA. A list of specimens we examined is available upon request to JWT. The following herbaria had no specimens of *S. dura*: ASC, BAYLU, BHSC, CSCN, FHKSC, ILLS, KNFY, KSTC, NMC, NSMC, PUSC, ROPA, SAT, SDU, SOC, SRSC, TTC, UNLV, UNM, WCW, and WWB.

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SEEDLING MORPHOLOGY IN *CLEMATIS* (RANUNCULACEAE) AND ITS TAXONOMIC IMPLICATIONS

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ABSTRACT

Seeds of 58 species of *Clematis* and *Clematopsis* were obtained from a variety of sources, germinated, and their seedling and juvenile morphology observed. Two very distinctive patterns emerged, each consisting of a cluster of characters. In Type I seedlings, the eophylls are alternate and toothed. Hypocotyls are elongate (except in *Clematopsis*), elevating the cotyledons and apical bud above ground, and buds are lacking in the axils of the cotyledons. Such seedlings are similar to those found in related genera such as *Anemone*, and are found in *Clematis* in the infrageneric taxa *Clematis, Lasiantha, Connatae, Tubulosae, Atragene, Meclatis, Cheiropsis, Bebaeanthera, Naraveliopsis, Papuasicae*, and in the genus *Clematopsis*. In Type II seedlings, leaves are paired from the beginning, but the first 1 – 3 pairs are usually reduced to cataphylls. Leaves are generally entire, often becoming lobed or divided, but not toothed. Hypocotyls are short, keeping the cotyledon bases and the epicotyl at first subterranean. Buds are typically present in the axils of the cotyledons. Such seedlings are found in the infrageneric taxa *Crispae, Viticella, Patentes, Rectae*, and *Angustifoliae*. These differences in seedling morphology and some correlated characters suggest a fundamental split in the genus and a basis for a revised infrageneric classification.

RESUMEN

Semillas de 58 especie de *Clematis* y *Clematopsis* fueren obtenido de orígenes diversos, se germinó, y sus morfoligía juvenil se observió. Dos modelos distintos se manifestaron, cada uno consite en un grupo de varios caracteres. En las plantas de semilleros del Tipo Uno los eofilos son alternos y dentados. Los hipocotilos son alargados (con exclusión de *Clematopsis*), y elevan los cotiledones y la yema cimera sobre la tierra. Yemas son ausente de las axilas do los cotiledones. Plantas de seimlleros de este tipo son semejante a aquellas hallado en géneros relatados como *Anemone*. Se encuentran en las taxa infragenéricas *Clematis, Lasiantha, Connatae, Tubulosae, Atragene, Meclatis, Cheiropsis, Bebaeantehra, Naraveliopsis, Papuasicae*, de *Clematis* y en el género *Clematopsis*. En plantas de semilleros del Tipo II, todas hojas son opuestas, per las parea 1 – 3 son usualmente reduciendo a catáfilos. Las hojas son usualmente enteras, frecuentemente lobados pero no dentados. Hipocotilos son corto, y las bases de los cotiledones y la yema cimera se quedan subterráneo. Yemas se encuentran en las axilas de los cotiledones. Plantas de semilleros de este tipo se hallan en las taxa infragerérricas *Crispae, Viticella, Patentes, Rectae*, y *Angustifoliae*. Estas differencias morfológicas de las plantas de semilleros y algunes caracteres correlativos sugeron una división fundamental in el género y un fundamento para revisar la clasificación infragenérica.

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INTRODUCTION

The genus *Clematis* is a large and diverse genus of the presumedly archaic family Ranunculaceae. Found on every continent except Antarctica, the approximately 300 species of *Clematis* occur in nearly every climatic zone from the taiga to the equatorial tropics, and display a wide variety of both vegetative and floral forms. There has been no comprehensive revision of the genus since that of Kuntze (1885), but there have been recent efforts to develop a modern infrageneric classification. Authors have subdivided the genus in various ways (see Keener & Dennis, 1982, for a review), some dividing it into subgenera, others dividing it into sections. Tamura (1967) divided *Clematis* into 12 sections (Table 1) in the most comprehensive of recent classifications. His great familiarity with Asiatic Ranunculaceae allowed him to define fairly precisely various infrageneric taxa occurring in that region, but species from other regions, particularly Africa and New Zealand, are sometimes difficult to place in his system. Tamura did not attempt to group his sections into subgenera, perhaps feeling that there was insufficient basis for recognizing major divisions within the genus.

Keener and Dennis (1982), on the other hand, divided the native and naturalized North American species into four subgenera, drawing upon earlier subgeneric concepts. They did not attempt to incorporate the old world taxa into their system, or to further divide their subgenera into sections, etc., stating that a new world-wide monographic treatment would be needed in order to accomplish this. Thus, the reconciliation of Tamura's sectional classification with the subgeneric system of Keener and Dennis remains to be done.

Tamura's system emphasizes floral and inflorescence characters, as can be seen in Table 1. The best and most natural classification systems generally result, however, when a full range of characters from flower, fruit, seed, seedling, and vegetative shoots are employed. Study of additional characters, particularly vegetative characters, and perhaps also cytological and chemical characters, is therefore needed in this genus. A comprehensive new classification should reflect major lines of evolution at the subgeneric level, and link the sections, subsections, etc. in a hierarchical fashion.

In building up a collection of tropical and subtropical species of *Clematis* at the University of South Florida Botanical Garden, striking differences in seedling morphology and related vegetative features were noticed, suggesting that a survey of the genus would be worthwhile. Little has been recorded concerning seedling morphology in *Clematis*, despite the fact that numerous species have been cultivated over the past two centuries. Lubbock (1892) described and illustrated the seedlings of three species (*C. recta* L., *C. orientalis* L. (as *C. graveolens* Lindl.), and *C. (Atragene) alpina*

TABLE 1. Classification of the Clematis alliance according to Tamura 1956, 1967), with distinguishing characters as reported by Tamura; asterisk indicates taxa known to have Type II seedlings.

- Genus CLEMATIS [leaves opposite, sepals valvate]
  - Section *Viorna* [sepals erect, often colored, stamen filaments hairy]
    - Subsection *Connatae* [woody vines, leaves toothed]
    - Subsection *Tubulosae* [erect semi-shrubs, leaves toothed]
    - *Subsection *Crispae* [perennial herbs or weak-stemmed vines, leaves entire]
  - Section *Bebaeanthera* [as in Viorna, but flowers fasciculate with new growth]
  - Section *Atragene* [flowers with stamen-derived "petals," leaves toothed]
  - Section *Meclatis* [sepals spreading to erect, mostly yellow to orange, stamen filaments hairy]
    - Subsection *Orientales* [flowers few to many in axillary or terminal clusters]
    - Subsection *Tanguticae* [single flowers terminating new shoots]
  - Section *Clematis* [sepals spreading, whitish, stamen filaments glabrous, leaves mostly toothed]
    - Subsection *Pterotianae* [flowers 3–3.5 cm diam., stamen filaments dilated downward]
    - Subsection *Vitalbae* [flowers < 3cm diam., stamen filaments filiform]
    - Subsection *Dioicae* [as above, but flowers mostly dioecious]
    - Subsection *Aristatae* [as above, but stamen connective projected]
    - Subsection *Papuasicae* [similar to above, difference in structure of panicle]
    - Subsection *Crassifoliae* [stamen filaments rugulose, leaves coriacious, entire]
    - *Subsection *Rectae* [anthers elongate; leaves entire]
    - *Subsection *Angustifoliae* [as above but flowers large, with 6 sepals]
  - Section *Cheiropsis* [flowers fasciculate with new growth, large, bisexual, sepals spreading]
  - Section *Lasiantha* [as above but flowers dioecious]
  - Section *Viticella* [flowers large, sepals spreading, colored, stamens glabrous, leaves entire]
    - Subsection *Floridae* [flowers solitary, axillary, subtended by two bracteoles, styles plumose]
    - *Subsection *Viticella* [as above, but styles short, not plumose]
  - *Section *Patentes* [as above but flowers from bud produced in fall]
  - Section *Pterocarpa* [achenes strongly compressed and winged, leaves entire]
  - Section *Fruticella* [woody shrubs with very small leaves]
  - Section *Naraveliopsis* [anther connectives much prolonged, similar to *Papuasicae*]
- Genus **Archiclematis** [leaves alternate throughout, otherwise similar to *Connatae*]
- Genus **Clematopsis** [flowers large, sepals imbricate, otherwise similar to *Connatae*]
- Genus **Naravelia** [flowers with elongate, petal-like staminodes]

(L.) Miller). The seedling morphology of *C. recta* described by Lubbock agrees with the "Type II" morphology described in this paper, while that for *C. graveolens* and *C. alpina* agree with the "Type I" morphology described here. Erickson (1945) illustrated *C. fremontii* S. Watson var *riehlii* Erickson, and it agrees with "Type II."

This study was undertaken then in anticipation that unrecognized and overlooked vegetative features, such as those of the seedling, might provide clues to the major lines of evolution in the genus that are ambiguous when only floral features are used.

MATERIALS AND METHODS

Efforts were made to obtain seed of species representing all recognized infrageneric taxa in *Clematis* and of several closely related genera, following the classification of Tamura (1967, see Table 1). According to Tamura, three genera, *Archiclematis, Clematopsis*, and *Naravelia*, are distinct from *Clematis*, but closely related. Each has been included in it by various previous authors. Therefore, they have been considered in this study, although I thus far have only obtained seed of *Clematopsis*. Altogether, Tamura's smallest units (subsections and undivided sections), plus the three related genera, make 26 initial units for systematic study.

Seedlings of 58 species, representing 20 of these 26 units (Table 2) were observed. Seeds were obtained from a variety of sources, including botanical gardens, commercial seed companies, and private collectors. Seeds of native Florida species and some others were collected by the author. Seed from cultivated sources frequently prove to be misidentified or of dubious or mixed ancestry. Therefore, great care has been taken to assure that the material reported upon has been accurately identified. Identity of all specimens is being verified as the plants become mature, and specimens whose identity or infrageneric placement is still uncertain are not included.

Seeds were germinated in a greenhouse at the USF Botanical Garden, some only after stratification and/or a long period of dormancy. Many plants were later transferred to an outdoor experimental plot. All accessions were photographed after the first leaf appeared and often at later stages. Seedlings of many species were preserved and examined under a dissecting microscope. Voucher specimens and photographs are being made as each specimen blooms for the first time.

TABLE 2. Species examined (all cultivated at USF Botanical Garden).

Name	*Taxon*	*Type*	*USF Acc. #*
C. addisonii Britton	Crispae	II	87-40
C. alpina Miller	Atragene	I	87-41
C. apiifolia DC.	Vitalbae	I	82-22
C. aristata R. Br.	Aristatae	I	87-57
C. baldwinii Torrey & A. Gray	Crispae	II	86-25
C. barbellata Edgew.	Bebaeanthera	I	87-139
C. brachiata Ker.-Gawl	Vitalbae	I	87-2
C. buchaniana DC.	Connatae	I	87-104
C. campanuliflora Brot.	Viticella	II	87-33
C. catesbyana Pursh	Dioicae	I	85-9, 86-35
C. chinensis Osbeck	Rectae	II	88-2
C. chrysocoma Franchet	Cheiropsis	I	87-48

TABLE 2 (Continued)

C. cirrhosa L.	Cheiropsis	I	87-5
C. crispa L.	Crispae	II	85-2
C. denticulata Vell.	Dioicae	I	87-79
C. drummondii Torrey & A. Gray	Dioicae	I	87-34
C. filamentosa Dunn	Naraveliopsis	I	87-58
C. flammula L.	Rectae	II	87-121
C. fusca Turcz.	Crispae	II	87-122
C. gentianoides DC.	Aristatae	I	86-28
C. glaucophylla Small	Crispae	II	87 136
C. grata Wallich	Vitalbae	I	87-105
C. heracleifolia DC.	Tubulosae	I	87-53
C. hexapetala Pall.	Angustifoliae	II	87-71
C. hirsutissima Pursh	Crispae	II	86-30
C. integrifolia L.	Crispae	II	85-3
C. intricata Bunge	Meclatis	I	87-70
C. kirilowii Maxim.	Rectae	II	87-76
C. lasiantha Nutt.	Lasiantha	I	87-7
C. leschenaultiana DC.	Connatae	I	87-66
C. ligusticifolia Nutt.	Dioicae	I	87-4, 86-32
C. macropetala Ledeb.	Atragene	I	86-33
C. mandshurica Rupr.	Rectae	II	87-124
C. microphylla DC.	?	?	87-43, 87-55
C. napaulensis DC.	Bebaeanthera	I	87-106
C. orientalis L.	Meclatis	I	86-33
C. orientalis "ladakhiana"	Meclatis	I	87-107
C. papuasica Merr. & Perry	Papuasicae	I	89-1
C. patens Morr. & Decne	Patentes	II	87-140
C. peterae Hand.-Mazz.	Vitalbae	I	87-50
C. pierotii Miquel	Pierotianae	I	86-37
C. pitcheri Sargent	Crispae	II	88-33
C. ranunculoides Franchet	Connatae	I	87-49
C. recta L.	Rectae	II	86-39
C. rehderiana Craib	Meclatis	I	88-24
C. reticulata Walter	Crispae	II	85-7
C. serratifolia Rehder	Meclatis	I	87-125
C. tangutica Korsh	Meclatis	I	87-73
C. terniflora DC. (as C. paniculata)	Rectae	II	85-6
C. terniflora DC.	Rectae	II	85-8
C. texensis Buckley	Crispae	II	87-38, 87-78
C. viorna L.	Crispae	II	88-32, 87-39
C. vitalba L.	Vitalbae	I	86-1a, 86-42
C. viticella L.	Viticella	II	88-39
CLEMATOPSIS			
C. villosa DC.		I	86-45
C. scabiosifolia Viguier & Perrier var. kirkii	Oliver	I	86-47
C. anethifolia Hook.		I	88-42

FIG. 1. Seedling types. A. Type I seedling of *Clematis heracleifolia* DC. B. Type II seedling of *Clematis crispa* L. C. Type I seedling of *Clematis catesbyana* Pursh. D. Type II seedling of *Clematis terniflora* DC.

RESULTS

The specimens studied fall into two major categories with respect to four distinct sets of characters involving not only seedling morphology, but also aspects of the adult foliage and the achenes. The features associated with each type of seedling are summarized in Table 3, and discussed in detail below. A summary of Tamura's taxa falling into the two categories, along with the taxa that have not yet been studied is presented in Table 4.

1. Seedling phyllotaxy

In Type I seedlings (Figure 1A,C), the first several eophylls (seedling leaves) are alternate, and closely spaced, forming a small rosette at the apex of the hypocotyl. This alternate phyllotaxy later gives way to the opposite phyllotaxy typical of the adult plants, usually at the time that internodal elongation begins. This may happen as early as the third and fourth leaves in some taxa, but in *Connatae* and *Clematopsis*, leaves may remain alternate throughout the first juvenile shoot. The genus *Archiclematis* has been segregated from *Clematis* on the basis of its permanently alternate phyllotaxy. In section *Meclatis*, the first eophyll is typically followed quickly by a second eophyll without internodal elongation, giving the appearance of opposite or subopposite leaves. Internodal elongation in *Meclatis* begins after 2 or 3 eophylls, while the leaves are still alternate.

Type II seedlings (Figure 1B,D, 2L) contrast strongly in that leaves are opposite from the beginning, and several sets of paired cataphylls are produced before any leaflike eophylls are produced. Internodal elongation is present from the beginning also, even during the catophyll stage, except that the first pair of catophylls may be produced immediately above the cotyledons (e.g. in *Clematis crispa* L.).

TABLE 3. Characters distinguishing Type I from Type II *Clematis*.

Character	*Type I*	*Type II*
Phyllotaxy of seedling	alternate	opposite
Hypocotyl	mostly elongate (except in *Clematopsis*)	suppressed
Initial shoot	condensed rosette	elongate
Cataphylls	absent	several pairs present
Eophyll margin	toothed	entire
Adult foliage	most often toothed and membranous, or entire and glossy-coriaceous	often lobed or dissected but not toothed, mostly membranous
Regenerative buds	in aerial leaf axils or (in *Clematopsis*) in subterranean axils of rosette eophylls	in subterranean axils of cotyledons and some cataphylls
Growth form	woody vines or shrubs; many rooting at aerial nodes	perennial erect herbs, weak-stemmed vines or sometimes woody vines; these regenerating from subterranean buds
Achenes	laterally compressed, but narrow, turgid	broad, very flat

2. Eophyll and leaf morphology.

In Type I seedlings, leaf shape varies considerably (Figure 2C – K), but eophylls are typically broad, sometimes 3-lobed, with small veins diverging from the peripheral region and terminating in marginal teeth. This pattern usually persists in the adult foliage, and most of the taxa with Type I seedlings have conspicuously dentate foliage throughout the plant. In Section *Meclatis* the first eophylls are narrow and little-toothed (typically entire to irregularly 1-toothed — Figure 2I,J), but subsequent leaves are dentate. Section *Atragene*, considered a distinct genus by some authors, differs from the common form only in that the first eophylls are deeply divided (Figure 2C).

In Type II seedlings, The first eophylls (after the cataphylls) are mostly elliptic-ovate and entire, although in *C. terniflora* the first eophylls are sometimes 3-lobed at the tip (Figure 1D). Adult foliage may be variously divided and lobed but never toothed as in Type I species.

3. Cotyledon, hypocotyl orientation, and habit.

In the terminology of Duke and Polhill (1981) most Type I seedlings are phaneroepigeal, i.e. the cotyledons and epicotyl are elevated above ground by an elongate hypocotyl. As adults, Type I plants are mostly woody vines, or in subsection *Tubulosae*, suffrutescent shrubs. Branching can occur only from aerial nodes above the hypocotyl. Many species, however, readily form adventitious roots when aerial shoots touch the ground, and can spread quite rampantly in this way.

In the three species of *Clematopsis* examined, which otherwise have all the characteristics of Type I species, the cotyledons emerge from the ground, but the hypocotyl does not elongate and the cotyledon bases, and initially the epicotyl, remain below ground (phanerohypogeal). Several eophylls are produced without internodal elongation, forming a small rosette, and these subterranean nodes form a rootcrown with buds that can repeatedly regenerate the plant if the top dies off due to drought, fire or normal seasonal cycles.

Type II seedlings are all hypogeal, as the hypocotyl does not elongate, although the blades of the cotyledons may emerge (phanerohypogeal). In this one respect they are similar to the species of *Clematopsis* mentioned above. However, in Type II plants, an elongate shoot is produced directly, without formation of a rosette. Regenerative buds are produced in the axils of the cotyledons and some of the lowest cataphylls.

The predominant growth form in Type II *Clematis*, at least in subsections *Crispae* and *Angustifoliae*, and in *Clematis recta*, is a perennial herb or weak-stemmed vine, in which stems die back to the ground each winter. The underground rootcrown established by the seedlings allows for repeated renewal of the plant in successive growing seasons. Other taxa with Type II seedlings, such as *Clematis terniflora* and several of its Eurasian relatives in section *Rectae*, along with the sections *Viticella* and *Patentes* have persistent

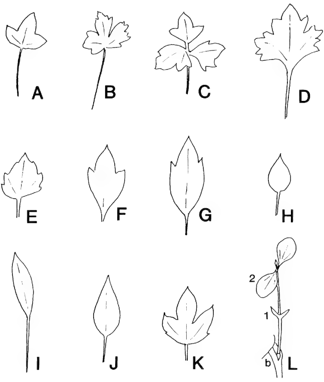

FIG. 2. Variation in first seedling leaf, including outgroup comparisons with *Anemone* (A,B); A-K represent Type I seedlings, L is Type II. A. *Anemone pulsatilla* L. (*Pulsatilla vulgaris* Miller). B. *Anemone berlandieri* Pritzel. C. *Clematis* (*Atragene*) *alpina* Miller. D. *Clematis chrysocoma* Franchet. E. *Clematopsis villosa* DC. F. *Clematis papuasica* Merrill & Perry. G. *Clematis gentianoides* DC. H. *Clematis filamentosa* Dunn. I. *Clematis orientalis* L. J. *Clematis tangutica* Korsh. K. *Clematis microphylla* DC. (one of two opposite leaves). L. *Clematis fusca* Turcz. (first and second pair of leaves are numbered; "b" indicates position of buds in axils of cotyledons).

TABLE 4. Summary of Tamura's (1967) infrageneric taxa displaying Type I and Type II morphologies.

Type I	*Type II*	*Undetermined*
Vitalbae	Crispae	Crassifoliae (prob. I)
Pierotinae	Rectae (Eurasian group)	Rectae (tropical Asian) (prob. I)
Dioicae	Viticella	Fruticella (?)
Bebaeanthera	Patentes	Pterocarpa (prob. II)
Lasiantha	Angustifoliae	Floridae (prob. II)
Cheiropsis		Naravelia (prob. I)
Aristatae		Archiclematis (prob. I)
Naraveliopsis		
Papuasica		
Connatae		
Tubulosae		
Meclatis		
Atragene		
Clematopsis		

woody stems, but even in well-established plants, new shoots can arise from the subterranean buds at the base of the original shoot.

There is a strong trend toward cryptohypogeal germination in this group, in which the cotyledons remain within the seedcoat below ground. The specimens studied of *Clematis viorna, reticulata, fusca, texensis, pitcheri, glaucophylla,* and *patens* were cryptohypogeal, while *C. integrifolia, crispa, baldwinii, terniflora, hexapetala* and *kirilowii* were phanerohypogeal.

4. Achene shape.

Achenes in Type I taxa, although laterally compressed, tend to be small and turgid, while those in Type II taxa tend to be very broad and flat, and often have a conspicuously thickened rim.

Of all the specimens examined, just one appears to be intermediate between Type I and Type II seedlings. Specimens of *Clematis microphylla* DC from Australia have seedlings with an elongate hypocotyl, with the eophylls strongly 3-lobed and toothed. Eophylls are paired from the beginning, however, and there are buds in the axils of the cotyledons, the internodes are elongate after the first pair of leaves, and the achenes are broad and flat. Whether this species is phylogenetically intermediate between the two types or represents convergence or reversal in some characters remains to be elucidated through further study.

DISCUSSION

This survey of seedling morphology and correlated characters of the foliage and achenes reveals two well-defined patterns in *Clematis* (Table 3), suggesting a fundamental and natural division in the genus that could provide the basis for clearly defined subgenera. Taxonomic division of the genus along Type I and Type II lines (Table 4) would, however, require a radical departure from the traditional system of Tamura (1967), which was based primarily on floral characters (Table 1). It would cut across Tamura's two largest sections, *Clematis* and *Viorna*, and require a regrouping of the smaller sections.

Traditionally, section *Clematis* is defined as having numerous, small, upright flowers, usually produced in complex dichasial panicles, and with thin, spreading, whitish sepals (true petals are lacking in the genus) and glabrous stamens. Section or subgenus *Viorna*, on the other hand, is characterized by relatively large, generally nodding, urn-shaped flowers with rather thick, colored, erect sepals and hairy stamen filaments, and which are either solitary or in few-flowered inflorescence units. Both sections, however, contain subgroups with Type I and Type II morphologies (Table 1). The smaller sections are mostly distinguished on the basis of minor variation from one of these two patterns, and most likely will not be found to contain more than one seedling type.

Adherence to the traditional system of classification (Table 1) would require the interpretation that the rather extended set of specialized Type II vegetative characters, including fundamental differences in embryonic development, evolved independently several times, presumably in response to similar ecological conditions. The alternate system, based on a division between Type I and Type II seedling morphology, requires the interpretation that similar floral types, particularly small white flowers produced in masses, have evolved at least twice in the genus, in response to a common pollination strategy.

Which of these two alternatives most likely reflects the actual phylogeny of the genus, and should therefore serve as the basis for an infrageneric classification? The most parsimonious alternative is the latter one, i.e. a primary division along the lines of seedling morphology, with later radiation and convergence of pollination types. The changes involved in seedling morphology are complex, involving many changes in the shape, venation and phyllotaxy of the embryonic leaves, and in the growth pattern of the seedling axis. The changes required to shift pollination strategies are by contrast rather simple: increased branching of the inflorescence, reduction in size and pigmentation of the flowers, and loss of hairs on the stamen filaments. Similar shifts have occurred in many plant families.

Some additional information can be interjected at this point. Data on historical hybridization within the genus, although somewhat scant, supports the natural division of *Clematis* along Type I and Type II lines. This genus has been popular in horticulture for several centuries and many hybrids have been made. As far as can be gathered from the horticultural literature, however, no hybrids have ever been made between Type I and Type II taxa, even those having similar looking flowers and placed traditionally in the same section. On the other hand hybrids have been made between species with small white flowers and species with large colored flowers placed traditionally in different sections, but sharing the same seedling and vegetative morphology. Notable are the crosses between Type I taxa *Vitalbae* (section *Clematis*) and *Tubulosae* (section *Viorna*), between Type II taxa *Rectae* (section *Clematis*) and *Crispae* (section *Viorna*), and between *Rectae* and section *Viticella* (also Type II) (Table 5). Many of the most popular garden hybrids arose from crosses among the various large-flowered Type II taxa that are placed in separate sections in Tamura's system. Multiple attempts by the author at hybridization between *Clematis terniflora* DC (Type II) and the superficially similar *C. catesbyana* Pursh (Type I), which are traditionally placed in the same section, caused initiation of achenes, but these all aborted after a few weeks.

Based on the data presented here, the following phylogenetic scenario for *Clematis* is suggested: Type I seedling characters and related morphology represent the ancestral or plesiomorphic condition, as they occur in related genera such as *Anemone* (Figure 2A,B). The ancestral population of *Clematis* therefore had Type I seedlings, coarsely toothed foliage, and flowers with large, colored, erect to spreading sepals and hairy stamens. These early *Clematis* were essentially like many members of the modern subsection *Connatae*. An early lineage developed Type II characters, apparently in response to strongly seasonal climates. These characters included the suppression of hypocotyl elongation, the resulting hypogeal germination, and the regenerating rootcrown. Within both Type I and Type II lineages, one or more groups shifted, in parallel, to small, more numerous, white flowers with glabrous stamens, adapting to a rather common and successful pollination syndrome. Other Type I and Type II groups retained the ancestral type of flower.

TAXONOMIC CONCLUSIONS

Although considerable study is still needed before a complete new infrageneric classification can be developed for *Clematis*, the system of subgenera employed by Keener and Dennis (1982) and earlier workers can be supported and extended to the old world taxa defined by Tamura (1956,

TABLE 5. Historic hybrids among infrageneric taxa.

Type I × Type I
Vitalbae × Tubulosae (C. × jouiniana C. K. Schneider, fide Hortus Third, 1976)
Vitalbae × Tubulosae (C. × takedana Makino, fide Ohwi, 1965)
Type II × Type II
Viticella × Crispae (*C.* × *eriostemon* Decne., fide Hortus Third, 1976)
Viticella × Crispae (*C.* × *cylindrica* Sims, fide Kuntze, 1885)
Viticella × Florida (*C.* × *jackmanii* T. Moore, fide Hortus Third, 1976)
Florida × Crispae (*C.* × *durandii* Durand, fide Kuntze, 1885 and Hortus Third, 1976)
Florida × Patentes (*C.* × *lawsoniana* T. Moore & Jackmann, fide Hortus Third, 1976))
Crispae × Rectae (*C.* × *aromatica* Lenne & Koch, fide Kuntze, 1885 and Hortus Third 1976)
Rectae × Viticella (*C.* × *violacea* A.P. DeCandolle, fide Kuntze, 1885)
Rectae × Viticella (*C.* × *rubromarginata*, fide Lloyd 1965)

1967), with the following specific modifications suggested by the current data:

1. Type I taxa include the type species (*Clematis vitalba* L.) of subgenus *Clematis* sensu Keener and Dennis, and therefore Type I characters can be considered definitive for subgenus *Clematis*.

2. Type II taxa include the type species (*Clematis viorna* L.) of subgenus *Viorna* sensu Keener & Dennis (and genus *Coriflora* Weber 1982), and therefore Type II characters should be considered definitive for subgenus *Viorna*.

3. Part of subsection *Rectae* (the two series, *Rectae* and *Chinenses*, defined by Tamura in 1956) should be transferred from subgenus *Clematis* to subgenus *Viorna*. The remaining series in subsection *Rectae* (series *Crassifoliae, Meyenianae,* and *Uncinatae*) need further study, but based on the shape of their achenes and rather different foliage, most likely will be excluded from *Rectae*.

4. Subsection *Angustifoliae* should be included under subgenus *Viorna*. It differs very little from subsection *Rectae*.

5. Tamura's subsections *Connatae* and *Tubulosae* of his section *Viorna* should be transferred to subgenus *Clematis*.

6. Subgenus *Viticella* (Moench) Keener & Dennis should be reconsidered. It shows much affinity with other Type II taxa, and probably should be included as a section under *Viorna*.

7. Subgenus *Atragene* should be reconsidered. It has Type I seedling morphology and differs from subgenus *Clematis* only in the usual presence

of petal-like staminodes. It possibly should be included as a section under subgenus *Clematis*.

8. *Clematopsis* has been excluded from *Clematis* in the past primarily because of its broad, imbricate sepals, which contrast with the valvate sepals of *Clematis*. Otherwise, it has the characteristics of the genus *Clematis* and fits in with the old world complex of Type I taxa. Thorough study of the African *Clematis* is needed in order to determine the appropriate status for this taxon.

Placement of other sections, and formal infrageneric reorganization of *Clematis*, is deferred pending more complete studies. Recognition of the two major phyletic lines in the genus, should, however, make it easier to proceed with revisionary and phylogenetic studies. It is recommended that future uses of the subgeneric taxa *Clematis* and *Viorna* reflect the changes outlined here.

ACKNOWLEDGEMENTS

I thank all of the individuals and institutions who kindly provided seed for this study.

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A NEW SPECIES OF *CONRADINA* (LAMIACEAE) FROM NORTHEASTERN PENINSULAR FLORIDA

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ABSTRACT

Conradina etonia, a new species of shrubby mint endemic to northern peninsular Florida is diagnosed, described, and figured. Differences between it and its closest morphological relative, *C. grandiflora* Small, are detailed. Attention is given to the fact that *C. etonia* is a narrow endemic, that it is on land being developed presently for residential use, and that it therefore should receive a high conservation priority.

Conradina (Lamiaceae) as currently treated (Shinners 1962; T. C. Gray, unpublished Ph.D. thesis 1965) is a genus of five allopatric species bicentrically confined to the southeastern United States. One center is interior, where the arenaceous rocky bars and bluffs of Cumberland Kentucky and Tennessee streams support *C. verticillata* Jennison, a threatened species. The other center is lower Coastal Plain. *Conradina canescens*, the most abundant and polymorphic species, occupies coastal dunes, white sand scrub and contiguous longleaf pineland from southeastern Mississippi eastward across southern Alabama and the Florida Panhandle. Inland locally is the rare *C. glabra* Shinners, a narrow endemic growing chiefly around the rims of steepheads on the east side of Florida's Apalachicola River. The two remaining species (*C. brevifolia* Shinners and *C. grandiflora* Small) are found in sand scrub habitat in Central Florida (Polk and Highlands counties) and in eastern peninsular Florida, respectively. As mentioned, of the four species in the southern center, only *C. canescens* is at once abundant within a fairly large range and exhibits considerable variation. The other three have more restricted ranges and show less variation within or between popula-

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tions. Most circumstantial evidence, both morphological and geographic, points to a relatively recent origin for the species in peninsular Florida.

All four Coastal Plain Conradina are confined to sandy soils. Major portions of Florida with deep, well-drained sand once supported extensive forests of Longleaf Pine (*Pinus palustris*) with a ground layer dominated by Wiregrass (*Aristida stricta*). This system was maintained by and dependent upon relatively frequent, low-intensity ground fires. The more xeric Longleaf Pine-Wiregrass ecosystems are here referred to as "sandhill." These contrast with those finer textured (often aeolean) deposits of white sand which support the scrub ecosystem characterized by Sand Pine (*P. clausa*) and shrubby evergreen oaks such as *Quercus geminata* and *Q. myrtifolia* and are referred to here as "sandscrub." Historically this latter system burned infrequently but catastrophically. All who have studied the flora of the two basic systems know that both are very rich in endemics and that many species occupy very limited and circumscribed ranges within them. Scrub ecosystems, once exclusive to Florida or best developed there, have been so heavily impacted by agricultural and other development along with fire suppression that only fragmentary, often degraded, remnants exist today. Conservation agencies are actively working to preserve key areas, particularly in the Lake Wales Ridge area of Central Florida where an unusual concentration of rare endemics occurs.

The typical scrub habitat and several of the plant and animal species associated with it reach their northern geographic limits in the center of the Florida peninsula west of Saint Augustine. One such northern extension of deep sand scrub was investigated by the junior author on September 20, 1990. This area along Etonia Creek northeast of Florahome in Putnam County, was noted to have several species not only characteristic of south Florida scrub but also at or near their very northern limits (i.e. *Persea humilis*, *Ilex cumulicola*, *Garberia fruticosa*). An endangered bird, the Scrub Jay, was also seen, but curiously the Scrub Palmetto (*Sabal etonia* Swingle ex Nash), named for this locality, was not observed.

Most interesting of all, however, was the discovery within a small area of the Etonia Scrub of a distinctive *Conradina*, seemingly a new species. A limited amount of material for exsiccatae and for propagation was collected and living plants from cuttings are now part of the comprehensive collection of southeastern woody Lamiaceae in cultivation at Woodlanders, Inc., in Aiken, South Carolina. Dr. R. K. Godfrey was given directions to the site and, accompanied by Mr. Angus Gholson, visited the location on 12 October 1990, so as to collect an abundant sample for definitive study. This indispensable aid is hereby gratefully acknowledged.

The affinities of this new plant are plainly with its nearest geographic neighbor in the genus, *C. grandiflora* Small, which ranges intermittently in the coastal scrub of eastern peninsular Florida from Dade County northward to an area in Volusia County roughly 70 air miles southeast of the Etonia Creek site. In general habit and in the large size and general configuration and pigmentation of flower the two look much the same. There are, however, striking differences as will be explained below. We name the new discovery *C. etonia*, after the remarkable locality where it was found.

CONRADINA ETONIA Kral & McCartney, sp. nov. Figs. 1, 2.

Conradina etonia, sp. nov.; differt a *C. grandiflora* foliis latioribus, hebetiviridibus, nervis lateralibus distinguibilibus, utroque latere 2 – 4; paginissurculorum juvenorum, laminorum foliorum et tuborum calicorum uniformiter patenti-puberulis.

Virgate shrubs to 1.5 m high, with numerous, frequently arching primary branches, the new shoots slender, ca. 1 mm thick, quadrate, downy-spreading-puberulent, scattered-glandular, reddish-brown, on older growth thickening, terete, the outer bark exfoliating in long, narrow, gray strips, exposing red-brown or orange-brown smooth inner bark. Leaves deciduous in 2 – 3 years, spreading to ascending, each node with axillary buds typically developing short, leafy shoots, thus foliage appearing fascicled-verticillate; principal leaf blades spreading to spreading-ascending, broadly to narrowly oblanceolate or spathulate, 15 – 30 mm long, (2) 3 – 9 mm wide, tips rounded to broadly acute, margins narrowly and tightly revolute, base narrowly cuneate to attenuate on a short (less than 1 mm) petiole, the adaxial blade surface uniformly downy-spreading-puberulent, copiously and punctately gland-dotted, dull green, the midrib evident at base of a strong median groove, the exposed abaxial surface concave, slightly paler, the puberulence very dense, the midrib strongly raised, likewise with dense spreading puberulence and producing 2 – 4 strong branch nerves per side (a unique trait in this genus!). Cymes produced from all or most nodes from midstem up, (1) 3 – 7 (12) flowered, either subsessile or on spreading-ascending peduncles to 2 (3) mm long, these and the ascending branches all densely and uniformly downy-puberulent, their successive nodes with progressively reduced, narrower, decussately-arranged pairs of similarly downy bracteal leaves; pedicels erect or spreading-ascending, 1 – 3 mm long, ebracteolate, spreading-puberulent. Calyx at anthesis bilabiate, 7.5 – 8.1 mm long, the tube cylindro-campanulate, 5 mm long, distally densely villous-annulate within, otherwise smooth, externally 13-nerved, with nerves uniformly downy and intervals smooth to downy, strongly gland-dotted, the upper lip upswept (1.8) 2 – 2.7 (3) mm long, tridentate, the teeth broadly triangular, strongly hirsute-ciliate, connivent; lower lip directed forward

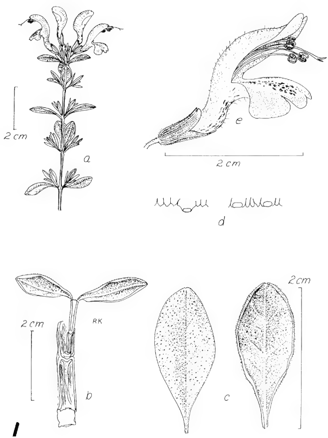

FIG. 1. *Conradina etonia* (*Godfrey* with *Gholson 84008*). — a. Flowering branchlet. — b. Sector of old shoot with branchlet base. — c. Adaxial (left hand) and abaxial (right hand) views of stem leaf. — d. Small sector, ideal cross-section, adaxial surface of leaf (left) and that of abaxial surface (right). — e. Side view of flower at anthesis.

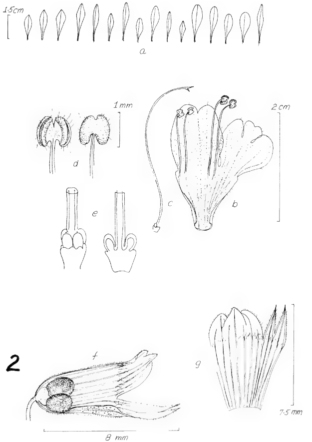

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FIG. 2. *Conradina etonia* (*Godfrey* with *Gholson* 84008). — a. A range of principal shoot leaf types and sizes drawn to scale. — b. Opened corolla (with small portion of tube removed) to show inner surface, stamens. — c. Gynoecium, side view. — d. Adaxial (left) and abaxial (right) view of anthers. — e. Gynoecial base, ideal view, showing placement of nutlets on gynophore (left) and a median longisection showing placentation (right). — f. Calyx, opened to show fruit placement, annulus. — g. Opened calyx to show arrangement of calyx teeth.

and upcurved, 2.5 – 3.1 mm long, cleft to near base, the teeth narrowly triangular-subulate, likewise variably hirsute-ciliate with hairs under 1 mm. Corolla strongly bilabiate, 20 – 25 mm long to tip of lower lip, the slender tube gradually broadened to a geniculation at throat base ca. 2 mm above calyx sinus, funnelform to level of limb, from base to limb densely villose within; upper lip galeate, broadly oblong, 10 – 11 mm long, the keel continuous with the upper side of throat, projected outward and forward as a strong arch, apically emarginate; lower corolla lip bent abruptly down, slightly longer, trilobed, the laterals ascending-oblong, producing an ascending, oblong-rounded extension, the central lobe shortest, obcordate; corolla tube and throat adaxially lavender-blue to lavender-rose, the upper lip uniformly lavender, the lower lip and throat medially with a broad longitudinal zone of white or cream mottled with spots and streaks of deep purple, the bordering lobes and edges again uniformly lavender, all edges intermittently pilose-ciliate, the external surfaces with a mixture of downy and villous hairs and gland-dotted. Stamens tetradynamous, both pairs roughly paralleling the upper lip and directly under its keel, the shorter pair extending ca. to its tip, the longer slightly beyond, arching outward and downward, the anthers slightly divergent on broad connective, ca. 1 mm long, broadest across the base, the thecae dark purple, white-villous-pilose along the dehiscence line. Style sigmoid, its bifid-stigmatose tip exserted slightly beyond level of anthers. Nutlets mostly 4, obovoid, 1 – 1.2 mm long, brown, very finely reticulate toward apex.

TYPE: U.S.A. FLORIDA. PUTNAM CO.: Sand Pine Scrub, undeveloped subdivision, SE on Fla. rd 100, 2 mi from Florahome thence to left on Holladay Rd. 1.9 mi to Blossom Rd. on right, thence to intersection Blossom and Garden St., 20 Sep 1990, *Robert B. McCartney, s.n.* (HOLOTYPE: SMU; ISOTYPE: VCB).

Additional specimens examined: TOPOTYPES: 12 Oct 1990, *R.K. Godfrey* with *Angus Gholson 84008* (BH, F, FLAS, FSU, GA, GH, K, NCU, NY, PH, RSA, TENN, TEX, UC, USC, US, VDB, VSC, WAT, WILLI).

The habitat in detail is a deep white-sand scrub dominated by *Pinus clausa, Quercus chapmanii, Q. geminata, Q. myrtifolia*, with some *Q. laevis* and a mixed understory of *Serenoa repens, Smilax, Persea humilis, Asimina, Ceratiola, Sageretia minutiflora, Ilex cumulicola, Licania, Rubus cuneifolius, Garberia*, and herbs such as *Eupatorium compositoflium, Liatris chapmanii, Balduina angustifolia, Carphephorus corymbosus, Chrysopsis scabrella, Palafoxia integrifolia, Elephantopus, Polygonella*. The *Conradina* are most abundant in sandy natural or artificial clearings, less so in the scrub itself; it would appear, therefore, that this mint responds abundantly to disturbance (historically this probably fire) as do many of the other shrubs and herbs of this habitat type.

Those who work with *Conradina* will agree that *C. etonia* as described here shares more character states with *C. grandiflora* than it does with any other *Conradina*, that it shares similar habitat, and that it is closest geographically to that species. Thus the burden of proof is in establishing the most apparent differences in character between the two:

1. Indumentum of young shoots of *C. etonia* is puberulent, the hairs thus minute, spreading, downy; that of *C. grandiflora*, likewise minute and abundant, is mostly upcurved. That of inflorescence branches in both is also abundant and minute, but that of the former is again spreading, more uniform, while in the latter it may be admixed with some pilosity.

2. Leaves of the two differ strongly, those of *C. etonia* being distinctly broader with lateral veins quite evident on the undersurface, a feature held by no other known species of *Conradina*; both adaxial and abaxial surfaces are dull green, each with a uniform spreading-and-downy puberulence (the texture of this adaxial side much like that of the undersurface of Chalk Maple leaves!), that of the adaxial surface slightly less than that of the paler, abaxial side. In *C. grandiflora* the adaxial side of the leaf is dark green, lustrous, with a minute, incurved, harder pubescence, that of the abaxial side is whitened by a dense mat of white, short, appressed tomentulum and shows no branching from the usually sparsely strigillose midrib.

3. Dimensions, shapes, and pollination guide markings in flowers of both species overlap very much, with calices extremely similar in size-range, but those of *C. etonia* (again) with puberulence denser and more uniform (downy), very rarely with the tube having any pilosity and this confined to a few "whiskers" at or toward its base; in *C. grandiflora* most specimens show a very strongly gradate pubescence of calyx tube, from some long pilosity over 1 mm to an admix of shorter pilosity, some gland-tipped, and puberulence. Calyx teeth in both are hirsute-ciliate, but such hairs in *C. etonia* are shorter, more uniform. Corollas of these species are hardly distinguishable.

4. Stamens of the two species are again very similar as to size and shape, but while anthers of *C. etonia* are bedecked with a distinctive long fringe of white pilose-villous hairs, those of *C. grandiflora* have fewer and shorter hairs, these tending to be concentrated more at anther sac tips and bases.

The features detailed above convince us that *C. etonia* could well be the best-marked species in a genus whose species differ mostly in very fine characters.

We are hopeful that further exploration of the northern lobes of Florida scrub habitat will yield more records for this beautiful new species. Indeed, it may show us some intermediates. A clue to this is a Volusia County collection of *C. grandiflora* (Sand Pine sandridge by I-95, 0.6 mi S Port

Orange exit, 28 Aug 1974, *Kral 54022*) in which new shoots have an atypical spreading downiness similar to that in our new species. But even this material in no other way resembles *C. etonia*.

Because *Conradina etonia* is rare and perhaps restricted to a small area of highly vulnerable habitat, we have attempted to expedite the publication of its description and initiate appropriate protection strategies. The known range is within a subdivided tract with streets roughed-in and a few residences built. Botanists, the general public, and affected property owners will hopefully refrain from actions which might further jeopardize the survival of this species and will support efforts to conserve it.

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OBSERVATIONS ON *FRYXELLIA PYGMAEA* (MALVACEAE)

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ABSTRACT

The rediscovery of the rare *Fryxellia pygmaea* (Correll) Bates in central Coahuila is reported, and its ecology and taxonomic affinities are discussed. The plant has a chromosome count of $2n = 16$.

RESUMEN

Se reporta el redescubrimiento de una población de la infrecuente *Fryxellia pygmaea* (Correll) Bates de la parte central de Coahuila, y se discute su ecología y sus afinidades taxonómicas. El número cromosómico de la planta es $2n = 16$.

The monotypic genus *Fryxellia* has been one of the least known genera of the Malvaceae. The type was collected by Capt. John Pope in 1854 at an unknown locality in Texas, probably west of the Pecos River (Correll 1968; Bates 1974). The species was subsequently recollected by Robert M. Stewart in 1941 near Puerto del Aire near the southern end of the Sierra de la Encantada in Coahuila. Originally described in the genus *Anoda* (Correll 1968), the plant was recognized by Bates (1974) to be distinct and to constitute a monotypic genus, isolated from other genera of the tribe Malveae (Bates 1974; Fryxell 1988) as the Fryxellia alliance.

In early September 1990 we had the opportunity to revisit Puerto del Aire (Fig. 1) in an attempt to relocate the plant. We succeeded in finding a population of several hundred plants, perhaps the same population found by Stewart. The population was restricted to a relatively small area of "dry open hillside." The area occupied by the population was perhaps 100 – 150 m in diameter, beyond which no plants were found. Within the area, however, the population was relatively dense, with individual plants occurring within a meter or two of one another. The population was clearly an old

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one, with many individual plants having extensive perennial rootstocks. What edaphic or other factors are involved in restricting the population to this small area were not immediately evident and are not known. It may be speculated, however, that the population observed is in fact an ancient clone, spreading laterally by proliferating rootstocks. Even though the plant has an apparently efficient method of seed dispersal, and subsequent germination tests have shown the seeds to be fully viable, seedling establishment at a new locality in the severe desert environment of central

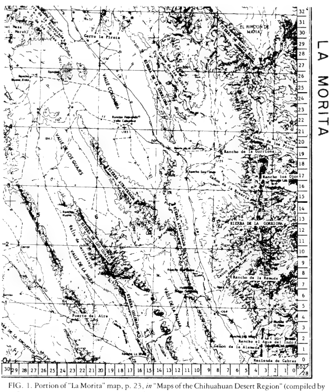

FIG. 1. Portion of "La Morita" map, p. 23, *in* "Maps of the Chihuahuan Desert Region" (compiled by José García), to accompany "A Gazetteer of the Chihuahuan Desert Region, A Supplement to the Chihuahuan Desert Flora" (by J. Henrickson and R.M. Straw, 1976).

Coahuila may be a relatively rare event, dependent upon a favorable pattern of rainfall in a particular year. A perennial, caespitose habit, coupled with vegetative propagation by root proliferation, may be the secret of survival for this species in this habitat. Unfortunately, we did not consider this possibility at the time we were in the field when, as a test of this hypothesis, we could have looked for subterranean interconnections of adjacent plants.

The Plants

Summer rainfall in this area had been above average in 1990, so that the plants were in relatively good condition. All except the youngest plants were fruiting, with flowers and buds still developing. Fruits were relatively abundant, indicating that the plants were vigorously reproductive. Individual plants form small rosettes on the order of 15 cm diameter. They are not acaulescent (as described), although they are indeed caespitose. Each plant has one to several short stems $1-2$ cm long with very short, crowded internodes. The rootstocks are thick (ca. 1 cm or more in diameter), well branched, and penetrate deep into the gravelly soil; the roots are apparently food-storage organs.

Buds and flowers were observed and photographed, on the basis of which corolla color can be described as a rich orange (Fig. 2). After abscission of the corolla, the accrescent calyx ultimately flares to a rotate form and, as the fruit matures, takes on a reddish coloration on the exposed (adaxial) side. Upon maturation of the fruit, abscission is at the base of the calyx, so that the calyx and the contained fruit together are the diaspore. The calyx evidently serves as a sail to be blown over the ground as a form of wind dispersal.

Styles and stigmas were observed and were found to have the abruptly capitate form and glabrous condition that are characteristic of the genus *Anoda*. These features, together with the general aspect of the fruits, explain Correll's original placement of this species in *Anoda*. On the other hand, the dorsal spur, which accounts for the resemblance of the mericarps of *Fryxellia* to those of *Anoda*, differs in that the spur clearly has a suture of dehiscence in *Fryxellia* and but not in *Anoda*.

The mericarps of *F. pygmaea* (Correll) Bates are well illustrated by Bates (1974, Fig. 1, Ab, Ac). One item of information can be added, however. The endoglossum is in fact a divided structure, consisting of two awl-like internal growths extending forward from the dorsal wall, not a single such growth as was illustrated. Thus, the endoglossum shows a resemblance to that found in the genus *Batesimalva*, most nearly to that found in *B. pulchella* Fryx.

FIG. 2. *Fryxellia pygmaea*. Plant grown in the greenhouse from seed.

Questions remain concerning the affinities of the genus *Fryxellia*. The stigma morphology suggests an affiliation with *Anoda*. The endoglossum structure suggests an affiliation with *Batesimalva*, as does the leaf form and geographical distribution. Furthermore, the accrescent calyx of *F. pygmaea* shows some resemblance to the somewhat accrescent calyx of *B. pulchella*. However, other characters, such as the caespitose habit, the orange corolla, the strongly accrescent calyx, and the detailed fruit morphology, clearly justify Bates' segregation of *Fryxellia* as a distinct genus. Conceivably, *Fryxellia* may be a connecting link (by reduction of the upper cell of the mericarp, with the endoglossum remaining as a vestige of this former, hypothesized condition) between *Batesimalva* and *Anoda* and thus provide an indication of the phylogenetic origin of the *Anoda-Periptera* alliance. A chromosome count of $2n = 16$ was obtained for *F. pygmaea* (Fig. 3). The base chromosome number for *Anoda* is $x = 15$ (Bates 1987), for *Batesimalva* $x = 16$ (Bates & Blanchard 1970). Pollen aperture number (Hashmi 1970, Fryxell 1988), is 3 for *Fryxellia*, 3 − 4 for *Batesimalva*, and usually 30 or more for *Anoda*. These data indicate a placement of *Fryxellia* closer to

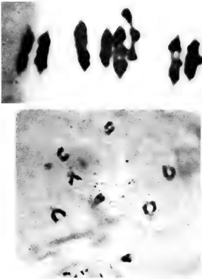

FIG. 3. Chromosomes of *Fryxellia pygmaea*. Top, metaphase I (× 2160); bottom, diplotene (× 833).

Batesimalva than to *Anoda*.

Finally, it may be asked if this species should be considered as "threatened or endangered." The plants observed were locally abundant and highly fruitful, producing abundant viable seeds, but were very localized in distribution. What ecological factors mediate this localization are unknown. Only one population of the species is certainly known, and the species can arguably be described as the rarest plant of the Chihuahuan Desert. Yet it was also collected in Texas by Pope, probably somewhere west of the Pecos River, a direct distance of 200 – 300 km (or more) to the northwest. An ample amount of relatively undisturbed, apparently suitable habitat lies in the intervening area, in which the species might be expected to occur. Much of this area is unexplored botanically or at least poorly explored. Therefore, it seems more suitable to describe this species as "insufficiently known" rather than "threatened, endangered, or extinct," as listed by Valdés and Johnston (1988).

The recent collection, duplicates of which will be distributed, is cited as follows:

MEXICO: COAHUILA: Mpio. de Ocampo, Sierra de la Encantada (28° 4-1/2′ N, 102° 25′ W), alt. 1250 m, 8 Sep 1990, *Fryxell, Valdés, Carranza, Vázquez & Meza 5006* (ANSM, BRIT-SMU, pf, and other duplicates to be distributed).

ACKNOWLEDGMENTS

Appreciation is extended to Miguel A. Carranza P., Ricardo Vázquez Aldape, and Orlando Meza, who helped with the field work, and to Juan Díaz-Colón and David M. Stelly, who provided the chromosome preparations and photographs.

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HASHMI, S.H. 1970. The palynology of the Malvaceae of Texas. Ph.D. Dissertation, Texas A&M University. (University Microfilms no. 70-16729)

VALDÉS, J. and M.C. JOHNSTON. 1988. Botanical resource and floristic diversity depletion in the Chihuahuan Desert Region of Mexico. Third Symposium on Resources of the Chihuahuan Desert: U.S. and Mexico (abstract). 10 – 12 November 1988 at Sul Ross State University, Alpine, Texas.

BIOCIDAL *SIDA* (MALVACEAE)

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ABSTRACT

The secretions of glandular trichomes of two South American species of *Sida* are highly toxic to ants and cockroaches. In natural habitat, these secretions most likely provide resistance to herbivory by insect or other small arthropods.

INTRODUCTION

During preparation of a monographic treatment of *Sida* section *Oligandrae* (Malvaceae) two species were observed with an interesting vestiture of stalked glandular trichomes (Fig. 1). One species, *Sida jatrophoides* L' Héritier, is a xerophyte occurring in scattered populations from coastal Peru and the Galapagos. The other, *Sida palmata* Cavanilles, is a mesophyte occuring along trailsides in northern Peru and southern Ecuador (Burandt 1992). Touching the young stems or petioles of either species left the skin covered with a moist but not sticky film, evidently the secretion of these trichomes.

Several observations coincided to suggest and support a hypothesis that the trichome secretions in these species might function to repel or possibly kill walking arthropods: 1. The droplets of secretions formed at the elevated tips of the trichomes (Fig. 1) would undoubtedly contact an insect walking on the plants. 2. The trichomes were more densely distributed (especially in young *S. jatrophoides*) in the inflorescence branches (Fig. 1) and in the petiole area just below the blades. A walking insect would be obliged to cross a veritable mine field of droplets to get to the presumably more delectable leaf blades and flowers. 3. Plant populations studied in the field appeared relatively free of insects, and the leaves were free of evidence of insect herbivory.

The lethality of morphologically similar glandular trichomes to arthropods has been frequently reported (Juniper and Southwood 1986). While toxic compounds may also be present in trichome secretions (Carter et al. 1989, Walters et al. 1989, Dimock and Kennedy 1983, Gerhold et al. 1984, and Williams et al. 1980), their role in pest resistance is complicated by the fact that most trichome secretions are adhesive and the principal mode of action is by trapping - larvae or adults are immobilized until they

SIDA 14(3):405 – 410. 1991.

die. Conversely, the trichome secretions of *Sida* sect. *Oligandrae* are non-adhesive and any antibioses observed for the these secretions would likely be attributable to the effects of toxins alone. This study presents experimental evidence which strongly supports the hypothesis that natural toxins in the secretions in *Sida* section *Oligandrae* potentially function as deterrents to arthropod herbivory.

METHODS

Plants of *S. palmata* and *S. jatrophoides* were germinated from scarified seeds placed in 75 to 95 mm plastic pots filled with sand/clay/peat mix. Seedlings were kept in a growth chamber illuminated with fluorescent "gro-lights" and set for a 12 hr photoperiod with 17° night and 27° C day temperatures. They were supplied with deionized water and commercially available fertilizers. To encourage flowering, fertilizers were discontinued, soils were leached by excess provision of deionized water, and plants were allowed to become water-stressed. Inflorescences were well developed after six months of growth, and trials were begun.

Toxicity of the secretions of these species was assayed using fire ants (*Solenopsis invicta* L.) and German cockroaches (*Blattella germanica* Buren). Ants were collected as needed from field colonies, whereas immature cockroaches (5 − 10 mm in length excluding antennae) were gathered from a laboratory-maintained colony. Active specimens of these insects were subjected to various topical applications as described below. After treatment, test and control specimens were housed in covered 500 ml glass containers for observation.

SIDA PALMATA assay:

Trial no. 1. Fifteen ants were individually gathered with an artist's small paintbrush and repeatedly pressed against secretory trichomes of *S. palmata*. Ants were then placed collectively in a container. As a control, 15 ants were "jostled" with a clean paintbrush and placed collectively in a separate container. Mortality was recorded at 21 hrs.

Trial no. 2. Ten ants were similarly treated but placed in 10 individual containers. As a control, 10 ants were repeatedly pressed against trichome-bearing parts of a dried specimen of *S. palmata* and placed in 10 individual containers. A second control consisted of 10 otherwise unmolested ants placed in 10 individual containers. Mortality was recorded at 21 hrs.

Trial no. 3. Ten ants were individually gathered with a paintbrush and gently placed on plant parts bearing numerous secretory trichomes. If necessary, they were coaxed to walk sufficiently to come into contact with trichomes. Ants that fell were retrieved and again placed on trichome-

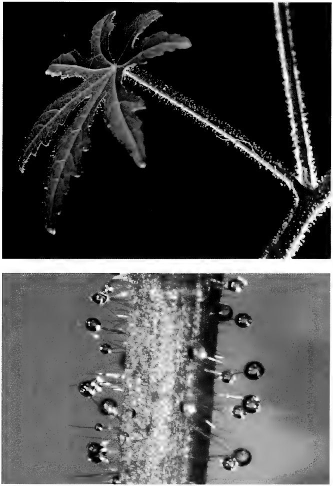

FIG. 1. Above: branches of leafy inflorescence of *S. jatrophoides*; below: petiole of *S. jatrophoides* (ca. 1.25 mm diameter).

bearing areas. Ants were then placed in 10 individual containers. As a control, 10 ants were placed individually in 10 containers and, using a clean paintbrush, swabbed with deionized water. Mortality was recorded at 7 hrs.

Trial no. 4. Twelve cockroaches were placed individually in glass containers and anesthetized with CO^2 gas. Secretions were then collected by passing an artist's small paint brush over appropriate plant surfaces until bristles were saturated. Cockroaches were then "painted" on their ventral sides with the secretions. As a control, 12 roaches were placed individually in glass containers, anesthetized with CO^2, and "painted" on their ventral sides with deionized water. Mortality was recorded at 5 hrs.

***Sida jatrophoides* assay:**

Trial no. 1. Twenty ants (two combined trials) ants were individually gathered with a paintbrush and gently placed on plant parts bearing numerous secretory trichomes. If necessary, they were coaxed to walk sufficiently to come into contact with trichomes. Ants that fell were retrieved and again placed on trichome-bearing areas. Ants were then placed in 20 individual containers. As a control, 20 ants were placed individually in 20 containers and, using a clean paintbrush, swabbed with deionized water. Mortality was recorded at 8 hrs.

Trial no. 2. Thirteen cockroaches were individually placed in glass containers and anesthetized with CO^2 gas. Secretions were then collected by passing an artist's small paint brush over appropriate plant surfaces until bristles were saturated. Cockroaches were then "painted" on their ventral sides with the secretions. As a control, 13 roaches were placed individually in glass containers, anesthetized with CO^2, and "painted" on their ventral sides with deionized water. Mortality was recorded at 5 hrs.

Trial no. 3. Seven cockroaches were treated as in the preceding trial but "painted" on their dorsal sides with the secretions of *S. jatrophoides*. As a control, 7 roaches were treated as above but "painted" with deionized water on their dorsal sides. Mortality was recorded at 5 hrs.

RESULTS

Insect behavior

Initial responses of both roaches and ants to application of plant secretions was similar. Brief episodic whole-body convulsions and tremors occurred sporadically within the first few minutes. Individual legs became sporadically or continuously rigid and were dragged or remained variously skewed to the side or to the rear. Rarely, an appendage would disarticulate. Effective walking gradually became impossible and specimens collapsed

Table 1. Lethality of secretions of *S. palmata* and *S. jatrophoides* to ants and roaches. S = secretions applied, C = control. For each, the number dead precedes the number treated (N).

Trial Number:	1		2			3		4		Total	
	S	C	S	C	C	S	C	S	C	S	C
S. palmata											
Ants	9(15)	1(15)	9(10)	2(10)	0(10)	6(10)	0(10)	·	–	24(35)	3(45)
Roaches	–	–	–	–	–	–	–	12(12)	0(12)	12(12)	0(12)
S. jatrophoides											
Ants	19(20)	2(10)	–	–	–	–	–	–	–	19(20)	2(10)
Roaches	13(13)	0(13)	7(7)	0(7)	–	–	–	–	–	20(20)	0(20)
								Grand Totals			
									Ants	43(55)	5(55)
									Roaches	32(32)	0(32)

and could not right themselves. In ants and occasionally in roaches, these symptoms appeared to subside within 30 minutes of treatment but later returned, however, with increasing dysfunction eventually involving all appendages. A few ants appeared to completely recover.

Insect Mortality

At natural concentrations, secretions of the glandular trichomes of both *S. palmata* and *S. jatrophoides* were very lethal. Roach and ant mortality pertrial and per control(s) are summarized in table 1. Of 35 ants variously treated with secretions of *S. palmata*, 24 died whereas only 3 of 45 control ants died. All 12 roaches treated with *S. palmata* died whereas none of the 12 control roaches died. Of 20 ants treated with secretions of *S. jatrophoides*, 19 died whereas only 2 of 10 control ants died. All 20 roaches treated with secretions of *S. jatrophoides* died whereas none of the 20 control roaches died. Totaling the toxicity assays using ants, 43 of 55 of those treated with plant secretions died whereas only 5 of 55 control ants died. Totaling the toxicity assays using cockroaches, 32 of 32 treated roaches died whereas none of the 32 control roaches died.

DISCUSSIONS

All plants exhibit potential resistance to herbivory. Deterrent morphologies range from the simple mechanical resistance provided by toughened tissues to the honed injection devices of the trichomes of Urticaceae. An array of molecular defenses is also available to plants. Ordinary sap, exuded as a result of wounding, may be mildly repellent, or lethal toxins such as pyrethrins and nicotine may be produced.

Most plant structures and molecules serve several functions, however, and their roles in herbivore resistance is often subsidiary to other functions and difficult to establish. The dramatic lethality of trichome secretions of *Sida* is thus more remarkable since it appears to be due solely to the effect of toxins. That such a specialization might evolve from glandular trichomes with broader methods of antibiosis is not surprising but is, nevertheless, apparently rare or little reported. It should be interesting to survey additional taxa and assay for toxicity those which possess similar non-adhesive trichome secretions.

ACKNOWLEDGEMENTS

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THE GENUS *HOSTA* TRATT. (LILIACEAE) IN KOREA

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ABSTRACT

Based on the result of a biosystematic study that employed phenetic analyses of morphological and enzyme electrophoretic data, and fieldwork, six Korean species can be recognized: *Hosta yingeri* S. B. Jones (Tae-huk-san, So-huk-san, Hong islands); *H. capitata* (Koidz.) Nakai (southern Korea); *H. clausa* Nakai (central and northern Korea); *H. minor* (Baker) Nakai (south and middle-eastern Korea, including Wan and Ko-jae islands); **H. taquetii** (Lévl. in Fedde) M. Chung & J. Kim comb. nov. (= *H. venusta* F. Maekawa) (Che-ju Island); and *H. jonesii* M. Chung (southern islands). Keys, typications, synonomies, descriptions, and distributions are included.

INTRODUCTION

Hosta is a horticulturally important genus of approximately 22 − 25 species of herbaceous perennials restricted to eastern Asia (Chung and Jones 1989; Jones 1989). Many species and cultivars are widely grown in shady gardens in Asia, Europe, North America, and New Zealand (Chung 1990; Jones 1989). Numerous nomenclatural and taxomonic problems exist within the genus (Aden 1988). Bailey (1930), Stearn (1931), Hylander (1954), and Lee (1957) all pointed out that *Hosta* is taxonomically confused genus. The taxonomic difficulty has been attributed to the presence of relatively few diagnostic characters on dried herbarium specimens (Hylander 1954). In addition, many species of *Hosta* are so variable ecologically and morphologically that a proper species concept requires morphological, ecological, and biosystematic studies (Chung 1990). Over 2,500 cultivars further confound the taxonomic status of several *Hosta* species. These difficulties have given rise to broad (Fujita 1976) or narrow (Maekawa 1940, 1969) species concepts; 15 or 25 Japanese species, respectively. Although Fujita carefully described morphological characters and

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ecological and geographical distributions, his studies were confined to Japan and did not include Korean or mainland Asian taxa.

MATERIALS AND METHODS

Samples of *Hosta* rootstocks (978) were collected from 45 localities in South Korea and two on Tsushima Island (*H. tsushimensis* N. Fujita), Japan (Chung et al. 1991). Observations were made of the habitats, and notes were taken on characteristics of the populations. The rootstocks were grown under uniform conditions in the Botany Growth Facilities at the University of Georgia. Voucher specimens of all collections are deposited at GA, SNU, and KYO. Herbarium materials from BH, BM, E, GA, K, KYO, L, MO, NA, NY, PE, SNU, TI, and US were examined in order to search type specimens of Korean *Hosta* taxa and determine the total range of geographic variation and the distribution of each taxon, especially those collected from North Korea and Manchuria, China. In addition, the Herbaria at Tokyo University (TI) and Kyoto University (KYO), where the majority of type specimens of *Hosta* are kept, were visited by MGC.

TAXONOMY

The taxonomic treatment presented here is the result of a biosystematic study that employed phenetic analyses of morphological data (Chung 1990; Chung and Jones 1990), data from enzyme electrophoresis (Chung et al. 1991), and fieldwork (Chung 1990; J. Kim pers. comm.). Four complexes, one with three species (*H. minor, H. taquetii* [= *H. venusta*], and *H. jonesii*) and the remaining three each with a single species (*H. yingeri*; *H. capitata*; and *H. clausa*) can be recognized in Korea. This conclusion conflicts with the sectional treatments of *Hosta* by Maekawa (1940) and Fujita (1976). For example, Maekawa (1940) and Fujita (1976) treated *H. capitata, H. minor*, and *H. taquetii* in section *Lamellatae* F. Maekawa because these three species have ridged scapes. Results by the study of Chung (1990) and Chung et al. (1991), however, showed that *H. minor* and *H. taquetii* are closely related to each other, while *H. capitata* is quite distinct. In addition, *H. tsushimensis* and *H. jonesii*, which belong to section *Tardanthae* (F. Maekawa) F. Maekawa (Chung 1989; Fujita 1976) show close relationships with *H. minor* and *H. taquetii*. Thus, sectional treatments of the Korean hostas must wait until the entire genus has been examined.

While examining loans from the 12 Herbaria and specimens at TI and KYO, four type specimens: *H. clausa* (*Nakai s.n.*), *H. clausa* var. *normalis* F. Maekawa (*Nakai 5255*), *H. ensata* F. Maekawa (*Nakai 5253*), and *H. longipes* var. *alba* Nakai (*Utiyama s.n.*) were not encountered. Probably, these four type specimens were lost (H. Ohba pers. comm.). We therefore designate lectotypes for two names, *H. clausa* var. *normalis* and *H. ensata*, and neotypes for two names *H. clausa* and *H. longipes* var. *alba*.

A KEY TO THE KOREAN SPECIES OF *HOSTA*

1. Bracts, pappillous at apex, greenish when fresh, remaining green at flowering, and persistent with the fruits.
   2. Scapes ridged or longitudinally striate.
      3. Leaf 6.5 – 10 cm long; length of inner and outer perianth lobes equal to subequal . . . . *H. taquetii*
      3. Leaf 14 – 35 cm long; outer perianth lobes longer than inner lobes . . . . *H. minor*
   2. Scapes smooth, not ridged.
      4. Racemes distichous; transparent lines on perianth ca. 5 mm long; stamens 3 + 3 (the exceptional length of the second set of stamens) . . . . *H. yingeri*
      4. Racemes secund or subsecund; transparent lines on perianth ca. 15 mm long; length of stamens same . . . . *H. jonesii*
1. Bracts, not pappillous at apex, whitish green when fresh, fading to whitish brown at flowering, not persistent with the fruits.
      5. Scapes ridged or longitudinally striate; leaf blades scabrous on the nerves below; inner perianth lobes ca. 14 mm wide; anthers whitish yellow with purple dots . . . . *H. capitata*
      5. Scapes smooth, not ridged; leaf blades smooth on the nerves below; inner perianth lobes ca. 9 mm wide; anthers dark purple . . . . *H. clausa*

HOSTA CLAUSA Nakai, Bot. Mag. (Tokyo) 44:27. 1930. *Funkia lancifolia* auct. non Sprengel; Komarov, Fl. Manshur. 2:328. 1901. *Funkia ovata* auct. non Sprengel; Komarov, ib. 2:329. 1901. *Hosta lancifolia* auct. non Engler; Nakai, J. Coll. Sci. Imp. Univ. Tokyo 31:250. 1911. *Hosta caerulea* auct. non (Andrew) Tratt.; Nakai, ib. 31:251. 1911. *Funkia lancifolia* auct. non Sprengel; F. Czerniakovska in Komarov, Fl. URSS, 4:55, t. 5 f. 2. 1935. — TYPE: KOREA. PROV. KYEONG-GI-DO. Kwang-nung, n.d., *Nakai s.n.* (n.v.). — NEOTYPE, here designated: KOREA. PROV. KYEONG-GI-DO. Kwang-nung, 16 Aug 1929, *Lim s.n.* (SNU!).

Hosta japonica Thunb. var. *lancifolia* Nakai, Rep. Veg. Diamond Mts. 167. 1918. *nom. illeg.*

Hosta clausa Nakai var. *normalis* F. Maekawa, J. Jap. Bot. 13:899. 1937. — TYPE: KOREA. PROV. KANG-WON-DO. Mt. Kum-gang, n.d., *Nakai 5255* (n.v.). — LECTOTYPE, here designated: KOREA. PROV. KANG-WON-DO. Mt. Kum-gang, 20 Aug 1902, *Uchiyama s.n.* (TI!) — PARATYPES: KOREA. PROV. KANG-WON-DO. Mt. Kum-gang, 5 Aug 1932, *Kobayashi s.n.* (TI!); PROV. PYEONG-AN PUK-DO. Jeon-san, 12 Aug 1912, *Imai 7* (TI!).

Hosta ensata F. Maekawa, J. Jap. Bot. 13:900. 1937. — TYPE: KOREA. PROV. KYEONG-GI-DO, n.d., *Nakai 5253* (n.v.). — LECTOTYPE, here designated: CHINA. MANCHURIA. PROV. MUKDENSIS, 13 Jul 1897, *Komarov 366* (NY!; ISOLECTOTYPES: BM!, K!).

Glabrous, herbaceous perennials from creeping rhizomes. Leaves ascending obliquely; petioles (2.2-)4 – 10(-18.5) cm long, 3 – 5 mm wide at middle of petiole, greenish or sometimes with purple dots, winged; blades 6.5 − 13.2(-16) cm long, 1.6 − 6.3 cm wide, lanceolate or narrowly ovate, rigid and heavy-textured, acuminate at apex, gradually narrowed at base to petiole, the veins of upper leaf surface conspicuous when fresh, the veins of lower leaf surface in 4 − 8 elevated pairs. Scapes erect, terete, 26 − 62 cm long, (2-)3 − 4 mm wide, with bright purple dots on all parts, below inflorescence bearing (2-)3 − 4(-5) clasping, lanceolate bracts, these 15 − 20 mm long, 8 − 13 mm wide, obtuse at apex; raceme subsecund, (8-) 10 − 23(-26)-flowered; inflorescence bracts, acute, navicular, whitish green (fresh), 7 − 12 mm long, 4 − 7 mm wide, fading to whitish brown at or after flowering; pedicels horizontally spreading, 8 − 12 mm long, whitish purple, usually the same as the subtending bracts, bright purple after flowering. Perianth (fresh) 35 − 50 mm long, ca. 32 mm in diameter, bluish purple, color between the narrow and inflated perianth tube slightly different, greenish purple in bud; upper dilated portion of perianth tube somewhat bell-shaped, the apex of perianth lobes slightly decurrent; inner nerves not intensely purple-colored; translucent lines 12 − 16 mm long, extending to the middle of lower narrowed perianth tube, conspicuous; stamens 39 − 48 mm long; filaments white, attached to the base of the perianth tube, nearly equal to or slightly longer than perianth; anthers ca. 3 mm long, dark bluish purple on the basal surface. Capsule cylindric, 25 − 34 mm long, 4 − 7 mm wide, purple dotted. Flowering mid June to August; fruit ripening late July to September.

Korean name: Jukok-bibich'u, Cham-bibich'u.

This species grows along streams in central and northern Korea and in Manchuria, China, with three morphs present within population (Chung 1990). The first morph bearing lanceolate leaves grows on rock and appears to be Maekawa's *H. ensata*. The second morph, with ovate leaf blades, grows on sandy soil in open areas and corresponds to *H. clausa* var. *normalis*. A third morph grows under dense *Salix gracilglans* Nakai stands and appears to be reproduced only by rhizomes (Chung 1990). Plants with closed flowers, *H. clausa* var. *clausa*, were not found during field studies of 1988 and 1989. However, they are known in garden cultivation (S. B. Jones pers. comm.). Maekawa (1969) noted that *H. clausa* var. *clausa* is a rare variety, whereas variety *normalis* is common. Lee (1973) proposed that varietal rank not be recognized. We have followed Lee's (1973) treatment. Morphologically, *H. clausa* is distinct from other species with clasping ground bracts, flowering bracts fading to whitish brown after flowering, dark purple anthers, terete scapes, and elevated veins on the lower leaf surface. Isozymically, this species is distinct from other taxa (Chung et al. 1991).

Hosta minor (Baker) Nakai, J. Coll. Sci. Imp. Univ. Tokyo 31:251. 1911 (excl. syn. *H. longipes*). — Basionym: *Funkia ovata* var. *minor* Baker, J. Linn. Soc., Bot. 11:368. 1870. — Type: Korean Archipelago, 1863, *Oldham 865* (holotype: K, Photo!; isotype: L!).

Hosta minor (Baker) Nakai f. *alba* (Nakai) F. Maekawa, J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 5:418. 1940. — Basionym: *H. longipes* var. *alba* Nakai, Rep. Veg. Diamond Mts. 167. 1918, *nom. illeg.* — Type: KOREA. Prov. Kang-won-do. Mt. Kumgang, 16 Aug 1902, *Utiyama s.n.* (n.v.). — Neotype, here designated: KOREA, Prov. Kang-won-do. Mt. Kum-gang, Nae-kum-gang, 8 Aug 1932, *Kobayashi s.n.* (TI!).

Herbaceous perennials from creeping rhizomes. Leaves erect-patent, spirally arranged at base of stem; petioles 7.0 − 21.0 cm long, purple dotted, winged; blades ovate or narrowly ovate, 7.5 − 15 cm long, 5.0 − 8.1 cm wide, dull green, obtuse or acuminate at apex, with (6-)7 − 9 pairs of somewhat smooth, not elevated, nearly glabrous nerves on lower leaf surfaces. Scapes usually erect, longitudinally striate, 30 − 65(-80) cm long, 2 − 4(-5) mm wide, usually purple-dotted on the lower part, below inflorescence bearing 1 − 4(-5) navicular bracts, these (8-)18 − 26(-35) mm long, (4-)6 − 12 mm wide; raceme subsecund, (7-)10 − 15(-22)-flowered; inflorescence bracts acute, navicular, greenish (fresh), 7 − 12 mm long, 4 − 8(-11) mm wide, usually open at flowering, persistent after flowering; pedicels obliquely descending or horizontally spreading, 5 − 10 mm long, greenish, minutely purple-dotted, usually shorter than subtending bracts. Perianth (fresh) 35 − 45 mm long, ca. 30 mm in diameter, whitish purple, greenish in bud; the lower narrower portion of perianth tube whitish; the upper dilated portion more or less bell-shaped, whitish purple; inner nerves intensely purple-colored; lobes oblong, acute, 14 − 22 mm long and 7 − 14 mm wide; translucent lines 13 − 20(-25) mm long, extending to the middle of lower narrower perianth tube; stamens 35 − 45 mm long, nearly equal or slightly longer than perianth; anthers yellowish with purple dots on the basal surface. Capsule cylindric, 22 − 36 mm long, 3 − 6 mm wide. Flowering in July to early August; fruits ripening in late July to August.

Korean name: Chom-bibich'u.

This species is found on the granitic and humus soils and under pine-oak forests on hillsides or somewhat open areas of eastern and southern Korea, including Wan and Ko-jae islands. (Korean endemic species.)

Hosta taquetii (Lévl. in Fedde) M. Chung & J. Kim, comb. nov. — Basionym: *Funkia subcordata* Sprengel var. *taquetii* Lévl., Repert. Spec. Nov. Regni Veg. 9:322. 1911. — Type: KOREA. Prov. Che-ju-do. Che-ju Island, Mt. Hal-la; elev. ca. 1,700 m, 4 Aug 1910, *Taquet 4047* (holotype: E!).

Hosta venusta F. Maekawa, J. Jap. Bot. 11:245. 1935. — TYPE: origin unknown, cultivated plant at Tokyo, Japan, 10 Jul 1934, *Terasaki s.n.* (HOLOTYPE: TI!).

Hosta venusta var. *decurrens* F. Maekawa, J. Jap. Bot. 13:897. 1937. — TYPE: KOREA. PROV. CHE-JU-DO. Che-ju Island, Mt. Hal-la; elev. ca. 1,500 m, 14 Aug 1912, *Isidoya 32* (HOLOTYPE: TI!).

Herbaceous perennials from long creeping rhizomes. Leaves erect-patent, spirally arranged at base of stem; petioles 1.8 − 5.0 cm long; blades narrowly ovate, 4.2 − 7.4(-8.0) cm long, 2.0 − 3.9(-4.5) cm wide, dark dull green, slightly rigid, acuminate at apex, nerves of upper leaf surface inconspicuous when fresh, nearly glabrous on the 5 − 6 pairs of more or less smooth, none elevated nerves on lower leaf surfaces. Scapes erect, longitudinally striate, 25 − 40(-50) cm long, 2 − 3 mm wide, usually purple-dotted on the lower part, below inflorescence bearing 1 − 2 lanceolate bract(s), these 10 − 17(-25) cm long,4 − 9 mm wide; raceme subsecund, 3 − 8(-9)-flowered; inflorescence bracts acute, navicular, greenish (fresh), 6 − 11 mm long, 3 − 5(-7) mm wide, usually open at flowering, persistent after flowering; pedicels more or less horizontally spreading, 7 − 13 mm long, greenish with purple dots, usually longer than the subtending bracts. Perianth (fresh) 30 − 35 mm long, ca. 28 mm in diameter, whitish purple, greenish in bud; the lower narrower portion of perianth tube whitish purple; the upper, dilated portion of perianth tube somewhat bell-shaped, whitish purple; the inner nerves intensely purple-colored; outer and inner lobes nearly equal 13 − 16 mm long and 7 − 12 mm wide; stamens 32 − 35 mm long, slightly longer than perianth; anthers yellowish with purple dots on the basal surface. Capsule cylindric, usually with purple dots, 20 − 30 mm long, 4 − 7 mm wide. Flowering in mid July to mid August; fruits ripening in August to September.

Korean name: Halla-bibich'u.

Hosta taquetii occurs basaltic soil in somewhat open areas or under *Cryptomeria* on Che-ju Island, Korea. Taxonomically, it is closely associated with *H. minor*, but differs by 6.5 − 10 cm long leaves (vs. 14 − 35 cm in *H. minor*) and equal to subequal length of inner and outer perianth lobes (vs. outer perianth lobes longer than inner lobes in *H. minor*). (Korean endemic species.)

HOSTA CAPITATA (Koidz.) Nakai, Bot. Mag. (Tokyo) 44:514. 1930. — BASIONYM: *H. caerulea* var. *capitata* Koidz., Bot. Mag. (Tokyo) 30:326. 1916. — TYPE: JAPAN. PROV. AWA, HIGASHIIYAYAMA-MURA, 29 Jun 1915, *Koidzumi s.n.* (HOLOTYPE: TI!).

Hosta nakaiana F. Maekawa, J. Jap. Bot. 11:687. 1935. — TYPE: KOREA. PROV. CHOL-LA NAM-DO. Mt. Paek-un, based on a cultivated plant originally collected Aug 1934, Jul 1935, *Nakai s.n.* (HOLOTYPE: TI!). — PARATYPE: KOREA. PROV. CHOL-LA NAM-DO. Mt. Paek-un, 20 Aug 1934, *Nakai s.n.* (TI!).

Herbaceous perennials from creeping rhizomes. Leaves erect-patent, spirally arranged at base of stem; petioles 6 – 12(-19.5) cm long; blades cordate, 8.2 – 18 cm long, 6.5 – 7.9 cm wide, dull green, margins undulate, rigid, abruptly acuminate at apex, nerves of upper leaf surfaces conspicuous when fresh, scabrous on the 7 – 9 pairs of elevated nerves on lower leaf surfaces. Scapes erect, longitudinally striate, 37 – 60 cm long, 3 – 5 mm wide, purple-dotted on the lower part, below inflorescence bearing 2 – 4(-5) lanceolate bracts, these 1.4 – 6.5 cm long, 9 – 12 mm wide; (3-) 7 – 18 flowers clustered near the top of scape; inflorescence bracts boat-shaped, whitish with a purple tint (fresh), tightly closed and short-beak-like before flowering, fading to whitish brown after flowering, 1.6 – 2.2 cm long, 1 – 1.8 cm wide; pedicels, 4 – 8 mm long, whitish with a purple tint, shorter than subtending bracts. Perianth (fresh) 45 – 60 mm long, ca. 25 mm in diameter, whitish purple; the lower, narrower portion of perianth tube whitish, 3.5 – 4(-5) mm in diameter; the upper, dilated portion of perianth tube somewhat bell-shaped; the inner nerves intensely purple-colored; lobes oblong, 16 – 24 mm long and 10 – 15 mm wide; translucent lines, 13 – 24 mm long, reaching almost through the lower, narrower perianth tube; stamens more or less protruding from the perianth; anthers oblong, whitish yellow with purple dots on margin of basal surface. Capsule cylindric, 17 – 25 mm long, 4 – 7 mm wide. Flowering in mid June to mid July; fruits ripening in late July to August.

Korean name: Ilwal-bibich'u, Bangwul-bibich'u.

This species is found on humus soils in pine-oak forest hillsides or in open areas (e.g., Mts. Chi-ri, Prov. Chol-la Nam-do) in southern Korea.

Hosta yingeri S. B. Jones, Ann. Missouri Bot. Gard. 67:602 – 604. 1989. — Type: KOREA. Prov. Chol-la Nam-do. Tae-huk-san Island, 23 Sep 1985, *Yinger et al. 3616* (holotype: NA!). — **Paratypes**: KOREA. Prov. Chol-la Nam-do. Tae-hak-san Island, garden-grown material of same collection as holotype, *Yinger et al* (GA!); 18 Sep 1985, *Yinger et al. 3244* (NA!) and garden-grown material (GA!); 22 Sep 1985, *Yinger et al. 3585* (NA!) and garden-grown material (GA!); and 23 Sep 1985, *Yinger et al. 3610* (NA!) and garden-grown material (GA!); So-huk-san Island, 15 Aug 1985, *Yinger et al. 3164* (NA!).

Glabrous, herbaceous perennials from short, clumpy rhizomes. Leaves ascending obliquely, spirally arranged at base of stems; petioles 3.5 – 12(-16.5) cm long, 2 – 5 mm wide at middle of petiole, greenish or sometimes purple dotted, winged; blades 7.5 – 17(-21.5) cm long, 6.2 – 12,5(-17) cm wide, elliptic-lanceolate or narrowly ovate, rigid and heavy-textured, acuminate at apex, gradually narrowed at base to the petiole, the veins of upper leaf surfaces inconspicuous when fresh, the veins of lower leaf surfaces in 5 – 8 pairs. Scapes 2 – 4 times longer than leaves, erect, terete, below inflorescence bearing 1 − 2 linear-lanceolate bracts, these 2 − 3 cm long, 3 − 8 mm wide; raceme 17 − 43 − flowered, the flowers equally arranged around the central axis of raceme; inflorescence bracts flat, greenish (fresh), papillose at apex, 8 − 12 mm long, 2 − 3 mm wide; pedicels 1.2 − 2.4 cm long, longer than the subtending bracts. Perianth (fresh) whitish purple, ca. 3.6 − 4.2 cm long, greenish purple in bud; the upper, dilated portion of perianth tube funnel-shaped; the inner nerves not intensely purple-colored; translucent lines ca. 5 − 6 mm long; lobes ca. 1.8 − 2 cm long, ca. 5 mm wide. Stamens distinct, 3 + 3, conspicuously exserted, one set ca. 3.4 cm long, the other set ca. 4.6 cm long; anthers ca. 3 mm long, whitish yellow beneath. Style filiform, ca. 4.5 cm long, exserted beyond the stamens. Capsule cylindric, 2.5 − 3 cm long, 4.5 − 6 mm wide; seeds black, flattened, winged, ca. 8.4 mm long, ca. 3.4 mm wide. Flowering in August and September; fruits ripening in September.

Korean name: Huksando-bibich'u (M. Chung & J. Kim, nom. nov.)

Hosta yingeri is on rocky areas near the ocean at Tae-huk-san, So-huk-san, and Hong islands in Korea. This species is distinct from other species of *Hosta* in its relatively thick, lustrous, adaxially dark green leaves. It is further distinguished by its delicate raceme of flowers spread evenly around the central axis of the inflorescence; typically, other *Hosta* species have subsecund racemes. An additional diagnostic feature of *H. yingeri* is the 3 + 3 set of stamens. *Hosta yingeri* is an attractive species with horticultural potential (Jones 1989). (Korean endemic species.)

Hosta jonesii M. Chung, Ann. Miss. Bot. Gard. 76:920 − 922. 1989. — Type: KOREA. Prov. Kyeong-sang Nam-do. Nam-hae Island, Mt. Kum-san, 28 Aug 1988, *Chung & Chung 1613* (holotype: GA!). — Paratypes: KOREA. Prov. Kyeosang-sang Nam-do. Nam-hae Island, Mt. Kum-san, 5 May 1980, garden-grown material, *Chung s.n.* (GA!). Prov. Chol-la Nam-do. Dol-san Island, 29 Aug 1988, *Chung 957* (GA!); 21 Sep 1988, *Lee 101* (GA!); 22 Sep 1988, *103* (KYO!); 23 Sep 1988, *106* (MO!); 24 Sep 1988, *107* (SNU!); 26 Sep 1988, *112* (TI!).

Herbaceous perennials from short, creeping rhizomes. Leaves erect-patent, spirally arranged basally on the stem; petioles 4.5 − 13 cm long, 4 − 7 mm wide, purple dotted, slightly winged; blades elliptic-lanceolate or narrowly ovate, 6 − 13 cm long, 3 − 5 cm wide, dark dull green, slightly rigid, obtuse or acuminate at apex, gradually narrowed at base to petioles, the nerves of upper leaf surface inconspicuous when fresh, nearly glabrous on the 5 − 7 pairs of somewhat smooth, usually none elevated nerves of lower leaf surfaces. Scapes usually erect, terete, 35 − 60 cm long, 2 − 4 mm wide, purple-dotted on lower part, below inflorescence bearing 2 lanceolate bracts, these 15 − 20 mm long, 4 − 7 mm wide; raceme

(1)3 − 20 − flowered; bracts acute, navicular, green, 8 − 13 mm long, 3 − 4 mm wide, usually not open at flowering, relatively persistent after flowering; pedicels obliquely ascending, 4 − 8 mm long, whitish green, minutely purple-dotted, usually shorter than the subtending bracts. Perianth (fresh) 40 − 50 mm long, ca. 25 mm in diameter, whitish purple, greenish in bud; the lower, narrower portion of perianth tube whitish; the upper, dilated portion of perianth tube somewhat bell-shaped; the inner nerves intensely purple-colored; lobes oblong, acute, 13 − 15 mm long and 7 − 8 mm wide; translucent lines extending to the middle of lower narrower perianth tube; stamens 39 − 48 mm long, nearly equal to or longer than perianth; anthers ca. 3 mm long, yellowish with purple dots on the basal surface. Pistil 45 − 52 mm long. Capsule cylindric, 22 − 33 mm long, 4 − 6 mm wide. Flowering in mid August to early September; fruits ripening in September.

Korean name: Tadohae-bibich'u.

Hosta jonesii is found in shade of pine-oak forests on rocky and rich humus soils at Nam-hae, Dol-san, Po-gil islands, and nearby islands in Korea. This species is distinguished from other species of *Hosta* by the short creeping rhizomes; the navicular, green, relatively persistent bracts; bell-shapes corollas; terete scapes; an adaxially dark dull green leaves. *Hosta jonesii* appears to be related to *H. minor* by the navicular bracts and bell-shaped perianths, and by the creeping rhizomes, but differs by the terete scapes (vs. ridged in *H. minor*), elliptic-lanceolate leaf blades (vs. ovate or narrowly ovate in *H. minor*), obliquely ascending pedicels with fruits (vs. descending in *H. minor*), and flowering in mid August to early September (vs. July to early August in *H. minor*). *Hosta jonesii* is very closely related to *H. tsushimensis* N. Fujita (Fujita pers. comm.), but differs by the former's short creeping rhizomes, bell-shaped upper dilated portion of perianth tube, whitish purple inner perianth nerves, scapes dotted with purple on the lower part, somewhat smooth, and none elevated nerves on lower leaf surfaces. *Hosta yingeri* differs from *H. jonesii* by its ovate, adaxially lustrous leaves; delicate raceme of flowers spread around the central axis of the inflorescence; decurrent, flat bracts; relatively longer pedicels; and distinct, exserted 3 + 3 stamens. (Korean endemic species.)

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COMMON NAMES FOR VASCULAR PLANTS: GUIDELINES FOR USE AND APPLICATION

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ABSTRACT

Guidelines for structure, spelling, use, and application of common names for vascular plants are presented.

We have developed the following guidelines to assist editors, field biologists, naturalists, and others who use common names in their work, to establish a pattern for more uniform usage and application of common names for plants. These guidelines have resulted from an effort to provide a common name for each accepted plant species known for the North American continent north of Mexico, which is now in press (Kartesz 1991). The guidelines cover structure, spelling, use, and application of names. It should be indicated, however, that these guidelines are subject to modification because of common sense, tradition, good taste, and the desire to avoid unreasonable rigidity.

Common names for plants are generally composed of two parts: the first is referred to as the modifier, the second as the group name. The modifier, usually quite variable, provides the uniqueness for each common name at the species level. Conversely, the group name is quite constant, establishing the identity of taxa above the species level, i.e., families, genera, subgenera, tribes, etc. Group names may not necessarily require a modifier. In some cases, for example (usually in small genera), a single word or fanciful phrase is all that is necessary to constitute a group name.

I. GROUP NAMES

Group names are often composed of a single word describing a particular family, genus, subgenus, tribe, or section. These names are of three basic types:

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1. Simple Group Names: Simple group names are represented by a single word, e.g.

ash	aster	clover	fern
grass	lily	mallow	mustard
orchid	pine	rose	rush
sedge	stopper	tulip	willow

2. Singly-Compound Group Names: These are group names composed of two root-words or elements that are connected as one. Names of this type are composed of a pair of single-syllable words *or* of both a single- and a double-syllable word. For these names, both words or elements should be joined to form a single word (unless the words or elements begin and end with the same letter, e.g. saw-wort, cat-tail), e.g.

bloodleaf	chickenthief	goldenrod	hawkweed
hawthorn	lousewort	mousetail	nipplewort
quillwort	rockcress	sneezeweed	waternymph

3. Doubly-Compound Group Names: Doubly-compound group names represent the most complex type. These are names composed of two or more distinct words or elements totalling four or more syllables. Each word or element of this type is separated from the others by a hyphen. These names may be subdivided into the following four categories:

a. Doubly-compound group names with two words, each word having two or more syllables, e.g.

Kenilworth-ivy	monkey-flower
morning-glory	popcorn-flower
pygmy-melon	roving-sailor
treasure-flower	trumpet-creeper
water-horehound	yellow-saucers

b. Doubly-compound group names with two words, one word with three or more syllables, the other word with a single syllable, e.g.

butterfly-weed	burr-cucumber
pincushion-plant	rattlesnake-root
strawberry-tree	scorpion-tail
unicorn-plant	vegetable-sponge

c. Doubly-compound group names with three or more words, e.g.
pale *alpine*-forget-me-not (*alpine* is part of the group name, not a modifier)
arctic *sweet*-colt's-foot (*sweet* is part of the group name, not a modifier)

NOTE: In the above examples, since the words alpine and sweet precede taxonomically *incorrect* group names, they are set off by hyphens. These examples differ from the two that follow, which include taxonomically *true* groups (see Section IX for a discussion of true groups), e.g.

d. Doubly-compound group names similar to those of category c, but differ by having a "false modifier" as part of the group name, e.g.

fringed *yellow* star-grass (*yellow* is part of the group name "yellow star-grass," and is not a true modifier)
Sonoran *false* prairie-clover (*false* is part of the group name "false prairie-clover," and is not a true modifier)

In these cases, neither the modifier nor the "false modifier" should be connected by a hyphen to what follows.

II. GUIDELINES FOR HYPHENATION OF GROUP NAMES

Group names should be hyphenated *only* under the following conditions:

1. when the group name is composed of two words or elements, with each word or element beginning and ending with the same letter e.g.

cat-tail	desert-thorn
five-eyes	saw-wort
trumpet-tree	yellow-wood

2. when the group name is doubly-compound, i.e., when each word or element of a pair has two or more syllables, or when either element of the pair has three or more syllables (see I-3a and I-3b above).

3. when the final word or element of the group name is taxonomically misapplied (unless historically spelled as a single word, e.g., buckwheat, toadflax), e.g.

star-grass (not a grass of the Poaceae)
poison-oak (not an oak of the genus *Quercus*)
water-lily (not a lily of the genus *Lilium*)

NOTE: See extended listing below for taxonomically *true* groups (Section IX).

4. when three or more words or elements comprise the group name (see I-3c above).

5. when a word or element of a group name includes an apostrophe, e.g.

adder's-mouth orchid	bishop's-cap
Jacob's-ladder	mare's-tail
Solomon's-seal	St. John's-wort

NOTE: Hyphens should *never* be used for a group name to set off the words false, mock, wild, or true, since the status is already suggested by the existing modifier. Nor should the unconventional use of hyphens be included in canonizations or in titles of individuals, e.g.

Aunt Lucy (not Aunt-Lucy)
Good King Henry (not Good-King-Henry)
Maid Marian (not Maid-Marian)
St. John's-wort (not St.-John's-wort)

NOTE: Hyphens are also discouraged when separating proper names such as geographic place names or when setting off directions (northern, eastern, southern, and western) from other associated adjectives, e.g.

Blue Ridge gayfeather (not Blue-Ridge gayfeather)
eastern fringed catchfly (not eastern-fringed catchfly)
Great Plains bladderpod (not Great-Plains bladderpod)
Gulf Coast searocket (not Gulf-Coast searocket)
northern marsh yellowcress (not northern-marsh yellowcress)
southern Sierran pincushion (not southern-Sierran pincushion)

III. GENERAL GUIDELINES FOR GROUP NAMES

Group names should:

1. be as concise as possible;
2. never repeat the generic name except when steeped in tradition (e.g., aster, iris, mimosa);
3. reflect official state tree, shrub, and wildflower names when possible;
4. follow long-standing tradition;
5. follow names in popular use (e.g., field guides and conservation literature);
6. be unique for each genus. Understandably, this may not always be possible, e.g., when similar and well-established group names exist for different genera, e.g.

   Huperzia — club-moss
   Lycopodiella — club-moss
7. reflect as much ethnobotanical heritage as possible, and commemorate aboriginal usage (e.g., pawpaw, a Native American name);
8. be easily understood by avoiding or minimizing the use of technical or unfamiliar terminology;
9. avoid the word "weed" for plant genera with rare species;
10. provide unique common names for well-defined subgenera or subgroups within genera; e.g.

Erythronium:	white or pink flower — fawn-lily
	yellow flower — trout-lily
Ribes:	spineless plants — currant
	spiny or thorny plants — gooseberry

NOTE: Occasional departure from the accepted group name is also encouraged in the case of more fanciful, descriptive, or traditional common names, e.g.

camphor-daisy (for *Machaeranthera phyllocephylla*; departs from the group name tansy-aster)

dunedelion (for *Malacothrix incana*; departs from the group name desert-dandelion)

shieldplant (for *Streptanthus tortuosus*; departs from the group name jewelflower)

whip-poor-will-flower (for *Trillium cernuum*; departs from the group name wakerobin)

(Also see Section VI, Fanciful Phrases as Common Names)

11. be used in the possessive when using animals parts, e.g.

adder's-tongue	bird's-foot-trefoil
crane's-bill	hound's-tongue
ladies'-tresses	mare's-tail
pheasant's-eye	stork's-bill

12. when using animal names, group names should not be used in the possessive, and the policies governing group names should be followed, e.g.

chickweed (not chick's-weed) dog-fennel (not dog's-fennel)
dog-mustard (not dog's-mustard) rat-apple (not rat's-apple)
thin-leaf owl-clover (not thin-leaf owl's-clover)

IV. MODIFIERS

Modifiers are used to establish uniqueness for the group name. Mostly adjectival, they are of four basic types:

1. Those that provide description of plant or animal parts, size, shapes, colors, fragrances, number, and textures, e.g.

hare-foot locoweed	hay-scented fern
long-leaf pine	sharp-keel milk-vetch
single-leaf pinyon	red-seed plantain

2. Those that provide descriptions for plant habits or habitats, e.g.

annual hedge-nettle	bottom-land post oak
coastal-plain mountain-mint	granite stonecrop
vernal-pool snake-lily	water-thyme

3. Those that commemorate individuals, e.g.

Douglas-fir	Gray's lily
Johnson grass	Thieret's skullcap

4. Those that describe geographic locations, e.g.

African basil	Blue Ridge horsebalm
Caribbean hair-sedge	Carolina hemlock
eastern white pine	Ozark spiderwort

V. GENERAL GUIDELINES FOR MODIFIERS

The following guidelines apply to the use of modifiers.

1. Modifiers composed of two words should be used in the nominative rather than the adjectival form (unless the modifiers are well established in usage, e.g., hay-scented fern), e.g.

broad-leaf lancepod (*not* broad-leaved lancepod)
little-tooth sedge (*not* little-toothed sedge)
long-leaf starwort (*not* long-leaved starwort)
slim-pod rush (*not* slim-podded rush)
tough-leaf dogwood (*not* tough-leaved dogwood)

2. Modifiers composed of one word should be used in the adjectival rather than the nominative form, e.g.

bearded jewelflower (*not* beard jewelflower)
crested wheat grass (*not* crest wheat grass
jeweled rocket (*not* jewel rocket)
rusty lupine (*not* rust lupine)
spotted lupine (*not* spot lupine)
tufted bulrush (*not* tuft bulrush)

3. Modifiers should be hyphenated when describing plant or animal parts, shapes, colors, sizes, fragrances, or textures, except when referencing proper names (e.g., Ottertail Pass saxifrage), e.g.

bird-bill dayflower	bird-eye speedwell
dog-tooth noseburn	five-leaf cinquefoil
fox-tail prairie-clover	shell-bark hickory
short-leaf cinquefoil	hairy-seed crown grass

4. Modifiers describing color shades should be hyphenated, e.g.

midnight-blue clustervine
ocean-blue morning-glory
sky-blue scorpion-weed

5. When describing plant communities or plant habitats, two-word modifiers should be combined as one when *both* words are single-syllable (unless the first and last letters of each word are the same, e.g., sand-dune thistle), e.g.

oldfield milkvine	pineland golden-aster
saltmarsh sandspurry	seaside sedge

streambank leopard's-bane	roadside raspberry

6. When describing plant communities or habitats, two-word modifiers should be hyphenated when *either* word is composed of two or more syllables, e.g.

Arctic-tundra whitlow-grass	coastal-plain dawnflower
cold-desert phlox	river-bar bird's-foot-trefoil
sandy-plain clustervine	vernal-pool pincushion-plant

7. Independent, second-word modifiers should remain separated without a hyphen, e.g.

American water starwort (*not* American-water starwort)
dotted wild coffee (*not* dotted-wild coffee)
early blue violet (*not* early-blue violet)
leafless beaked ladies'-tresses (*not* leafless-beaked ladies'-tresses)
sticky purple crane's-bill (*not* sticky-purple crane's-bill)

8. Independent, third-word modifiers should also remain separated without a hyphen, e.g.

lesser yellow-throat gily-flower (*not* lesser-yellow-throat gily-flower)
little red-stem monkey-flower (*not* little-red-stem monkey-flower)

9. When commemorating individuals, possessive modifiers *should always* be used (unless well established in tradition e.g., Douglas-fir, Johnson grass), e.g.

Britton's skullcap (*not* Britton skullcap)
Gray's lily (*not* Gray lily)
Hall's rush (*not* Hall rush)
Small's skullcap (*not* Small skullcap)
Ward's willow (*not* Ward willow)

NOTE: When both the given name and the surname of an individual are used, a hyphen is *not* required between the names, e.g.

Alice Eastwood's fleabane (*not* Alice-Eastwood's fleabane)
Carl Mason's ragwort (*not* Carl-Mason's ragwort)

10. When describing plant or animal parts, modifiers (unlike group names) *should not* be used in the possessive, e.g.

fox-tail prairie-clover (*not* fox's-tail prairie-clover)
cat-claw mimosa (*not* cat's-claw mimosa)
stag-horn fern (*not* stag's-horn fern)

11. When designating national subdivisions (i.e., states, counties, and

provinces), nominative rather than adjectival modifiers should be used, e.g.

Alaska-cedar	Alberta spruce
Gila County live-forever	New Mexico milkwort
Utah juniper	Texasplume

12. When designating countries and continents, adjectival rather than nominative modifiers should be used, e.g.

American spurred-gentian	Brazilian peppertree
Canadian thistle	European bellflower
Jamaican-broom	Japanese honeysuckle
Mexican-orange	Persian rye grass

13. When describing geographic direction, adjectival rather than nominative modifiers should be used, e.g.

northern silverpuffs	southern threeawn
eastern teaberry	western sea-purslane

14. When selecting modifiers for related species, parallel structure should be sought, e.g.

broad-leaf sand-verbena	narrow-leaf sand-verbena
false babystars	true babystars
johnnynip	johnnytuck
king-of-the-meadow	queen-of-the-meadow
northern adder's-tongue	southern adder's-tongue
small-whorl mallow	large-whorl mallow

15. For very wide-ranging species, use of local or provincial names should be avoided, e.g.

common St. John's-wort (not Klamathweed, presumably a local name in the Pacific states)

common dandelion (not pee-da-bed, local name in northeastern U.S.)

lyre-leaf rockcress (not Kamchatka rockcress, local name in Pacific Northwest)

small cranberry (not wren's-egg cranberry, local name used mostly along the coast of Maine)

16. Modifiers should be concise, yet meaningfully descriptive, using the most colorful adjectives and reflecting uniqueness of habitat, geography, toxic or medicinal properties, and flower morphology, color, or fragrance.

17. When selecting modifiers, mere English translation of Latin or Greek epithets should be avoided. Avoid surnames of individuals as modifiers because such modifiers provide very limited information on proper-

ties, characteristics, and other features of a plant.

18. In selecting modifiers, the word "common" and other rather shallow descriptive adjectives should similarly be avoided except when steeped in tradition (e.g., common dandelion).

VI. FANCIFUL PHRASES AS COMMON NAMES

Fanciful phrases composed of two or more words or elements as common names are encouraged. They are often used as substitute names for group names, or they can be used as the accepted group names. Such names should be governed by the guidelines established for group names. Phrase names, especially lengthy ones, should be hyphenated between each word or element, e.g.

devil's-darning-needles	forget-me-not
herb-of-the-crown	jack-in-the-pulpit
kiss-me-over-the-garden-gate	love-in-a-mist
old-man-in-the-spring	midnight-horror

NOTE: Fanciful phrases, however, should be limited to five or six words or elements, thus avoiding excessively lengthy names such as welcome-home-husband-however-drunk-you-be.

VII. GENERAL GUIDELINES FOR SPELLING

Consistency of spelling and form should be sought for both group names and modifiers. The following suggestions are provided for words with alternate spellings or forms:

burr (not bur)
coastal (not coast)
county should be spelled out (not abbreviated as co.)
forked (not forking)
gray (not grey)
gypsum (not gyp)
mountain should be spelled out and singular (not abbreviated as mt., mts., mtn., or mtns.; however, Mt. is preferred to Mount)
pygmy (not pigmy)
savannah (not savanna)
woolly (not wooly)
Allegheny for the mountain range (not Alleghany)
Great Smoky Mountain for the mountain range (not Smoky Mountain)
Guadalupe Mountain for the mountain range (not Guadeloupe)

Rocky Mountain for the mountain range (not Rocky Mountains)
Sierran for the mountain range (not Sierra nor Sierra Nevada)
Guadeloupe for the country (not Guadalupe)
Chihuahuan for the desert (not Chihuahua)
Mojave for the desert (not Mohave)
Sonoran for the desert (not Sonora)
St. (not Saint)
greater is preferred to larger
lesser is preferred to smaller
papery is preferred to membranaceous (and membranous)
pinewoods or pineland is preferred to pine
seaside is preferred to seabeach

VIII. GENERAL GUIDELINES FOR CAPITALIZATION

The following guidelines have been prepared to assist in the use of capitalization of proper nouns and adjectives for common names.

1. Capitalize surnames of individuals used in group names and modifiers, e.g.

Bradbury-bush	Douglas-fir
Engelmann's flat sedge	Gray's lily
Johnson grass	Klein's evening-primrose
Nuttall's oak	Small's ragwort

2. Capitalize names honoring nationalities and human races

Chinese hemlock-parsley	Italian lords-and-ladies
Hopi-tea	Norwegian whitlow-grass
New Zealand-flax	Barbados aloe

3. Capitalize the names of gods, goddesses, and other religious figures, including names referring to the deity or holy works

Adam-and-Eve	Adam's-needle
Christmas-rose	Crucifixion-vine
Easter-bonnet	Joseph's-coat
Hercules-club	Heart-of-Jesus
Holy Ghost skyrocket	Joshua-tree
Our-Lord's-candle	Venus' flytrap

4. Capitalize names suggesting titles, canonizations, and ranks of honor, e.g.

Aunt Lucy	St. Catherine's -lace
Queen Ann's-lace	St. John's-wort

NOTE: Capitalization should *not* be used when specific reference to an individual is not provided, e.g.

king orchid	kingdevil
madam-gorgon	princess-of-the-night
princesstree	queen spleenwort

5. Capitalize international and national place names and national subdivisions such as continents, countries, states, counties, parishes, provinces, and territories e.g.

American holly	Asian sword fern
European mountain-ash	Florida bear-grass
Ohio buckeye	New York fern
Shasta County leopardbane	Yukon lupine

6. Capitalize local place names, including the names of cities, parks, and other recreational areas, e.g.

Everglades palm	Grand Canyon glow-weed
San Diego bear-grass	Santa Fe phlox
Yosemite woolly-sunflower	Yellowstone rockcress

7. Capitalize geographic directions only when they designate specific areas or regions, e.g.

East Indian holly fern	North Pacific whitlow-grass
North African knapweed	South American saltbush

NOTE: Mere directional adjectives should *not* be capitalized, e.g.

northern birch	southern cat-tail
western Australian flooded gum	western sand-parsley

8. Capitalize modifiers that comprise part of a proper name and are written in the singular, such as:

bay	basin	butte	canyon
cape	county	creek	delta
desert	flat	gap	glacier
gulf	harbor	head	island
lake	Mt.	mountain	ocean
pass	peak	peninsula	plain
plateau	point	range	ridge
river	sea	straight	valley

Examples of these modifiers include:

Blue Ridge bittercress	Cape Thompson whitlow-grass
Grant's Pass willowherb	Great Basin tumble-mustard
Mt. Lassen fairyfan	Rocky Mountain bluebells
Syes Butte plains-mustard	Wind River tansy-mustard

IX. TRUE GROUP NAMES

The following genera are listed with their "true group" names. All other genera referencing these common names should be considered misapplied.

Abutilon – velvetleaf
Achillea – yarrow
Aesculus – buckeye
Allium – garlic, leek, onion
Aloe – aloe
Agropyron – wheat grass
Amaranthus – pigweed, tumbleweed
Andropogon – bluestem, broom grass
Apocynum – dogbane
Arctostaphylos – manzanita
Aster – aster
Brandegea – starvine
Brickellia – brickellbush
Buxus – box
Camassia – camas
Capparis – caper
Carex – sedge
Castanea – chestnut
Cedrus – cedar
Cimicifuga – bugbane
Cirsium – thistle
Citrus – orange, lemon, lime
Corallorrhiza – coralroot
Corylus – hazel
Cucumis – cucumber, melon
Cupressus – cypress
Cydonia – quince
Cytisus – broom
Digitalis – foxglove
Dioscorea – yam
Dracocephalum – dragonhead
Elymus – wild rye
Erica – heath
Eugenia – stopper
Fagopyrum – buckwheat
Ficus – fig
Fragaria – strawberry
Gaylussacia – huckleberry
Geum – avens
Gossypium – cotton
Helleborus – hellebore
Houstonia – bluet
Hyacinthus – hyacinth
Ilex – holly
Ipomoea – morning-glory
Abies – fir
Achyranthes – chaff-flower
Alisma – water-plantain
Alnus – alder
Ageratina – snakeroot
Alocasia – taro
Anchusa – bugloss
Antirrhiunm – snapdragon
Arachis – peanut
Aristolochia – birthwort, Dutchman's-pipe
Bambuseae – bamboo
Brassica – mustard, cabbage, rape
bryophyte – moss
Calluna – heather
Campanula – bellflower
Capsicum – pepper
Carum – caraway
Castanopsis – chinkapin
Cichorium – chicory
Cinnamomum – cinnamon
Cissus – treebine
Convolvulus – bindweed
Corchorus – jute
Croton – croton
Cucurbita – pumpkin, squash
Cydista – with
Cynara – artichoke
Dianthus – pink
Diodia – buttonweed
Dodecahema – spinyherb
Drypetes – rosewood
Epilobium – fireweed, willowherb
Eucalyptus – gum
Euphorbia – spurge
Fendlera – Fendlerbush
Foeniculum – fennel
Fraxinus – ash
Gentiana – gentian
Gnaphalium – cudweed
Helianthus – sunflower
Hemizonia – tarweed
Humulus – hop
Hyssopus – hyssop
Indigofera – indigo
Isoetes – quillwort

Jasminum – jasmine
Juncus – rush
Lagerstroemia – crape-myrtle
Lavandula – lavender
Ligustrum – privet
Linaria – toadflax
Liriodendron – tuliptree
Loeseliastrum – calico
Lonicera – honeysuckle
Lythrum – loosestrife
Malva – mallow
Matthiola – stock
Mercurialis – mercury
Mimulus – monkey-flower
Morus – mulberry
Myosotis – forget-me-not
Myrtus – myrtle
Nicotiana – tobacco
Ocimum – basil
Oryza – rice
Panicum – millet, panic grass
Pastinaca – parsnip
Petroselinum – parsley
Phragmites – reed
Pinguicula – butterwort
Pinus – pine
Polygala – milkwort
Portulaca – purslane
Primula – primrose
Prunus – plum, cherry, almond, peach
Pyrola – wintergreen
Quercus – oak
Raphanus – radish
Rheum – rhubarb
Ribes – currant, gooseberry
Rosa – rose
Rubia – madder
Rumex – sorrel
Sabal – palmetto
Salvia – sage
Santalum – sandalwood
Satureja – savory
Scirpus – bulrush
Scutellaria – skullcap
Selinocarpus – moonpod
Sideritis – ironwort
Solidago – goldenrod
Sullivantia – coolwort
Swietenia – mahogany
Juglans – walnut
Lactuca – lettuce
Laurus – laurel
Levisticum – lovage
Lilium – lily
Linum – flax
Lithospermum – gromwell
Lomatium – desert-parsley
Lychnis – campion
Malus – apple
Marrubium – horehound
Mentha – mint
Mesembryanthemum – iceplant
Mirabilis – four-o'-clock
Musa – banana
Myrrhis – anise
Nelumbo – lotus
Obolaria – pennywort
Olea – olive
Paeonia – peony
Papaver – poppy
Penstemon – beardtongue
Phoradendron – mistletoe
Phaseolus – bean
Pimenta – allspice
Plantago – plantain
Pontederia – pickerelweed
Potamogeton – pondweed
Proboscidea – unicorn-plant
Psidium – guava
Pyrus – pear
Ranunculus – buttercup
Rhamnus – buckthorn
Rhus – sumac
Robinia – locust
Rosmarinus – rosemary
Rudbeckia – coneflower
Ruta – rue
Salix – willow
Sambucus – elder
Sarcodes – snowplant
Saxifraga – saxifrage
Scrophularia – figwort
Sedum – stonecrop
Sequoia – redwood
Solanum – nightshade
Spinacia – spinach
Swertia – felwort
Symphoricarpos – snowberry

Symphytum – comfrey
Tagetes – marigold
Tamarindus – tamarind
Taraxacum – dandelion
Thalictrum – meadow-rue
Thymus thyme
Trichostema – bluecurls
Tragopogon – salsify
Tussilago – colt's-foot
Urtica – nettle
Verbascum – mullein
Vicia – vetch
Viola violet
Wolffia – watermeal
Zingiber ginger
Symplocarpus – skunk-cabbage
Talinum – fameflower
Tanacetum – tansy
Teucrium – germander
Thuja arborvitae
Tillandsia – airplant
Trifolium – clover
Tsuga – hemlock
Ulmus – elm
Vallisneria – eel-grass
Verbena – vervain
Vinca – periwinkle
Vitis – grape
Zea – corn

All genera of the following plant families (or major plant groups) represent true types; thus, their group names should not be hyphenated:

Arecaceae – all names referencing palm
Cactaceae – all names referencing cactus
Cucurbitaceae – all names referencing gourd
Cyperaceae – all names referencing sedge
Orchidaceae – all names referencing orchid
Poaceae – all names referencing grass
Pteridophytes – all names referencing fern and "fern-allies"

The following words are of indeterminate application, not representing true groups, and thus can be used in various group names or fanciful phrases:

balm	balsam	bay
briar	creeper	cress
daisy	flag	haw
hedge	ivy	mampoo
mangrove	osier	rocket
rodwood		

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PARONYCHIA CHARTACEA SSP. *MINIMA* (CARYOPHYLLACEAE): A NEW SUBSPECIES OF A RARE FLORIDA ENDEMIC

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ABSTRACT

Paronychia chartacea ssp. **minima** (Caryophyllaceae) from the Florida panhandle is formally described. The new subspecies is polygamodioecious and exhibits sexual dimorphism. It is distinguished from *P. chartacea* ssp. *chartacea* of peninsular Florida, and a map of their ranges is given.

Florida is noted for its relatively large number of rare or endemic plants (Ward 1979). Muller et al. (1989) list 235 endemic and 40 nearly endemic taxa of vascular plants in Florida. Many of the state's endemics are concentrated in three areas: (1) the Miami Ridge pine rocklands of Dade and Monroe counties; (2) the Central Ridge of peninsular Florida, especially the Lake Wales Ridge in Highlands and Polk counties with its sand pine scrub, which is noted for a number of endemic *Dicerandra* species (Christman and Judd 1990); and (3) the wetlands of the Apalachicola River basin of Franklin, Liberty, Gulf, and Bay counties, which house two endemic monotypic genera — *Harperocallis* and *Stachydeoma*.

One of the endemics of the Lake Wales Ridge is *Paronychia chartacea* Fern. (the papery nailwort or whitlow-wort). It is considered endangered in Florida (Wood 1990) and is listed nationally as threatened (Federal Register, 21 Jan 1987). It has smaller flowers than any other *Paronychia* in the world. Small (1925) erected the genus *Nyachia* for it (as *N. pulvinata*), and Fernald (1936) transferred the species to *Paronychia* as *P. chartacea* because the name *P. pulvinata* was pre-empted. Recent authors have followed Fernald's placement (Core 1941, Chaudhri 1968, Ward 1977).

Paronychia chartacea is occasional in open sand scrub on Lake Wales Ridge but can be locally abundant on disturbed sites such as along fire lanes or trails (VanderKloet 1986) or in response to fire in the scrub (Johnson and Abrahamson 1990). The Florida Natural Areas Inventory has recorded 124 occurrences of this species, but Christman and Judd (1990) note that a Lake County specimen was misidentified. Its present range is much smaller

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than its historical range because more than 70% of the southern Lake Wales Ridge xeric uplands has been lost to citrus cultivation and residential development in the past 40 years (Myers 1990).

While surveying plants of the karst lake region of Washington and Bay counties (which contains the endemics *Hypericum lissophloeus* Adams and *Xyris isoetifolia* Kral and near-endemics *Rhexia salicifolia* Kral & Bostick and *Xyris longisepala* Kral), I found a *Paronychia* in flower that appeared to be a new species. After obtaining fruiting material, I was convinced it was conspecific with *P. chartacea* but sufficiently distinct to warrant recognition as a subspecies.

Paronychia chartacea Fern. ssp. **minima** L. Anderson, ssp. nov.

Plantae persimiles eis subspeciei chartaceae sed habitu minore annuali subtiliore in ramificatione, caudicibus 1 mm in crassitudine vel tenuioribus, caulibus maculis purpureis parvis notatis, foliis principalibus 1.2 − 3 mm latis, cymulis 1.5 − 4 mm latis, sepalis in maturitate plus minusve patentibus differunt.

Annual, wiry branched often matted herb; caudex (0.4) 0.7 − 1.0 (1.5) mm thick; stems 2 − 15 (24) cm long, sparsely to much branched, minutely purple spotted with vertically elongate epidermal inclusions, sparsely to densely retrorsely pubescent mostly on one side only. Leaves opposite; leaf blades 1.5 − 5 mm long, 1 − 2.3 mm wide, oblong or oblong-lanceolate to triangular-ovate, apex acute to broadly acute, margin strongly revolute, base truncate to somewhat auriculate; petiole none; stipules 0.7 − 2.5 mm long, lanceolate, membranous, margins fimbriate. Cymes much-branched, open, the flowers in small clusters 1.5 − 4 mm wide; stipular bracts shorter than to slightly longer than flowers, leafy bracts shorter to longer than flowers. Flowers 0.6 − 1 mm long, polygamo-dioecious, sparsely pubescent below with straight to somewhat hooked trichomes; sepals (3) 4 − 5, greenish or yellow-green to brownish, sometimes whitish-margined, oblong, 0.5 − 0.7 mm long, apically hooded, the prominent hood obtuse, typically with a subapical acute to obtuse mucro 0.15 − 0.25 mm long, the mucro often paler than the sepal body; petals absent; stamens 4 − 5; styles 2 or 3, distinct, 0.07 − 0.26 mm long. Utricle ovoid to ellipsoid, 0.5 − 0.6 mm long, almost smooth, slightly shorter than the sepals, ± exposed at maturity.

Type: UNITED STATES. FLORIDA. Washington Co.: locally common on open, coarse, white sand of upper shoreline of Crystal Lake, 11 air mi S of Vernon, E½ of NE¼ Sec 35, T1N, R15W, 1 Oct 1990, *L. C. Anderson 13301* (holotype: NY; isotypes: AUA, FLAS, FSU, GA, GH, MO, SMU, UNC, US, USF, VDB).

Additional specimens examined. FLORIDA: **Bay Co.**: River Lake, S side rte 20, 7.5 air mi NNW of Vicksburg, 3 Aug 1990, *Anderson 13182* (FSU, MO, NY); Shirt Tail Lake, 7 air mi NNE of Vicksburg, 3 Aug 1990, *Anderson 13184* (FSU, MO, NY); White Western

Lake, 6 air mi NW of Vicksburg, 1 Oct 1990, *Anderson 13305* (FSU, MO, NY). **Washington Co.**: Crystal Lake (type locality), 6 Jul 1990, *Anderson 13080* (FSU, KNK, MO, NY, UNC), 3 Aug 1990, *Anderson 13151* (FLAS, FSU, GA, MO, SMU, TENN, USCH, USF, VDB), 27 Dec 1990, *Anderson 13343* (FSU); Sand Lake, 2.5 air mi SSE of Greenhead, 3 Aug 1990, *Anderson 13160* (FSU, MO, NY); Gully Lake, 2 air mi ESE of Greenhead, 3 Aug 1990, *Anderson 13167* (FSU, NCU, USF); small pond at SW end of Gully Lake, 27 Dec 1990, *Anderson 13348* (FSU); Whitewater Lakes, N shore of main lake, 6.5 air mi ESE of Greenhead, 3 Aug 1990, *Anderson 13172* (FSU); Boat Lake, Sunny Hills, 4 air mi NE of Greenhead, 3 Aug 1990, *Anderson 13181* (AUA, BRY, FLAS, FSU, GA, GH, KNK, KSC, MO, SMU, TENN, UC, USCH, USF, VDB), 1 Oct 1990, *Anderson 13279* (FSU, NCU); 27 Dec 1990, *Anderson 13352* (FSU).

Sexual dimorphism occurs (Fig. 1). Predominantly male plants are more openly branched, usually with two successive dichotomies that result in a spindly, cruciform prostrate plant, whereas plants with predominantly bisexual or rarely pistillate flowers are more densely matted and have more numerous, shorter branches. The sexual dimorphism and the rare conditions of 3 sepals or 3 styles in this species are possibly unique in the genus.

Locally established in coarse white sand along margins of karst lakes, often in nearly pure stands, apparently favored somewhat by mild disturbance. It is either in nearly pure strands or associated with some of the following: *Amphicarpum muhlenbergianum* (Schult.) Hitchc., *Bulbostylis barbata* (Rottb.) Clarke, *B. ciliatifolia* (Ell.) Fern., *Chrysopsis lanuginosa* Small, *Eriocaulon lineare* Small, *Hypericum lissophloeus*, *H. reductum* Adams, *Lachnanthes caroliniana* (Lam.) Dandy, *Lachnocaulon anceps* (Walt.) Morong, *Paronychia patula* Shinners, *Polypremum procumbens* L., *Rhexia salicifolia*, *Rhynchospora globularis* (Chapm.) Small, *Sagittaria isoetiformis* J. G. Sm., and *Xyris longisepala*. Flowers July to October; nearly all seed shed by late December.

Paronychia chartacea ssp. *minima*, with its polygamodioecy and dimorphic morphology (Fig. 1), could be an example of disruptive selection (or the dimorphism could be selectively neutral). Selection pressure for better pollen dispersal possibly produced cruciform branching with longer internodes in the predominantly male plants, whereas selection for better pollen reception resulted in compactly matted plants that are repeatedly branched with shortened internodes in plants with predominantly bisexual or pistillate flowers. On the other hand, the compact form may be advantageous for successful protection, maturation, or dispersal of the seed. Sexual dimorphism is present, but much less pronounced, in ssp. *chartacea*.

Quantitative differences between the subspecies are listed in Table 1. The two subspecies of *P. chartacea* also differ in longevity. Plants of ssp.

FIG. 1. Old plants of *Paronychia chartacea* ssp. *minima* (*Anderson 13343*) showing extremes in sexual dimorphism; compact hermaphroditic or functionally female plant is on the left, and loosely branched functionally male plant is on the right (with one of its dichotomous branches broken off).

TABLE 1. Some quantitative differences between subspecies of *P. chartacea*.

Feature	ssp. *minima*	ssp. *chartacea*
Caudex (stem base) width, mm	(0.4) 0.7 – 1.0 (1.5)	(1.0) 1.5 – 3.5 (4.2)
Leaf width, mm	1.2 – 3.0	0.5 – 1.5
Flower cluster (cymule) width, mm	1.5 – 4.0	3.0 – 20.0

minima are strictly annual and generally smaller, have more delicate, frequently cruciform, branching and less reddish-brown pigmentation, but have colored epidermal inclusions on the stems. *Paronychia chartacea* from Lake Wales Ridge (i.e., ssp. *chartacea*) has repeatedly been described as annual (Small 1925, Core 1941, Chaudhri 1968, Ward 1977, Christman and Judd 1990, Johnson and Abrahamson 1990), but it is often a short-lived perennial. Many specimens exhibit dead tops with green, new branches developed toward the base of the plant. They form larger mats (seldom with cruciform pattern) and generally have darker coloration but lack the purple epidermal inclusions.

Much of the distinction between the two subspecies is a matter of degree. Plants of ssp. *minima* seem somewhat less pubescent than those of ssp. *chartacea*. The sepal mucro is more prominent in most plants of ssp. *minima*; the mucro is usually shorter and blunter in ssp. *chartacea*. At maturity the sepals of ssp. *minima* frequently spread open, whereas sepals of ssp. *chartacea* remain directed forward. Collections of ssp. *minima* are mainly from July through October (plants collected in December were overly mature and dry; the stems were more or less disarticulated), whereas ssp.*chartacea* has been collected throughout the year (mainly August through March).

With the description of *Paronychia chartacea* ssp. *minima*, both subspecies qualify as taxa of special concern and should be officially protected because of the limited range for each subspecies. The species continues to be a Florida endemic (Fig. 2), but it now has an interrupted distribution between two centers of high endemism in the state (the karst lake area is adjacent to the Apalachicola River system and could be considered part of that region of high endemism).

Other examples linking these two areas of high endemism are rare. An example in *Conradina* comes to mind (see Shinners 1962). *Conradina canescens* (T. & G.) Gray tends to occur in sand near the gulf coast from Wakulla County, Florida, westward through the Apalachicola region to coastal sites in Alabama and Mississippi. It has also been found inland bordering a karst lake in Washington County (*Anderson 13295*, FSU), but *P. chartacea* was absent at that particular lake. The closely related *Conradina* *brevifolia* Shinners is a scrub endemic of the Lake Wales Ridge in Polk and Highland counties. Wunderlin (1982) apparently considers the two conspecific because he lists the plants from Polk and Highlands counties as *C. canescens*. An additional endemic, *C. glabra* Shinners, occurs solely in the Apalachicola River region; whereas another endemic, *C. grandiflora* Small, occurs just east of the Lake Wales Ridge.

Two rare, closely related lupines have somewhat similar distributional patterns. *Lupinus westianus* Small is endemic to the Florida panhandle, and *L. aridorum* McFarlin ex Beckner is restricted to the Central Ridge in Orange and Polk counties. Another example is the rare lichen *Cladonia perforata* Evans, which involves one of these centers of endemism. This *Cladonia* is known from Okaloosa County in the panhandle (Wilhelm and Burkhalter 1990) and from the Lake Wales Ridge in Highlands County (Buckley and Hendrickson 1988).

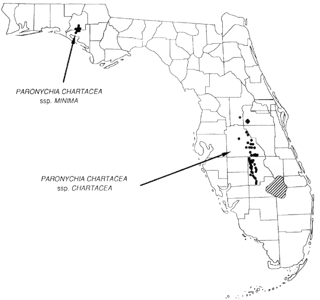

FIG. 2. Range of *Paronychia chartacea* in Florida; each subspecies is located in an area of high endemism. Extant and historic sites are plotted for ssp. *chartacea*; Core (1941) listed a few collections from DeSoto County, but county lines were later redrawn, and those sites are now in Highlands County.

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BOOK REVIEWS

Gregersen, Hans, Sydney Draper, and Dieter Elz. Editors. 1989. People and Trees, the Role of Social Forestry in Sustainable Development. Available from: Publication Sales Unit, The World Bank, 1818 H Street, N.W., Washington, DC 20433. Price Unknown; Tele: 202/477-1234. (8.5 x 11) 273 pp.

This book is one of a number in the EDI (Economic Development Institute of the World Bank) Seminar Series designed for use in EDI courses and seminars.

"The distinguishing feature of social forestry, as distinct from industrial and large-scale government forestry, is the involvement of local, generally rural, people in growing trees for their own use. ...The book's main purpose is as a reference for training people who formulate policies and design or implement programs that recognize the vital importance of integrating trees into farming and ecological systems."

The text is organized into Part 1. Social Forestry and Development with 5 chapters, each composed of 3 to 7 topics and Part 2. Planning and Implementing Social Forestry Projects with 10 chapters, each composed of 3 to 8 topics. Seventeen authors have contributed to the text with the editors integrating the chapters to eliminate duplication and to make the chapters consistent. wfm

McNeely, Jeffrey A., Kenton R. Miller, Walter V. Reid, Russell A. Mittermeir, Timothy B. Werner. 1990. Conserving the World's Biological Diversity. World Bank Publications, P. O. Box 7247-8619, Philadelphia, PA 19170-8619. Order Stock £11384. $14.95 paper (8.5 x 11) 174 pp.

This book is published by the World Bank, The World Resources Institute, the International Union for Conservation of Nature and Natural Resources, Conservation International, and the World Wildlife Fund.

Chapter 1. Biological Diversity: What it is and Why it is Important (3 topics); Chapter 2. The Values of Biological Diversity (5 topics); Chapter 3. How and Why Biological Resources are Threatened (4 topics); Chapter 4. Approaches to Conserving Biological Diversity (5 topics); Chapter 5. The Information Required to Conserve Biological Diversity (5 topics); Chapter 6. Establishing Priorities for Conserving Biological Diversity (3 topics); Chapter 7. The Role of Strategies and Action Plans in Promoting Conservation of Biological Diversity (4 topics); Chapter 8. How to Pay for Conserving Biological Diversity (4 topics); Chapter 9. Enlisting New Partners for Conservation of Biological Diversity (4 topics); Annex 1, Classification of Life on Earth by Phylum; Annex 2, The World Charter for Nature; Annex 3, International Legislation supporting Conservation of Biological Diversity; Annex 4, The Bali Action Plan; Annex 5, The World Bank Wildlands Policy; Annex 6, Glossary. wfm

ANNOTATED CHECKLIST OF ARIZONA CONVOLVULACEAE

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ABSTRACT

Specimens examined in 14 herbaria indicate that there are 30 native and naturalized species of Convolvulaceae in the state of Arizona. Types and select specimens are cited. Notes are given on county distributions, habitats, altitudes, and flowering dates. Comments are made on taxonomic problems, abundance and natural history of selected taxa. A lectotype for *Ipomoea heterophylla* Ortega is selected.

RESUMEN

Una revisión de las muestras de 14 herbarios indica que existen 30 especies nativas y naturalizadas para el estado de Arizona. Se citan los tipos y los ejemplares estudiados. Se nota la distribucion por los condades, el habitato, la distribucion altitudinal, y las fechas de floracion. Se commenta sobre los problemas taxonómicos, la historia natural, y la abundancia de los taxa. Se selecciona un lectotipo para *Ipomoea heterophylla* Ortega.

During preparation of the family Convolvulaceae for the *Vascular Plants of Arizona,* certain taxonomic notes were found necessary (Austin 1990). The following annotated checklist, which includes all correct names of species known for the state, provides notes on several aspects of systematics, abundance and natural history of Arizonan morning glories. In some cases notes are given on the living colors of floral parts since these details are normally not part of floristic surveys. Included are the corresponding names from Kearney and Peebles (1951) and Kearney et al. (1960) and some additional synonyms. Where types have not been seen, the usage is based on other authors who have seen authentic material, except in a few cases where it is based on the protologue.

1. *CALYSTEGIA*

1. Calystegia longipes (S. Watson) Brummitt, Ann. Missouri Bot. Gard. 52:215. 1965. — Type: NEVADA: in 1872, *Wheeler s.n.* (US!). *Convolvulus longipes* S. Watson, Amer. Naturalist 7:302. 1873.

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Sida 14(3):443–457. 1991.

Convolvulus linearilobus Eastw., Proc. Calif. Acad. Sci. Ser. 4, 20:470. 1931. — TYPE: ARIZONA: Mazatzal Mts, *Eastwood 17264* (CAS!; photo of K specimen at NY!).

Known from Coconino, Gila, Maricopa, Mohave and Yavapai cos. The species grows in chaparral although it has been found extending into the Upper Sonoran zone; 609 – 1706 m; flowering March to October.

This rare species, having been collected few times since the 1930s and 1940s, is endemic to the Southwest, from California (San Diego Co. to Inyo Co. and from Kern Co. to San Luis Obispo Co.), s Nevada (Clark Co.), Utah (Washington Co.) and Arizona. The species appears to be rare throughōut its range.

Corollas are white with a cream-colored throat, and have pink patches on the limb around the nectar guides (interplicae). Styles, androecia and gynoecia are white, but the nectary is yellow. Flowers are pollinated by *Osmia* sp. (Megachilidae).

2. CALYSTEGIA SEPIUM (L.) R. Br. ssp. ANGULATA Brummitt, Kew Bull. 35(2):328. 1980. — TYPE: IDAHO. CANYON CO.: *Macbride 318* (NY!). *Calystegia sepium* (L.) R. Br. var. *angulata* (Brummitt) N. Holmgren in A. Cronquist et al., Intermountain Fl. Vasc. Pl. Intermountain West, U.S.A. 4:77. 1984.

Known from a single specimen collected in 1882 from a garden in Cochise Co.; ca 1524 m; flowering in June.

These plants are easily confused with the Great Plains taxon *C. sylvatica* (Kit.) Griseb. ssp. *fraterniflora* (Mackenzie and Bush) Brummitt as shown by the interpretations in Tryon (1939), Correll and Correll (1972) and Lehr (1978). The quadrate sinuses in the leaf bases of *C. sylvatica* allow separation from the V-shaped or U-shaped sinuses of *C. sepium*.

3. CALYSTEGIA MACOUNII (Greene) Brummitt, Ann. Missouri Bot. Gard. 52:215. 1965. — TYPE: CANADA. SASKATCHEWAN: Assiniboia, Milk River, Aug 1905, *Macoun 11883* (not seen). *Convolvulus macounii* Greene, Pittonia 3:326. 1898.

Convolvulus sepium sensu Kearney and Peebles.
Convolvulus interior House, Bull. Torrey Bot. Club 32:140. 1905. — TYPE: COLORADO: near Fort Collins, *Crandall 1625* (NY!, US!).

Known from Apache, Coconino, Navajo and Yavapai cos. Growing in moist sites, near lakes and streams; 1950 – 2042 m; flowering June to July.

This rare species is a Great Plains endemic that had not been collected in Arizona since 1971 until it was relocated in 1990 (*Austin & Austin 7661*, ASU).

Corollas, stamens and gynoecia are white, although the nectary is yellow. Bees (not yet determined) visit the flowers.

2. *CONVOLVULUS*

1. Convolvulus arvensis Linnaeus, Sp. Pl. 153. 1753. — Type: SWEDEN: specimen 218.1 (LINN, microfiche!).

This introduced European weed was first collected in Arizona in 1843 near the Navajo Ordinance Depot in Flagstaff by Lt. P. Shallert, an army surgeon. A short time later, in 1882, Lemmon collected it in the Huachuca Mountains near Ft. Huachuca. The species is now known from all Arizona counties except La Paz. A collection from Greenlee Co. (*Austin & Austin 7634*, ASU) is a new county record. Common in disturbed sites, roadsides, and cultivated fields; 341 – 2346 m; flowering April to October. Common name: "Bindweed."

2. Convolvulus equitans Benth., Pl. Hartweg. 16. 1839. — Type: MEXICO: 1837, *Hartweg 98* (presumably K).

C. incanus sensu auctt., non Vahl.

Known from all Arizona counties except Yuma and La Paz. Frequent in grasslands and plains; 762 – 1981 m; flowering March to November. Local common names are: "Silver Bindweed" (*Little 37*, ARIZ), and "Desert Bindweed" (*Wilcox s.n.*, ARIZ).

The filaments are white, the anthers purple. Styles and the bases of the stigma lobes are white, but the tips of stigma lobes are purple. The nectary is yellow and cup-shaped. Visited by honeybees (*Apis mellifera*) and bumblebees (*Bombus* sp.) (Pima Co., *Austin & Austin 7561*, ASU).

3. *CRESSA*

1. Cressa truxillensis H.B.K., Nov. Gen. Sp. Pl. 3:93. 1819. — Type: PERU: Trujillo, *Humboldt & Bonpland 3727* (B: microfiche!, isotype: F!).

C. depressa Goodd., Bot. Gaz. 37:58. 1904. — Type: NEVADA: *Goodding 726* (UC!).
C. insularis House, Bull. Torrey Bot. Club 33:315. 1906. — Type: MEXICO: Revillagigedo Isls, *Barkelew 252* (US!, UC!).
C. erecta Rydb., Bull. Torrey Bot. Club 40:466. 1913. — Type: UTAH: *Garrett 870* (NY!).
C. minima Heller, Muhlenbergia 8:140. 1913. — Type: NEVADA: *Heller & Kennedy 8663a* (NY!). *C. truxillensis* H.B.K. var. *minima* (Heller) Munz, Aliso 4:96. 1958.
C. pumila Heller, Muhlenbergia 8:142. tab. 17. 1913. nomen nudum.
C. vallicola Heller, Muhlenbergia 8:140. tab. 17. 1913. — Type: CALIFORNIA: *Heller 8936a* UC!). *C. truxillensis* H.B.K. var. *vallicola* (Heller) Munz, Aliso 4:96. 1958.
C. cretica L. var. *truxillensis* (H.B.K.) Choisy in DeCandolle, Prodr. 9:440. 1845.

Known from Coconino, Maricopa, Mohave, Navajo, Pinal and Yuma cos. Occasional in saline desert; 30 – 1524 m; flowering May to November.

Plants were last collected in Mohave Co. in 1912 (*Jepson 5026*, ARIZ); in Pinal Co. in 1937 (*Peebles 13233*, ARIZ); in Maricopa Co. in 1964 (*Rea s.n.*, ASU); and in Navajo Co. in 1978 (*Pinkava et al. 13839* ASU). Although last collected in Yuma Co. in 1971 (*Hamilton s.n.*, ARIZ, ASU, DES), the plants were relocated in 1989 (*Austin & Austin 7586*, ASU).

Previously the plants had been separated into species or varieties on the basis of growing erect or prostrate. Both growth forms were growing side by side in Yuma. Plants were not found in flower.

4. *DICHONDRA*

1. DICHONDRA ARGENTEA Willd., Hort. Berol. 297. t. 81. 1806. — TYPE: COLOMBIA: Tolima ca. Honda, *Bonpland* (B?).

Known from a single collection from Bisbee in Cochise Co. in 1931 (*Harrison 8256*, ARIZ). In New Mexico the plants grow in Chihuahuan desert scrub and Madrean oak woodlands; ca. 1615 m; flowering in September, earlier in New Mexico and Mexico.

The species is frequent in Texas and New Mexico as far west as the Organ Mts. Perhaps the Arizona collection represented a western limit to the natural range of the species, or perhaps it was introduced into Bisbee during the mining operations. Plants have not been relocated in Arizona even though several people have searched for them.

2. DICHONDRA BRACHYPODA Wooton & Standley, Contr. U.S. Natl. Herb. 16:160. 1913. — TYPE: NEW MEXICO. DOÑA ANA CO.: Organ Mountains, Filmore Canyon, 23 Sep 1906, *Wooton & Standley s.n.* (US!).

Known from Cochise and Santa Cruz cos. Occasional in Madrean oak woodlands and lower ponderosa pine zones; 1219 – 1889 m; flowering July to October.

Although the morphological traits given by Tharp & Johnston (1961) are sufficient to distinguish species, they also differ by colors of flower parts. The corolla lobes are cream, green at base. Filaments and stigmas are green. Anthers are white with a purple stripe and the nectary is dark green. The ovary is light green and the styles are cream. Mature fruits collected on 9 Sep 1989 (Cochise Co. Rucker Canyon. *Austin & Austin 7611*, ASU). Fruits were fully mature by October.

3. DICHONDRA SERICEA Swartz, Prodr. Veg. Ind. Occ. 54. 1788. — TYPE: JAMAICA: *Swartz* (S?). *D. repens* Forster & Forster var. *sericea* (Swartz) Choisy in DeCandolle, Prodr. 9:451. 1845.

D. repens sensu auctt., non Forster & Forster.

In Arizona the species is known exclusively from the Pajarito Mts. in

Santa Cruz Co. Rare in streamside vegetation; ca. 1112 m; flowering May to December.

The single Arizona location is Sycamore Canyon (Santa Cruz Co. from 1936, *Goodding 6620* ARIZ to 1962, *Barr 62-863* ARIZ) near the Mexican border. This population was relocated after an hiatus of 19 years (*Austin & Austin 7604*, ASU), but its size has apparently declined. Based on herbarium specimens flowers and fruits are uncommon in this population. Flowers were found in April. Petals, anthers and gynoecia are pale green (*Austin & Austin 7604*, ASU). No flower visitors were seen.

5. *EVOLVULUS*

1. EVOLVULUS ALSINOIDES L. var. ANGUSTIFOLIA Torrey, Bot. Mex. Bound. 150. 1858. — TYPE: TEXAS. PRESIDIO CO.: ca. the "Grand Canyon" of the Rio Grande. August, *Parry* (not found in CM, GH, ISC, MO, NY, PH, US or YU).

   E. alsinoides L. var. *acapulcensis* (Willd.) Ooststr., Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 14:34. 1934. — TYPE: MEXICO. GUERRERO: ca. Acapulco, *Willdenow 6128* (B).

Known from Cochise, Pima, Pinal and Santa Cruz cos., and reportedly in Gila and Maricopa (Kearney and Peebles 1951, 1960). Occasional in pine-oak woodlands, saguaro desert scrub, and desert grasslands; 762 – 1828 m; flowering February to October. The common name: "DIO DE VIBORA" (Lehr 1978) must represent an error in spelling, or an orthographic variant either of "TIO DE VIBORA" or "DIOS DE VIBORA," although I have found neither of these common names to be in use.

Flowers open 8:00-9:00 a.m., and close ca. 4:00-5:00 p.m. (Pima Co., *Austin & Austin 7598*, ASU). Corollas are blue on the limb, white in the throat. Stamens and gynoecia are white. No flower visitors were seen.

2. EVOLVULUS ARIZONICUS A. Gray, Syn. Fl. N. Amer. 2, 1:218. 1878. — TYPE: MEXICO: SONORA: sandy prairies, Sep 1857, *Thurber 1023* (GH!). See Austin (1990) on complexities of typification.

   Evolvulus laetus A. Gray, Proc. Amer. Acad. Arts 17:228. 1882. – TYPE: ARIZONA: 1881, *Pringle s.n.* (F!, GH!, US!). *E. arizonicus* A. Gray var. *laetus* (A. Gray) Ooststr., Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 14:76. 1934.

Known from Cochise, Gila, Graham, Greenlee, Mohave, Navajo, Pinal, Pima, Santa Cruz and Yavapai cos. Occasional to frequent in different parts of the state; more common in the southern counties. Plants grow in chapparal, Madrean oak woodlands, and mesquite grasslands; 883 – 1828 m; flowering April to October. Common name: "FALSE FLAX" (*McGinnies 4*, ARIZ).

Flowers, which open 7:00-8:00 a.m. and close 3:00-4:00 p.m., have blue limbs, white throats, and white stamens and gynoecia, and are visited by bees (not caught but possibly Halictidae). Pollen was gone and some of the anthers were stripped from flowers by 11:30 a.m. (*Austin & Austin 7588*, ASU).

3. EVOLVULUS NUTTALLIANUS Roem. & Schult., Syst. Veg. 6:198. 1820. — TYPE: on the banks of the Missouri, *Nuttall* (B?).

   E. pilosus Nutt., Gen. N. Amer. Pl. 1:174. 1818, nom. superfl. — TYPE: on the banks of the Missouri, *Nuttall* (B?).

   E. oreophilus Greene, Leafl. Bot. Observ. Crit. 1:151. 1905. — TYPE: NEW MEXICO: *Metcalfe 1228* (NMC!, NY!, UC!, US!).

Known from Apache, Cochise, Coconino, Gila, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz and Yavapai cos. Occasional in chaparral, Madrean oak woodlands, ponderosa pine zone, pinon-juniper zone, and rocky grasslands; 822 – 2438 m; flowering April to September.

Some herbarium specimens are difficult to separate from *E. sericeus*. The species usually may be separated by the spreading-villose trichomes on the sepals of *E. nuttallianus* (Santa Cruz Co., *Austin & Austin 7572*, ASU) and appressed-pilose trichomes on *E. sericeus* although there are intermediate specimens (*Metcalfe 1228*, NMC, NY, US).

Corolla limbs are pale blue changing to white near the base; the short tube is pale yellow within. Androecia and gynoecia are white. No insect visitors were seen.

4. EVOLVULUS SERICEUS Swartz, Prodr. Veg. Ind. Occ. 55. 1788. — TYPE: JAMAICA: *Swartz* (M, S).

   E. wilcoxianus House, Bull. Torrey Bot. Club 33:315. 1906. — TYPE: ARIZONA: *Wilcox 96* (US!).

Known from Cochise, Gila, Graham, Greenlee, Pima, Pinal, Navajo, Santa Cruz and Yavapai cos. Frequent in chaparral, Madrean oak woodlands, and desert grasslands; 975 – 1889 m; flowering May to October.

For those wishing to recognize them, two varieties have been named: var. *discolor* (Benth.) A. Gray, with upper leaf surface glabrous and var. *sericeus*, with leaves sericeous on both surfaces. Since these plants may be found growing together outside the U.S.A., I do not recognize the distinction.

Specimens that were separated as *E. oreophilus* Greene were treated by Ooststroom (1934) as *E. sericeus* var. *discolor* form B. These are better treated as *E. nuttallianus* because of their habit, corolla shape and color and indumentum on both leaf surfaces.

The androecium and the gynoecium are white (Cochise Co. *Austin & Austin 7571*, ASU). No flower visitors have been seen.

6. *IPOMOEA*

1. Ipomoea barbatisepala A. Gray, Syn. Fl. N. Amer. 2, 1:212. 1886. — Type: TEXAS: *Wright* 507 (GH!, US!).

Known from Cochise, Gila, Graham, Greenlee, Maricopa, Pima, Santa Cruz, and Yavapai cos. Occasional in mesquite grasslands and Madrean oak woodlands; 853 – 2438 m; flowering July to December.

Flowers open at dawn, and are at first blue on the limb with a white throat. The outside of the tube is white on the folds (plicae) and pale green on the unfolded area (interplicae). As senescence beings, the corolla turns pink and then reddish. Anthers are white, but the filaments are pale yellow. The style is green, the stigma white and 2-lobed, the ovary green, and the disc yellow and cup-shaped (Pima Co., *Austin & Austin 7594*, ASU).

2. Ipomoea capillacea (H.B.K.) G. Don, Gen. Syst. 4:267. 1838. — Type: COLOMBIA: *Bonpland* (microfiche!).

I. muricata Cav., Icones Pl. 5;52. pl. 478. f. 2. 1794, non L. (1763), non Jacq. (1789).

Known from Cochise, Coconino, Pima, Santa Cruz and Yavapai cos. Occasional in Madrean oak woodlands, desert grasslands, and ponderosa pine zones; 1524 – 2499 m; flowering July to September.

Flowers open at dawn. The corolla limb is lavender and the tube white, within and without. Androecia and gynoecia are also white. Beeflies (Bombyliidae) visit the flowers (Cochise Co., *Austin & Austin 7569*, ASU).

3. Ipomoea cardiophylla A. Gray, Syn. Fl. N. Amer. 2, 1:213. 1886. — Type: TEXAS: *Wright 511* (GH!).

No Arizona specimens were seen by Kearney and Peebles (1951, 1960) although they suggested this species' presence in Arizona as probable. A population was reported near Tombstone by Mason et al. (1986) and was relocated in 1989 (Cochise Co., *Austin & Austin 7608*, ASU). The species is represented by scattered plants extending along the road for about 0.8 miles at an altitude of 1127 m in mesquite-creosote bush scrub (Chihuahuan desert scrub sensu Brown and Lowe 1980). No fruits were present on 7 Sep 1989; some mature fruits were found on 26 Sep, but were heavily parasitized by insects. Rare and local.

Flowers open at 6 a.m.; mostly wilted by 11 a.m. The corolla tube is pale yellow on the outside; the limb is pale blue (as in *I. tricolor*). Stamens are white to pale cream; the style is green, the stigma white. No odor was detectable, and no insects visited between 6:00 and 6:30 a.m. McDonald (1982) found no pollinators on the species in Texas and New Mexico and had a 90% seed set on cultivated plants. The species may be considered autogamous.

4. IPOMOEA COSTELLATA Torr., Bot. Mex. Bound. 149. 1859. — TYPE: TEXAS: *Wright 505* (GH!, US!).

I. futilis A. Nelson, Univ. Wyoming Publ. Sci. 1(3):65. 1924. — TYPE: ARIZONA: *Hanson 1016* (RS, not seen; photo FAU!).

Known from Apache, Cochise, Coconino, Gila, Greenlee, Mohave, Navajo, Pima, Pinal, Santa Cruz and Yavapai cos. Common in chaparral, Madrean oak woodlands, and ponderosa pine zones; 975 – 2133 m; flowering July to October.

Flowers begin to open at 8:15 a.m. and begin to wilt at 10:30 a.m. The corolla limb is lavender, the tube white within and without. Filaments and anthers are white; white trichomes extend along the filaments from base to apex; the ovary is cream, and the style is green. A stigma was 3-lobed on one flower, 2-lobed on others. The flowers are visited by bumblebees (Cochise Co. *Austin & Austin 7584*, ASU).

5. IPOMOEA CRISTULATA H. Hallier, Med. Rijksherb. Leiden 46:20. 1922. A new name for *Quamoclit gracilis* H. Hallier. — TYPE: MEXICO: based on syntypes including *Bourgeau 1061* (G-DC!). *Quamoclit gracilis* H. Hallier, Bull. Herb. Boiss. 7:416. 1899.

I. coccinea auctt., non L.

Known from all Arizona counties except La Paz. Plants grow in chaparral, Madrean oak woodlands, and ponderosa pine zones; 731 – 2773 m; flowering May to November. This is probably the most common and widespread species in the state. "STAR GLORY" (*Blakeley & Marshall 568*, DES)

Flowers, which are open from 6:00 a.m. into the late afternoon, are visited by hummingbirds. Since the stigma is held below the level of stamens, the plants may be facultatively allogamous (Pima Co., *Austin & Austin 7593*, ASU). According to an anonymous reviewer the species is probably predominantly selfing and there may be cleistogamous flowers under low light conditions. Even when chasmogamous the anthers dehisce before anthesis.

7. IPOMOEA HEDERACEA Jacq., Collect. Bot. 1:124. 1786. — TYPE: based on Dillenius, Hort. Elth. t. 80, fig. 92 (plate selected lectotype! by Verdcourt, 1957).

I. desertorum House, Ann. New York Acad. Sci. 18:203. 1908. — TYPE: ARIZONA: *Thornber 29* (ARIZ!, NY!).

Although not reported for Arizona by Kearney and Peebles (1951, 1960), certain specimens identified as "*I. hirsutula*" are of this species, the others are *I. purpurea* (Austin, 1990).

Known from Cochise, Coconino, Gila, Graham, Maricopa, Pima, Pinal, Santa Cruz, Yavapai and Yuma cos. Common in various disturbed sites, especially cotton fields; 883 – 1859 m; flowering August to November.

The corollas open at dawn, some closing by 8:15 a.m., and all are closed by 11 a.m. Honeybees were seen bypassing flowers after pausing. A bumblebee bypassed flowers of *I. hederacea* but visited those of *I. costellata* and *Convolvulus equitans*. However, flowers of *I. hederacea* were visited by short-tailed black swallowtail butterflies (*Papilio indra*). Corolla limbs are blue early after opening but begin to include reddish pigments as they begin to wilt and turn more purple. The corolla tube is white within and without. The stamens and the styles are white; the ovary is cream (Pima Co., *Austin & Austin* 7596, ASU).

8. Ipomoea leptotoma Torr., Bot. Mex. Bound. 150. 1859. — Type: MEXICO. Sonora: *Thurber* 977 (GH!).

I. leptotoma var. *wootonii* E. Kelso, Rhodora 39:151. 1937. — Type: ARIZONA: 10 Sep 1914, *Wooton 10* (US!). *I. leptotoma* Torr. f. *wootonii* (E. Kelso) Wiggins, Contr. Dudley Herb. 4:21. 1950.

Known from Cochise, Gila, Graham, Pima, Pinal, Santa Cruz and Yavapai cos. Occasional in plains, Sonoran desert scrub; 609 – 1371 m; flowering June to October.

The corolla opens as the sun rays touch it, between 7:30 and 8:00 a.m., and close between 10:30 and 11:00 a.m. Corolla limbs are lavender, and there is a white zone between the limb and pale yellow base of the tube. The tube is white without. Orange trichomes adorn filaments from base to apex; the androecium, gynoecium, style, ovary, and disc are white. Skippers (Hesperiidae) visit flowers (Gila Co., *Austin & Austin 7601*, ASU, which is a new county record; Pima Co. *Austin & Austin 7595*, ASU).

9. Ipomoea × leucantha Jacquin, Icones Rar. 2:t. 318. 1788. — Type: no specimen known; illustration chosen as lectotype by Austin in 1978.

I. triloba sensu auctt., non L. (1753).
I. lacunosa sensu Shinners (1965), non L. (1753).

Known from Maricopa, Pima and Yuma cos. Plants grow in disturbed sites; ca. 701 m; flowering March to November.

Known from three old collections (Santa Cruz Co., *Pringle* in 1884, ARIZ; Pima Co., *Thornber* in 1912, ARIZ; county unknown, *LeRoy s.n.*, NY); one in 1945 (Pima Co. *Goodding & Lusher 128-45*, NY), and two recent ones (Maricopa Co. 4 Oct 1979, *Heathman s.n.*, ARIZ, ASU; Yuma

Co. 7 Nov 1985, *Tuttle s.n.*, ARIZ). The hybrids are probably not as rare as collections seem to indicate since they are weeds in cotton fields.

10. Ipomoea lindheimeri A. Gray, Syn. Fl. N. Amer. 2, 1:210. 1886. — Type: TEXAS: *Wright 508* (GH!, US!).

Known from Cochise Co. (Gleeson, 25 Aug 1927, *Thornber s.n.*, ARIZ; Bisbee, 30 Sep. 1930, *Thornber s.n.*, ARIZ); reportedly from Pima Co. (Kearney and Peebles 1951; Kearney et al. 1960). Plants grow in Madrean oak woodlands, and Chihuahuan desert scrub zones; 1066 – 1371 m; flowering August to September.

An extremely rare species; its continued existence in Arizona is problematical. Probably related to and easily confused with *I. pubescens* Lam., the two collections from Arizona are somewhat intermediate between the two on the basis of sepal shape and pubescence.

11. Ipomoea longifolia Benth., Pl. Hartweg. 16. 1839. — Type: MEXICO: *Hartweg* (K).

Known from Cochise and Santa Cruz cos. Locally common in Madrean oak woodlands; 975 – 1828 m; flowering July to September.

The nectary is cream-colored, and the androecium and gynoecium are white. Early in the evening the flowers have a slight sweet fragrance. Flowers are pollinated by moths (Austin 1986). Flowers open 3:00 to 4:00 p.m. and close near dawn; a few were still open at 7:30 a.m. (Cochise Co., *Austin & Austin 7582*, ASU).

12. Ipomoea plummerae A. Gray, Syn. Fl. N. Amer. 2, 1:suppl. 434. 1886. — Type: ARIZONA: *Lemmon 2839* (GH!).

I. cuneifolia A. Gray, Proc. Amer. Acad. Arts 19:90. 1883, non Meisner (1869). — Type: ARIZONA: *Lemmon 2839* (F!, GH!, US!).

I. egregia House, Torreya 6:124. 1906, nom. nov. for *I. cuneifolia* A. Gray.

Known from Apache, Cochise, Coconino, Gila, Graham, Greenlee, Pima, Santa Cruz and Yavapai cos. Occasional in the ponderosa pine zone; 1219 – 2743 m; flowering April to October.

The corollas open by ca. 6:30 a.m., are closing at 10:30 a.m. and are completely closed at 11:50 a.m. Corolla limbs are lavender, the tube white within and without. The ovary and style are green, the stigma and stamens white (Cochise Co., *Austin & Austin 7581*, ASU).

13. Ipomoea pubescens Lam., Encycl. Meth. Bot. 1:265. 1791. — Type: AMERICA: collector unknown (K!).

I. heterophylla Ortega, Nov. Pl. Descr. Dec. 1:9. 1797. — Type: MEXICO: Horto Regio., 1797, *Ortega* (lectotype: MA 222592, photo FAU!).

The curator of the herbarium in Madrid sent me photographs of six specimens of *Ipomoea heterophylla* in their collection. One of these was collected in Peru (MA 222596) and will not serve as a lectotype because the protologue cites only Cuba and Mexico. Two other sheets (MA 222595, 222597) are labeled with the dates 1798 and 1801, respectively. These will not serve as lectotypes because they are dated after the publication by Ortega. Two of the remaining sheets (MA 222593, 222594) were labeled by J.D. Rodrigues, and are excluded because they are incomplete in comparison to the last collection which carries Ortega's name. Therefore, the specimen with Ortega's name as collector is chosen as lectotype.

I. lindheimeri A. Gray var. *subintegra* House, Ann. New York Acad. Sci. 18:196. 1908. — Type: ARIZONA: *Lemmon 2835* (GH!).

Known from Cochise and Santa Cruz cos. Growing in canyons; 106 − 1371 m; flowering August to September.

This is now an extremely rare plant in Arizona. Of the seven sites where it was formerly collected, plants were relocated in only one (Santa Cruz Co., *Austin & Austin 7605*, ASU). The plants are not common in adjacent Mexico and should be considered endangered in the state of Arizona. Plants in Texas, New Mexico and Arizona have flowers considerably larger than the populations in Meso-America and South America. Perhaps more than one taxon is involved.

Flowers begin to close at 9:40 a.m., and all are closed by 10:15 a.m. Corolla limbs are lavender, and the tubes are white within and without. Styles, stigmas and stamens are white.

14. Ipomoea purpurea (L.) Roth, Bot. Abh. 27. 1787. — Type: U.S.A.: Dillenius, Hort. Elth. t. 84, fig. 97. 1732 (chosen lectotype! by Verdcourt, 1963).

I. hirsutula Jacq. f., Eclog. Pl. Rar. 1:63. t. 44. 1811. — Type: no specimen found, the plate chosen as lectotype by Austin (1990).

Known from Apache, Cochise, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Santa Cruz and Yavapai cos. Found in cultivated fields and other disturbed sites; 304 − 2286 m; flowering July to November. Occasional to common in counties bordering Mexico.

Flowers in cultivated plants have variable corolla colors, but the wild populations are consistently purple on the limb, with pink nectar guides (plicae), and tubes which are white within and without. In wild plants, the ovary is green, and the androecium, style and stigma are white; in cultivated plants, the ovary is cream, the style white. Flowers (wild plants) are visited by sulphur butterflies (Cochise Co., *Austin & Austin 7614*, ASU).

15. Ipomoea tenuiloba Torr., Bot. Mex. Bound. 148. 1859. — Type: TEXAS: *Bigelow* (US!).

I. lemmoni A. Gray, Proc. Amer. Acad. Arts 19:20. 1883. — Type: ARIZONA: *Lemmon 2840* (GH!, US!). *I. tenuiloba* Torr. var. *lemmonii* (A. Gray) Yatskievych & Mason, Madroño 31:102. 1984.

Known from Cochise, Pima and Santa Cruz cos. Plants grow in chaparral, Madrean oak woodlands, and ponderosa pine zones; 1280 – 1920 m; flowering August to September.

A rare species that should be considered threatened in Arizona. Two varieties exist (Yatskievych and Mason 1984): *I. tenuiloba* var. *tenuiloba* has white flowers; *I. tenuiloba* var. *lemmoni* (A. Gray) Yatskievych and Mason has purple flowers.

Flowers of var. *lemmoni* open before daylight between 1:00 and 5:00 a.m. and close between 7:00 and 8:00 a.m. Corolla limbs are pale lavender and the tube is white within and without. Stamens and stigmas are white. Although the morphology of the flowers indicates adaptation for moth pollination, no moth scales on the stigmas or other evidence of visitation was found. The flowers had no fragrance. Perhaps the plants in Arizona, being on the northern fringe of the range, are autogamous.

Plants had been in flower for 10 days by 29 Aug 1989, and fruits were about half grown on a few plants. About 30 flowers were found in the population on 29 Aug; 24 flowers on 30 Aug. The population was rechecked in Bear Canyon 14 Sep and was still alive but no longer in flower (Pima Co., Bear Canyon, *Austin & Austin 7592*, ASU).

Plants grow in the *Pinus-Juniperus-Quercus* zone in Santa Catalina Mts. and Huachuca Mts. Found on quartzite in the Huachuca Mts. (Santa Cruz Co., *Austin & Austin 7618*, ASU). This substrate is the only one where the species occurs in the Huachuca Mts. (F. Reichenbacher, pers. comm., 1989).

16. Ipomoea thurberi A. Gray, Syn. Fl. N. Amer. 2, 1:212. 1886. — Type: ARIZONA: *Thurber 966* (holotype: GH!).

I. gentryi Standley, Field Mus. Nat. Hist. 22:46. 1940. — Type: MEXICO. Chihuahua: Rio Mayo, Sierra Canelo. 30 Aug 1936, *Gentry 2497* (holotype: F!).

Known from Cochise, Pima and Santa Cruz cos. Grows in Madrean oak woodlands, near lakes; 1158 – 1524 m; flowering July to September.

For some time the species was thought to be endemic to the United States. Although not included under *I. thurberi* for Mexico by Matuda (1963-1965), he did include it from Chihuahua, Durango and Sonora under *I. gentryi*.

MEXICO. Sonora: vic. El Llano, ca. 9.5 mi W of San Felipe, Sierra Los Locos, 11-12 Aug 1980, *Hole & Martin s.n.* (ARIZ).

Kearney and Peebles (1951) wrote that the plants had "purple flowers opening in the evening." In fact, the flowers have a pink limb and green throat; they wilt and dry with a green tube and purple limb. Flowers, opening near 6:30 p.m., are visited by sphinx moths (probably *Hyles* *lineata*). All flowers examined had moth scales on the stigmas, further indicating moth pollination. Gynoecia and androecia are white. Only 30 − 50 plants comprise the population (Santa Cruz Co., *Austin & Austin 7603*, ASU). The species is rare in Arizona and in Mexico (J. A. McDonald, personal communication, Nov. 1989), and should be placed on Arizona's endangered list.

Tentatively placed in *Ipomoea* section *Tyrianthinae* by McDonald (1987), the species does not belong to that section because it has three carpels. The species belongs to *Ipomoea* section *Pharbitis* where it was originally placed by A. Gray.

7. *JACQUEMONTIA*

1. Jacquemontia agrestis (Choisy) Meisn. in Mart., Fl. Bras. 7:306. 1869. — Type: BRAZIL: *Martius* (M!, photo MO!). *Convolvulus agrestis* Choisy in DC., Prodr. 9:405. 1845.

   J. palmeri S. Watson, Proc. Amer. Acad. Arts 24:63. 1889. — Type: MEXICO: Guaymas, *Brandegee s.n.* (GH!, NY!, US!).

In Arizona, known only from Pima Co. Plants probably grow in semidesert grassland; ca. 1219 m; flowering August to October.

This species was collected in the Baboquivari Mts. several times between the 1920s and 1940s, but it has not been collected since. Although the species is associated with cultivated land in many places in Mexico, its current status in Arizona is uncertain. It may have been brought into the state from Mexico as a weed with plants cultivated by the Tohono O'odham. In Mexico and elsewhere the species is commonly a weed in maize fields and other cultivated crops.

2. Jacquemontia pringlei A. Gray, Proc. Amer. Acad. Arts 17: 228. 1882. — Type: ARIZONA: *Pringle 295* (GH!).

   J. pringlei var. *glabrescens* A. Gray, Proc. Amer. Acad. Arts 21:402. 1886. — Type: MEXICO: *Palmer 107* (GH! chosen lectotype by Robertson (1971), but not published; his choice here upheld).

Known from Pima, Pinal, Yuma and doubtfully recorded Cochise Co. Frequent in saguaro desert scrub; 914 − 1371 m; flowering April to October.

There is a specimen supposedly collected in the Chiricahua Mts. (Cochise Co. Chiricahua Mountains, 20 Jul 1895, *Toumey s.n.* NY!, US!). Since no one else has located the species in this mountain range, nor in the nearby ranges, the specimen probably was incorrectly labeled. The plants are Sonoran Desert endemics ranging from Pima Co., Arizona, south to Los Mochis, Sinaloa, Mexico (Robertson 1971).

Flowers, which are white throughout, open at dawn, as the sun strikes them, and close between 3:00-4:00 p.m. Pollination is by the bee *Duforea* sp. (Halictidae) which drinks nectar but does not actively collect pollen. Numerous bees visit the flowers regularly. Later in the season, fruit set is high, with most flowers producing some seed (Pima Co., *Austin & Austin 7591*, ASU).

The following species are now or have been in cultivation in Arizona: *Convolvulus cneorum* L. (Morning Glory, Bush Morning Glory), *Convolvulus tricolor* L. (Morning Glory), *Convolvulus sabatius* Viviani var. *mauritanicus* (Boiss.) Sa'ad (Morocco Glorybind, Ground Morning Glory), *Dichondra micrantha* Urban (Pennywort), *Ipomoea batatas* (L.) Lam. (Sweet Potato, Batata, Camote), *Ipomoea carnea* Jacq. ssp. *fistulosa* (Choisy) D. Austin (Tree Morning Glory, Bush Morning Glory), *Ipomoea tricolor* Cav. (Morning Glory, Heavenly Blue), and *Merremia dissecta* (Jacq.) H. Hallier (Alamo vine, Mile-a-minute vine).

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BOOK REVIEWS

Goudey, Christopher J. 1988. A Handbook of Ferns for Australia and New Zealand. Lothian Publishing Company. Order from: International Specialized Book Services, Inc., 5602 NE Hassalo Street, Portland, OR 97213-3640. \$19.95 paper. 212 pp.

This handbook of ferns is concerned with the horticultural aspect as opposed to an identification manual. There are 3 chapters in Part 1. How to Identify Ferns; 5 chapters in Part 2. Propagation of Ferns; 2 chapters in Part 3. Pests and Diseases; 2 chapters in Part 4. Ferns in Cultivation; 3 chapters in Part 5. Where to See Ferns; 6 chapters (concerning hardiness, indoor, hanging baskets, and terrariums) in Part 6. Plant Lists. At the end of the text is a glossary, list of fern societies, and index. There are diagrammatic illustrations in Part 1 but the taxa are mostly photographs, black and white with some colored plates. An excellent book for the fern horticulturist. wfm

Cody, Wm. J. and Donald M. Britton. 1989. Ferns and Fern Allies of Canada. Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, Canada K1A 0S9. \$38.50 CAN; \$46.20 US (Check to Receiver General for Canada).

This manual includes keys, synonymy, descriptions, cytology, habitat, range, remarks, and diagrammatic illustrations. The distribution maps are clustered prior to the glossary, references, and index.

"It is hoped that the book will prove to be a useful tool, not only to individuals taking a first look at these interesting plants but also to the dedicated amateur and the professional botanist." And I believe it will be very useful to all three groups. wfm

Brown, Anthony H.D., Michael T. Clegg, Alex L. Kahler, Bruce S. Weir. Editors. 1989. Plant Population Genetics, Breeding, and Genetic Resources. Sinauer Associates, Inc., Sunderland, MA 01375-0407. \$36.00 paper; \$60.00 cloth. 449 pp.

This book is based upon the International Symposium on Population Genetics and Germplasm Resources in Crop Improvement, held August 11 – 13, 1988 at the University of California, Davis. The articles or chapters are grouped under 3 sections: Section 1: Genetic Diversity: Kinds and Amounts (7 chapters); Section 2: Evolutionary Processes (7 chapters); Section 3: Applications in Plant Breeding and Genetic Resources (6 chapters).

The symposium also was to honor Professor Robert W. Allard, who founded experimental plant population genetics as a scientific discipline. Allard wrote the first chapter: Future Directions in Plant Population Genetics, Evolution, and Breeding. An excellent resource text with a compilation of the literature citations of the individual chapters at the end near the Index. wfm

TWO NEW *VITIS* (VITACEAE) FROM MOUNTAINOUS MEXICO

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ABSTRACT

Two new species, *Vitis bloodworthiana* and *V. jaegeriana*, are described and compared to the two most similar species in series *Occidentales*. *Vitis bloodworthiana* was found only at high elevations (1820 − 2360 m) in the Sierra Madre Occidental in the states of Sinaloa and Durango, and *V. jaegeriana* occurred in similar, high elevations in the Sierra Madre Oriental of San Luis Potosi.

RESUMEN

Dos especies nuevas, *Vitis bloodworthiana* y *V. jaegeriana*, son descritas y comparadas con las dos especies más similares en la serie *Occidentales*. Se encontró a *Vitis bloodworthiana* solamente en altitudes mayores (1820 − 2359 m) en la Sierra Madre Occidental de los estados de Sinaloa y Durango; asimismo *Vitis jaegeriana*, ocurrió en altitudes mayores, pero en la Sierra Madre Oriental del estado de San Luis, Potosi.

Two new species of *Vitis* (*Vitaceae*) were found in mountainous regions of central and western Mexico. The closest species morphologically to these listed by Standley (1924) for Mexico appears to be *V. arizonica* Engelm. These species belong to series *Occidentales* Munson, which is characterized by having leaves with small stipules (1 − 3 mm long), small fruit (4 − 11 mm dia.) and flowering during mid season when grown along with other species (Munson 1909). Series *Occidentales* includes western North American species: *V. arizonica* Engelm., *V. californica* Bentham, *V. girdiana* Munson and *V. treleasei* Munson. Table 1 provides a comparison between the new species and the two most similar species in series *Occidentales*, *V. arizonica* and *V. treleasei*.

No other species of North American *Vitis*, except *V. rotundifolia* Michx., *V. munsoniana* Planchon ex Munson and *V. monticola* Buckley are known to bear fruit with lenticels (Munson 1909). Fruit with fewer, less conspicuous lenticels were observed on some individuals of *V. treleasei* and *V. arizonica* during studies (Table 2). Both new species bear fruit with lenticels. Fruit of *V. bloodworthiana* observed from numerous vines in the field, consistently were covered with small, circular, tan lenticels that were less obvious as the fruit ripened and became black. Similar lenticels occurred on fruit of *V. jaegeriana*, although in some vines the lenticels were not conspicuous.

SIDA 14(3):459 − 466. 1991.

Vitis bloodworthiana Comeaux, sp. nov. Fig. 1.

Caules angulatescens teres, glabrescentes ad interdum puberuli, striati, sine lenticellis; apices et folia immatura manifeste colorata cum pigmentum rubrum. Folia plerumque interdum sine lobata, longa-cordiforma ad fere deltoidea, longa-acumminata, cordata ad fere truncata lobi laterales interdum divergentes acutati ad acuminati; lamina matura glabrata limitata ad venae primarias et axillares. Baccae nigrae, glaucae, 6 – 11 mm diam.; tactae cum lenticellis circulares fulvae; semina 3.5 – 5 mm longa, 3 – 3.5 mm lata.

Vines to 10 m, stems on current season growth glabrescent or occasionally pubescent then turning glabrescent, striated; branchlets angled, becoming terete; internodes 3 – 16 cm long; nodes rarely encircled with red pigmentation; pith interrupted at nodes by a diaphragm 2 – 3 mm thick; bark brown, shredding during second season growth; lenticels absent; growing tips glabrous to glabrescent, occasionally pubescent, with white to tan trichomes, not enveloped by young leaves, *ordinarily tips and immature leaves prominently colored with red pigmentation*; bud scales glabrous to pubescent, 3 – 4 mm long, brown. *Leaves long-cordiform to nearly long-deltoid*, flat, usually 3-lobed, with lateral lobes acute to acuminate, often divergent, *apex long accuminate*, base cordate to nearly truncate, lateral sinuses acute (rounded on ground shoots); margins serrate to nearly crenate, with teeth 0.5 – 3 mm long, oriented perpendicularly to margin, towards apex or base, triangular or with concave or convex sides, occasionally ciliate, with veins extending beyond teeth, midrib with 4 – 7, usually 6 pairs of prominent veins; *lamina glabrous on both surfaces of mature leaves*, except for simple, straight, pointed trichomes and arachnose trichomes on primary veins and vein axils, 7 – 13 cm wide, 9 – 17 cm long; petioles glabrous to puberulent, striated, 3 – 10 cm long; stipules brown, glabrous to pubescent, 1 – 1.5 mm wide, 1 – 2.5 mm long, caducous; pubescence white to tan, consisting of straight, pointed, simple trichomes and arachnose trichomes. Tendrils and inflorescences absent every third node, tendrils bifurcate or trifurcate, to 20 cm long. Inflorescences 1 – 8 cm long, peduncles 1.2 – 4.5 cm long, shoulder 1 – 4.5 cm long. Flowers not observed. Fruit a berry, black, glaucous *with small, tan, circular lenticels*, 0.6 – 1.1 cm in diameter; skin thin; pulp clear, greenish to purplish. Seeds brown, irregular in shape, ovate to nearly pyriform, 3 – 3.5 mm wide, 3.5 – 5 mm long.

Type: MEXICO. Durango: 16.5 km W of Del Diablo and 35.5 km E of Tropic of Cancer via Hwy 40, 2,300 m, 1 Jul 1986, *Comeaux 4219* (holotype: SMU; isotypes: MEXU, PH).

Paratypes. Durango: 39 km W of Del Diablo and 13 km E of Tropic of Cancer, via Hwy 40, 2,174 m, 1 Jul 1986, *Comeaux 4214* (SMU); 37.4 km W of Del Diablo and 14.6

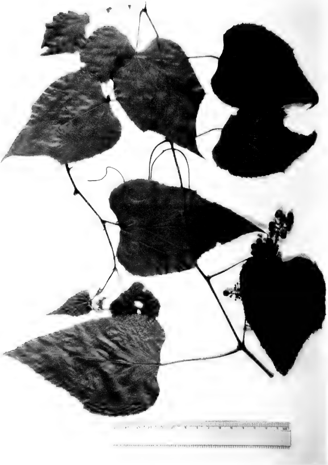

FIG. 1. Type specimen of *Vitis bloodworthiana* (*Comeaux 4219*).

km E of Tropic of Cancer via Hwy 40, 2,143 m, 1 Jul 1986, *Comeaux 4215* (SMU); 33.4 km W of Del Diablo and 18.6 km E of Tropic of Cancer via Hwy 40, 2,236 m, 1 Jul 1986 *Comeaux 4216* (SMU); 22.6 km W of Del Diablo and 29.4 km E of Tropic of Cancer via Hwy 40, 2,113 m, 1 Jul 1986, *Comeaux 4218* (SMU). Sinaloa: 52.3 km W of Del Diablo and 0.2 km W of Tropic of Cancer via Hwy 40, 1,820 m, Jul 1, 1986, *Comeaux 4209, 4210* and *4211* (SMU); 52.0 km W of Del Diablo and 50 m W of Tropic Cancer via Hwy 40, 1,990 m, 1 Jul 1986, *Comeaux 4212* (SMU); 49.6 km W of Del Diablo and 2.4 km E of Tropic of Cancer via Hwy 40, 2,150 m, 1 Jul 1986, *Comeaux 4213* (GA, SMU).

TABLE 1. Comparison of four species of series *Occidentales* Munson.

Character	*V. bloodworthiana* (11 Vines Sampled)	*V. jaegeriana* (11 Vines Sampled)	*V. arizonica* (12 Vines Sampled)	*V. treleasei* (15 Vines Sampled)
1. Leaves lobed	usually	*rarely	usually	usually
2. Leaves pubescent				
abaxial surface	gs[1]	gt[2], pr[3], pb[4]	gs, gt, pr, pb	gs
adaxial surface	gs	gs , gt	gs, pr, pb	gs
3. Leaf index (width/Length)				
mean	0.7	0.7	0.9	0.9
range	0.5 – 0.9	0.6 – 0.9	0.8 – 1.1	0.7 – 1.1
4. Teeth number (for 1 side of leaf)				
mean	27	20	21	30
range	20 – 41	15 – 27	14 – 26	13 – 30
5. Midrib pairs per leaf				
mean	5.4	4.3	4.0	4.0
range	4 – 7	4 – 5	3 – 5	3 – 5
6. Basal sinus width (in degrees)				
mean	107	77	73	79
range	70 – 170	30 – 150	**-30 – 175	-1 – 150
7. Stems pubescent	gs, gt, pr, pb	pr, pb	pr, pb	gs, gt, pr
8. Stem tips pubescent	gs, gt, pr	pb	gt, pr, pb	gt, pr, pb
9. Stem tip pubescence color	(g)[5], (w)[6], re[7], t[8]	(w), t, ru[9]	w, (re)	w, g, re
10. Stem tip enveloped by leaves	n[10], f[11]	n, f	f, sl[12]	n,f,sl,st[13]
11. Leaf and stem pubescence color	w, t	w, t, ru	w	w

() = rarely observed
1 - gs = glabrous
2 - gt = glabrescent
3 - pr = puberulent
4 - pb = pubescent
5 - g = green
6 - w = white
7 - re = red
8 - t = tan
9 - ru = rufescent
10 - n = negative
11 - f = faintly
12 - sl = slightly
13 - st = strongly

*Only two leaves were observed from different vines out of many individuals examined in the field.
**Negative values relate to cases where leaf bases overlapped.

TABLE 2. Specimens of *Vitis arizonica* and *V. treleasei* examined in comparison with *bloodworthiana* and *jaegeriana*.

VITIS ARIZONICA Engelm. ARIZONA. **Cochise Co.**: 9.6 km S of Sierra Vista on Carr Canyon Rd., 1,500 m, 5 Jul 1986, *Comeaux 4236, 4237, 4238, 4239*, 4240 and *4241* (SMU). **Santa Cruz Co.**: 28 km S of Sonoita via Hwy 83, 1,500 m, 5 Jul 1986, *Comeaux 4242* (SMU); 28.5 km S of Sonoita via Hwy 83, 1,580 m, 5 Jul 1986, *Comeaux 4243* and *4244* (SMU); 1.0 km NE of Nogales via Hwy 82, 1,200 m, 5 Jul 1986, *Comeaux 4245* (SMU); 3 km W of E. city limits in Nogales via Hwy 82, 1,175 m, 5 Jul 1986, *Comeaux 4246, 4247* and *4248* (SMU).

VITIS TRELEASEI Munson. ARIZONA. **Maricopa Co.**: Fish Creek Hill bridge via Hwy 85, NW of Lost Dutchman St. Park, 700 m, 6 Jul 1986, *Comeaux 4249, 4250, 4251, 4252* and *4253* (SMU). NEW MEXICO. **Catron Co.**: 4 km NE of Aragon via Hwy 12, 2,100 m, 4 Jul 1986, *Comeaux 4226, 4227* and *4228* (SMU); 3 km NE of Aragon via Hwy 12, 2,075 m, 4 Jul 1986, *Comeaux 4229* (SMU). **Socorro Co.**: 1.5 km downstream from Water Canyon Campground between stream and road, Cibola National Forest, 2,180 m, 4 Jul 1986, *Comeaux 4220, 4221, 4222, 4223, 4224* and *4225* (SMU).

This species is named in honor of P. J. Bloodworth (1950-), grape breeder and fellow student under the direction of the late W. B. Nesbitt. Jeff is acknowledged for his assistance in the author's research, willingness to share his great knowledge, and for his devotion to the vine. Also, the epithet *bloodworthiana* seems appropriate as the dark-red growing tips and young leaves that characterize this species are distinctive in the series.

Vitis bloodworthiana was found only at high elevations (1,820 − 2,359 m) in pine forests within the Sierra de las Ventanas mountains, Sierra Madre Occidental, in Durango and Sinaloa. Annual recipitation is 40 − 80 cm and minimum temperatures range from -10° to 0° C (Rzedowski & Huerta 1978). This species occurs in dry or relatively moist, but well-drained sites, without sympatric species of *Vitis*. More field studies are needed to ascertain the overall distribution of *V. bloodworthiana*.

The long-cordiform leaves, as indicated by the small leaf index values (Table 1) for *V. bloodworthiana* and *V. jaegeriana*, easily separate these from the two similar species in series *Occidentales*. *Vitis bloodworthiana* differs from *V. jaegeriana* in having more teeth and pairs of lateral veins per leaf, consistently broader basal sinuses, and the dark red-colored pigmentation in growing tips and young leaves. All of the nearly 70 seedlings grown in containers outdoors at Galveston College from one collection of *V. bloodworthiana* (*Comeaux 4213*) easily were differentiated within two months after germination from seedlings of numerous other species of *Vitis*, including *V. treleasei* and *V. arizonica*, by their brilliant red growing tips and long-cordiform leaves. Four seedlings grown for one season, each with stems over 2 m in length, were distinguished readily from about 300 individuals of similar size, representing numerous species and hybrids, by their red growing tips and various degrees of red pigmentation in all mature leaves.

Vitis jaegeriana Comeaux, sp. nov. Fig. 2.

Caules angulatescens teres, puberuli obscura ad conspica, striati, sine lenticellis. Folia sine lobati plerumque, longa-cordiforma, long-accuminata, cordata, lamina matura supra glabras ad glabrescentes, infra puberuli leviter ad modice, alinquando glabrescente, trichomata fulva and ferruginea, vel alba. Baccae nigrae, glaucae, $6-11$ mm diam., tectae cum lenticellis circulares fulvae; semina $3.5-5$ mm longa, $3-5$ mm lata.

Vines to 7 m, stems on current season growth puberulant to pubescent; striated; branchlets angled becoming terete; internodes $3-10$ cm long; nodes faintly to conspicuously encircled with red pigmentation, pith interrupted at nodes by a diaphragm $2-3$ mm thick; bark brown, shredding during second season growth, lenticels absent; growing tips pubescent, tan or rufescent, occasionally white, not enveloped by young leaves; bud scales pubescent, $2-3$ mm long, brown. *Leaves long-cordiform*, flat, *rarely lobed*, then lobes acute, *apex long-acuminate*, base cordate, lateral sinuses acute (when present); margin serrate, with teeth $0.5-3$ mm long, oriented perpendicular to margin, towards apex or base, triangular or with convex sides, ciliate, with or without veins extending beyond teeth, midrib with 4 to 7 pairs of prominent veins; lamina with glabrous to glabrescent adaxial surfaces on mature leaves, abaxial surfaces pubescent to puberulent, occasionally glabrescent on mature leaves, not glaucous, with or without tufts of trichomes in axils of major veins, $4-10$ cm wide, $6-15$ cm long, petioles pubescent to puberulent, faintly striated, $1.3-7.5$ cm long; stipules brown, pubescent to puberulent, $1-1.5$ mm wide, $1-3$ mm long, caducous; pubescence tawny, rufescent or white, consisting of straight, pointed, simple trichomes or arachnose trichomes. Tendrils and inflorescences absent every third node, bifurcate, to 20 cm long. Inflorescences $1.2-5.8$ cm long, peduncles $0.6-4.7$ cm long, shoulders $0.2-2.3$ cm long, occasionally replaced by a tendril. Flowers not observed. Fruit a berry, black, glaucous, *with small, tan, circular lenticels*, $0.6-1.1$ cm in diameter; skin thin pulp clear to purplish. Seeds brown, irregular in shape, ovate to nearly pyriform $3-5$ mm wide, $4-5$ mm long.

Type: MEXICO. San Luis Potosi: 86.7 km W of jct. Hwy 70 and 69 in Rio Verde, 2,150 m, 24 Aug 1987, *Comeaux 4681* (holotype: SMU; isotypes: MEXU, PH).

Paratypes: San Luis Potosi: 94.6 km W of jct Hwy 70 and 69 in Rio Verde, 2,400 m, 27 Jun 1986, *Comeaux 4176, 4177* and *4178* (SMU); 75.7 km l.c., 1,938 m, 28 Jun 1986, *Comeaux 4206* (SMU); 92.6 km l.c., 1,815 m, 24 Aug 1987, *Comeaux 4674–7* (SMU); 86.7 km l.c., 2,150 m, 24 Aug 1987, *Comeaux 4679, 4680* (SMU).

This species is named for the grape breeder, Hermann Jaeger (1844 – 1895?), Neosho, Missouri (Smith 1962). Thomas V. Munson (1843 – 1913), the world renowned grape breeder, referred to Jaeger as

FIG. 2. Type specimen of *Vitis jaegeriana* (*Comeaux 4681*).

"my esteemed co-worker" who "for more than twenty years hunt[ed] and hybridize[d] grapes" (Munson 1900). A grateful French government awarded Jaeger the Cross of the Legion of Honor in 1889 for his contributions towards saving the French wine industry, previously devastated by the phylloxera root louse (Smith 1962). Hermann and his brother, John Jaegar sent millions of grape cuttings to France as phylloxera resistant rootstocks for the native French varieties.

Vitis jaegeriana was found only at high elevations (1815 – 2400 m) in the Sierra de Juarez mountains, Sierra Madre Oriental, in San Luis Potosi. Vegetation at the collection sites is dominated by *Juniperus* spp. Minimum temperature and annual precipitation are similar to those reported for *V. bloodworthiana* (Rzedowsik, J. and L. Huerta 1978). *Vitis jaegeriana* occupies relatively drier sites than the former species, and also has no associated sympatric species of *Vitis*. Additional field work is needed to clarify the distribution of *V. jaegeriana*.

Leaves of *V. jaegeriana* examined during field work consistently were without any lobing, except for a few isolated leaves observed only on two vines. This character easily separates if from *V. bloodworthiana*, the only species in series *Occidentales* similar long-cordiform leaves. Another distinctive feature of *V. jaegeriana* is the generally tan pubescence on growing tips, and young stems and leaves.

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NOTEWORTHY PLANTS FROM NORTH FLORIDA. V.

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ABSTRACT

The following appear to be first reports for the state of Florida: *Anthemis arvensis, Artemisia vulgaris, Carex leavenworthii, Cerastium semidecandrum, Cicuta maculata, Cladium mariscoides, Curcuma zedoaria, Hedyotis purpurea, Paspalum minus, Ranunculus marginatus,* and *Silene virginica.* Some additions to the Florida panhandle are documented here also, and several significant range extensions, particularly for rare or endangered taxa within our area, are given.

This is the fifth installment of a series (Anderson 1984, 1986, 1988a, 1989) to update our knowledge of the flora of the Florida panhandle and Clewell's (1985) guide to the flora. The area of coverage is from the Suwannee River west to the Alabama state line.

New discoveries — i.e., taxa not listed by Clewell — and range extensions of selected rare or otherwise noteworthy taxa are given here. Exotics that appear to be adventive or naturalized are also listed. Collections at FLAS, FSU, USF, and the Gholson Herbarium were consulted in addition to pertinent literature. Wilhelm (pers. comm.) provided updated distributional data for his 1984 study, and Wunderlin (pers. comm.) shared his Florida checklist of vascular plant species. Voucher specimens for this report are at FSU unless noted otherwise.

TAXA NEW TO THE AREA

ACACIA ANGUSTISSIMA (P. Miller) Kuntze var. HIRTA (Nutt.) B. L. Robinson. **Dixie Co.**: frequent near junction rtes 358 and 361, just NE of Jena, 2 Jun 1989, *Anderson 12045* (FLAS, FSU). **Jefferson Co.**: Monticello, Jun 1931, *J. K. Small s.n.* (FLAS); new to Florida panhandle.

AMORPHA HERBACEA Walt. var. HERBACEA. **Dixie Co.**: frequent in cutover flatwoods bordering rte 361, ca. 6 air mi S of Steinhatchee, 2 Jun 1989, *Anderson 12050*; new to Florida panhandle. See map in Wilbur (1975) for previously known range.

ANTHEMIS ARVENSIS L. **Jackson Co.**: weed in garden area, 1 mi W of Grand Ridge, 11 and 18 May 1980, *A. K. Gholson 8298, 8302* (Gholson Herbarium); naturalized, new to Florida.

Artemisia vulgaris L. **Alachua Co.**: roadside by wet woods N side of Gainesville, 11 Nov 1980, *K. D. Perkins 855* (FLAS); **Escambia Co.**: Pensacola near Pensacola Bay, 17 Sep 1980, *J. K. Burkhalter 7210* (FLAS); abundant along sandy roadside of Hollywood Avenue near Pensacola, 29 Oct 1989, *J. R. Burkhalter 11717*; naturalized, new to Florida.

Bothriochloa ischaemum (L.) Keng. var. songarica (Fish. & Mey.) Celarier & Harlan. **Escambia Co.**: Naval Air Station, SW of Pensacola, 17 Sep 1988, *J. R. Burkhalter 11138*; vacant field S of Pensacola, 24 Sep 1988, *J. R. Burkhalter 11149*; W end of Santa Rosa Island, 28 Oct 1989, *J. R. Burkhalter 11715*; **Santa Rosa Co.**: hiway 98 E of Gulf Breeze, 6 Nov 1988, *J. R. Burkhalter 11310*; **Washington Co.**: beside hiway 90 in Chipley, 10 May 1990, *L. C. Anderson 12714*; native, new to Florida panhandle.

Carex leavenworthii Dewey. **Gadsden Co.**: locally established near Marion Street, Chattahoochee, 10 May 1990, *L. C. Anderson 12681*, 26 Aug 1985, *A. K. Gholson 11305* (Gholson Herbarium); **Jackson Co.**: Neal's Landing, Lake Seminole, under *Quercus* above floodplain, 18 May 1982, *A. K. Gholson 9729* (Gholson Herbarium); native, new to Florida.

Cerastium semidecandrum L. **Escambia Co.**: abundant on sandy roadside of Saufley Field Road near Pensacola, 9 Mar 1990, *J. R. Burkhalter 11811*; naturalized, new to Florida.

Cicuta maculata L. **Jackson Co.**: frequent along open border of pine-oak woodland on S side of I-10, ca. 5 air mi SSW of Sneads, 26 May 1990, 12 Jul 1990, *L. C. Anderson 12846, 13093*; apparently native, new to Florida.

Cladium mariscoides (Muhl.) Torr. **Santa Rosa Co.**: abundant in ditch E of Gulf Breeze on S side of hiway 98, 16 Jul 1989, *J. R. Burkhalter 11500*; native, new to Florida. Kükenthal (1942) listed Florida as part of this species' range, but recent workers have found no documented collections for the state—see Bridges and Orzell (1989) for notes on the ecology and geography of this species in the eastern United States.

Curcuma zedoaria (Christm.) Rosc. **Leon Co.**: locally established along margin of Freeman Creek Cove of Lake Talquin, ca. 17 air mi W of Tallahassee, 24 May 1989, *L. C. Anderson 12007*; naturalized, new to Florida.

Cyperus echinatus (L.) Wood. **Gulf Co.**: edge of wet flatwoods 5.5 air mi NW of Wewahitchka, 15 Jun 1989, *L. C. Anderson 12095*; native, new to Florida panhandle.

Eleocharis rostellata Torr. **Taylor Co.**: common in roadside ditch beside tidal marsh near mouth of Fish Creek, ca. 2.5 air mi SSE of Keaton Beach, 2 Jun 1989, *L. C. Anderson 12060*; **Wakulla Co.**: St. Marks, 1843 or 1845, *F. Rugel 281* (FLAS); not listed by Clewell (1985) for the Florida panhandle.

HEDYOTIS PURPUREA (L.) T. & G. **Jackson Co.**: alluvial area below Neal's Landing, Lake Seminole, 24 Apr 1972, *Gholson 3039, 3040* (Gholson Herbarium), Neal's Landing, 17 May 1978, *Gholson 7100* (Gholson Herbarium); native, new to Florida.

INDIGOFERA SPICATA Forskal. **Leon Co.**: frequent in newly sodded lawn, F.S.U. campus, Tallahassee, 21 May 1990, *Anderson 12851*; fallow field, Tallahassee, 3 Dec 1990, *Anderson 13342*. **Taylor Co.**: frequent in dry sand of disturbed site along Alvarez Street in Perry, 21 Jun 1989, *Anderson 12067* (FLAS, FSU); naturalized, new to Florida panhandle. Morton (1989) reports this species is widespread in southern Florida, where it is a hazard to grazing animals (some horses have been fatally poisoned).

MURDANNIA KEISAK (Hassk.) Hand.-Mazz. **Jackson Co.**: extensive mats along shoreline of Lake Seminole near Parramore Landing, 13 Sep 1976, *Gholson 3553* (Gholson Herbarium); naturalized, new to Florida panhandle. This Asian species has been spreading in the southeastern United States relatively recently (Dunn and Sharitz 1990).

PASPALUM MINUS Fourn. **Escambia Co.**: near Perdido River, N of hwy 90 and NW of Pensacola, 7 Aug 1990, *Burkhalter 12223*; native, new to Florida.

RANUNCULUS MARGINATUS D'Urville var. TRACHYCARPUS (Fischer & Meyer) Azn. **Washington Co.**: moist sandy loam of shaded floodplain of Holmes Creek at roadside park beside rte 79 just N of Vernon, 4 May 1990, *Anderson 12631*; native, new to Florida (see Keener and Hoot 1987).

SILENE VIRGINICA L. **Bay Co.**: frequent with *Carex baltzellii* on shaded steep slopes of ravine E of Hammond Lake, ca. 3.5 air mi WNW of Fountain, 4 May 1990, *Anderson 12679*; new to Florida. This species has been found sporadically in other southern states (Moore 1956), and Kral (1966) suggests this Pleistocene relict has been able to persist by inhabiting ravine banks where cold air drainage provides a suitable niche in an otherwise inhospitable environment.

SOLANUM PSEUDOCAPSICUM L. **Jefferson Co.**: persisting shrub in mesic hardwoods of Avalon Plantation, S of Capps, 26 Apr 1989, *Gholson 12126* (Gholson Herbarium), 1 Mar 1989, *Godfrey 83004*; naturalized, new to Florida panhandle.

ADDITIONAL RANGE EXTENSIONS

The following collections represent additional counties of record for taxa listed by Clewell (1985) from only one county, or they are significant range extensions for rare or otherwise noteworthy species.

ARNOGLOSSUM DIVERSIFOLIUM (T. & G.) H. Robins. **Holmes Co.**: 4 mi S of rte 2 on rte 177, 26 May 1967, *Smith 1324* (FLAS). **Jackson Co.**: Chipola River, 6 mi S of Marianna, 6 Jun 1957, *Kral 4813* (FLAS). **Walton Co.**: shaded floodplain of Choctawhatchee River just S of rte 20, 25 May 1990, *Anderson 12814*. **Washington Co.**: Holmes Creek at rte 280, 30 Jul 1954, *E. S. Ford 3779* (FLAS); upper Holmes Creek, ca. 5.5 air mi SW of Chipley, 31 May 1985, *Anderson 8207*, 15 Jun 1989, *Anderson 12111*; Hightower Spring, 3.5 air mi WSW of Vernon, 25 May 1990, *Anderson 12820*; Brunson Landing, Holmes Creek, ca. 3 air mi WSW of Vernon, 15 Jun 1990, *Anderson 12941*; Live Oak Landing, Holmes Creek, 7.5 air mi WSW of Vernon, 22 Jun 1990, *Anderson 12958*; new counties of record for this threatened species (state listed, Wood 1990).

ASCLEPIAS RUBRA L. **Escambia Co.**: 3.5 mi E of Muskogee, 7 Jun 1962, *E. S. Ford 6312a* (FLAS); Spanish Mill Creek at Gonzalez, 26 Jul 1980, *Burkhalter s.n.* (FLAS). **Santa Rosa Co.**: edge of mesic thicket, Paquette Camp, Blackwater State Forest, 29 Jun 1990, *Anderson 13013*. **Walton Co.**: bayhead 6.5 mi SE of DeFuniak Springs, 1 Jun 1954, *West & Arnold s.n.* (FLAS); boggy area 3.5 mi S of DeFuniak Springs, 29 May 1967, *Smith 1335* (FLAS).

CAREX BALTZELLII Chapm. ex Dewey. **Escambia Co.**: wooded slope on Univ. W. Fla. campus near Pensacola, 2 Apr 1978, *Burkhalter 5748* (FLAS). **Okaloosa Co.**: 6.5 air mi N of Ft. Walton Beach, 20 Mar 1968, *Ward 6603* (FLAS); near Rogue Creek, 7 mi NW of Niceville, 20 Mar 1968, *Ward 6599* (FLAS). **Santa Rosa Co.**: Weaver Creek, 5 mi N of Holley, 21 Mar 1968, *Ward 6637* (FLAS). **Washington Co.**: frequent on shaded slopes of sinkhole ravine ca. 12 air mi S of Chipley, 26 May 1990, *Anderson 12830*. This endangered species (Wood 1990) is nearly endemic to the Florida panhandle; Muller et al. (1989) give the previously known range of this species.

CAREX SEORSA Howe. **Liberty Co.**: common on floating islands in beaver-dammed swamp of Pittman Creek just N of rte 20, 0.8 mi W of Ochlockonee River, 22 May 1990, *Anderson 12741*.

CONOPHOLIS AMERICANA (L.f.) Wallr. **Okaloosa Co.**: oak-beech-magnolia woods SW of Laurel Hill, 3 Mar 1990, *Burkhalter 11807*; new to western panhandle (not listed by Wilhelm 1984).

DIOCLEA MULTIFLORA (T. & G.) Mohr (= *Galactia mohlenbrockii* Maxwell). **Gadsden Co.**: mesic hardwoods of Chattahoochee Nature Park below Morgan Avenue near Apalachicola River on SW side of Chattahoochee, 4 June 1990, *Anderson 12858*. **Washington Co.**: head of Blue

Springs just E of Econfina Creek, ca. 14 air mi SE of Vernon, 24 May 1990, *Anderson 12768*.

DROSERA FILIFORMIS Raf. **Washington Co.**: with *D. intermedia* on open, peaty shore of Lucas Lake, 8 Jun 1990, *Anderson 12875*; edge of Rattlesnake Lake, 5 Jul 1990, *Anderson 13042*; with *D. tracyi* (no signs of intergradation) in small seepage bog on S side of Gully Lake, 5 Jul 1990, *Anderson 13048*.

HEDYOTIS NUTTALLIANA Fosberg. **Washington Co.**: frequent in dry sand of open turkey oak woodland ca. 12 air mi S of Chipley, 26 May 1990, *Anderson 12831*. The only other collection in Florida from Walton County was listed as quite atypical by Terrell (1959).

JUNCUS GYMNOCARPUS Coville. **Washington Co.**: sphagnum seepage in mixed hardwoods of steephead 5 air mi SE of Vernon, 31 May 1985, *Anderson 8200*; loamy sand of mesic woodland E of Gap Lake, ca. 15 air mi S of Chipley, 11 May 1990, *Anderson 12721*; with *Kalmia latifolia* along White Oak Creek, NE of Gap Lake, 8 Jun 1990, *Anderson 12897*.

LUDWIGIA ERECTA (L.) Hara. **Walton Co.**: marshy border of Fuller Lake on Coffeen Nature Preserve near Four Mile Village just E of Sandestin, 21 Oct 1989, *Anderson 12487*. The species was first reported for the Florida panhandle by Anderson (1986); this collection extends its range westward significantly.

LUDWIGIA LANCEOLATA Ell. **Walton Co.**: Pine flatwoods between coastal dunes and Fuller Lake in Four Mile Village (Coffeen Nature Preserve), 21 Oct 1989, *Anderson 12479*. This is a range extension westward from Franklin County (Peng 1989).

MATELEA FLAVIDULA (Chapm.) Woodson. **Washington Co.**: infrequent in hardwoods on upper slopes of small sinkhole ravine just N of Washington Blvd, 12 air mi S of Chipley, 8 Jun 1990, *Anderson 12891*.

NEPTUNIA PUBESCENS Benth. **Taylor Co.**: Frequent along edge of tidal marsh at N edge of Keaton Beach, 2 Jun 1989, *Anderson 12062*.

PHYSOSTEGIA GODFREYI Cantino. **Walton Co.**: swampy ditch SW of Bruce, 18 Jun 1971, *H. A. Davis 15829* (FLAS); locally common in mesic roadside depression along rte 20 just W of Black Creek bridge, 7.7 mi E of Freeport, 24 May 1990, *Anderson 12773*. These represent a significant range extension to the west for this Florida panhandle endemic (Cantino 1979).

PINCKNEYA BRACTEATA (Bartr.) Raf. **Washington Co.**: edge of *Magnolia-Liriodendron* thicket bordering Boggy Branch, 1.9 air mi W of rte 77 and Greenhead, 26 May 1990, *Anderson 12836*; listed as threatened in Florida (Wood 1990).

Pluchea oblongifolia Nash. **Dixie Co.**: 4 mi N of Shired Island, 10 Jul 1989, *Godfrey 83348*. **Taylor Co.**: mesic woodland near Fish Creek, 3.5 air mi SE of Keaton Beach, 2 Jun, 1989, *Anderson 12059*.

Rhexia salicifolia Kral & Bostick. **Okaloosa Co.**: E of Destin along Four Prong Lake, 11 Jul 1990, *A. F. Johnson 8747*; new county record for this rare species (Bounds 1987). Its center of distribution appears to be the karst lake region of Washington County, where it is usually associated with endangered *Hypericum lissophloeus* and *Xyris longisepala* (Wood 1990), and the following collections further document its presence there: **Washington Co.**: Chain Lakes, W of Greenwood, 6 Jul 1963, *Godfrey 62951* (FLAS); Sparkleberry Lake, 15 Jun 1990, *Anderson 12935*; Piney Lake, 6 Jul 1990, *Anderson 13077*; Crystal Lake, 6 Jul 1990, *Anderson 13082*; 3 Aug 1990, *Anderson 13153*; Sand Lake, 3 Aug 1990, *Anderson 13164*; Whitewater Lake, 3 Aug 1990, *Anderson 13170*; Porter Lake, 3 Aug 1990, *Anderson 13177*; Major Lake, 1 Oct 1990, *Anderson 13296*.

Rhynchospora crinipes Gale. **Santa Rosa Co.**: banks of Sweetwater Creek, ca. 3 air mi S of Munson, 5 Aug 1989, *Johnson 8368*; Big Coldwater Creek, ca. 0.6 mi above rte 191 bridge, 29 Jun 1990, *Anderson 12996*. These collections increase the known range considerably for this very rare species (Anderson 1988b).

Stachys hyssopifolia (Michx.) var. lythroides (Small) J. B. Nelson. **Jefferson Co.**: periodically wet pine-hardwood stand on Norias Plantation, NNE of Lake Miccosukee, 19 Jul 1990, *Godfrey 83917*, 27 Jul 1990, *Anderson 13098*. This Florida endemic was previously known only from a few collections in Leon County (Nelson 1981).

Uvularia sessilifolia L. **Walton Co.**: Knox Hill, 22 Mar 1968, *Ward 6643* (FLAS). **Washington Co.**: 26 May 1990, *Anderson 12827*.

Xyris longisepala Kral. **Walton Co.**: 3.5 mi SSW Mossy Head, 7 Aug 1969, *Ward 7216* (FLAS); 3 mi SW Mossy Head, 10 Sep 1979, *Judd 2255* (FLAS). **Washington Co.**: sandy shores of the following karst lakes: Parrish Pond, 8 Jun 1990, 5 Jul 1990, *Anderson 12883, 13028*; Boat Lake, 8 Jun 1990, *Anderson 12885*; Fox Pond, 8 Jun 1990, *Anderson 12902*; Sparkleberry Lake, 15 Jun 1990, *Anderson 12934, 12936*; Hammock Lake, 5 Jul 1990, *Anderson 13037*; Rattlesnake Lake, 5 Jul 1990, *Anderson 13044*; Gully Lake, 5 Jul 1990, *Anderson 13047*; Piney Lake, 6 Jul 1990, *Anderson 13079*; Crystal Lake, 3 Aug 1990, *Anderson 13156*; Sand Lake, 3 Aug 1990, *Anderson 13163*; Whitewater Lake, 3 Aug 1990, *Anderson 13171*; Porter Lake, 3 Aug 1990, *Anderson 13173, 13176*; unnamed lake W of Porter Lake, 3 Aug 1990, *L. C. Anderson 13180*; Mule Pond, W of Sunny Hills, 1 Oct 1990, *Anderson 13293*; Major Lake, 1 Oct 1990, *Anderson 13298*; new counties of record (Clewell 1985) for this Florida endangered species (Wood 1990). A Leon County collection (Lake Iamonia, 21 Aug 1989, *L. C. Anderson 12198*) is particularly interesting because at that location the plants occur in peaty muck of floating islands in the lake rather than in coarse sands bordering karst ponds as in all other known populations.

ACKNOWLEDGMENTS

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A REPORT OF *CYPERUS GRAYIOIDES* AND *CYPERUS RETROFLEXUS* (CYPERACEAE) NEW TO MISSOURI AND NOTES ON OTHER SELECTED MISSOURI *CYPERUS*

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ABSTRACT

Field work in southeastern Missouri during 1989 and 1990 has resulted in a number of noteworthy *Cyperus* records. *Cyperus grayioides* and *Cyperus retroflexus* are reported new to Missouri. Also, additional records of *Cyperus croceus* and *Cyperus* × *mesochorus* and two previously unknown *Cyperus* hybrids are reported.

INTRODUCTION

Our investigation has been centered on a system of dry sandy ridges and rises in Mississippi, New Madrid, and Scott counties of southeastern Missouri. This part of Missouri is located in the Mississippi Embayment, a northward extension of the Gulf Coastal Plain (Fenneman 1938, Walker and Coleman 1987). Soils of the Scotco series [previously classified as Crevasse series] occur on and along these prominent sandridge formations, which rise as much as 30 feet above the surrounding floodplain. Scotco soils are excessively drained and droughty, coarse sands (Brown 1977, Festervand 1981). Many of the natural Scotco sandridge habitats are highly disturbed or have been destroyed by row-crop agriculture and construction of buildings or roads.

The presence of *Cyperus grayioides* and certain of its associates on the Scotco sandridges of southeastern Missouri indicates a floristic affinity with sandridges of eastern Texas and adjacent Louisiana and sand prairies of central and northern Illinois (Bowles et al. 1986, Bridges and Orzell 1989). Furthermore, it is interesting to note that prairie vegetation originally occurred to a limited extent in southeastern Missouri on these coarse sandy soils (Brown 1977).

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CYPERUS GRAYIOIDES NEW TO MISSOURI

Cyperus grayioides Mohl. is an obscure member of *Cyperus* section *Laxiglumi*, which until recently was poorly known and infrequently collected. It was originally described from sand-prairies of northwestern Illinois (Mohlenbrock 1959), and its occurrence in eastern Texas and Louisiana on xeric sandridges was subsequently documented in a thorough taxonomic treatment of *Cyperus* section *Laxiglumi* by Marcks (1972). More recently, additional populations in eastern Texas were reported (Bridges and Orzell 1989). *Cyperus grayioides* is listed among "candidates for possible addition to the List of Endangered and Threatened Plants," category 2, by the U. S. Fish and Wildlife Service (1990). It was thought that the Texas and Louisiana populations were disjunct by a distance of more than 850 km from the nearest Illinois sites.

Cyperus grayioides has not been previously recorded from the state (Yatskievych and Turner 1990). It is locally abundant on open, Scotco sands in southeastern Missouri, where it is associated with the following species: *Cenchrus longispinus* (Hack.) Fern., *Conyza canadensis* (L.) Cronq., *Croton glandulosus* L., *Cycloloma atriplicifolium* (Spreng.) Coulter, *Cyperus lupulinus* (Spreng.) Marcks ssp. *lupulinus*, *C. lupulinus* ssp. *macilentus* (Fern.) Marcks, *Diodia teres* Walter, *Eragrostis cilianensis* (All.) Vign. ex Janchen, *Euphorbia dentata* Michaux, *Froelichia floridana* (Nutt.) Moq. var. *campestris* (Small) Fern., *Helianthus petiolaris* Nutt., *Heterotheca subaxillaris* (Lam.) Britton & Rusby, *Monarda punctata* L., and *Opuntia humifusa* Raf.

A distribution map based upon examination of specimens (ILL, MO, NLU, TEX-LL, VSC) and other data (Mohlenbrock 1959, Marcks 1972, Bowles et al. 1986, Bridges and Orzell 1989) is shown in Figure 1. Collection data for *Cyperus grayioides* in Missouri are given below.

MISSOURI. **Mississippi Co.**: 0.2 mi E of jct of county roads 408 and 433, S of county road 408 by about 0.2 to 0.4 mi, T26N R14E S26, rim of sandy ridge around pine thicket and along old fence row, open, highly disturbed area, 26 Sep 1990, *Bryson 10472* (ctb-personal herbarium of C.T. Bryson, MO, VDB, VSC); 0.5 mi W of jct of county road CC and hwy I-57/US 60, just N of hwy I-57, near Scott-Mississippi county line, 26 Sep 1990, *Bryson 10474* (ctb, VSC). **New Madrid Co.**: sandy rise in floodplain, E of hwy I-55 frontage road, 1.0 mi S of Sikeston city limit, T25N R14E NW¼ S3, locally common on loose sand, 27 Aug 1989, *Carter 8263* (IBE, MO, SMU, VDB, VSC); sandy rise in floodplain, E of hwy I-55 frontage road, 0.8 mi S of Sikeston city limit, T26N R14E SW¼ S34, 36° 50′ 41″ N, 89° 31′ 52″ W, locally abundant on loose sand, 27 Aug 1989, *Carter 8267* (IBE, MICH, MO, NY, NYS, SWSL, SMU, US, VDB, VSC, WIS); 6.6 to 7.1 mi N of jct of hwy MO 80 and county road AA, S of Sikeston city limits, E of hwy I-55, T25N R14E NE¼ S3, open sandy area, 26 Sep 1990, *Bryson 10460* (ctb, IBE, MICH, MO, SMU, SWSL, VDB, VSC); 4.7 mi N of jct of hwy MO 80 and county road AA, S of Sikeston, T25N, R14E, NW¼ S11, open sandy area, 26 Sep 1990, *Bryson 10462* (ctb, VDB, VSC); 6.6 mi N of jct of hwy MO 80 and county road AA, S of Sikeston; T25N R14E S3, along E side of county

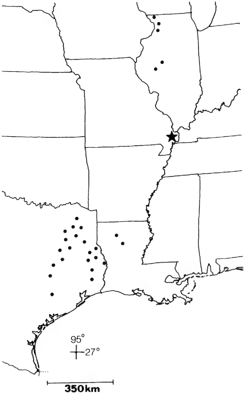

FIG. 1. The distribution of *Cyperus grayioides*.

road AA, open gentle slope at base of sandridge, sandy soil, 27 Sep 1990, *Bryson 10509* (ctb, VDB, VSC). Scott Co.: 0.2 mi W of jct of hwy MO 77 and county road 514, T27N R15E SE¼ S5, sandy soil in ditch along county road 514, 26 Sep 1990, *Bryson 10478* (ctb, MO, VDB, VSC); 2.1 mi E of Blodgett city limit and jct of county roads 514 and H, T27N R15E SW¼ S6, open areas along roadside, crest and slopes of sandy ridge N of county road 514, sandy soil, 26 Sep 1990, *Bryson 10481* (ctb, MO, SMU, VDB, VSC) and *10483* (ctb, IBE, MICH, MO, NLU, NYS, SMU, SWSL, TAES, US, VDB, VSC); 1.8 mi SSE of hwy I-55 and county road H by dead end, unnumbered access road, T27N R14E SW¼ S34, gentle slope near road, open sand, 26 Sep 1990, *Bryson 10498* (ctb, VDB, VSC).

CYPERUS RETROFLEXUS NEW TO MISSOURI

Cyperus retroflexus Buckley [= *Cyperus uniflorus* Torrey & Hooker, *non* Thunberg (*fide* Tucker 1987)] ranges from northern Mexico into New Mexico and throughout much of Texas and eastward into Oklahoma, Arkansas, and Louisiana (Carter, in prep.). Recently, it has been reported from Mississippi and Alabama (Carter, Bryson and Lipscomb 1987). During September 1990, an extensive population of *Cyperus retroflexus* was discovered growing on a Scotco sandridge in Mississippi County, Missouri. This species has not been previously reported from Missouri (Yatskievych and Turner 1990). Collection data for *C. retroflexus* in Missouri follow.

MISSOURI. **Mississippi Co.**: 0.2 mi E of jct of county roads 408 and 433, S of county road 408 about 0.2 to 0.4 mi, T26N R14E S26, along top of sandy ridge, around pine thicket and along old fence row, most of area highly disturbed and open, 26 Sep 1990, *Bryson 10473* (ctb, IBE, MICH, MO, NLU, SMU, SWSL, TAES, VSB, VSC).

ADDITIONAL RECORDS OF *CYPERUS* × *MESOCHORUS*

During 1989, plants with sharply angled, scabrid culms; ascending bracts; and multiple, pedunculate inflorescence rays were located in New Madrid County, Missouri, along an open roadside and edge of an adjacent field in coarse sandy soil of the Scotco series (Brown 1977, Festervand 1981), only about one-half mile from the aforementioned *Cyperus grayioides* site.

Initially, these plants were placed with *Cyperus schweinitzii* Torrey; however, a critical examination indicates they are actually *Cyperus* × *mesochorus*, a hybrid between *C. schweinitzii* and *C. lupulinus* (Spreng.) Marcks ssp. *lupulinus* (Marcks 1974). *Cyperus* × *mesochorus* Geise is rare in Missouri, and has not been previously reported from the southeastern quadrant of the state (Steyermark 1963, Yatskievych and Turner 1990).

Cyperus × *mesochorus* was found growing with only one of its putative parents, *Cyperus lupulinus* (Spreng.) Marcks ssp. *lupulinus*. However, its sharply angled, scabrid culms and ascending spikelets leave little doubt that *C. schweinitzii* is its other parent. Although it is disconcerting that *C. schweinitzii* was not found at any of these sites, this kind of problem is not unprecedented in Cyperaceae (Cayouette and Morisset 1985). Moreover, further investigation may document the occurrence of *C. schweinitzii* in the vicinity, which would be similar to a situation in *Carex* described by Catling et al (1989).

These plants also exhibit reduced fertility (ca 50% mean seed set) when compared with *Cyperus schweinitzii* (≥94%), which indicates a hybrid origin. The low fertility observed in this southeastern Missouri population is consistent with observations of Marcks (1974). Additionally, a number of the specimens are intermediate and difficult to place taxonomically, which suggests that introgression, as documented by Marcks (1974), has occurred.

Thus, we hypothesize that (1) *Cyperus schweinitzii* is rare in southeastern Missouri and was overlooked in our brief field work; (2) the intermediate plants have been formed by backcrossing between F1 hybrids and either or both parents; and (3) *C.* × *mesochorus* is the result of hybridization or introgression between *Cyperus schweinitzii* and *Cyperus lupulinus* ssp. *lupulinus*. Collection data for *Cyperus* × *mesochorus* follow.

MISSOURI. **Mississippi Co.**: 0.2 mi E of jct of county roads 408 and 433, S of county road 408 about 0.2 – 0.4 mi, T26N R14E S26, rim of sandy ridge around pine thicket and along old fence row, highly disturbed open sand, 26 Sep 1990, *Bryson 10471* (ctb, **MO**, VDB, VSC). **New Madrid Co.**: sandy rise in floodplain, E of hwy I-55 frontage road, 0.4 mi S of Sikeston City limit, T26N R14E NW¼ S34, locally abundant in loose sand, 27 Aug 1989, *Carter 8276* (IBE, MICH, MO, NY, NYS, SMU, US, VDB, VSC); 0.5 mi N of jct of hwy MO 80 and county road AA and 0.25 mi E of county road AA. T25N R14E S35, open well drained sandy ridge, 27 Sep 1990, *Bryson 10510* (ctb, VSC).

A RECENT COLLECTION OF *CYPERUS CROCEUS*

The correct name for the species long known as *Cyperus globulosus* Aublet is *Cyperus croceus* Vahl (Carter and Kral 1990). In the United States *Cyperus croceus* Vahl is distributed from New Jersey southward throughout Florida then westward into eastern Texas and Oklahoma. It is common in the Atlantic and Gulf coastal plains and occurs sporadically inland into Tennessee and Missouri (Carter, in prep.). *Cyperus croceus* was collected in Missouri in the late 19th and early 20th centuries but apparently has not been collected there since 1910. During 1989, a population of *Cyperus croceus* was located in New Madrid County, Missouri, where it was growing in sandy loam soil in a poorly kept lawn. This collection is the first of its species from Missouri in nearly 80 years. Data for all Missouri specimens of *C. croceus*, which we have examined, are given below.

MISSOURI. **Dunklin Co.**: "sandboden," without locality, 27 Jul 1893, *H. Eggert s.n.* (MO 759399); without locality, 18 Sep 1893, *Bush 140* (NY); Kennett, 27 Jul 1895, *Bush 683* (NY); Campbell, woods, 7 Sep 1910, *Bush 6222* (NY, US); Malden, sands, 8 Sep 1910, *Bush 6270* (NY, US). **New Madrid Co.**: New Madrid, poorly kept churchyard about a block W of levee, at corner of Russell and Vandenvender streets, T23N R14E S34, locally common, 27 Aug 1989, *Carter 8261* (**MO, VDB, VSC**). **St. Louis Co.**: Allenton, Jul 1889, *G. W. Letterman s.n.* (MO 795915); city of St. Louis: without locality, 12 Jul 1884, *G. W. Letterman s.n.* (NY).

PREVIOUSLY UNREPORTED *CYPERUS* HYBRIDS

Cyperus lupulinus (Spreng.) Marcks ssp. *lupulinus* × *Cyperus strigosus* L. — Hybrid plants of low fertility (<1%) were found in Scott County growing with *Cyperus lupulinus* ssp. *lupulinus* and *Cyperus strigosus*. The hybrids were found along a gentle slope between a swale and well drained sandy rise. Furthermore, this site was artificially watered by irrigation runoff. *Cyperus strigosus* was located in the swale, and *Cyperus lupulinus* ssp. *lupulinus* on the sandy rise. Presumably, the artificial water source has produced an intermediate habitat favorable for survival of hybrids. This situation appears to be analagous with the hybridized habitat described by Anderson (1949). The reduced fertility of these hybrids is not surprising since the parents are not closely related. Following are collection data for this hybrid.

MISSOURI. Scott Co.: NW of jct of hwy US I-55 and US 62 and between Sikeston Inn and I-55, open sandy soil, 25 Sep 1990, *Bryson 10453* (ctb, MICH, MO, SMU, SWSL, VDB, VSC); 1.8 mi SSE of jct of hwy US I-55 and county road H, by dead-end, unnumbered access road, SW¼ of SW¼ of Sec. 34, T27N, R14E, open sandy soil, gentle slope near road, 26 Sep 1990, *Bryson 10500* (ctb, VSC).

Cyperus grayioides Mohl. × *Cyperus lupulinus* (Spreng.) Marcks ssp. *macilentus* (Fern.) Marcks. — A single completely sterile hybrid plant was found growing with *Cyperus grayioides*, *C. lancastriensis* Porter in Gray, and *C. lupulinus* ssp. *lupulinus*. This plant is apparently an F1 hybrid between *Cyperus grayioides* and *Cyperus lupulinus* (Spreng.) Marcks ssp. *macilentus* (Fern.) Marcks and is intermediate between these taxa with respect to spikelet posture and anther length. Following are collection data for this hybrid.

MISSOURI. Scott Co.: 0.2 mi W of jct of Hwy MO 77 and county road 514, T27N, R15E, SE¼, Sect. 5, sandy soil in ditch along county road 514, 26 Sep 1990, *Bryson 10479* (ctb).

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BOOK REVIEWS

VAN DER VALK, ARNOLD. Editor. 1989. Northern Prairie Wetlands. Iowa State University Press, 2121 S. State Avenue, Ames, IA 50010. $38.95 hardbound. 400 pp.

This volume evolved from papers presented at a regional symposium held at the Northern Prairie Wildlife Research Center of the U. S. Fish and Wildlife Service in Jamestown, North Dakota in November 1985 under the auspices of the National Wetlands Technical Council.

The twelve chapters were written by nineteen authors or coauthors. The ecological aspects are reflected in the different chapter topics such as: Chapter 5. Vegetation of Wetlands of the Prairie Pothole Region and Chapter 6. Algae in Northern Prairie Wetlands. This volume is a review of the ecology of the palustrine and lacustrine wetlands in the northern prairie region. wfm

MADSEN, BRIGHAM D. Editor. 1989. Exploring the Great Salt Lake, the Stansbury Expedition of 1849 – 50. University of Utah Press, 101 University Services Building, Salt Lake City, UT 84112. $29.95 hardbound. 889 pp. with 2 maps in packet attached to back cover. Black and white reproductions of the Stansbury Expedition maps suitable for framing may be ordered separately – Tele: 801/581-6771 or toll-free: 1/800/444-8638, ext. 6771.

The publishing of the daily activities provides an insight into that time period and provides a valuable contribution to the history of that expedition. The publication of the journal entries on a day-by-day account from all diarists plus any military orders or correspondence has produced each day's activities from all perspectives.

Appendix A: Plant Specimens – This was reprinted from *Brittonia* (39: 86 – 95. 1987). Arnold Tiehm of the New York Botanical Garden wrote the article presenting a synonymized list, including a list of types, of the plants collected on Howard Stansbury's expedition to the Great Salt Lake. Appendices B through D are, respectively, Bird and Mammal Specimens, Amphibian and Reptile Specimens, and Crustaceans followed by the bibliography and index. An excellent book at a very reasonable price. wfm

ADDITIONS TO THE FLORA OF ARKANSAS

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ABSTRACT

The authors provide a list of 32 additions, significant collections, and reinstatements for the vascular flora of Arkansas, with annotations and citation of voucher specimens.

Since the publication of the second edition of *An Atlas and Annotated List of the Vascular Plants of Arkansas* (Smith 1988), a number of new records have appeared. Two new endemic species have been described for Arkansas: *Polymnia cossatotensis* Pittman & Bates in the Asteraceae (Pittman, Bates & Kral 1989), and *Mespilus canescens* J. B. Phipps in the Rosaceae (Phipps 1990). In this paper, we list 32 additional new, significant, or reinstatements of vascular plant records for the Arkansas flora. Several of these records were found by R. Dale Thomas and C. Amason in their southern Arkansas collections, and by P. Hyatt in his floristic study of Baxter County (for his M.S. degree). A number were found by restudy of old material at UARK by E. B. Smith or in collections made by E. Sundell in southeastern Arkansas. A few were collected by other workers. Several were listed as possible additions in Smith (1988).

In the list that follows, taxa are listed alphabetically by family, genus, species and variety; a brief annotation about the collection follows; ranges

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in N. America north of Mexico are taken mostly from Steyermark (1963), Correll & Johnston (1970), Gleason (1952), Radford *et al.* (1968), MacRoberts (1988), and Godfrey & Wooten (1979, 1981); finally, one or more voucher specimens and the herbaria that house the vouchers are cited.

AMARANTHACEAE

AMARANTHUS ARENICOLA I. M. Johnst. — This species was reported for Lee Co. by Davis (1974) but voucher material of it could not be located. It is a weed of waste ground from Iowa to Colorado, south to Louisiana, Texas and New Mexico, introduced in Missouri and northeastern states. Authentic material of it was collected on a sandy terrace of the Arkansas River 16 mi NE of Dumas, in Desha Co. in 1988 by E. Sundell (We thank R. L. McGregor, KANU, for verifying the identification); *Sundell 8638*, with Van Horn, Black & Etheridge (UAM, UARK).

APIACEAE (Umbelliferae)

CENTELLA ASIATICA (L.) Urban — This addition was collected in C. Amason's back yard near Calion, in Union Co. in 1989 by R. D. Thomas and C. Amason; it may have been introduced with plant material from Port Arthur, Texas many years ago, but is spreading aggressively. It is a species of low, wet soils and the U.S. range was earlier listed as Delaware south to Florida and west to eastern Texas; *Thomas & Amason 111,290* (NLU, UARK).

ERYNGIUM HOOKERI Walp. — Material of this species was collected at the edge of a backwater pond near the Mississippi River one mi N of Hwy. 208, in Chicot Co. in 1989 by E. Sundell and D. Etheridge; it was earlier listed for eastern Texas and Louisiana; *Sundell & Etheridge 9091*, UAM, UARK.

ASTERACEAE (Compositae)

CONYZA BONARIENSIS (L.) Cronq. — Material of this species was collected in a railroad yard in El Dorado, in Union Co. in 1989 by R. D. Thomas and C. Amason; it is a weed of waste places, with a U.S. distribution of Florida to eastern Texas; *Thomas & Amason 112,799* (NLU, UARK).

MARSHALLIA CAESPITOSA Nutt. var. CAESPITOSA — This variety was collected in 1989 along Pine Creek in Madison Co. by Rory Dalton and Jeanne Dow. We thank L. Watson for verifying the identification. At the time of this collection, it was a new state record. In the meantime, however, Watson and Estes (1990) indicated its range as eastern Texas to extreme southeastern Kansas, extreme southwestern Missouri, western Arkansas (apparently Montgomery and Yell counties), and eastern Louisiana. The Dalton and Dow collection is the first for the Ozark area of Arkansas; *Dalton & Dow la* (UARK).

SOLIDAGO DRUMMONDII T. & G. — This species was originally reported for Arkansas by Branner & Coville (1891), but had been synonymized under *S. argua* var. *strigosa* (Smith 1988). However, P. Hyatt's collections of it from north-facing limestone bluffs in Baxter Co. (*Hyatt 1041.03*, UARK) convinced Smith that it should be recognized separately; a 1937 Palmer collection of it from Marion Co. was located at MO, with enquiry to that institution (our thanks to H. H. Schmidt) and Hyatt recently recollected it at Palmer's site (*Hyatt 3670.45*, MO, UARK). It ranges from Illinois and Missouri to Arkansas and Louisiana.

SOLIDAGO LUDOVICIANA (Gray) Small — This species was first listed for Arkansas by Demaree (1943), but was considered a synonym of *S. salicina* by Smith (1988), a synonym of *S. arguta* by MacRoberts (1988), and a synonym of *S. bootii* (*S. arguta* var. *bootii*) by Correll & Johnston (1970). It evidently should be recognized as a separate species. It is now known in Arkansas from Calhoun (*Miller 628*, UARK), Cleveland (*Miller 316*, UARK), Columbia (*Miller 267*, UARK), Hempstead (*Moore 400449*, UARK), Miller (*Roberts 914* & *940*, UARK), Nevada (*Roberts 119* & *487*, UARK), and Union (*Thomas 102,729*, NLU, UARK) counties, grows in moist sandy soil, and ranges on into Texas and northern Louisiana.

SOLIVA MUTISII Kunth in H.B.K. — Restudy by Smith of a specimen collected several years ago as a garden weed in Pine Bluff, by Marie P. Locke in Jefferson Co. indicated that it was material of this species; it is a weed of disturbed areas, previously known from the U.S. in eastern Texas and Louisiana; *Locke 3084* (UARK).

BORAGINACEAE

MYOSOTIS DISCOLOR Pers. — A previously misidentified 1980 collection from Benton Co. by Ellen Neaville, on recent study was found by Smith to be material of this species. A population of this species was reported by Gary Tucker (pers. comm.) from Pope Co. (*Holben 34159*, and *Sanders 65*, both at APCR); it has not persisted there. It was recently found as a ball field weed in Monticello in Drew Co. by E. Sundell. This plant is adventive from Europe and Western Asia and occurs in waste areas on both coasts of N. America (*M. versicolor* in Gleason 1952) and, now, sporadically in Arkansas and Louisiana; *Neaville 5* (UARK), *Sundell 9403* (NLU, UAM, UARK).

CAMPANULACEAE

Wahlenbergia marginata (Thunb.) DC. — This new record was collected on a sandy road bank 2.1 mi south of Calion, in Union Co. in 1989 by R. D. Thomas and C. Amason; it ranges from the Carolinas south to Florida and west to Louisiana and Arkansas. *Thomas & Amason 111,677* (NLU, UARK).

CAPPARACEAE

Cleome gynandra L. — Material of this species, collected as a weed in a soybean field in Prairie Co., was sent to UARK by John Boyd (Coop. Ext. Service, Little Rock) for identification, and was determined by E. B. Smith; it was listed for Arkansas by Branner & Coville (1891), but on the basis of no voucher material available was excluded from the Arkansas flora by Smith (1988). It should be reinstated; it is a weed of African origin, in much of the U.S. from North Carolina to eastern Texas; *Boyd s.n.*, 3 Aug 1989 (UARK).

CARYOPHYLLACEAE

Stellaria pallida (Dumort) Pire — This close relative of *S. media* was collected by P. Hyatt in Baxter Co. in 1988 and identified by R. K. Rabeler (Michigan State Univ.). It has petals minute or absent and 2 stamens with gray-violet anthers; *S. media* has well-developed petals (rarely absent) and 3 — 7 stamens with red-violet anthers. This Eurasian weed was reported for North Carolina, Pennsylvania, and Michigan in Rabeler (1988). It has since been collected (mostly by Hyatt) in Arkansas from several counties and is evidently common here. Presently, *S. pallida* is known from Ashley, Baxter, Boone, Carroll, Conway, Crawford, Independence, Izard, and Washington counties. It occurs at least at scattered locations in the eastern U.S. Much of the UARK material is out on loan, so we cite only the following vouchers: Baxter (*Hyatt 1077.03*, UARK), Boone (*Hyatt 1185.05*, UARK, Independence (*Hyatt 1510.32*, UARK), and Izard (*Hyatt 1208.33*, UARK) counties.

CONVOLVULACEAE

Cuscuta coryli Engelm. — This species was listed for Arkansas by Branner & Coville (1891), but on the basis of no known voucher material was reduced to a possible addition by Smith (1988); recently collected material of it growing on *Campsis radicans* near Lake Wedington in Washington Co. was determined by L. A. Prather (Okla. State Univ.); its range is southern New England to Montana, south to North Carolina, Arkansas, Texas, New Mexico, and Arizona. *Cartwright s.n.*, 17 Aug 1988 (UARK).

Cuscuta obtusiflora H.B.K. var. glandulosa Engelm. — This species was collected in Union Co. in 1989 by E. Sundell, R. D. Thomas and C. Amason; it ranges in the U.S. through the gulf states, including Texas and Arkansas. *Sundell, Thomas & Amason 9176* (UAM).

CYPERACEAE

Bulbostylis ciliatifolia (Ell.) Fern. — Earlier reports of this species for Arkansas (Moore 1965, Wilcox 1973) were probably based on material of the very similar *B. capillaris*. Smith (1988) excluded it, but it should be reinstated. Authentic material of it is now known from Miller (*Roberts 902*, UARK), Nevada (*Roberts 134*, UARK), Ouachita (*Thomas et al. 100,682*, NLU, UARK), and Union (*Thomas et al. 112,946*, NLU, UARK) counties.

Carex hirtifolia Mack. — This new record extends the southern range of the species about 80 mi southwest from the nearest known location in southeast Missouri (previous range: New Brunswick and Quebec to Ontario and south to Maryland, Kentucky, Missouri and Kansas); it was collected in sandy soil over sandstone outcrops in Baxter Co. by P. Hyatt; *Hyatt 2823.03* (UARK).

Cyperus hystricinus Fern. — Some of the material at UARK collected on sand hills of southwest Arkansas, earlier determined *C. retroflexus* Buckley, was determined in 1990 by R. Carter (Valdosta State College, Ga.) as this new record; this species is now known in Arkansas from Miller (*Roberts 920A, 944*, UARK) and Union (*Thomas & Amason 111,726*, NLU, UARK) counties. Its range is difficult to determine, since it has been confused with *C. retroflexus*, but apparently includes much of the eastern U.S.

Eleocharis flavescens (Poir.) Urban (including *E. olivacea* Torr.) — This species was listed for Arkansas by Branner & Coville (1891), but on the basis of no known voucher material was not included by Smith (1988); material of it was collected partly submerged in a stream five mi south of Calion in Union Co. in 1988 by E. Sundell, with R. D. Thomas, C. Amason, and D. Etheridge; its range is eastern N. America, west to Minnesota and Texas. *Sundell 8754* (UAM, UARK).

Fuirena simplex Vahl var. aristulata (Torr.) Kral — A specimen from Little River Co. was determined this by R. Kral (Vanderbilt Univ.) although it was apparently mapped (Kral 1978) as var. *simplex*; both the Little River (*Iltis 5170A*, UARK) and the Miller (*Atkinson s.n.*, 15 Jul 1946, UARK) Co. dots for *F. simplex* in Smith (1988) represent material of this variety. In addition, two recent collections of the variety (*Sadler 448, 463*) have been made in Crawford Co.; it is a plant of open, limy or sandy soils, ranging in the U.S. from Nebraska and northwestern Missouri to Texas and New Mexico (Kral 1978).

FABACEAE (Leguminosae)

CROTALARIA ANGULATA Miller — Material of this species at UARK has passed as *C. sagittalis*; it is now known from Bradley (*Leslie & Cornish 1028*, NLU, UARK), Clark (*Tucker 12337*, APCR, UARK), Ouachita (*Roberts 305A*, UARK), and Prairie (*Smith 4132*, UARK) counties. It is found from Virginia, south to Florida, west to Alabama and Arkansas.

DESMODIUM CUSPIDATUM (Muhl. ex Willd.) DC. var. LONGIFOLIUM (T. & G.) Schub. — Material of this variety was not recognized in UARK material earlier (Smith 1988); Smith now recognizes it for Baxter (*Hyatt 2327.03*, UARK) and Pulaski (*Merill 985*, UARK) counties. It ranges from the north central U.S. south to Alabama, Louisiana and Kansas.

GERANIACEAE

GERANIUM TEXANUM (Trel.) Heller — An old specimen of this species, misidentified as *G. carolinianum*, has been found from Miller Co. at UARK; it might be better treated as *G. carolinianum* L. var. *texanum* Trel. and occurs in Arkansas, Louisiana and Texas; *Moore 510141* (UARK).

HYPERICACEAE

HYPERICUM DENTICULATUM Walt. — This addition was collected in Ashley Co. in 1988 by E. Sundell and D. Etheridge; its range extends from New Jersey to Ohio and southern Illinois, south to northern Florida, southeastern Arkansas and Mississippi; *Sundell & Etheridge 8531* (UAM).

IRIDACEAE

IRIS HEXAGONA Walt. — This Iris was recently collected along a Forest Service road near Chapel Hill in Sevier Co. by A. J. Higginbottom (P. O. Box 102, Kirby, AR) and determined by Smith; the range extends from South Carolina to Florida, west to southeastern Texas and north to Arkansas and southeastern Missouri; *Higginbottom s.n.*, 30 Apr 1990 (UARK).

LAMIACEAE (Labiatae)

MENTHA ARVENSIS L. — This mint was collected in Baxter Co. in 1989 by P. Hyatt. Its site of collection (below Bull Shoals Dam) puts the small population in jeopardy, with high water releases from the dam; elsewhere it occurs from Canada through much of the northern half of the U.S., to New Mexico and Arizona; *Hyatt 2245.03* (UARK).

LILIACEAE

SMILAX ECIRRHATA (Engelm.) Wats. — Two old collections at UARK from rich woods in Conway (*Moore 1242*, UARK) and Newton (*Moore & Iltis 492*, UARK) counties represent this species. The plant occurs from Ontario to Minnesota and South Dakota, south to Tennessee and Arkansas.

MALVACEAE

HIBISCUS COCCINEUS Walt. — This species is cultivated in our area, and is locally escaping to disturbed areas in and around El Dorado in Union Co.; it ranges from Georgia to Florida and Alabama west to Arkansas and Louisiana; *Sadler 439* (UARK).

NYCTAGINACEAE

MIRABILIS JALAPA L. — This cultivated species, native to tropical America, was collected as an escape in Union Co. in 1989 by R. D. Thomas and C. Amason. It had earlier been reported for Arkansas by Thompson (1977) and by Leslie (1986), probably on the basis of cultivated material. It was excluded by Smith (1988), but should be reinstated; *Thomas & Amason 111,373* (NLU, UARK).

POACEAE (Gramineae)

HYDROCHLOA CAROLINIENSIS Beauv. *Luziola fluitans* (Michx.) Terrell & H. Robins. — This species has been found in Hot Springs Co. as a serious weed in a fish pond near Malvern. Material of it was sent to UARK by W. D. Sample (Fish & Game Serv., Stuttgart) for identification and was determined by Smith (*Sample s.n.*, 28 Jul 1989, UARK). It may become a serious pest in fish ponds of southern Arkansas. It ranges in the U.S. from North Carolina to Florida, west to Arkansas and eastern Texas; it has also recently been collected in Cleburne Co. (*Thomas et al. 122,059*, NLU, UARK), and Union Co. (*Sundell et al. 8251*, UAM; *Thomas 104,756*, NLU).

ROSACEAE

PRUNUS CAROLINIANA Ait. — This cultivated species has been collected in several Arkansas counties, apparently always in cultivation, and was listed by Tucker (1976) as persistent after cultivation. However, a collection in Union Co. in 1989 by R. D. Thomas and C. Amason was apparently from an escaped plant. It was excluded by Smith (1988), but should be reinstated; it ranges from South Carolina, along the coast to Texas and Arkansas; *Thomas & Amason 111,245* (NLU, UARK).

SAXIFRAGACEAE

DECUMARIA BARBARA L. — This species was collected along a roadside in southern Union Co. in 1989 by R. D. Thomas and C. Slaughter; the species occurs in southeastern Virginia, south to Florida and west to Louisiana, Arkansas and Tennessee; *Thomas & Slaughter 110,064* (NLU, UARK).

SCROPHULARIACEAE

AGALINIS HOMALANTHA Pennell — Some material from near the Arkansas River in Pine Bluff, Jefferson Co., collected several years ago by Marie P. Locke, on further study by Smith is apparently this species. It was reported for Bradley Co. by Leslie (1976), on the basis of material of *A. tenuifolia*, and was therefore excluded by Smith (1988) but should be reinstated. It occurs in eastern and north central Texas to southern Oklahoma and southern Arkansas; *Locke 53* & *858* (UARK).

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Part I. Basic Techniques in Plant Biotechnology consists of 5 chapters; Part II. Regulation of Gene Expression in Plants – 7 chapters; Part III. Prospects for Manipulation of Chloroplast Genomes – 5 chapters; Part IV. Applications of Biotechnology in Plant Systems – 1 chapter, followed by Index. wfm

CAREX BALTZELLII (CYPERACEAE) NEW TO MISSISSIPPI WITH NOTES ON *CAREX PICTA* AND *CAREX IMPRESSINERVIA* IN MISSISSIPPI

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ABSTRACT

Carex baltzellii was discovered for the first time in Mississippi from Marion County. The southwestern range limit of *C. picta* was extended by its discovery in Marion and Pearl River counties, Mississippi. *Carex impressinervia* was relocated in Forrest and Marion counties, Mississippi. Habitat information was acquired for each species.

INTRODUCTION

The records reported herein are from mesic ravines along minor streams in southern Mississippi. These ravines are in the Longleaf Pine Belt of the East Gulf Coastal Plain Region of the southern portion of Mississippi (Lowe 1921). The ravines are composed of relatively open, predominantly hardwood forests along small streams. The hilltops above these ravines support a dry *Pinus*, *Quercus*, and *Carya* forest with shrub species including *Cornus*, *Ilex*, and *Vaccinium*.

The Ragland Hills area of Forrest and Perry counties and the Devil's Backbone area of Marion and Pearl River counties, Mississippi include some of the most rugged terrain and unusual flora of southern Mississippi. Although a part of the Longleaf Pine Belt of Mississippi, these areas include an unusual diversity of swamps, sandhills, bottomland hardwoods, and upland forests of pines, mixed pine-hardwoods, and hardwoods. Of special interest to many botanists are the beech-magnolia communities found within the mesic ravines, which range in elevation from approxi-

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mately 150 feet on the lower slopes to about 300 feet on the uppermost crests.

The surface and near surface materials consist of Miocene-Age Hattiesburg and Pascagoula clays, Plio-Pleistocene Citronelle gravel and clays, and/or Holocene clastics (Mississippi Geol. Soc. Map 1969; D. Patrick pers. comm. 1991). Soils of the ridge crests and slopes of the mesic hardwood areas are usually characterized as brown silt loams or grayish brown sandy loams (USDA 1979, 1983, and 1985).

The flora of Ragland Hills has been intensively studied (Rogers 1977), whereas that of the Devil's Backbone area is less well known. Of the 1019 species listed for the 3600 acre Ragland Hills area, 15 are considered as rare, threatened, or of special concern by the Mississippi Natural Heritage Program (Mississippi Natural Heritage Program 1987). Surveys initiated in 1989 were responsible for relocating seven of the rarer species (Rosso and McPhail 1989 and Rosso et al. 1990); however, *Carex impressinervia* Bryson, Kral, and Manhart and several others remained unobserved until the report herein (Rosso and McPhail in press).

CAREX BALTZELLII NEW TO MISSISSIPPI

For many years, *Carex baltzellii* Chapm. ex Dewey was known only from the type locality in northwestern Florida (Mackenzie 1933) and from adjacent Georgia (Mackenzie 1935). It is a rare species that is found in mesic, sandy loam ravines in the lower Coastal Plain in extreme southeastern Alabama and southwestern Georgia and in the Appalachicola and Chattahoochee River areas of northwestern Florida (Kral 1983). According to Kral, *C. baltzellii* is always found on moist, well-drained, humified sandy soils in steep ravines. It blooms in February and fruits in March and April.

While trying to relocate previously known populations of *C. impressinervia*, we discovered *C. baltzellii* on steep slopes in a narrow ravine above a small stream in Marion County, Mississippi. The plants appeared somewhat like *C. picta* Steudel but differed by their more erect habit and glaucous vesture. In contrast to the colonial structure as first described for *C. picta* by Charles C. Deam (Hermann 1940), plants did not form the typical circular tufts with hollow centers. Upon closer inspection, it was determined that the plant was not dioecious as in *C. picta* but was actually *C. baltzellii*.

Discovery of *C. baltzellii* in Mississippi extends the range of this species westward by about 375 miles. *Carex baltzellii* and *C. impressinervia* are listed among "candidates for possible addition to the List of Endangered and Threatened Plants," category 2, by the U. S. Fish and Wildlife Service (1990). Collection data for *C. baltzellii* in Mississippi are given below.

MISSISSIPPI. **Marion Co.**: Devil's Backbone, E of MS Hwy 43 about 17 air mi SSE of Columbia, 11 Apr 1991, *C. T. Bryson 10658* & *S. W. Rosso* (ctb-Charles T. Bryson personal herbarium, IBE, MICH, SWSL, USM-University of Southern Mississippi); Devil's Backbone, E of MS Hwy 43 about 18 air mi SSE of Columbia, 26 Apr 1991 *C. T. Bryson 10729, R. F. C. Naczi, T. E. Newton,* & *S. W. Rosso* (ctb).

Associates on the slope with *C. baltzellii* include *Acer saccharum, Arisaema dracontium, A. quinatum, Aristolochia serpentaria, Berchemia scandens, Callicarpa americana, Carex abscondita, C. digitalis* var. *asymmetrica, C. striatula, Carpinus caroliniana, Carya* sp., *Cornus florida, Dirca palustris, Euonymus americanus, Fagus grandifolia, Halesia diptera, Hexastylis arifolia, Ilex opaca, Illicium floridanum, Kalmia latifolia, Liriodendron tulipifera, Magnolia grandiflora, M. macrophylla, M. pyramidata, Quercus alba, Smilax* sp., *Trillium* sp., and *Viola* sp. Present downslope along the stream just below *C. baltzellii* were *Carex abscondita, C. atlantica* ssp. *atlantica, C. crebriflora, C. debilis, C. leptalea* and *C. willdenowii*. All *C. baltzellii* clumps were found on a humic, coarse sandy loam soils that were on steep slopes just above streams. Fewer than 50 clumps of *C. baltzellii* were located.

CAREX IMPRESSINERVIA IN MISSISSIPPI

Carex impressinervia was first collected in Mississippi by Ken Rogers in the Ragland Hills area in Forrest County and was identified as the closely related *C. oligocarpa* Schkuhr (Rogers 1977). At the time that *C. impressinervia* was described (Bryson *et al*. 1987), the senior author had spent several days in the field alone and with Will McDearman (MMNS) trying to relocate the population in Forrest County and find additional populations. Despite these efforts and those of Robert F. C. Naczi (MICH), the Forrest and Marion County populations were not relocated (Naczi and Bryson 1990).

In early March, 1991, Sam W. Rosso located a population of approximately 50 clumps of *C. impressinervia* in the Ragland Hills area of Forrest County. After several visits to the Devil's Backbone area in 1991, the authors found this species in steep, mesic ravines in Marion County, Mississippi. The Devil's Backbone population consists of about 200 clumps scattered along several narrow terraced ravines. The rediscovery is significant because *C. impressinervia* may well be the rarest *Carex* endemic to eastern North America. Collection data for *C. impressinervia* are given below.

MISSISSIPPI. **Forrest Co.**: Ragland Hills, 21 Mar 1991, *S. W. Rosso 91-111* (ctb, USM); 11 Apr 1991, *C. T. Bryson 10630* & *S. W. Rosso* (ctb, IBE, MICH). **Marion Co.**: Devil's Backbone, E of MS Hwy 43, ca. 18 air mi SSE of Columbia, 26 Apr 1991, *C. T. Bryson 10730, R. F. C. Naczi, T. E. Newton,* & *S. W. Rosso* (ctb, IBE, VDB).

As with the Alabama populations of *C. impressinervia* (Bryson *et al.* 1987 and Naczi and Bryson 1990), the Forrest and Marion County populations are restricted to narrow terraces at the base of slopes above small streams. In each case, these small streams were narrow enough to be crossed by a single step. Occasionally but rarely *C. impressinervia* plants were found slightly upslope and almost never along wet stream banks. The narrow microhabitat requirements of *C. impressinervia* may be one reason that it is so rare.

In Forrest County, *C. impressinervia* is most closely associated with *Fagus grandifolia*. Other woody associates include *Acer saccharum*, *Ilex opaca*, *Illicium floridanum*, *Kalmia latifolia*, *liriodendron tulipifera*, *Magnolia grandiflora*, *M. macrophylla*, *Ostrya virginiana*, *Quercus alba*, *Rhus radicans*, *Smilax* sp. and *Vitis* sp. Unlike the Alabama sites, *C. picta* and *C. striatula* occur just above *C. impressinervia*. Additional associates immediately upslope were *Callicarpa americana*, *Cornus florida*, *Fraxinus* sp., *Mitchella repens*, *Polystichum acrostichoides*, *Stewartia malacodendron*, and *Vaccinium elliottii*. Other herbs in close proximity with *C. impressinervia* were *Aristolochia serpentaria*, *Carex laxiflora* var. *serrulata*, *Hexastylis arifolia*, and *Viola* sp. Downslope were *Carex abscondita*, *C. debilis*, *C. digitalis* var. *asymmetrica*, *Euonymus americanus*, and *Sebastiana ligustrina*. The associates for the Marion County location are similar to that of the Forrest County station with one exception. *Dirca palustris* was present in Marion County.

ADDITIONAL RECORDS OF *CAREX PICTA* IN MISSISSIPPI

Carex picta Steudel has not been previously reported from Marion and Pearl River counties in Mississippi. Apparently, these records are the southwesternmost stations for this species in Mississippi and in the United States. According to Nelwyn Gilmore McInnis of the Louisiana Heritage Program (pers. comm. Apr 1991) the type locality of *C. picta* cited as "*Drummond* (*s.n.*) Louisiana, N. Orleans" (Mackenzie 1933) is evidently inaccurate and probably refers to the herbarium where the specimen was housed or it was just a generic locality that Drummond had as his base or where he shipped specimens (A. A. Reznicek pers. comm. May 1991). Reznicek also suggested that it would be interesting to look through Drummond's itineraries to see if he traveled up the Pearl River. Such a trip might have been a logical trip from New Orleans in those days. Both theories may explain why there are other references to plants supposedly collected in southern Louisiana by early botanists that are currently unknown from the New Orleans area. The only confirmed records of *C. picta* cited in Louisiana are from the northern part of the state in Bossier and Jackson parishes (MacRoberts 1988).

Of additional significance is the fact that in Marion County *C. baltzellii*,

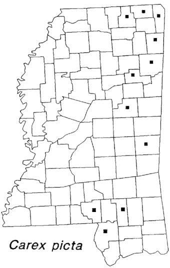

FIG. 1. Distribution of *Carex picta* in Mississippi.

C. impressinervia, and *C. picta* are found on the same bluff above a small tributary of the Pearl River. These species are not common at this locality. The microhabitats were isolated from one another by slope position and, to some degree, soil texture. *Carex impressinervia* and *C. picta* were found higher up the slopes than *C. baltzellii*. All three were growing on highly humic loam soils. However, the soil texture was a finer grain loam under the *C. picta* than the soil under *C. baltzellii*. The soil texture was even finer grain under *C. impressinervia*.

A distribution map based on examination of specimens from Mississippi (ctb, IBE, MISS, MISSA, MMNS, USM) is shown in Figure 1. The new collection data for *C. picta* in Mississippi follow.

MISSISSIPPI. **Marion Co.**: Devil's Backbone, E of MS Hwy 43, ca. 17 air mi SSE of Columbia, 11 Apr 1991, *C. T. Bryson 10648* & *S. W. Rosso* (ctb, IBE, MICH, SWSL); Devil's Backbone, E of MS Hwy 43, ca. 18 air mi SSE of Columbia, 26 Apr 1991, *C. T. Bryson 10726*, *R. F. C. Naczi*, *T. E. Newton*, & *S. W. Rosso* (ctb, MICH, USM). Pearl River Co.: E and W of MS Hwy 43 ca. 3 mi S of Marion-Pearl River County line, 12 Apr 1991, *C. T. Bryson 10678* (ctb, IBE, MICH); 26 Apr 1991, *C. T. Bryson 10754*, *R. F. C. Naczi*, *T. E. Newton*, & *S. W. Rosso* (ctb, MMNS).

Each population is restricted to a small area of less than 100 square feet except the population located in Marion County on 26 Apr 1991 which covers a south-facing slope of more than 10,000 square feet. In this population there are several thousand circular to semi-circular clumps. The Pearl River County population is the smallest and consists of fewer than 30 widely scattered small clumps.

The associated species for *C. picta* were similar to those of *C. baltzellii*; however, the following species were only found upslope with *C. picta*: *Arundinaria gigantea, Carex digitalis* var. *macropoda, C. laxiflora* var. *serrulata, Sanicula canadensis, Sanguinaria canadensis, Uvularia grandiflora*, and *Yucca filamentosa* var. *smalliana*. The woody species most closely associated with *C. baltzellii, C. impressinervia*, and *C. picta* was *Fagus grandifolia*.

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ANNOUNCEMENT

The herbarium and botanical library of Southern Methodist University (SMU) have been placed on loan to the Botanical Research Institute of Texas (BRIT) in Fort Worth, Texas. SIDA also will be published from this new location.

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DOCUMENTED CHROMOSOME NUMBERS 1991: 1. CHROMOSOME NUMBERS IN *HYBANTHUS* (VIOLACEAE)

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ABSTRACT

Chromosome numbers for 13 species of the pantropical or subtropical genus *Hybanthus* Jacq. (Violaceae) are known, including 9 species from Australia, 4 from North and South America and one from Afroasia. Diploid counts of $2n = 8$, 12, 16, 24, 32 and 48 have been published for the various species. The genus appears to have a base chromosome number of $x = 4$ since polyploidy on such a base will account for all of the numbers reported to date. Dysploids among the various ploidy levels have not been found. In the present paper 5 meiotic counts are presented for four populations of the previously unreported *Hybanthus verticillatus* ($n = 8$ and 16 pairs), and one new meiotic count is given for *H. attenuatus* ($n = 12$ pairs).

The genus *Hybanthus* (Violaceae) is a largely pantropical or subtropical genus with perhaps 60 species. Most of these are concentrated in the New World, with a secondary center in Australia; only a few taxa occur in Africa and Asia. A survey of the literature reveals that chromosome counts for about 13 species of *Hybanthus* have been published (Table 1). Two new species counts are added in the present paper: the previously unreported, largely temperate North American species, *H. verticillatus* (including *H. linearis* (Torr.) Shinners) with meiotic counts of $n = 8$ and 16 pairs, and *H. attenuatus* with meiotic counts of $n = 12$ pairs.

METHODS

Original chromosome counts reported in the present paper were made from meiotic material fixed in a modified Carnoy's solution (4:3:1; chloroform, 95% ethanol, glacial acetic acid, respectively) and stained with acetocarmine using standard methods. Vouchers are on deposit at TEX.

DISCUSSIONS

Hybanthus contains a variety of life forms that range from annual herbs to small trees; many of the annuals are weedy and these presumably could be readily grown from seeds in the greenhouse. Some years ago the junior author undertook a systematic study of the widespread highly variable

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TABLE 1. Chromosome numbers in *Hybanthus*

Species	Numbers (n pairs)	Area	Ref. or Voucher
H. attenuatus (H.B.K.) Schulze	16	Nicaragua	Davidse (1971)
————	16	S. America	Sundberg & Dillon (1986)-
————	12	Mexico	*Turner 15893* (TEX)
H. aurantiacus (Benth.) Muell.	8	Australia	Bennett (1972)
H. bilobus Gardn.	12, 24	Australia	Bennett (1972)
H. calycinus (DC.) Muell.	6, 12	Australia	Bennett (1972)
H. communis (St. Hil.) Taub.	16	S. America	Gadella et al. (1969)
H. cymulosus Gardn.	6	Australia	Bennett (1972)
H. enneaspermus (L.) Muell.	16	Africa	Margenot & Mangenot (1962)
————	8	Australia	Bennett (1972)
————	16	Asia	Sarkar et al. (1980)
————	8	Asia	Peng & Chen (1985)
H. epacroides (Gardn.) Melch.	12	Australia	Bennett (1972)
H. floribundus (Lindl.) Muell.	6, 12, 24	Australia	Bennett (1972)
H. monopetalus (R. & S.) Domin	4	Australia	Bennett (1972)
H. parviflorus (Mut.) Baill.	12	S. America	Heilborn (1926)
————	6	S. America	Di Fulvio (1977)
H. verticillatus (Ort.) Baill.	8	TEXAS: Cameron Co.	*Escobar 610* (TEX)
————	8	TEXAS: Gonzales Co.	*Escobar 595* (TEX)
————	16	TEXAS: Live Oak Co.	*Whalen 262* (TEX)
————	8, 16	TEXAS: Real Co.	*Escobar 600* (TEX)
H. volubilis Bennett	4	Australia	Bennett (1972)

temperate species, *Hybanthus verticillatus* and related taxa (unpubl.). She concluded that two names previously associated with this complex (i.e., *H. linearis* and *H. verticillatus* var. *platyphyllus* (A. Gray) Cory and Parks) were in fact but leaf forms of *H. verticillatus*. As shown in Table 1, the species includes both diploids and tetraploids; the different numbers are unrelated to leaf forms or yet other recognizable morphological features. Indeed, polyploidy is fairly common within a given taxon and all of the species can be said to have a base chromosome number of $x = 4$, since that number is divisible into all of the counts available to date, and none of the taxa is reported to have dysploid counts. Australian species show the largest array of chromosome numbers; these range from diploids with $n = 4$ pairs to dodecaploids with $n = 24$ pairs (Table 1).

The New World species are poorly represented to date, but chromosome numbers of $n = 8$, 12 and 16 pairs have been reported for the several species examined. It is likely that a range of polyploid numbers on a base of $x = 4$ will be recorded for the widespread weedy taxa; thus the only three counts for *H. attenuatus* reveal haploid numbers of $n = 12$ and 16, and the few very localized counts of *H. verticillatus* reveal haploid numbers of $n = 8$ and 16. The senior author has long attempted to interest some student with an urge to travel, collect and cogitate, to initiate a monographic study of this fascinating group.

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NOTES

A NOTE ON THE GEOGRAPHIC RANGE OF *ANTENNARIA AROMATICA* EVERT (ASTERACEAE: INULEAE) — In the spring of 1980, Ledyard Stebbins and I discovered a herbarium specimen collected by Arthur Cronquist at Quad Creek, Beartooth Pass, Montana that appeared to be different from any other *Antennaria* known to us. Later that summer, a visit to the herbarium of Montana State University (MONT) turned up several other specimens of the taxon, identified variously as *A. alpina* (L.) Gaertner, *A. media* E. Greene, and *A. umbrinella* Rydberg. We were able to collect and study specimens from Quad Creek (*Bayer & Stebbins 8092*), Tiger Butte south of Great Falls, Montana (*Bayer & Stebbins 8113*), and Mt. Sacajawea north of Bozeman, Montana (*Bayer & Stebbins 8104*), the first two collections being eventually cited as paratypes of the new species. It was immediately obvious to us that this very glandular, aromatic, plant was an undescribed species of *Antennaria*. About the same time we became aware that Erwin Evert, who was working on a floristic treatment of Park County, Wyoming, had come to the same conclusion, after collecting the species on limestone talus near Cody, Wyoming. In collaboration with us, he published the new species, calling it *A. aromatica* Evert (1984). Evert described the range as Park Co., Wyoming to Cascade Co., Montana (Evert 1984).

As a result of a search through all area herbaria, a distribution map was presented recently, showing the approximately 30 known sites for the species in Wyoming, Montana, with two slightly disjunct populations in Alberta (Bayer 1989B). My idea of the geographical distribution of the species has changed little from Evert's (1984) first description; its primary geographical distribution is the front ranges of the Rockies from near Cody, Wyoming north to the Alberta/Montana border (Bayer 1989B). Some disjunct populations occur in previously unglaciated portions of the Alberta front range north to near Mountain Park, Alberta (Bayer 1989B).

In a recent discussion of the range of the recently described *A. aromatica* Chmielewski & Chinnappa (1988) accepted it as a distinct species, but some of the eight specimens they cited as *A. aromatica* are misidentified. I have been able to determine by inspection or deduce that most of the five specimens cited by Chmielewski & Chinnappa (1988) from Montana are *A. aromatica* (sensu Bayer 1989B). Three of the specimens represent collections from sites previously known to me; *Cronquist 8092* (which originally led us to the type locality), *Neeley & Smith 1665* (at or near the type locality), and *Daubenmire 48231* (same as *Bayer et al. MT-754* cited in Bayer

1989A). I have not seen *Forsella s.n.*, but it is likely to be *A. aromatica* sensu Bayer, 1989B) as it is from the peak adjacent to Mt. Sacajawea, where *A. aromatica* is abundant. One specimen, *Suksdorf 1063* is clearly non-glandular with light brown phyllaries and upsurgent stolons and in my opinion typical *A. umbrinella* Rydberg (sensu Bayer 1988). The specimen from southern Alberta could pass for *A. aromatica* (Stebbins, pers. comm.) and is within the extended range of the species recently presented by me (Bayer 1989B). I was unable to obtain the British Columbia collection (*Selby 289*) for verification.

The most significant and controversial range extension they Chmielewski & Chinnappa 1988) report is *Bell & Johnson* 766 from Mono Co., California. After examination of this non-glandular, black-phyllaried specimen, I conclude it is alpine *A. media* E. Greene (sensu Bayer 1988). Stebbins and Evert, after examining this specimen, concur that it is clearly *A. media* (Stebbins, pers. comm.).

In my opinion, two of the eight specimens that Chmielewski & Chinnappa (1988) have sited as *A. aromatica*, including the major range extension to California, are misidentified. Consequently, I still maintain that *A. aromatica* is a narrowly restricted endemic, based on the size of its range and the rather unique habitat requirements when compared to other sexually reproducing species of *Antennaria*. — *R. J. Bayer, Department of Botany, University of Alberta, Edmonton, Alberta T6G 2E9, CANADA.*

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TWO WEEDY SPECIES, *AMMOSELINUM BUTLERI* (UMBELLIFERAE) AND *LEPIDIUM AUSTRINUM* (CRUCIFERAE), NEW TO MISSISSIPPI. — The following notes on two species, *Ammoselinum butleri* (S. Wats.) Coult. & Rose and *Lepidium austrinum* Small, are additions to the flora of Mississippi. Both occur as weeds in open or partially shaded areas on sandy, sandy loam, or silty loam soils and in association with *Sclerochloa dura* (L.) Beauv. recently reported new to Mississippi (Carter, Morris, and Bryson 1990).

Ammoselinum butleri is a small sand parsley that occurs from Kansas, E Oklahoma and Arkansas southward into Texas (Correll and Johnston 1970, McGregor et al. 1986, Smith 1978). In Kansas this species is known from two counties where it is a weed in a lawn and a city park. In Texas it is reported principally from bottomlands and moist woodlands in the Timber Belt, and Blackland and Coastal prairies.

Specimens collected: MISSISSIPPI. **Sunflower Co.**: S of Drew, W of Hwy US 49W, Sec. 5, T22N, R3W, 11 Apr 1990, *Bryson 8799 & Newton* (IBE, NLU, SWSL); 1 mi W of Ruleville, S of Hwy MS 8, Sec. 2, T21N, R4W, 11 Apr 1990, *Bryson 8812 & Newton* (IBE, MO, SWSL, VDB). **Washington Co.**: 2.2 mi NE of Stoneville, Sec. 36, T19N, R2W, 20 Apr 1987 *Bryson 5354* (IBE, NLU, SMU, SWSL, TAES, VDB, VSC); 3 mi S of Leland, E of old Hwy US 61, pecan orchard, 21 Apr 1987, *Bryson 5368* (SWSL); S of Greenville and N of Hwy US 82, BASF Research Farm, 21 Apr 1988, *s. coll. s.n.* (SWSL); Stoneville, Mississippi Agricultural & Forestry Experiment Station, Delta Branch, lawn weed, 12 Apr 1990, *Bryson 8827* (SWSL).

This species is a common weed of lawns or disturbed areas, but it is also abundant in no-tillage experimental cotton and soybean-crop-production systems plots in the Stoneville area. With increased use of reduced tillage agriculture, *A. butleri* may become more widespread. However, it is speculated to have little economic effect on summer row-crop production because it is an early spring annual. It may have been overlooked in the past because its habit and habitat are similar to *Coronopus didymus* (L.) Small.

Lepidium austrinum is a hispid peppergrass of sandy or sandy loam soils. It ranges from southeastern Kansas and Oklahoma southward into southern Texas; it also occurs in the Trans-Pecos of Texas and in Mexico (Correll and Johnston 1970, McGregor et al. 1986). It also occurs in Arkansas and Louisiana but *L. austrinum* is rare in the eastern limits of its natural range and is undoubtedly introduced into South Carolina on imported wool (Al-Shehbaz 1986).

Specimens collected: MISSISSIPPI. **Washington Co.**: Leland, jct. old Hwy US 61 & Hwy US 82, May 1985, *Saucier 31* (SWSL); NE of Stoneville, Delta Experimental Forest, Sec 27, T19N, R7W, 15 Apr 1990, *Bryson 8848 & Newton* (IBE, MICH, NLU, SWSL); Leland, along Deer Creek Drive, 30 Apr 1990, *Elmore s.n.* (SWSL); Stoneville, Mississippi Agricultural & Forestry Experiment Station, Delta Branch, Sec. 11, T18N, R7W, 7 May 1990, *Bryson 8968* (DSC, DUR, FLAS, FSU, GA, GH, IBE, LSU, MICH, MISS, MISSA, MMNS, MO, NLU, NY, SMU, SWSL, TAES, TENN, UARK, US, VDB, VSC).

This species is an abundant weed in Washington County along roadsides, in no-till fields, and in wheat fields. In competition with wheat, it is not uncommon to find *L. austrinum* plants 1 to 1.2 m tall. Without crop competition plants are generally less than 0.5 m tall.

We thank Richard Carter (VSC) for review of the manuscript and identification of *A. butleri*, Sidney McDaniel (IBE) for verification of *L. austrinum*, and R. K. Rabeler (MICH) for the review of the manuscript and loan of specimens representive of several *Lepidium* species, which were compared with our Mississippi collections. — *Charles T. Bryson, USDA, ARS, Southern Weed Science Laboratory (SWSL) and C. Dennis Elmore, USDA, ARS, Field Crops Mechanization Laboratory, Stoneville, MS 38776, U.S.A.*

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THE IMPENDING NATURALIZATION OF *PISTACIA CHINENSIS* (ANACARDIACEAE) IN EAST TEXAS — Why do some exotic woody plants escape from cultivation and naturalize quickly while others require decades to do so? *Pistacia chinensis* Bunge is a Chinese tree that has been slowly naturalizing in South Central and East Texas. Even though this ornamental tree was introduced to cultivation in 1897 (Chittenden 1951) and according to Texas Agricultural Experiment Station records has been cultivated in Texas since 1918, this is the first report of the species naturalizing in North America (Shetler and Skog 1978). In contrast, another well-known Chinese tree, *Sapium sebiferum* (L.) Roxb., introduced to cultivation in about 1850 and to Texas in the early 1900's (Jamieson and McKinney 1938), has quickly naturalized and is displacing native coastal marsh species.

Barkley (1943) listed several exotic members of the Anacardiaceae but he and later botanists did not consider *P. chinensis* to be naturalized in Texas (Johnston 1988) or even in North America (Shetler and Skog 1978). *Pistacia atlantica* Desf. is listed as established in Washington Co. Utah (Welsh, Atwood, Goodrich, and Higgins 1987).

Pistacia chinensis was not widely planted in Texas until after the 1960's. Shinners (1958) noted that "*P. chinensis* is rarely cultivated" and did not indicate that it had naturalized in the Dallas area. Since 1958 *P. chinensis* has become increasingly popular (Browse 1988) in the nursery industry throughout the Southern U. S. It is cultivated for its autumn color in many Texas counties.

One of the *first* locations where the tree was evaluated in the state was at the old Texas Agricultural Experiment Station nursery in College Station. By 1928, it became recognized that *P. chinensis* was well adapted there. Today seedling trees of various ages from young to flowering age can be found in the vicinity of defunct nurseries on the Texas A&M University (TAMU) Campus. Additional trees distributed by The Texas Forest Service were planted at the TAMU Floriculture Nursery in the 1940's as well as at various homes in Bryan and College Station and, to a limited extent, throughout East Texas as it became recognized that the ornamental tree was well adapted there. Seedlings distributed by the Texas Forest Service in the 1940's are now maturing and serving as seed sources for the naturalization of the species in East Texas. Although many plants have been produced and sold by commercial Texas nurseries in the last decade, these trees are still too young to reproduce.

I first observed about 20 young *P. chinensis* trees and seedlings naturalizing in the vicinity of the old Floriculture Nursery in College Station in 1972 and now a few of these second generation trees are fruiting (*McWilliams M7299030*, TAES) and producing seedlings. Young trees ranging in age from a few years to about 20 years can be found in disturbed Post Oak woodlands in central Brazos Co. Like many other exotic deciduous trees, *P. chinensis* seedlings retain their leaves longer than most of the native plants and their yellow-orange leaves are easily seen along the edges of woods in November or early December. Seedlings of the tree have also been observed in East Texas counties.

Long-distance dispersal of *P. chinensis* by man has already occurred throughout much of the state. Local dispersal by birds has and will probably continue to occur. The pattern of seed dispersal and ultimately of seedlings is related to the territoriality of the birds that disperse *P. chinensis* seeds (unpublished observation). Seedlings are often found in fence rows and beneath older trees and shrubs.

Based on the slow spread of *P. chinensis* at College Station and the observation of seedlings in other Texas cities, I hypothesize that similar patterns of "naturalization" will occur in other areas of East Texas as the now widely planted trees mature. In plant demography, older trees that produce large seed or pollen crops have a greater influence on reproduction than do younger trees. Obvious factors influencing rate of naturalization of cultivated plants are: date of introduction, numbers of plants produced commercially, length of life cycle, age to flowering, growth rate, breeding system, seed set and mode of dispersal. The ratio of female to male trees is particularly important in a species such as *P. chinensis* that produces many inviable seeds.

In comparing traits of *P. chinensis* and *S. sebiferum* we see that the former species was not initially as widely planted, takes more years to reach maturity, has a slower rate of growth but greater cold hardiness, and is less dependable in producing viable seed (Browse 1988) possibly because it is dioecious. Thus there appear to be several reasons why *P. chinensis* is slower to naturalize. On the other hand, the seed stratification requirement and the greater cold tolerance of *P. chinensis* indicate that the species will eventually naturalize farther north than have some exotics such *S. sebiferum*. Based on the performance of these plants and the tolerance range physiology of the species, additional *P. chinensis* naturalization may be expected in Hardiness Zone 8 (U.S.D.A. 1990) in East and South Central Texas. Collectors interested in testing this hypothesis should look within a kilometer of old female trees for seedlings and saplings of this exotic. The native, odd-pinnately compound *Pistacia texana* Swingle is now widely cultivated in Texas but I have not seen this species naturalize. The evenly compound leaves of *P. chinensis* are much larger than those of the native species.

To germinate uniformly, seeds of this exotic apparently require a period of cold stratification (Browse 1988) which they are unlikely to receive regularly in extreme South Texas, Hardiness Zone 10. Young plants and seedlings are damaged when temperatures drop below -10 degrees F and thus it is unlikely that the plant can naturalize as far north as Zone 6.

In summary, *P. chinensis* has slowly naturalized in parts of Brazos County Texas, and seedlings have been observed in other counties near mature trees. There appear to be several developmental and ecological reasons for the slow rate of naturalization of *P. chinensis*. Based on the adaptation of the old trees and their successful reproduction, where male and female trees occur together at several distant locations, I predict that the tree will naturalize over the next decade in Zone 8 of East Texas.

Assuming no major climatic change, the large number of cultivated trees throughout East Texas that are approaching maturity herald an impending period of widespread seed and subsequent seedling production and the eventual widespread naturalization of this exotic in disturbed areas of South Central and East Texas.

The extent of drought, shade and flood tolerance of *Pistacia chinensis* and whether the species will be able to invade undisturbed plant communities in Texas remain to be seen.

ACKNOWLEDGMENTS

I thank the Texas Forest Service for assistance with historical records on *Pistacia chinensis* and John Teas and Lynn Lowrey for information on the cultivation of *Sapium sebiferum* in Texas. — *Ed McWilliams, Department of Horticultural Sciences, TAMU, College Station, TX 77843, U.S.A.*

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THE REDISCOVERY OF *CAREX GIGANTEA* (CYPERACEAE) IN TEXAS — *Carex gigantea*Rudge is found infrequently throughout its range, however, it can be locally common. The most southwesterly extension of its range is Oklahoma and Texas. The last collection record in Texas was 47 years ago by *E. Boon 224* (TEX), 16 July 1943 (Jones and Hatch 1990). This distinct species was recently collected in Newton Co.: 28 July 1990, *S. & G. Jones* 5665 *& J.K. Wipff* (SMU, TAES, TX). Specimens were collected at the edge of a clear-cut area interfacing with a low lying swampy area. The collection site is 1.7 miles (2.8 km) NW on a dirt road extension of Spur 272 S with its junction with TX 12 in Deweyville, Neitsch et al (1982) classify the soil as the Gaillime-Spurger Association . However, the plants were growing specifically on the Gallime soil series. This series has a surface (A) horizon that is fine sandy loam in texture and is of medium acid. This soil is classified as a fine-loamy, siliceous, thermic, Glossic Paleudalf. The slope of the area is 0 − 3% and the elevation is approximately 15 m. The geology of the site is of the Quarternary System; Recent Pleistocene Series; Houston (Gulf Coast) Group, and of the Beaumont and Lissie Formation. Associated species include *Quercus nigra* L. *Magnolia virginica* L., *Nyssa sylvatica* Marsh, *Salix nigra* Marsh., *Persea borbonia* (L.) Spreng., *Cephalanthus occidentalis* L., *Myrica cerifera* L., *Rhus* sp., *Ampelopsis arborea* (L.) Koehne., *Chasmanthium latifolium* (Michx.) Yates, *Lygodium japonicum* (Thunb.) Sw., *Hydrolea ovata* Choisy, *Scirpus cyperinus* (L.) Kunth, *Eleocharis montana* (H.B.K.) Roem. & Schult., *Carex joorii* Bailey, *C. glaucescens* Ell., *Erianthus* sp., *Xyris* sp., *Panicum* spp., *Pluchea* sp., *Rhexia* sp., and *Ludwigia* sp.

In the southwestern United States, the authors have observed *Carex gigantea* growing in association with bald Cypress (*Taxodium distichum* (L.) Rich.). Bald cypress was not found within miles of this collecton site. Whether historically bald cypress grew at this site or not is difficult to ascertain.

We hope the rediscovery of this species in Texas will prompt the Texas Organization for Endangered Species to study this species as a candidate for the "state endangered species list" as defined by Beaty and Mahler (1987). — *Stanley D. Jones and J.K. Wipff, S.M. Tracy Herbarium, Department of Range Science, Texas A&M University, College Station, TX 77843, U.S.A., and Gretchen D. Jones, Department of Biology, Texas A&M University, College Station, TX 77843, U.S.A.*

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SYMPHORICARPOS OCCIDENTALIS (CAPRIFOLIACEAE), NEW TO TEXAS — *Symphoricarpos occidentalis* Hook., western snowberry, wolfberry, is a stoloniferous shrub to 1(1.5) m forming large colonies. This taxon is found in New Mexico at 1, 500-2, 600 m in Colfax (Martin and Hutchins 1981) and Union (Great Plains Flora Association 1977, Martin and Hutchins 1981) counties; in Morton County, Kansas (Great Plains

Flora Association 1977) and in Cimarron County, Oklahoma (Great Plains Flora Association 1977 and 1986, Waterfall 1972, Williams n.d.). Waterfall (1972) locates it in western Cimarron County south of Kenton. This is the first report of this species in Texas with herbarium specimens being deposited in the BRIT/SMU herbarium (in flower, *Simpson 689* and fruit, *Simpson 1189*). Neither Vines (1960), Correll and Johnston (1970), Waterfall (1972), Great Plains Flora Association (1977, 1986), nor Johnston (1988, 1990) list *S. occidentalis* as occurring in Texas. The Texas specimen is located on a northwest bank of Fryer Lake on Wolf Creek in Ochiltree County. Western snowberry occupies about a 15 m2 area and could be a single clone spreading by stolons from the original plant. *Prunus angustifolia* Marsh. marks its northeasterly boundary with putative *P. munsoniana* Wight & Hedr. at its southwestern extremities. Lake Fryer bounds it on the east and a road and an *Agropyron smithii* Rydb. grassland delimits it to the west. The colony flowers in June with fruit ripening in August-September and remaining on the bush through the winter or until taken by birds. Eighty-two per cent of dormant wood cuttings taken in January rooted. According to Vines (1960), the plant has potential for use as an ornamental, for erosion control, and as forage for cattle. — *Benny J. Simpson, Texas Agricultural Experiment Station, Texas A&M University Research and Extension Center, 17360 Coit Road, Dallas, TX 75252, U.S.A.*

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ADDITIONAL NOTES ON THE ASTERACEAE OF LOUISIANA — Following our publication on the Asteraceae of Louisiana (Gandhi and Thomas 1989), we have the following taxonomic and nomenclatural notes and a correction for Louisiana asters.

P. 79. **Eupatorium glaucescens** Ell. — Correll and Johnston (1970) recognized the name *E. glaucescens* Ell. 1823 and cited *E. cuneifolium* Willd. 1803, among others, in synonymy. They did not provide any explanation for accepting a later name over an earlier name. In a personal communication, Robinson disagreed with Correll and Johnston's disposition and suggested to us to recognize the name *E. cuneifolium* and include *E. glaucescens* in synonymy. Moreover, King and Robinson (1987) followed Robinson's suggestion. Following Robinson's suggestion, we recognized the name *E. cuneifolium* for the Louisiana asters.

On further study, we found that for *E. cuneifolium*, Willdenow cited *E. marrubium* Walt. 1789 in synonymy. Because of this citation, the name *E. cuneifolium* was rendered to be superfluous, and thus illegitimate. For this reason, we reject the name *E. cuneifolium* and recognize *E. glaucescens* to be the correct name.

P. 121. **Aster spinosus** Benth. — The disposition of spiny aster has been in dispute. Generally, it has been known by the name *A. spinosus* Benth. 1869. However, its uniqueness among the Aster species was noted by many authors. Among them, Greene considered it to be related to *Leucosyris carnosa* (Gray) Greene 1897 and made a new combination: *L. spinosa* (Benth.) Greene [Pittonia 3:244. 1897). There was very little or no following among subsequent authors for Greene's treatment.

Sundberg (1986) disagreed with both Bentham and Greene, and treated spiny aster as a member of the genus *Erigeron*, and made a new combination: *Erigeron ortegae* S. F. Blake var. *spinosa* (Benth.) Sundberg. In Feb 1988, we communicated to Dr. Almut Jones (ILL) and discussed Sundberg's treatment. Jones did not accept Sundberg's new combination. At this time, she thought that inclusion of spiny aster in *Leucosyris* "would probably be the best solution." We decided to accept the name *L. spinosa*. It must be emphasized here that although we accpted the suggestion of Jones, we are responsible for any nomenclatural and/or taxonomic error.

In Nov 1989, we discussed this disposition with Dr. John T. Kartesz (NCU), and in turn, he communicated to Jones. At this time, Jones disapproved the inclusion of spiny aster in *Leucosyris*, and suggested that "At this time, the best thing is to retain the species under Aster, with a question mark." Meanwhile, Dr. Guy Nesom (TEX) informed Kartesz that the type species of *Leucosyris* (i.e., *Linosyris carnosa* Gray) belongs in *Machaeranthera* Nees (Nesom 1989). Dr. Cronquist (NY) informed us that he would follow Sundberg's treatment. Unfortunately, Sundberg's trinomial remains unpublished (to the best of our knowledge). Moreover, we are of the opinion that *A. spinosus* should be included in a new genus. In such a complex situation and pending further study, we recognize the name "*?Aster spinosus*" for the Asteraceae of Louisiana.

P. 128. **Marshallia** — In a note given in the treatment of *M. tenuifolia*, we indicated that *M. graminifolia* (Walter) Small and *M. tenuifolia* Raf. are not easily separable (in Louisiana) using the key characters given by Cronquist (1980). We reduced *M. graminifolia* as a variety of *M. tenuifolia* and made a new combination: *M. tenuifolia* var. *graminifolia* (Walter) Gandhi & Thomas. We reject this combination and regret this nomenclatural error.

In a biosystematic and phenetic analysis of *Marshallia*, Watson and Estes (1990) also indicated that these taxa are morphologically indistinguishable. However, these authors emphasized the fact that these two species have a minor, but distinct geographical distribution: "*M. graminifolia* occurring on the Atlantic Coastal Plain of the Carolinas" whereas "*M. tenuifolia* occurring in farther south along the Atlantic Coastal Plain in Georgia, and Florida and along the Gulf Coastal Plain from Florida west to Texas." Because of the existence of a geographic component between these two taxa, Watson and Estes reduced *M. tenuifolia* as a subspecies of *M. graminifolia* and made a new combination: *M. graminifolia* ssp. *tenuifolia* (Raf.) Watson. For the Asteraceae of Louisiana, we accept their treatment and assign all Louisiana taxa previously known by the names *M. graminifolia* and *M. tenuifolia* to *M. graminifolia* ssp. *tenuifolia*.

Marshallia graminifolia ssp. **tenuifolia** (Raf.) Watson, Syst. Bot. 15:412. 1990.

M. tenuifolia Raf., New Fl. 4: 77. 1838.
M. graminifolia var. *cyananthera* (Ell.) Beadle & Boynt. Biltmore Bot. Stud. 1:4. 1901.
M. tenuifolia var. *graminifolia* sensu Gandhi & Thomas.

P. 129. **Matricaria** — The correct name for pineapple-weed in the genus *Matricaria* is *M. discoidea* DC. (fide Rauschert, Folia Geobot. Phytotax. 9:254–256. 1974). Rauschert indicated that Lessing proposed the name *Artemisia matricarioides* Less. [the basionym of *Matricaria matricarioides* (Less.) Porter] as an avowed substitute for *Tanacetum pauciflorum*

Richards., since the epithet pauciflora was preoccupied in *Artemisia* (e.g., *A. pauciflora* Spreng.). If Rauschert is correct, then the names *A. matricarioides* and *M. matricarioides* must be treated as taxonomic synonyms of *T. huronense* Nutt.

On verification of Lessing's protologue of *A. matricarioides*, we found that Lessing cited *T. pauciflorum* as a synonym and provided a description based on specimens collected by Chamisso and by Redowsky. Since Lessing's description is so different from Richardson's plant, some authors may argue that Lessing's citation of *T. pauciflorum* in synonymy should be viewed as incidental, and such authors may continue to recognize *M. matricarioides* to be the correct name for pineapple-weed. However, We emphasize the fact that under ICBN Art. 7.16, Ex. 3, the name *A. matricarioides* was solely validated by Lessing's reference to *T. pauciflorum*. Lessing's description is secondary here. Furthermore, Chamisso's and Redowsky's collections cited by Lessing are irrelevant in this respect, since Lessing did not definitely designate any one of them to be the type.

Lessing was not the only one who thought that *A. matricarioides* and *T. pauciflorum* were conspecific. De Candolle (Prodr. 6:131) recognized the name *T. pauciflorum* Richards. and cited *A. matricarioides* Less. as a synonym. The following is quoted from De Candolle's protologue of the name *T. pauciflorum*:

> "in Unalaschka (Cham.!), Kamschatka (Red.!), ... *A. matricarioides* Less. in linnaea 1831. p. 210. *Cotula matricarioides* Bong. Veg. sitch. p. 29."

We conclude that Lessing erred in citing *T. pauciflorum* as a synonym of *A. matricarioides* (but nevertheless his protologue included the type of Richardson's plant for *A. matricarioides*) and that Rauschert is correct on the nomenclature of pineapple-weed.

Matricaria discoidea DC., Prodr., 6:50. 1837.

> *Santolina suaveolens* Pursh, Fl. Amer. Sept. 2:520. 1814, non *Matricaria suaveolens* L., 1755.
> *Artemisia matricarioides* auct. non Less. 1831.
> *Matricaria matricarioides* auct. non (Less.) Porter 1894.

P. 162. **Solidago rugosa** Mill. — The given note "Cronquist (1980) treated *S. aspera* and *S. celtidifolia* as distinct subspecies of *S. rugosa*. We follow Taylor and Taylor (loc. cit. 1984)" is corrected to "Cronquist (1980) treated *S. aspera* as a subspecies of *S. rugosa*. We follow Taylor and Taylor (loc. cit. 1984). — *Kancheepuram N. Gandhi, North Carolina Botanical*

Garden, Department of Biology, University of North Carolina, Chapel Hill, NC 27599-3280, U.S.A. and R. Dale Thomas, Herbarium, Department of Biology, Northeast Louisiana University, Monroe, LA 71209, U.S.A.

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CALL FOR APPLICATIONS FOR THE 1991 DELZIE DEMAREE TRAVEL AWARD

An endowment to underwrite an annual travel award ($250) in memory of Dr. Delzie Demaree is given annually to a graduate student in systematics for tavel to the Systematics Symposium sponsored each fall by the Missouri Botanical Garden in St. Louis. Such an award is a very appropriate way to honor Dr. Demaree and to continue his legacy of assistance to students of botany.

The recipient of the 1990 travel award was Ms. Sara Hoot, University of Michigan, Ann Arbor. Ms. Hoot is doing an evolutionary study of the genus and section *Anemone* based on morphology and DNA restriction site variation. Her supervisor is Dr. A.A. Reznicek.

Letters of application for the 1991 travel award should be mailed to Donna M.E. Ware, Herbarium, Dept. of Biology, The College of William and Mary, Williamsburg, Virginia 23185. Applications should be postmarked by 1 August 1991. A complete application shall consist of a letter from the graduate student describing briefly his/her research and the benefits of symposium attendance, and a letter of recommendation from the student's major professor.

ERRATUM

Trent & Allred, Sida 14(2):251 – 261. The references to var. *hamulosa* occurring in Colorado (pages 253, 258, 260) are in error. Variety *hamulosa*, as far as we are aware, occurs only in Arizona, California, New Mexico, Texas, Guatemala, and Mexico.

Wanderings in the Southwest in 1855 by J. D. B. Stillman, edited with an introduction by Ron Tyler. Spokane Wash., Arthur H. Clark, p.o. box 14707, 1990. Pp. 193, illustrations, folding map, bibliography, index. $37.50.

Stillman will transport you to the "untrodden wilds" of west Texas. Here he is near Fort Duncan on the left bank of the Rio Grande:

> We found our trains ready to start, and standing in mud, while the teamsters, with their military great coats dripping with water, appeared reluctant to start. The rains had been so violent that the contents of the wagons were all wet, the covers having proved insufficient to protect them, and the men, who for two nights had slept in or under the wagons, seemed thoroughly watersoaked, and the wagon-master of my train was so completely soaked with something stronger, that he was lying on the ground in a state of insensibility. The captain ordered him to be taken out of the mud and placed on one of his wagons. [p. 116]

Jacob Davis Babcock Stillman was born in Schenectady, New York, 21 Feb. 1819, the son of Joseph and Eliza Ward (Maxson) Stillman. He graduated from Union College where he was a classmate of Charles Christopher Parry who later was warmly mentioned as "my old college friend, Charley Parry, botanist [of the Mexican Boundary Survey], Charley is now [1877] on the Gila River." Stillman took his M.D. degree at the College of Physicians and Surgeons in New York City. After serving at Bellevue Hospital he joined the argonauts and sailed around the Horn, his passage on the Pacific from New York, $300. His narrative, *Seeking the Golden Fleece* (1877), is highly readable. After 194 days he sailed into San Francisco harbor 5 August 1949. He moved to Sacramento in January, 1850, and associat ed with Dr. John F. Morse, opened the first hospital.

On 9 January the Sacramento River flooded, and as Ron Tyler narrates in the introduction to *Wanderings*, they "worked for two full days and nights treating patients and fearing all the while that the building would collapse under the pounding of the wind and waves." Henry Harris, M.D., tells us in *California Medical Story* that "Dr. Stillman, in November, 1849, lived in a home made from boards of dry-goods boxes." Office and sleeping quarters, 6 feet wide by 12 feet long, were divided by a curtain. Stillman confided that "the risk is too great for the reward. I can think of but few men whom I would advise come to California." After bouts of fever and jaundice complicated by homesickness, Stillman returned to New York City, but not before he had made plant collections for John Torrey whom he may have met in New York through Dr. Parry. Stillman had ranged as far afield as Marysville and Long Bar. His collection of the annual *Leptosyne stillmanii*

Gray is the type of what is now placed in *Coreopsis*. It was taken "in the valley of the Upper Scramento."

Henry M. Bolander wrote in *Proc. Calif. Acad. Sci.* ser. 1 4 (1872): 170:

> Dr. J. D. Stillman was a pioneer botanist of California, who, when the most of the first settlers were bent only on collecting the auriferous treasures of the placers, performed a journey through the northern part of the State for the purpose of making a collection of California plants, which he forwarded to Dr. Torrey. A number of new species were contributed by him, and the collection was of great service to the veteran botanist in making up his reports on the flora of this coast, as appears by the frequent references by him to the collection, in the Pacific Railroad and Mexican Boundary surveys. . . . No subsequent explorer has succeeded in finding [*Stipa stillmanii* Bolander] . . . this most excellent and showy species.

Ron Tyler, Director of the Texas State Historical Association, author of several books on the West, has provided full footnotes and invitations to further browsing. A collector's edition, bound in leather, is offered.

While Leland Stanford practiced law in San Francisco, Dr. Stillman was his physician. When Stanford, now president and director of the Central Pacific Railroad, and was planning the founding of Leland Stanford University, he asked that Dr. Stillman's son, John Maxson Stillman, be selected for the chair of chemistry at the University. After Dr. Stillman's marriage and their tour of Europe, he "heard the beat of the off-shore wind,/ and the thresh of the deep-sea rain" as had Kipling in his *The Long Trail*, "You have heard the song — how long? how long?/ Pull out on the trail again!"

Dr. Stillman was 36 when he arrived in Port Lavaca in May 1855. to study Texas' "resources and natural history." Tyler says "the young doctor was a full-fledged member of a generation that had fallen completely in love with America's natural beauty." There may have been other suasions besides the writings of Frederick Law Olmstead who had reported on his recent five-month sojourn in Texas. For example, the explorers' fever from Pacific Railroad Surveys that had begun in 1853, staffed with naturalists who had encountered new fauna and flora: Capt. R. B. Marcy, U.S. Army, moving "through unexplored Texas" in the fall of 1854. We wonder if during his New Orleans stopover on his way to Texas he met members of the recently organized New Orleans Academy of Science, particularly Dr. John Leonard Riddell of the Medical College of Louisiana, who had made two excursions to Texas reaching Comanche country in 1840. A key complement to Dr. Stillman's Texas journey may well have been his younger brother, William James Stillman (1828-1901). Also a graduate of

Union College, William Stillman later studied landscape painting under the naturalist-painter Frederic Edwin Church, had lived in England for two years, then in 1855 founded a monthly art magazine, *The Crayon*. In the first volume of *The Crayon*, the issue of 27 June 1855, there appeared Jacob Stillman's "Wanderings in the Southwest."

An example:

> I rode up to a cabin where a young man was skinning a deer, and proceeded without ceremony or invitation to unsaddle. A piece of that venison I meant to have. He referred me to the old man in the house, who, when I told him I had not breakfasted, asked me whether I would have breakfast or dinner' I told him I did not care by what name he called it, if there was only some venison in it. He was a middle-aged man, from Arkansas, and employed his time while talking to me, in striking at the chickens, dogs, and black children, who came unbidden into his presence. Just as dinner was announced, Mr. Tyson, a German settler on the Upper Guadaloupe, rode up and joined us. There were about five flaxen-haired children, and one sleeping in the cradle, five dogs, and three wooly heads, besides one of doubtful complexion. The charge of twenty-five cents for our meal we considered very moderate. [pp. 58 – 59]

Stillman's natural history interests included entomology:

> a little rain had fallen, which served to draw out these most interesting of all the numerous insects that swarm in hot climates. They were of several species of Eleteridae, and were so brilliant, that if they would but have kept over the road, I could not desire a better light. A single one would render everything visible for about a rod about, but leave it darker than before. . . .Scarabeus [sic] beetles are very numerous, rolling little balls of their favorite composite, in the road. One species is extremely beautiful, with colors of green and gold. [p. 52]

Ornithology: of Chuck-will's-widow he wrote:

> Its sweet note is heard all night long in the thickets along every water-course, where it is concealed by day so as to be rarely seen. He who had once heard its song, while he lies wrapped in his blanket under the silent moon, and starts plowing the clouds, will feel its witchery awakening memories that would have slumbered, and leaving an impression that he will retain when the fatigues of travel, the hard ground on which he slept, and the harder bread and bacon on which he fed, shall be forgotten. [p. 96]

Stillman knew S. F. Baird's report "Birds of the [Mexican] Boundary, and mentioned "Texas quail (*Ortyx texana*)":

> We camped the second night on the San Filippe, a clear but cheerless stream. My tent is pitched facing the fire, by a detachment of the dragoons assisted by the infantry. a cot, a trunk, and a camp table are placed in it. I had obtained from the commissary such stores as were necessary for the road, coffee, sugar, bacon, and hard bread, which last furnished me an excellent field for entomological resear-

> ches. [p. 123] . . . . Occasionally the valley spreads out into charming fields, with groves of post oak. This hilly region abounds everywhere with the white bundles of the flowers of the *Yucca fillamentosa*. [p. 59]

Susan Delano McKelvey would have been pleased with Stillman's prose:

> In the lower country, [Yucca] has a trunk resembling the palm tree, but wherever found on the table lands, its leaves start from the root, are from a yard to a yard and a half long, concave above, convex below, with sharp smooth edges, terminating in a hardened point; they are so rigid as to resist a blow from a club, and standing out in every direction, like radii from a centre. [p. 123]

Now and then Stillman's thoughts ran deep:

> Shouts of distress were heard in the rear, when presently Antonio's mule came swimming past without his rider. I endeavored to arrest him but he seemed to think it every mule's, as well as every man's duty to look out for himself in emergencies like the present. [p. 109]
>
> A small heap of stones told where a young girl was left in a nameless grave. The teamster knows the spot and the wolf howls her requiem. My tent could not be pitched for the want of sufficient soil to receive the stakes, and I slept in the ambulance, but there was a mule tied to each wheel, and as it was a long time since I slept in a cradle, I found my situation about as comfortable as might be supposed. [p. 128]

Stillman was certainly impressed with the Germans he met: "I have been in company with a room full of Germans, and there was not one of them who could not expound our Constitution and history better than I could [63]." New Brunfels enters his story again and again. We could wish he had named some of the Germans, for example, who was the world-renowned naturalist"? Was it Duke Paul Wilhelm of Wurttemberg (1797-1860) who visited the German settlements in Texas during April and May, 1855, on his third journey to America? Stillman runs through the tavern roster:

> I have seen a world-renowned naturalist, an honorary member of European societies; a jurist from the highest judicial tribunal in his native land; a professor in her university; a priest from her altars; a secretary of the interior in the republic; the son of the prime minister of the crown; some as poor as the poorest, and others in possession of great wealth, all seated at one table with the peasant, and from their demeanor you could not tell the peasant from the prince—all melted and bowed before the majesty of song." [p. 75]

Narratives like Stillman's are uncommon flowerings in the rich but scattered writings of naturalists. Another physician who knew the West and wrote with word-sensitive feeling was John Kirk Townsend who accompanied the Wyeth expedition. With his companions "Mr. N[uttall]" and "Captain T[hing]" he was in the Oregon Country twenty years before Stillman was crossing Texas. Townsend left us this paragraph:

> Having nothing prepared for dinner today, I strolled along the stream above the camp, and made a meal on rose buds, of which I collected an abundance; and on returning I was surprized to find Mr. N. and Captain T. picking the last bones of a bird they had cooked. Upon Inquiry, I ascertained that the subject was an unfortunate owl which I had Killed in the morning, and had intended to preserve, as a specimen. The temptation was too great to be resisted by the hungry Captain and naturalist, and the bird of wisdom lost the immortality which he might otherwise have acquired.

Dr. Townsend's well-prepared bird skins survive in our museums, but, though we read allusions to Stillman's trying to collect an unfamiliar bird for science, we find no record that he did so. More likely Stillman's name may be imbedded in old letters of New Brunfels naturalists. Professor S. W. Geiser, author of *Naturalists on the Frontier*, who relished such narratives as Stillman's, never chanced on the installments in *The Crayon*.

We leave Dr. Stillman here on the way to Fort Inge on the east bank of the Leona River:

> Air bubbled up from the ground with a noise of rushing water. The horses were snorting with impatience and terror, floundering in the mud and water, and seemed to have a better conception of the danger which surrounded their masters. The Judge still slept, though the water was lifting each corner of his mattress. Sechio slept in the wagon, Antonio leaned drowsily against a tree, having not been fully awake. The time had come for some decided action. "We must get to higher ground," said I to Sandy, "or we shall all drown." [p. 108]

A NOTE ON SOURCES

In 1946 I corresponded with Dr. Stillman's daughter, Amy S. Mulligan, of Twin Pines, Belmont, California, and she kindly obliged with answers to my questions in two letters, 23 Dec. 1946, and 6 Feb. 1947. When Prof. E. B. Babcock invited me to review San Francisco naturalists for *A Century of Progress in the Natural Sciences 1853-1953* (Calif. Acad. Sci. 1955), I recommended J. D. B. Stillman's *Seeking the Golden Fleece* (A. Roman, San Francisco, 1877). My copy had been a "discard" from the Lowell City Library. Stillman's story "Old Fuller" in *Overland Monthly* 14 June, 1875) 557 – 559 also will delight. In an unsigned editorial on "The Flora of California" in *Calif. Medical Gazette* 2 (March, 1870) 152 – 153, he comments on the role of H. N. Bolander in the State Geological Survey, then in progress. W. H. Brewer barely mentioned Stillman in his list of collectors appended to volume two of *Botany of California* (1880), Stillman having left California before the active years of the Academy.

David Starr Jordan's *Days of a Man* (New York, 1922) mentions Jacob and his son, John Maxson Stillman. Michael L. Smith, *Pacific Visions* (Yale, 1987) supplements John's story. Henry Harris, M. D., *California's Medical Story* (San Francisco, 1932) provides documented quotations, p. 400 et passim. For the artist-journalist brother, William James Stillman, see DAB, and E. P. Richardson, *Painting in America* (Crowell, N. Y., 1956) who deftly noted that William's real medium was words. William Stillman's *Autobiography of a Journalist* 2 vols. (Boston, Houghton Mifflin, 1901), a light-hearted revelation of his travels and friendships, tells in Chapter XI of his launching *The Crayon* but does not mention his brother's Texas "Wanderings." Amy Stillman Mulligan, in her letter of 23 Dec. 1946, answering my query regarding any Stillman portraits, wrote that "a portrait by [Domenico] Tojetti is now owned by his grandaughter Miss Minnie Stillman at Stanford University, Palo Alto, Calif. I dont know of any other." Dr. John Howell Thomas has kindly searched for the present fate of this portrait without success. That the doyen of Texas biohistorians, Samuel Wood Geiser, evidently did not discover J. D. B. Stillman is testimony of what lodes exist beyond the diggings of the argonauts. — *Joseph Ewan, Missouri Botanical Garden, St. Louis, MO 63166-0299, U.S.A..*

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UNA NUEVA ESPECIE DE *CALOCHORTUS* (LILIACEAE-TULIPEAE) DEL SUR DE MEXICO

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ABSTRACT

Calochortus balsensis, a new species from the Sierra Madre del Sur in Guerrero and Oaxaca, México, is described and illustrated. Its relationships are discussed.

RESUMEN

Se describe e ilustra una nueva especie, ***Calochortus balsensis***, proveniente de la Sierra Madre del Sur en los estados de Guerrero y Oaxaca, México. Se discuten sus relaciones con otras especies.

Calochortus Pursh es un género americano que comprende cerca de 60 especies concentradas principalmente en California, con su límite sur de distribución en Guatemala (Ownbey 1940). En México crecen 18 especies, la mayoría de ellas incluidas en la sección *Cyclobothra* (Ownbey 1940) o subgénero *Cyclobothra* (Painter 1911). El género ha sido revisado recientemente en México para la Flora de Nueva Galicia (McVaugh 1989), Flora Fanerogámica del Valle de México (Galván 1991) y Flora Mesoamericana (Mullin & Vickery, en prensa). Colectas recientes en el sur del país permitieron el descubrimiento de una nueva especie, que se describe a continuación.

Calochortus balsensis García-Mendoza, sp. nov. (Fig. 1)

Calochortus balsensis García-Mendoza, sp. nov. Ab aliis speciebus subsectionis *Barbati* floribus globosis magnis sepalisque glabris sine macula glandulosa distinguenda; *Calochorto barbato* (HBK) Painter proximo, a quo praeterea petalis ad apicem truncatis, infra glandulam non pilosis et pilis eandem cingentibus basaliter connatis differt.

Hierba de 50 – 70 (-100) cm de altura. Bulbo ovoide de 1.5 – 2.5 cm de diámetro, cubierto por vainas fibroso-reticuladas. Tallo erecto, glauco o rojizo, glabro, simple o con 1 – 2 ramificaciones de hasta 8 cm de largo. Hoja basal linear, de 30 – 45 (-55) cm de largo por (3-) 4 – 7 (-9) mm de ancho, más corta que el tallo; (5-) 6 – 8 hojas caulinares glaucescentes, amplexicaules, la inferior linear, de 15 – 25 (-30) cm de largo por (2-) 3 – 6 mm de ancho, por lo general no bulbífera, las superiores largamente triangulares, de 7 − 15 (-20) cm de largo por 0.5 − 1 (-1.5) cm de ancho. Bulbilos pedicelados, presentes sobre una estructura laminar poco conspicua en las axilas de las hojas y brácteas de la inflorescencia, parduscos, ovoides, fusiformes o asimétricos, de 2.5 − 5 mm de alto por 2 − 3 mm de diámetro, venación reticulada, prominente; brácteas de la inflorescencia 2, una más corta que la otra, erectas, de 6 − 12 cm de largo por 0.5 − 1 (-1.5) cm de ancho. Inflorescencia cimosa, con 1 − 2 flores; pedicelos de 5 − 16 cm de largo, con una bractéola basal. Flores péndulas, amarillas, glaucas, globosas o subglobosas; sépalos lanceolados, de 2.5 − 3.3 (-4) cm de largo por (0.5-) 1 − 1.7 cm de ancho, con venación prominente, glabros, en ocasiones pardo-oscuros o rojizos en la cara externa; pétalos obovados a espatulados, de (3-) 3.5 − 4.5 cm de largo por (1.7-) 2 − 3 cm de ancho, con la cara interna pilosa, excepto en el ápice y por debajo de la glándula, ápice truncado, pelos rojizos o negruzcos, de 1.5 − 2.5 (-4.5) mm de largo; margen ciliado, excepto en la parte superior e inferior; glándula presente en el tercio inferior del pétalo, deltada, de 3 − 4.5 (-5.5) mm de alto por 2 − 3 (-3.5) mm de ancho, ligeramente hundida, rodeada por los lados y la parte superior por pelos blanco-amarillentos que se fusionan basalmente formando una membrana corta; estambres amarillentos, de 1.6 − 2.2 cm de largo, del mismo tamaño o más cortos que el ovario, ligeramente adnados al perianto; anteras oblongas, de (4.5-) 6 − 8 mm de largo por 1.5 − 2 mm de ancho; ovario linear-oblongo, glauco, de 1.7 − 2 (-3) cm de largo por 2 − 3 mm de ancho; estigma trífido, de 2 − 3 mm de largo. Cápsula angostamente elíptica, de 5 − 6 cm de largo por 1 − 2 cm de ancho, erecta, triangular en sección transversal, glauca cuando joven, pardo-claro cuando madura. Semillas comprimidas, discoides, de 3.5 − 4 mm de largo por 1.5 − 2 mm de ancho, pardas, con la superficie finamente rugosa.

TIPO: MEXICO. OAXACA: Distrito de Juxtlahuaca, cañada Tziqui cuaza, 7 km al SO de San Juan Mixtepec, bosque de *Quercus-Pinus*, 2200 m, 21 Oct 1990, *A. García-Mendoza & J. Reyes 5090* (HOLOTIPO: MEXU; ISOTIPOS: ENCB, FCME, K, MO, TEX).

Especímenes adicionales examinados: MEXICO. **Guerrero**: Acocontzio, Sobaquitos, Jun 1964, González 87 (MEXU); Mpio. Alcozauca, La Loma, 100 m al E de la pirámide, Amalpica, 6 Nov 1983, Rodríguez & Martínez 72 (UAMIZ); Amalpica, 5 Nov 1983, Toledo 97 (UAMIZ); Mpio. Chilpancingo, al E de Omiltemi, camino a Palo Hueco, 8 Oct 1985, Antonio 392 (FCME); Gruta del Borrego, 3 km adelante de Xocomanatlán, 14 Oct 1984, Castelo et al. 355 (FCME); 11 km al O de Mazatlán, por el camino a El Alquitrán, 4 Oct 1989, Fonseca 1684 (FCME, MEXU); Mpio. Mochitlán, camino a Tepexiutla, a partir del poblado La Cumbre, 13 Oct 1988, Flores 617 (MEXU); Mpio. Tixtla, Omeaca, 5 km al E de Tixtla, 26 Oct 1984, Soto 6727 (MEXU); Mpio. Zitlala, 7 km al N de Sta. Cruz, por el camino a San Juan Las Joyas, 29 Sep 1987, Contreras 2102 (FCME). **Oaxaca**: Dto. Juxtlahuaca, Yucu shinu (Cerro de Paxtle), 2 km al S de San Juan Mixtepec, 21 Oct 1990, García-Mendoza & Reyes 5025 (ENCB, FCME, K, MEXU, MO); Río San Lucas, 2 km al

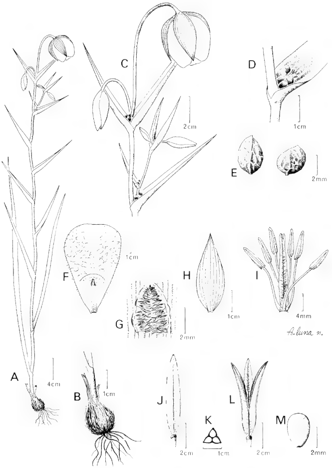

FIG. 1. *Calochortus balsensis*. A) hábito; B) bulbo; C) inflorescencia; D) axila de la hoja mostrando los bulbilos; E) bulbilos; F) pétalo; G) glándula; H) sépalo; I) androceo y gineceo; J) fruto maduro; K) corte transversal del fruto; L) cápsula abierta; M) semilla. Ilustración basada en los especímenes *García-Mendoza & Reyes 5000, 5090 y Reyes 2020.*

SO de San Juan Mixtepec, 2 Oct 1988, Reyes 661 (MEXU); Laderas del río Mixtepec, 9 km al NO de San Juan Mixtepec, 3 Oct 1988, Reyes 713 (MEXU, MO, TEX); 6 km al NO de San Juan Mixtepec, 8 Ene 1989, Reyes 1447 (MEXU); Yu nii (cañada antigua), 6 km al SE de San Juan Mixtepec, 7 Sep 1989, Reyes 2020 (MEXU); 6 km al NO de San Juan Mixtepec, 9 Sep 1989, Reyes 2073 (MEXU); Dto. Tlaxiaco, 7 km al NO de Tlaxiaco, 20 Oct 1990, García-Mendoza & Reyes 5000 (MEXU, TEX).

Por la cubierta fibroso-reticulada de sus bulbos, bulbilos no solitarios en las axilas de las hojas, flores péndulas, pétalos obovados a espatulados y barbados, *Calochortus balsensis* pertenece a *Calochortus* sección *Cyclobothra* subsección *Barbati* tal como ha sido delimitado por Ownbey (1940). De las 5 especies incluidas en la subsección, *C. balsensis* se distingue por sus grandes flores globosas o subglobosas y sépalos glabros sin mancha glandular. De *C. barbatus* (HBK) Painter (la especie más cercana) se distingue además, por el tamaño mayor de la planta, pétalos con ápice truncado, no pilosos por abajo de la glándula y por los pelos basalmente connados que rodean a la misma.

Calochortus balsensis crece en la Sierra Madre del Sur en los estados de Guerrero y Oaxaca. Habita preferentemente en laderas con bosques de *Quercus-Pinus* y sus ecotonos con las selvas bajas caducifolias, en altitudes que oscilan entre 1500 y 2200 m; los suelos son someros, ricos en materia orgánica y derivados de rocas ígneas. La especie florece al final de la época de lluvias, durante septiembre y octubre, con maduración de los frutos en enero. Las plantas son por lo general solitarias y escasas, creciendo en pequeños grupos dispersos por el bosque. "Ita sobilu" (flor oreja de gato) es el nombre mixteco que reciben en el distrito de Juxtlahuaca, Oaxaca.

El epíteto específico se refiere a su distribución, ya que habita en las cuencas de los ríos Mixteco (Oaxaca) y Mezcala (Guerrero) afluentes del Balsas.

AGRADECIMIENTOS

Agradezco la revisión crítica del manuscrito a Fernando Chiang, Patricia Dávila (MEXU), Raquel Galván (ENCB), Adolfo Espejo, Ana Rosa López (UAMIZ) y R. McVaugh (NCU), así como a Jerónimo Reyes por sus colectas, asistencia en el trabajo de campo y proporcionar los nombres en mixteco. La ilustración es aportación de Albino Luna (Instituto de Biología, UNAM) y la diagnosis en latín fué hecha por Fernando Chiang.

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LEMMA MICROMORPHOLOGY IN THE ERAGROSTIDEAE (POACEAE)

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ABSTRACT

Scanning electron microscopy was used to examine the lemma micromorphology of 30 genera and 57 species in the tribe Eragrostideae. Results show four silica deposition patterns: 1) cork cell associated with silica cell; 2) cork cell solitary; 3) cork cell with papillae; 4) cork cell not observed. The presence or absence of epidermal papillae, prickle hairs, micro- and macro-hairs is reported. An electron beam x-ray microanalysis indicated a high silica concentration in all structures examined including the cork cells. The distribution of cork cells and silica bodies has taxonomic significance and two subtribes within the tribe are proposed.

Key word: lemma micromorphology, silica deposition patterns, taxonomic significance, Eragrostideae, Poaceae.

RESUMEN

Se examinó la micromorfologia de la lema de 30 géneros y 57 especies de la tribu Eragrostideae mediante microscopía electrónica de barrido. Los resultados muestran cuatro patrones de deposición de sílice: 1) célula suberífera asociada con célula silicífera; 2) célula suberífera solitaria; 3) célula suberífera con papila; 4) no se observó célula suberífera. Se reporta la presencia o ausencia de papilas epidérmicas, aguijones, micropelos y macropelos. El microanálisis con haz electrónico de Rayos X indicó una alta concentración de sílice en todas las estructuras examinadas, incluyendo las células suberíferas. La distribución de células suberíferas y cuerpos de sílice tiene significado taxonómico y se proponen dos dentro de la tribu.

Palabras clave: micromorfología de la lema, patrones de deposición de sílice, significado taxonómico, Eragrostideae, Poaceae.

INTRODUCTION

The Eragrostideae tribe is composed of warm season grasses with a center of distribution in Africa, with extensions to the Indian subcontinent and Australia, and a sizeable incursion into North America (Phillips 1982). In

North America this tribe is best represented in the semiarid southwestern United States and northern Mexico, where it may comprise more than 50 percent of the grass vegetation (Gould and Shaw 1983).

In the United States and Mexico the tribe is represented by approximately 26 genera and 250 species of native and introduces grasses. The largest genera are *Eragrostis*, *Muhlenbergia*, and *Sporobolus*. Whereas, there are two or three genera of medium size, and the rest of the tribe is composed of an unusually large proportion of small, often monotypic, genera.

Members of the Eragrostideae contain paniculate inflorescences that are composed of several racemose or spicate branches, occasionally reduced to a simple spike. Spikelets commonly have 1 to several florets and the reduced florets when present are usually above the perfect ones. Disarticulation is above the glumes except in *Lycurus* and a few species of *Muhlenbergia*. Lemmas are 3-nerved, except in *Sporobolus* and *Calamovilfa*, which have 1-nerved lemmas, and in *Vaseyochloa*, with several-nerved lemmas. Caryopses have a large embryo with a punctiform or ellipsoid hilum, sometimes enclosed within a free pericarp (Phillips 1982; Gould and Shaw 1983).

Renvoize (1983) surveyed the leaf blade anatomy of the tribe and concluded that its genera have adapted to pioneer or harsh habitats. In adapting to such extremes the leaf blade morphology and anatomy have become highly modified.

Micromorphological features of the floral bracts of grasses have been utilized recently as valuable characters that reflects systematic relationships and evolutionary trends. Studies of the lemma micromorphology have been reported by Bjorkman (1960), Hsu (1965), Baum (1971), Clark and Gould (1975), Thomasson (1978a, 1978b, 1980, 1981, 1984, and 1986), Shaw and Smeins (1979), Terrell et al. (1983), Webster and Hatch (1983), Thompson (1983), and Barkworth (1983). Specific studies of silica cell and silica bodies were reported by Terrell and Wergin (1981). In addition silica cells and silica bodies have been recognized as structures of taxonomic significance in the grass family by numerous investigators including Metcalfe (1960), Ellis (1979), Palmer and Tucker (1981), and in other monocotyledons (Stant 1973).

However, few investigations of the lemma micromorphology of the Eragrostideae have been made with the exception of Sanchez (1983, 1984), who examined the epidermis of glumes, lemmas and paleas of *Blephridachne* and *Munroa*, and Peterson (1989), Peterson et al. (1989) who reported on the lemma micromorphology and leaf anatomy for 32 species of annual *Muhlenbergia*. Therefore, our objective was to study epidermal features of the lemma of 30 genera, 57 species, and two varieties of this tribe using scanning electron microscopy. Our specific objective was to document lemma micromorphology and detect different distributions of any epidermal patterns restricted to specific genera. This information would enable further evaluation of the phylogeny of the tribe.

MATERIALS AND METHODS

Lemmas of 57 species representing 30 genera of the Eragrostideae tribe were examined (Table 1) from herbarium specimens (ENCB, TAES, TEX). Specimens were selected to be representative of their respective genera in the Eragrostideae. Although primarily New World genera were examined, a few Old World genera were included. Three or more specimens per species were selected from different localities. All materials were identified using the most current treatments of the tribe available (Gould 1979; Gould and Shaw 1983). Lemmas were removed from the first and second florets of mature spikelets, oriented with the apex at the right, mounted on aluminum stubs with Avery's spot-o-glue to observe the abaxial surface, and then coated with 20 nm of gold palladium in a vacuum evaporator.

TABLE 1. Collectors and localities for the specific specimens studied, analyzed, and photographed with SEM.

Blepharidachne bigelovii (S. Wats.) Hack. — U.S.A. TEXAS. Pecos Co.: *Warnock 46198* (TAES).

Blepharoneuron tricholepis (Torr.) Nash — MEXICO. DURANGO: 8 mi N of Estacion Coyotes, *Breedlove 18855* (TAES).

Calamovilfa gigantea (Nutt.) Scribn. & Merr. — U.S.A. TEXAS. Hutchinson Co.: 8 mi S of Burger, *Gould 14345* (TAES).

Chaboissaea ligulata Fourn. — MEXICO. JALISCO: Ojuelos, *McVaugh 17058* (TAES).

Crypsis niliaca Fig. & DeNot. — U.S.A. CALIFORNIA. Merced Co.: *Crampton 3573* (TAES).

Crypsis schoenoides (L.) Lam. — U.S.A. CALIFORNIA. Sonoma Co.: *Rubtzoff* (TAES).

Dactyloctenium aegyptium (L.) Beauv. — U.S.A. TEXAS. San Patricio Co.: *Schneider 6329* (TAES).

Dasyochloa pulchella (H.B.K.) Willd. *ex* Rydb. — MEXICO. COAHUILA: Saltillo, *Valdes R. 1570. Hatch et al. 5055a* (TAES). — U.S.A. TEXAS. Presidio Co.: *Valdes-R. 1691*(TAES).

Eleusine indica (L.) Gaertn. — MEXICO. CHIAPAS: Tenejape, *Breedlove 14882* (TAES).

Eragrostis ciliaris (L.) R. Br. — U.S.A. FLORIDA: Canal Point, *Silveus 4065* (TAES).

Eragrostis curtipedicellata Buckl. — U.S.A. TEXAS. Archer Co.: *Gould 9776* (TAES).

Eragrostis erosa Scribn. — MEXICO. CHIHUAHUA: Guachochic, *Bye 6934* (TAES).

Eragrostis mexicana (Hornem.) Link — MEXICO. NUEVO LEON: Galeana, *Hatch et al. 4588* (TAES).

Eragrostis superba Peyr. — U.S.A. NEW MEXICO. Dona Ana Co.: *Yelwa 38* (TAES).

Erioneuron avenaceum (H.B.K.) Tateoka — MEXICO. COAHUILA: General Cepeda, *Valdes-R. 1561* (TAES). HIDALGO: 11 mi N Ixmiquilpan, *Gould 9564* (TAES). MEXICO: 1 km N San Juan Teotihuacan, *Rzedowski 17124* (TAES). NUEVO LEON: Galeana, *Hatch et al. 4998* (TAES). SAN LUIS POTOSI: Guadalcazar, *Valdes-R. 1612* (TAES); *Valdes-R. 1635, 1650* (TAES). ZACATECAS: El Tecomote, *Reeder 6292* (ENCB).

E. avenaceum var. *longiglumis* Parodi — ARGENTINA. JUJUY: Tilcara, *Correll et al. A676* (TEX).

E. grandiflorum (Vasey) Tataoka — MEXICO. MEXICO: Puebla, 9 km NW of San Lorenzo, *Davidse 9315* (TAES).

E. nealleyi (Vasey) Tateoka — MEXICO. COAHUILA: Acuna, *Valdes-R. 1246* (TAES), Saltillo, *Valdes-R. 1531, 1559* (TAES), *Hatch et al. 5050* (TAES). DURANGO: Poanas, *Gonzalez 2792* (TAES). NUEVO LEON: Galeana, *Hatch et al. 5002* (TAES), *Tateoka s.n.* (TAES). — U.S.A. TEXAS. Presidio, *Valdes-R. 1689* (TAES).

TABLE 1 continued

E. pilosum (Buckl.) Nash — MEXICO. COAHUILA: Est. Carneros, Saltillo, *Valdes-R. 1502* (TAES). — U.S.A. TEXAS. Travis Co.: Austin, *Valdes-R. 1653* (TAES).
Gouinia virgata (Presl.) Scribn. — MEXICO. SINALOA: 5 mi N of Mazatlan, *Gould 12233* (TAES).
Gymnopogon foliosus (Willd.) Nees — BRAZIL. BAHIA: Galheirao, *Davidse 12145* (TAES).
Leptocarydion vulpiastrum (De Not.) Stapf — KEYNA. Kiboko Res. Sta., *Hatch 4236* (TAES).
Leptochloa dubia (H.B.K.) Nees — MEXICO. COAHUILA: Buenavista, *Gould 6387* (TAES).
Leptochloa uninervia (Presl.) Hitchc. & Chase. — U.S.A. TEXAS. Hidalgo Co.: *Lonard 2731* (TAES).
Lycurus phleoides H.B.K. — MEXICO. COAHUILA: Sierra de Zapaliname, Saltillo, *Hatch et al. 4499* (TAES).
Muhlenbergia emersleyi Vasey — MEXICO. CHIHUAHUA: Chihuahua, *Valdes-R. 144* (TAES).
Muhlenbergia fastigiata (Presl.) Henrard — BOLIVIA. PUNO: Camjata Hacienda, *Tutin 975* (NY).
Muhlenbergia minutissima (Steud.) Swallen — MEXICO. BAJA CALIFORNIA: Sierra San Pedro Martir, *Moran 24653* (TAES).
Muhlenbergia plumbea Scribn. *in* Beal — MEXICO. Tlaxcala; El Carmen, *Sohns 622* (TAES).
Muhlenbergia pungens Thurb. — U.S.A. NEW MEXICO. McKinley Co.: *Morden et al. 860* (TAES).
Munroa squarrosa (Nutt.) Torr. — MEXICO. CHIHUAHUA: 4.1 mi N of Samalayuca, *Hendrickson 7490* (TEX). — U.S.A. TEXAS. Andrews Co.: *Powell 5882* (TAES).
Neeragrostis reptans (Michx.) Nicora — MEXICO. COAHUILA: Sabinas, *Gould 11241* (TAES).
Pereilema ciliatum Fourn. — MEXICO. CHIAPAS: 15 mi S of Ocozocoautla, *Brunken & Perino 314* (TAES).
Pereilema crinitum Presl — MEXICO. CHIAPAS: 36 km E of Tuxtla Gutierrez, *Gould & Hatch 14374* (TAES).
Redfieldia flexuosa (Thurb.) — Vasey U.S.A. NEBRASKA. Minden, *Hapeman* (TAES).
Scleropogon brevifolius Phil. — MEXICO. PUEBLA: 41 km SW of Perote, Ver. *Koch 77211* (TAES).
Sohnsia filifolia (Fourn.) Airy Shaw — MEXICO. SAN LUIS POTOSI: Guadalcazar, *Sohns 1341* (TAES).
Sporobolus airoides (Torr.) Torr. — MEXICO. COAHUILA: 3 mi N of Parras, *Gould 11550* (TAES).
S. asper (Michx.) Kunth var. *asper* — U.S.A. TEXAS. Jack Co.: *Gould 10286* (TAES).
S. clandestinus (Biehler) Hitchc. var. *canovirens* (Nash) Shinners — U.S.A. TEXAS. Robertson Co.: *Gould 11047* (TAES).
S. cryptandrus (Torr.) Gray — MEXICO. COAHUILA: Piedras Negras, *Gould 11283* (TAES).
S. indicus (L.) R. Br. — MEXICO. JALISCO: 2 mi W of Ayo el Chico, *McVaugh 17206* (TAES).
S. giganteus Nash — U.S.A. TEXAS. Bailey Co.: 2 mi E of Muleshoe, *Gould 7747* (TAES).
S. neglectus Nash — U.S.A. MISSOURI. Barron Co.: *Riggins 723* (TAES).
S. ozarkanus — Fern. U.S.A. MISSOURI. Jefferson Co.: *Riggins 444* (TAES).
S. pyramidatus (Lam.) Hitchc. — MEXICO. MEXICO: Ecatepec, *Rzedowski 20235* (TAES).
Trichoneura elegans Swallen — U.S.A. TEXAS. Cameron Co.: *Lonard 3183* (TAES).
Tridens albescens (Vasey) Woot. & Standl. — MEXICO. NUEVO LEON: Montemorelos, *Gould 12860* (TAES).
T. congestus (L.H. Dewey) Nash — U.S.A. TEXAS. San Patricio Co.: Sinton, *Hatch 4125*, (TAES).
T. muticus (Torr.) Nash — MEXICO. CHIHUAHUA: Ojinaga, *Valdes-R. 719* (TAES).
T. muticus var. *elongatus* (Buckl.) Shinners — U.S.A. TEXAS. Young Co.: *Gould s.n.* (TAES).
T. strictus (Nutt.) Nash — U.S.A. TEXAS. Kenedy Co.: *Johnson 1357* (TAES).
T. texanus (S. Wats.) Nash — MEXICO. NUEVO LEON: Monterrey, *Valdes-R. 1497* (TAES).
Triraphis stipoides (H.B.K.) Hitchc. — MEXICO. MEXICO: Juchitepec, *Rzedowski 32623* (TAES).
Triodia irritans R. Br. var. *laxispicata* N.T. Burbidge — AUSTRALIA. BALRANALD N.S.W.: *Henderson 333* (TAES).
T. mitchelli Benth. — AUSTRALIA. QUEENSLAND: *Scarth-Johnson 15* (TAES).
T. pungens R. Br. — AUSTRALIA. QUEENSLAND: *Hubbard 7358* (TAES).
Triplasis purpurea (Walt.) Chapm. — U.S.A. TEXAS. 2.5 mi NE of Kenedy Co.: *J. C. Johnson 1357* (TAES).
Tripogon spicatus (Nees) Ekman — MEXICO. VERACRUZ: XALAPA, *Beetle M2218* (TAES).
Vaseyochloa multinervosa (Vasey) Hitchc. — U.S.A. TEXAS. Brooks Co.: *Johnston 54508* (TAES).

Samples were examined at $5-15$ kV with $0°$ tilt on a JEOL JSM-25 SII scanning electron microscope. Lemmas of selected genera were examined with electron beam x-ray microanalysis on the JEOL JSM-35 scanning electron microscope to determine the elemental content of specific structures.

To examine the effects of herbarium preservation techniques on specimens, lemmas from living plants (*Tridens*) were fixed in 2.5% glutaraldehyde buffered in 0.1M sodium cacodylate for one hour; washed three times in 0.1M sodium cacodylate buffer for 10 min.; post fixed in 1% osmium tetroxide for one hour; washed three times for 10 min. each time with 0.1M sodium cacodylate buffer; dehydrated in a graded series of ethanol; dried in a DCP-1 critical point drying apparatus; and coated with TV tube koat and 20 nm of gold palladium. Lemmas of several genera were cleaned in xylene in an ultrasonic cleaner for one hour to remove epicuticular wax.

RESULTS AND DISCUSSION

The micromorphological surface features of the lemma of the Eragrostideae exhibit typical "chloridoid" characteristics (Prat et Vignal 1968), such as papillae, microhairs, macrohairs, abundant prickle hairs, and silica cells. This corresponds with the conclusion reported by Renvoize (1983) in the anatomical survey of the leaf blade of this tribe. Unique silica deposition was observed in cork cells (Figs. $1-2$). An electron beam x-ray microanalysis of this structure indicated a high concentration of silica. The analysis of the cork cell for *Erioneuron avenaceum* (Fig. 3) shows that a high silica concentration is associated with some artifacts of sample preparation (gold & palladium), and electrons emitted from the surrounding environment within the microscope (copper).

For comparative purposes, since all the samples were obtained from dried herbarium specimens, fresh lemma material from *Tridens strictus* was analyzed (Fig. 4). The osmium concentration was remarkably high due to the osmium tetroxide used in specimen fixation. The analyses of the prickle hairs and the silica cell (Figs. $5-6$) from the same *Erioneuron avenaceum* specimen used for the cork cell analysis, shows a high silica concentration.

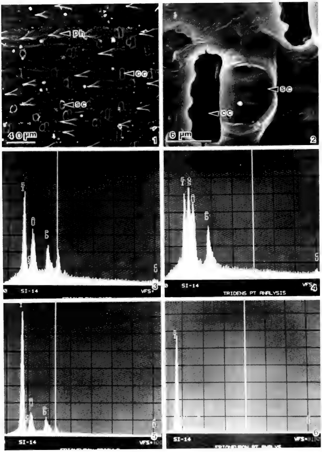
The presence or absence of the cork cell, silica cell, papillae, prickle hairs, microhairs, and macrohairs indicate four distinctive patterns within the tribe. The four patterns are discussed with representative examples.

I. **Cork cell associated with silica cell**. In Figure 7 the cork cell is evident with the associated round silica cell in *Triodia irritans* var. *laxispicata*. In *Triodia pungens* and *Neeragrostis reptans*, relatively short dumbbell-shaped silica cells and the associated cork cell are shown (Figs. $8-9$). Kidney-shaped silica cells and associated cork cell are evident in *Eragrostis* *erosa* and *E. mexicana* (Figs. 10 – 11). The cork cell, dumbbell-shaped silica cell, and prickle hairs of *E. ciliaris* (Fig. 12) exhibit a similar pattern reported by Baum (1971) in lemmas of *Avena*, and Terrell and Wergin (1981) in *Zizania*.

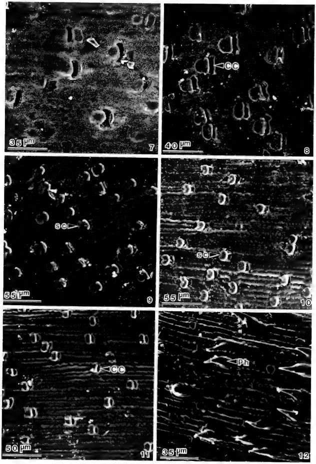
II. **Cork cells solitary**. This pattern characterized a number of the genera observed. In five species of *Tridens* the shape of the cork cell varies from crescent or kidney- to flattened dumbbell-shaped (Figs. 13 – 17). *Triplasis* (Fig. 18), *Sohnsia* (Fig. 19), *Eleusine* (Fig. 20), and *Dactyloctenium* (Fig. 21) have silica cells in rows that are not associated with the cork cells.

III. **Cork cells papillate**. In these taxa the cork cell is associated with small rounded papillae, similar to the ones illustrated by Clark and Gould (1975), Thomasson (1978b), and Terrell and Wergin (1981). This pattern is seen in *Leptochloa* (Fig. 22), *Tripogon* (Fig. 23), *Leptocarydion* (Fig. 24), *Gymnopogon* (Fig. 25), *Trichoneura* (Fig. 26), *Vaseyochloa* (Fig. 27), and *Scleropogon* (Fig. 28). When a silica cell was observed it was associated with the cork cell and papillae. In *Gouinia* a cork cell and papillae are shown but prickle hairs are not abundant (Fig. 29). *Erioneuron* seems to be intermediate between pattern I and II, since the cork cell may or may not be associated with the silica cell (Figs. 31 – 34). The shape of the cork cell was characteristically elongated vertically in *Erioneuron*, with an outline varying between oblong to crenate or scalloped. An abundance of prickle hairs occurs along the epidermal lemmatae.

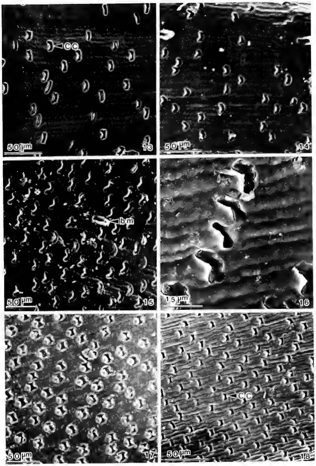
IV. **Cork cells not observed**. This patterms was found in *Munroa* (Figs. 35 – 36). The microhairs observed were hemispheric and similar to those reported by Sanchez (1984). Similar microhairs were also present in the genus *Erioneuron*. Papillae were also evident and abundant. *Blepharidachne* and *Redfieldia* have abundant prickle hairs throughout the epidermis (Figs. 37 – 38). Abundant prickle hairs have been reported for *Blepharidachne* by Sanchez (1983). In *Pereilema* the prickle hairs are associated with papillae over long cells (Figs. 39 – 40). However, a clear distinction could be made based on the long cell's shape. *Pereilema ciliatum* has characteristic raised cell walls forming a ridge around the long cells. In *Triniochloa* papillae, prickles and pitted long cells are shown (Fig. 41). Macrohairs and an abundance of small hooks are seen in *Sporobolus ozarkanus* (Fig. 42). *Blepharoneuron tricholepis* and *Muhlenbergia emersleyi* have bicellular microhairs, prickle hairs, papillae, and deeply undulating long-cells margins (Figs. 43 – 44). This characteristic shape of long cells is also observed in *Chaboissaea* (Fig. 45), *Lycurus phleoides* (Fig. 46), *Muhlenbergia minutissima* (Fig. 47), and *M. fastigiata* (Fig. 48). Dumbbell-shaped silica cells with a relatively wide central portion are seen in *M. plumbea* (Fig. 49), *Sporobolus pyramidatus* (Fig. 50), *S. airoides* (Fig. 51), *S. asper* (Fig. 52), *S. cryptandrus* (Fig. 53), and *Crypsis* (Fig. 54).



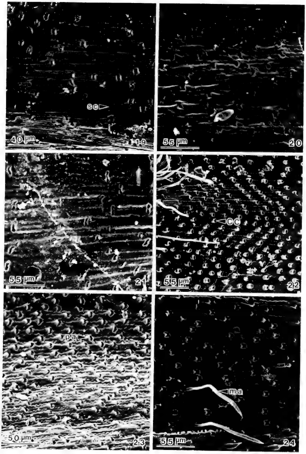
FIGS. 1 – 6. Lemma micromorphology and graphs of electron beam x-ray microanalysis of *Erioneuron* and *Tridens*. Note that a high silica concentration was found for all structures analyzed. Fig. 1. Silica bodies *E. nealleyi* (*Tateoka s.n.*). Fig. 2. Closeup of silica cell and associated cork cell. Fig. 3. Electron beam x-ray microanalysis of the cork cell of *E. avenaceum* (*Reeder 6292*). Fig. 4. Electron beam x-ray microanalysis of cork cell of *Tridens strictus* (*Valdes-R s.n.*) Fig. 5. Electron beam x-ray microanalysis of prickle hair. Fig. 6. Silica cell of *E. avenaceum* (*Reeder 6292*) Au = gold; Cu = copper; Us = osmium; Pd = palladium; ph = prickle hair; sc = silica cell; cc = cork cell; SI = silica.



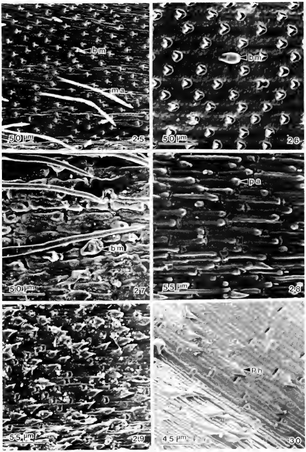
FIGS. 7 – 12. SEM photomicrographs of lemma surfaces from selected genera of Eragrostideae. Note that the silica cells vary from short dumbbell- to kidney-shaped and are associated with a cork cell. Fig. 7. *Triodia irritans* var. *laxispicata* (*Henderson 333*). Fig. 8. *T. pungens* (*Hubbard 7358*). Fig. 9. *Neeragrostis reptans* (*Gould 11241*). Fig. 10. *Eragrostis erosa* (*Bye 6936*). Fig. 11. *E. mexicana* (*Hatch et al. 4588*). Fig. 12. *E. ciliaris* (*Silveus 4065*). SC = silica cell; cc = cork cell; ph = prickle hair.



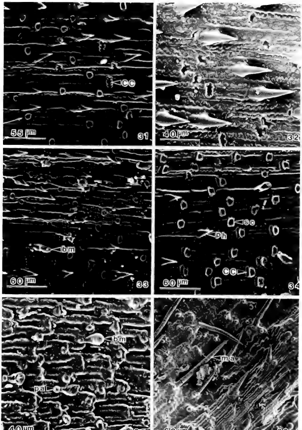
FIGS. 13 – 18. Lemma epidermal patterns for *Tridens* and *Triplasis*. The shape of the cork cell is kidney- to flattened dumbbell-shaped. The bullet-shaped bicellular microhair is characteristic of the genus *Tridens*. Fig. 13. *Tridens albescens* (*Gould 12869*). Fig. 14. *T. texanus* (*Valdes-R. 1497*). Fig. 15. *T. congestus* (*Hatch 4125*). Fig. 16. *T. strictus* (*Valdes-R. s.n.*). Fig. 17. *T. muticus* var. *elongatus* (*Gould s.n.*). Fig. 18. *Triplasis purpurea* (*Johnson 1357*). bm = bicellular microhair; cc = cork cell.



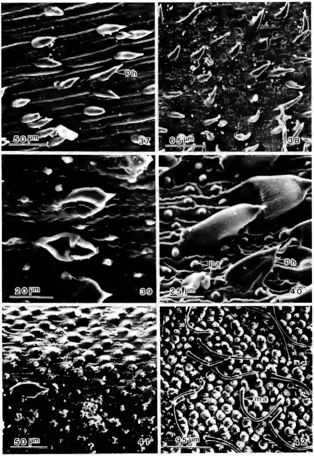
FIGS. 19–24. Lemma epidermal patterns for selected genera of Eragrostideae. Note the small papillae associated with the cork cell and the slender, villous macrohairs. Fig. 19. *Sohnsia filifolia* (*Sohns 1341*) with silica cells in rows and not associated with a cork cell. Fig. 20. *Eleusine indica* (*Breedlove 14882*). Fig. 21. *Dactyloctenium aegyptium* (*Schneider 6329*). Fig. 22. *Leptochloa uninervia* (*Lonard 2731*). Fig. 23. *Tripogon spicatus* (*Beetle M-2218*). Fig. 24. *Leptocarydion vulpiastrum* (*Hatch 4236*). sc = silica cell; cc = cork cell; pa = papillae; ma = macrohair.



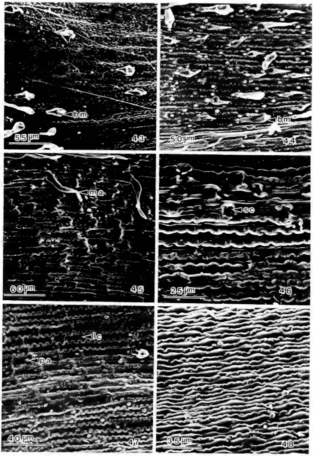
FIGS. 25 – 30. Lemma epidermal patterns for selected genera of Eragrostideae. Note the small papillae associated with the cork cell, the slender villous macrohairs, and hemispheric bicellular microhairs. Prickle hairs are present on *Gouinia* and *Erioneuron*. Fig. 25. *Gymnopogon foliosus* (*Davidse 12145*). Fig. 26. *Trichoneura elegans* (*Lonard 3183*). Fig. 27. *Vaseyochloa multinervosa* (*Johnston 54508*). Fig. 28. *Scleropogon brevifolius* (*Koch 17211*). Fig. 29. *Gouinia virgata* (*Gould 12253*). Fig. 30. *Erioneuron pilosum* (*Valdes-R. 1653*) bm — bicellular microhair, ma — macrohair, pa — papillae, ph — prickle hair.



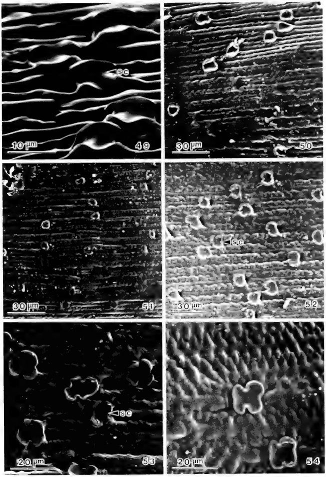
FIGS. 31 – 36. Lemma epidermal patterns for selected genera of the Eragrostideae. The cork cell shape is oblong to crenate in *Erioneuron* and *Dasyochloa*, with an abundance of prickle hairs. *Munroa* has hemispheric bicellular microhairs and an abundance of papillae. Fig. 31. *Erioneuron nealleyi* (*Valdes-R. 5002*). Fig. 32. *Dasyochloa pulchella* (*Valdes-R. 1691*). Fig. 33. *Erioneuron grandiflorum* (*Davidse 9315*). Fig. 34. *E. avenaceum* (*Valdes-R. 1635*). Fig. 35. *Munroa squarrosa* (*Henrickson 7490*). Fig. 36. *M. squarrosa* (*Rowell 5882*). cc = cork cell; ph = prickle hair; sc = silica cell; bm = bicellular microhair; ma = macrohair; pa = papillae.



FIGS. 37—42. Lemma epidermal patterns for selected genera of the Eragrostideae. Cork cells are absent and prickle hairs are abundant. Fig. 37. *Blepharidachne bigelovii* (*Warnock 46198*). Fig. 38. *Redfieldia flexuosa* (*Hapeman s.n.*). Fig. 39. *Pereilema crinitum* (*Gould 14374*). Fig. 40. *Pereilema ciliatum* with characteristic raised cell walls forming a ridge around the long cells (*Brunken and Perino 314*). Fig. 41. *Triniochloa stipoides* (*Rzedowski 20235*). Fig. 42. *Sporobolus ozarkanus* with unique abundant small hooks on the long cells, (*Riggins 444*). ph = prickle hair; pa = papillae; ma = macrohair.



FIGS. 43–48. Lemma epidermal patterns for selected genera of the Eragrostideae. Cork cells are absent and prickle hairs common. Long cells are deeply undulating with one papillae per cell that is located distally. Fig. 43. *Blepharoneuron tricholepis* (*Breedlove 18855*). Fig. 44. *Muhlenbergia emersleyi* (*Valdes-R. 144*). Fig. 45. *Chaboissaea ligulata* (*McVaugh 17058*). Fig. 46. *Lycurus phleoides* (*Hatch et al. 4499*). Fig. 47. *Muhlenbergia minutissima* (*Moran 24153*). Fig. 48. *M. fastigiata* (*Tutin 975*). bm = bicellular microhair; ma = macrohair; lc = long cell; pa = papillae; sc = silica cell.



FIGS. 49–54. Lemma epidermal patterns of *Sporobolus* and *Crypsis*. Silica cells are dumbbell-shaped. Fig. 49. *Muhlenbergia plumbea* (*Sohns 622*). Fig. 50. *Sporobolus pyramidatus* (*Rzedowski 20235*). Fig. 51. *S. atroides* (*Gould 11550*). Fig. 52. *S. asper* (*Gould 10286*). Fig. 53. *S. cryptandrus* (*Gould 11283*). Fig. 54. *Crypsis niliaca* (*Crampton 3573*). sc = silica cell.

A summary of the epidermal features with high silica content is presented in Table 2. Differences in the patterns of silica deposition are evident. The results of the SEM micromorphological study of the lemma are consistent with those of the anatomical and epidermal features of the leaf blade for the members of the Eragrostideae as reported by Metcalfe (1960), Clifford and Watson (1977), Ellis (1979), Palmer and Tucker (1981), Renvoize (1983), Peterson (1989), and Peterson et al. (1989). *Scleropogon* is the only genus possessing all characters observed.

TABLE 2. Presence (+) or absence (-) of epidermal features on the lemma of Eragrostideae grasses.

GENERA*	CHARACTER				
	Cork cell	Silica cell	Papillae	Prickle hairs	Long cells strongly sinuous with one papillae
Blepharidachne	-	-	-	+	-
Blepharoneuron	-	-	+	-	+
Calamovilfa	-	+	-	-	-
Chaboissaea	-	-	+	-	+
Crypsis	-	+	-	-	-
Dactyloctenium	+	-	-	-	-
Dasyochloa	+	+	-	+	-
Eleusine	+	+	+	+	-
Eragrostis	+	+	-	+	-
Erioneuron	+	+	-	+	-
Gouinia	+	-	+	+	-
Gymnopogon	+	-	+	-	-
Leptocarydion	+	+	+	+	-
Leptochloa	+	-	+	-	
Lycurus	-	+	-	-	-
Muhlenbergia	-	+	+	+	+
Munroa	-	-	+	+	+
Neeragrostis	+	+	-	-	-
Pereilema	-	-	+	+	+
Redfieldia	-	-	-	+	-
Scleropogon	+	+	+	+	+
Sohnsia	+	+	-	-	-
Sporobolus	-	+	+	-	+
Trichoneura	+	-	-	-	-
Tridens	+	-	-	-	-
Triniochloa	-	-	+	+	+
Triodia	+	+	+	-	-
Triplasis	+	-	-		-
Tripogon	+	-	+	-	-
Vaseyochloa	+	-	+	-	-

*Genera are alphabetical.

Phillips (1982) presented a numerical analysis of the tribe dividing the tribe into five groups based on gross morphology. The patterns of silica deposition reported here, correlate in part with that classification based on numerical analysis of morphological features. *Tridens, Triplasis, Erioneuron, Munroa, Leptocarydion, Leptochloa*, and *Tripogon* are placed in group A. The group is characterized as having lemmas with hairy nerves and frequently 2-toothed mucronate or awned apices. All taxa in this group have similar silica deposition patterns except *Erioneuron* and *Munroa*, which are distinct from the other morphologically closely related genera.

Nicora (1962) segregated *Neeragrostis* from *Eragrostis* based upon the extremely long bicellular microhairs of the former. The silica bodies of *Neeragrostis* are dumbbell-shaped and the elongated bicellular microhairs are due to a longer proximal cell. In this study both genera have similar epidermal features, which corresponds to the conclusions of Koch (1978). Koch examined *Eragrostis* in the southeastern United States and reported that *E. hypnoides* (Lam.) B.S.P. also has longer proximal cells in the bicellular microhairs.

Blepharoneuron, Chaboissaea, Lycurus, Muhlenbergia, Sporobolus, and *Crypsis*, a morphologically closely related group (Gould 1979), characteristically lack the cork cells. Clayton and Renvoize (1986) segregate *Muhlenbergia* and *Sporobolus* into the Sporobolinae subtribe using morphological characteristics. Although Clayton et al. (1974) earlier reported Sporoboleae as a tribe somewhat artificial because of the small differences between *Sporobolus* and certain species of *Eragrostis*. Campbell (1985) differed in placement of the genera and included them in the Cynodonteae tribe.

As a result of the examination of the lemma micromorphology a realignment of the genera within the two subtribes is proposed consisting of 1) a subtribe Sporobolinae with *Sporobolus, Muhlenbergia, Chaboissaea, Lycurus, Blepharoneuron*, and *Crypsis* and 2) a subtribe Eleusinae with *Tridens, Triplasis, Erioneuron, Dasyochloa, Munroa, Leptocarydion, Leptochloa*, and *Tripogon*. These two subtribes are not in agreement with the most recent classification (Clayton & Renvoize, 1986) where *Blepharoneuron* is placed in the Eleusinae and not in the Sporobolinae along with *Chaboissaea, Crypsis, Lycurus, Muhlenbergia, Pereilema*, and *Sporobolus*. Campbell (1985) on the other hand recognized a broadly defined tribe (Cynodonteae) that contains all of the genera proposed for this study. The results reported here indicate relationships of the subtribes within this subfamily. However, we recognize the need to correlate these data with gross morphology, as well as molecular, anatomical, and cytological characters to provide useful information in delimiting tribes and resolving taxonomic problems within the Eragrostideae.

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"HALOPH is the most extensive and referenced listing of halophytic and salt-tolerant plants available to date. The data base contains more than 1,560 species in 550 genera and 117 families indexed alphabetically by family, genus, and species. Catagories include: life form, plant type, geographic distribution, maximum reported salinity tolerance, photosynthetic pathway, economic uses, and pertinent references."

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A very well done book with beautiful photographs on Oregon rare and endangered plants. Contents: Introduction, purpose of the book, the plants included, conservation of rare plants, distribution of rare plants in Oregon, plant names, plant descriptions, plant photography, rare and endangered plants of Oregon with photographs; appendices: table of rarity status, plant classification of the species contained in this text, glossary, bibliography, index.

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A NEW SPECIES OF *CHEILANTHES* (ADIANTACEAE) FROM NORTHEASTERN MEXICO

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ABSTRACT

Cheilanthes hintoniorum sp. nov. is described from Nuevo Leon, Mexico, where it is endemic and restricted to habitats of gypsum. Among other species of northern Mexico, it apparently is most similar to the more widespread *C. hirsuta*.

RESUMEN

Se describe una nueva especie endémica de helecho, ***Cheilanthes hintoniorum***, de Nuevo León, México, restringida a los habitats de sustrato gipsio. Dentro de las especies encontradas en el norte del país, la nueva especie se parece mas a *C. hirsuta*, un taxón de ambito geografico amplio.

KEY WORDS: *Cheilanthes*, Adiantaceae, Mexico

Cheilanthes hintoniorum Mendenhall & Nesom, sp. nov. (Fig. 1.)

Cheilanthi hirsutae Link similis sed statura parviore, squamis filiformibus rhizomate, laminis late deltatis pinnis infimis inaequilateris, pinnis non papillatis, segmentis ultimis penitus integris, et habitatione gypseo differt.

Rhizomes stout, compact, horizontal-ascending; rhizome scales purplish-black, 5 − 7 mm long, entire, filiform, 1 − 2 cells wide, 3 − 4 cells wide only at the base, rarely slightly flattened and never with differentiated margins. Fronds evergreen, not ceraceous, 8 − 17 cm long, arising in dense clumps, the sterile ones slightly smaller than the fertile; stipe 1/3 − 2/5 the frond length, glabrous, dark purplish-black, wiry, terete, not at all sulcate, the basal portion persistent from the rhizome; blades bipinnate to tripinnate, broadly deltate, 3 − 7 cm long, 3 − 8 cm wide at the base, length:width ratio 0.8 − 1.0:1, the pinnae oppposite to subopposite, lowest pinnae the largest, deltate and strongly inequilateral by the prolongation of the basiscopic pinnule on the lower side, the ultimate segments all completely entire, eglandular, stiffly linear, mostly 8 − 20 mm long, 1.0 − 1.5 mm wide, with upper and lower surfaces glabrous and smooth. Sori at vein ends; laminar margins entire, minutely glandular-papillate, recurved, strongly modified into false indusia 0.5 − 0.7 mm wide, evenly and very narrowly decurrent along pinnule and rachis axes; spores brown, 64 per sporangium, globose, 50 − 60 μm in diameter, trilete.

South-central to southern Nuevo Leon (Fig. 1), crevices and shallow soil pockets in exposed gypsum, 1270 – 2000 m elevation.

TYPE: MEXICO. NUEVO LEON: Mpio. Galeana, 10 km NE of Pocitos, gypsum cliff over water, 1850 m, 26 Aug 1984, *Hinton et al. 18765* (HOLOTYPE: TEX!; ISOTYPES: MEXU!, NY!, UC!, to be distributed).

Additional collections examined: MEXICO. NUEVO LEÓN: Mpio. Dr. Arroyo, ca. 30 km ENE of Dr. Arroyo, W base of Cerro Peña Nevada, large area of exposed gypsum, 2000 m, 3 – 5 Aug 1981, *Nesom 4308* (TEX). Mpio. Galeana, Rincón San Antonio, ravine in gypsum hills, 1770 m, 18 Oct 1983, *Hinton et al. 18639* (TEX); Mpio. Zaragoza, below Puerto Piño [near saddle on N side of Peña Nevada complex], gypsum hillside, 1750 m, 2 Aug 1989, *Hinton et al. 19315* (TEX); Mpio. Rayones, Galeana to Rayones + 18 km, gypsum hillside, 1270 m, 27 Feb 1990, *Hinton et al. 20157* (TEX); Mpio. Aramberri, Aramberri to Lampazos, gypsum hillside of lechuguilla and *Hechtia*, 965 m, *Hinton et al. 21042* (TEX).

Cheilanthes hintoniorum is named for the son and grandson of G. B. Hinton, Jaime and George, whose extensive and carefully made collections from Nuevo Leon and Coahuila in the last two decades have added immensely to our knowledge of that area's flora. All but one of the collections known of this new species have been made by the Hintons.

In its recurved laminar margins, strongly modified into false indusia (Fig. 1.A), *Cheilanthes hintoniorum* clearly is a member of *Cheilanthes* sensu stricto (see Mickel 1979). It is distinctive in its evenly hair-like, concolorous rhizome scales, glabrous, non-sulcate stipes, 2 – 3-pinnate fronds, broadly deltate blades with inequilateral lowest pinnae and completely glabrous, linear, strictly entire, ultimate segments, its narrowly but long-decurrent indusia, and its apparently obligately gypseous habitats.

In the keys of both Knobloch (1976) and Mickel and Beitel (1988), *Cheilanthes hintoniorum* runs to the vicinity of *C. membranacea* (Davenp.) Maxon and *C. marginata* Kunth. *Cheilanthes hirsuta* Link (= *C. pyramidalis* Fee) is closely associated with these in the latter key, and we have contrasted the new species with it in the diagnosis because it is relatively common and widespread, occurring from northeastern Mexico in Nuevo Leon to Sonora and Baja California south to Chiapas, Guatemala, and Costa Rica. *Cheilanthes hirsuta* is distinct from *C. hintoniorum* in its much broader rhizome scales, generally larger and differently shaped (ovate to narrowly deltate) blades, often pinnatifid ultimate segments, and glandular-papillate surfaces of the leaf margins and indusia. The new species also usually produces more strongly inequilateral lowest pinnae. *Cheilanthes hirsuta*, however, is a variable species and as pointed out to us by Dr. John Mickel (in the review), plants of that species may sometimes produce broadly deltate blades, linear and entire ultimate segments, and pinnae

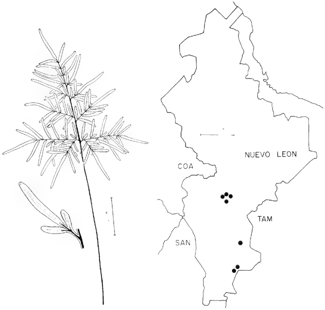

FIG. 1. Morphology and distribution of *Cheilanthes hintoniorum*. A. Frond and ultimate segment. B. Distribution. All collections from the Mexican state of Nuevo Leon; surrounding states as COA = Coahuila, SAN = San Luis Potosi, and TAM = Tamaulipas.

with the surface papillae indistinct or absent. The hair-like rhizome scales of *C. hintoniorum*, however, appear to be consistently different from those of *C. hirsuta*.

Cheilanthes marginata and *C. membranacea* are more similar to *C. hintoniorum* in their consistently deltate blades and glabrous leaf surfaces, but both of these species also produce broader rhizome scales and pinnatifid ultimate segments as well as fimbriate indusial margins and much larger blades, and both species occur primarily in the southern half of Mexico. *Cheilanthes marginata* is probably most closely related to *C. purpusii* T. Reeves of central Tamaulipas (Reeves 1982). Both of these produce small, evenly spaced glands along the lower margins of the ultimate segments, and the segment margins are distinctly crenulate. Further, except for *C.*

purpusii, none of the species putatively related to *C. hirsuta* grows on a substrate of gypsum, which is always the habitat of *C. hintoniorum*. In addition to the most recent collection (*Hinton 21042*) other localities almost certainly will be discovered for the new species in the numerous areas of exposed gypsum that lie between its two known primary loci of distribution (Fig. 1.B). We conclude that while it probably is most closely related to *C. hirsuta*, *C. hintoniorum* is a very distinct species, apparently somewhat isolated both in morphology and geography.

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SYNOPSIS OF THE MEXICAN AND CENTRAL AMERICAN REPRESENTATIVES OF *LOBELIA* SECTION *TYLOMIUM* (CAMPANULACEAE: LOBELIOIDEAE)

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ABSTRACT

A synopsis is presented of the seven species of *Lobelia* section *Tylomium* (K. Presl) Benth. & Hook. known to occur in Mexico and Central America. A previously undescribed species, *Lobelia zelayensis*, is described from recent collections made in northeastern Nicaragua. Two species, whose generic placement has been problematic, are herein transferred to *Lobelia*: **L. calochlamys** (J. D. Smith) comb. nov. (= *Pratia calochlamys* (J. D. Smith) F. Wimmer) and **L. guatemalensis** (B.L. Robinson) comb. nov. (= *Pratia guatemalensis* (B.L. Robinson) F. Wimmer).

Lobelia section *Tylomium* (K. Presl) Benth. & Hook. as defined by McVaugh (1940 and 1943) is a group of about twenty-five species of robust, suffrutescent plants distributed around the Caribbean occurring in the Antilles, Mexico and Central America and perhaps northern South America. The range of most species is narrowly limited and their isolated, often montane habitats result in morphologically sharply distinctive populations easily distinguished from one another. The recent intensive collecting program in Nicaragua in preparation of a flora of that country has resulted in a considerable increase in the floristic knowledge of that country and has also resulted in the discovery of a number of new species. One of these is a most distinctive species of *Lobelia* sect. *Tylomium* described in the following synopsis of the section as represented in Mexico and Central America (s.*lat*.).

The usually recognized sections of *Lobelia* as outlined by McVaugh (1940 and 1943) are not especially distinctive or at least the groupings are not so apparent as to stand out upon initial inspection. The species of Section *Tylomium* (K. Presl) Benth. & Hook, one of the six recognized by McVaugh as occurring in North America *s*.lat., are stout herbs or subshrubs whose corollas are red or reddish purple to brown, yellow, green or white but never blue. The seeds are ovoid to globose, smooth and usually polished and pitted. Included in the expanded concept of section *Tylomium* as employed in this synopsis are several species that were treated as

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members of the genus *Pratia* Gaudichaud by McVaugh (1943) and Wimmer (1943, 1953 and 1968). Perhaps the most striking difference between *Pratia* and *Lobelia* is that the first-mentioned genus has an indehiscent berry as its fruit while *Lobelia* has a dehiscent capsule.

McVaugh (1943) treated five Jamaican species and three Central American species as the North American representatives of the baccate genus *Pratia* Gaudichaud, otherwise largely confined to the Eastern Hemisphere. Adams (1972, p. 734), stated that the distinction between baccate and capsular fruited lobelioids "is not clear in Jamaican species where all of the endemic species seem to form a natural group. Although the fruits are fleshy at first they tend to dehisce if sufficiently dried . . . None has been observed to produce a true berry." All were treated by Adams and by Rendle (in Fawcett & Rendle, 1936) in the genus *Lobelia* and all whose fruit was mentioned by either author were described as capsules. Of the seven mainland species the capsular fruit of all but one has been observed. Wimmer (1943, 1953 and 1968) recognized the genus *Pratia* in his publications and his concept and that of McVaugh for the American taxa was substantially the same if one were to ignore the considerable narrower specific concept held by Wimmer. Although I am unable to offer any first-hand insight into the generic merit of *Pratia* in the Old World or even of the few alleged South American representatives, I believe enough information has accumulated to conclude that the three Mexican and Central American representatives formerly placed in *Pratia* are better treated in *Lobelia*. Dehiscing capsules have been observed in both *Pratia tatea* and *Pratia guatamalensis* and both are here treated in the genus *Lobelia*. Mature fruit has not been noted to my knowledge in *Pratia calochlamys*. Without fruit, generic placement is problematic. Previous opinions have been that it is either *Centropogon* or *Pratia* - both baccate genera but there is no firm evidence for this generic placement either. To me it seems more likely that it is a *Lobelia* but proving it without more complete specimens is impossible.

KEY TO *LOBELIA* SECT. *TYLOMIUM* IN MEXICO AND CENTRAL AMERICA

1. Flowers less than 3.9 cm long; corollas light green; filaments 2 cm long or less; anthers all distally tufted with stiff trichomes; plants of the Caribbean coast of Panama . . . . 1. *L. dressleri*.
1. Flowers 4 cm long or longer; corollas yellow, purple or reddish; filaments 2.5 cm long or longer; anthers variously pubescent but never with all 5 anthers only distally tufted with stiff trichomes; plants of Mexico through Nicaragua.
   2. Corollas externally yellow or yellowish green . . . . 2. *L. parvidentata*.
   2. Corollas externally reddish or purplish.

3. Anthers densely beset laterally throughout with brownish trichomes $2-3$ mm long forming a dense tangle . . . . 3. *L. tatea*.
3. Anthers mostly with only the two lowermost with a penicillate tuft of white trichomes but if lateral trichomes present, these shorter and scattered and not forming a dense brownish tangle.
    4. Calyx lobes 10 mm long or longer.
        5. Calyx lobes broadly triangular, elliptic or lance-ovate, basally $5-12$ mm wide; pedicellary bracteoles present; northern Guatemala . . . . 4. *L. calochlamys*.
        5. Calyx lobes narrowly lanceolate to linear, basally $2-2.5$ mm wide; pedicellary bracteoles lacking; northern Nicaragua . . . . 5. *L. zelayensis*.
    4. Calyx lobes less than 8 mm long.
        6. Calyx lobes 4 mm or more wide at base; pedicels basally bracteolate; corolla tube cleft dorsally only to within 1.5 cm of base or less; leaf margins crenate . . . . 6. *L. guatemalensis*.
        6. Calyx lobes 2 mm wide or less at base; pedicels ebracteolate; corolla tube cleft to within ca. 3 mm of base; leaf margin serrulate . . . . 7. *L. nubicola*.

1. **Lobelia dressleri** Wilbur, Ann. Missouri Bot. Gard. 61:889. 1974. — TYPE: PANAMA. COLÓN: near Coclé del Norte near beach, 18 Aug 1972, *Dressler 4206* (HOLOTYPE: DUKE!; ISOTYPE: PMA!).

Suffruticose herb $1-2.5$ m tall with the stem basally to 5 cm in diameter, apparently unbranched or nearly so and inconspicuously spreading short-pubescent. Leaves cauline, apparently numerous and rather evenly spaced along the stem, spreading-ascendent, thin papery to semichartaceous when dry, inconspicuously serrulate with appressed, incurved teeth, medially $1-3$ per cm; blades elliptic, broadest slightly above the middle, acutely tapering both apically and basally, ca. $15-30$ cm long and $3-7.5$ cm wide, about $4-6$ times as long as wide, glabrous on both the upper and lower surfaces; petioles glabrous, $1-2$ cm long. Inflorescence $6-10(-25)$ dm long, about $40-70$-flowered, narrowly cylindrical; bracts elliptic, tapering to either end and somewhat broader above the middle, inconspicuously serrulate, glabrous, the upper ca. 2 cm long and $6-8$ mm wide and the lowermost up to 10 cm long and $3-4$ cm wide; pedicels stiff, straight, strongly divaricate except distally where upturned at anthesis and somewhat incurved in fruit, $1.2-2.8$ cm long in flower and $2-3$ cm long in fruit, ca. $1-1.5$ mm in diameter, densely spreading short-pubescent and bearing a pair of linear to lanceolate, serrulate, glabrous bracteoles $6-10$ mm long and $1-2$ mm wide about three-fourths or more the distance from the base of the pedicel to the hypanthium. Flowers $2.8-3.2$ cm long; hypanthium at anthesis broadly hemispherical, glabrous or basally spreading short-pubescent, symmetrical or nearly so, $6-9$ mm high and 10 – 15 mm in diameter and with a free calycine rim ca. 2 mm high; calyx lobes at anthesis triangular or deltoid, glabrous, inconspicuously serrulate, 5 – 8 mm long and 2 – 4 mm wide at the base; corolla light green, glabrous, the tube ca. 10 – 15 mm long, distally strongly curved ventrally, dorsally slit at first to within ca. 6 – 8 mm and eventually to within 1 mm of the base and with 2 conspicuous lateral fenestrae ca. 4 – 6 mm high, the corolla lobes all strongly arching ventrally, the two upper linear or linear-lanceolate, 10 – 15 mm long and ca. 2 mm wide, acute and the 3 lower lobes 8 – 12 mm long and 2 mm wide, the filaments glabrous, 15 – 20 mm long, connate except for basal 4 – 5 mm, the anther tube 4 – 6 mm long, glabrous except for the dense tuft of white trichomes ca. 1 mm long at apex of each anther. Capsule somewhat depressed hemispheric, 8 – 12 mm high and 10 – 15 mm in diameter, ca. two-fifths superior, terminating in the tapering, 2 – 4 mm long, conical base of the style; seeds compressed, broadly oblong, ca. 0.8 mm long and 0.6 mm broad, shallowly pitted.

Distribution: known to me only from collections made in Colón Province, Panama, from near the beaches at Coclé del Norte and Miguel de la Borda.

Additional specimens examined: **PANAMA. Colón**: Miguel de la Borda along beach, 24 Apr 1970, *Croat 10016* (F, DUKE, MO); Coclé del Norte, along beach, Hammel 4571 (DUKE).

2. **Lobelia parvidentata** L. O. Williams, Ceiba 4:41. 1953. — TYPE: HONDURAS. MORAZÁN: in cloud forest, mountains above San Juancito, 2000 m, 22 Feb 1949, *Merrill, Williams & Molina 15663* (HOLOTYPE: EAP, not seen; ISOTYPES: F! GH! US!). [Merrill or Williams are listed first on different labels.]

Suffrutescent perennial herb or shrublet 5 – 20 dm tall, glabrous throughout. Leaves cauline, spreading, 1 – 20 per stem, the blades 3 – 22 cm long and 1.2 – 6 cm wide, elliptic to broadly lanceolate, apically acute to abruptly and shortly acuminate, basally cuneately tapering to somewhat rounded, marginally closely serrate-dentate with 35 – 90 purplish teeth along 80 – 90 percent of each margin, ca. 5 – 8 teeth per cm and the individual teeth pointing strongly towards the apex to widely divergent and 1 – 1.2 mm long on the outer margin and nearly as long on the inner margin; petiole slender, channeled above, 0.8 – 3 cm long. Inflorescence 10 – 20 cm long with 4 – 25 flowers each borne on a slender pedicel 3 – 8 cm long arising from the axil of the somewhat reduced upper leaves and the pedicels either ebracteolate or very rarely basally or subbasally bibracteolate. Flowers in anthesis 3.5 – 4.5 cm long; hypanthium 5 – 6 mm high and 6 – 9 mm in diameter, glabrous, ± 10-nerved; calyx lobes 6 – 13 mm long and 1 – 5-2.5 mm wide basally, narrowly triangular, acute, either denticulate with $2-3$ teeth per side and these $0.2-0.3$ mm long or rarely entire; corolla yellow or greenish-yellow, glabrous externally, reddish purple and puberulent internally especially along the base of the lower lip, the tube ca. 3 cm long and medially $2-3(4.5)$ mm in diameter, non-fenestrate or very tardily fenestrate but dorsally cleft to the base, the lobes ca. 10 mm long and 2 mm wide at base, linear, falcate; filaments glabrous except for the ciliate margins of the non-connate bases, ca. 25 mm long, the anther tube ca. 7 mm long with the 2 shorter anthers ca. 5 mm long and these apically white-tufted with trichomes $1.2-1.5$ mm long but all anthers otherwise glabrous. Capsule dehiscing apically by 2 valves, ca. 1/3 superior, ca. $1-1.5$ cm long; seed ca. 0.8 mm long and 0.6 mm wide, lenticular, shallowly reticulate.

Distribution: cloud forest in the mountains of the Departments of Santa Barbara and Morazán, Honduras.

Additional specimens examined: HONDURAS. **Dept. Sta. Barbara**: forested ridge S side of Montaña Sta. Barbara, alt. 2350 m, 7 Apr 1951, *Allen, Amour & Chable 6133* (F, GH, US). **Dept. Morazán**: Montaña La Tigra, Tegucigalpa, 1600 m, 6 Apr 1980, *Amador 118* (MO); Montaña La Tigra, Tegucigalpa, bosque nublado, 2333 m, 3 May 1980, *Cruz 156* (MO); Cerro Nebulosa, 20 kms NE of Tegucigalpa, $7-14$ Mar 1977, *Erazo, Cruz & Purdy 312* (MO); Montaña La Tigra, 2016 m, bosque nublado, *Garcia 212* (MO); bosque de nubes de Peña Blanca, Montaña de San Juancito, 2000 m, *Molina 5927* (F); sobre racas húmedas del bosque nebulosa Vuelta La Matraca en Montaña La Tigra norte de San Juancito, 2000 m, 24 Mar 1957, *Molina 7765* (GH, US); bosque húmedo y nebuloso de Rancho Quemodo en Montaña La Tigra suroeste de San Juancito, 2000 m, 18 Mar 1959, *Molina 8817* (F); abundantes en el bosque húmedo de Montaña La Tigra, 2000 m, 8 Mar 1962, Molina 10265 (F); mixed dense and wet cloud forests on mountain La Tigra, SW of San Juancito, $1800-2100$ m, 2 Feb 1966, *Molina, Williams, Burger & Wallenta 16970* (F, NY, US); on wet forest bank, Mountain La Tigra, between Jutiapa and Quebrado La Tigra, SE of San Juancito, 1800 m, 8 Feb 1967, *Molina 20286* (F, GH, NY); wet dense cloud forest of La Tigra, Mt. San Juancito, 2100 m, 4 Feb 1968, *Molina & Molina* 214741 (F, NY); abundante en el bosque abierto y húmedo de Montaña La Tigra, 2200 m, 8 Mar 1962, *Williams & Molina 10265* (LL); cloud forest area in mountains above San Juancito, 2200 m, 20 Feb. 1948, *Williams &* Molina *13680* (F, GH, US); floresta de nubes de la Montaña de la Tigra, suroeste de San Juancito, 200 m, *Williams & Molina 17077* (F, GH, US); common in edge of cloud forest above San Juancito, 1800 m, 24 Mar 1951, *Williams 17458* (F, GH, US); in cloud forest above San Juancito, 1800 m, 24 Mar 1951, Williams 17481 (F, GH, US); abundante en el bosque de nubes de Montaña La Tigra, cerca de San Juancito, 2000 m, 5 Oct 1953, *Williams & Molina 18883* (F, GH, US); clearing in forest above San Juancito, 2000 m, 21 Feb 1954, *Williams & Williams 18894* (F, GH, US).

3. **Lobelia tatea** (F. Wimmer) F. Wimmer in Engler's Pflanzenreich IV. 276b. 119. 1943. *Pratia tatea* F. E. Wimmer, Repert. Spec. Nov. Regni Veg. 29: 51, *pl. 115, f. 1.* 1931. — SYNTYPES: NICARAGUA. Prope Chontales, *R. Tate 194* and *Seemann 93* (K, neither seen). [McVaugh 1943, p. 113 indicated *Tate 194* was the "type", ie. lectotype.]

Erect, terrestrial herbs or shrublets (0.6) $1-2(3)$ m tall with glabrous stems. Leaves cauline, slightly fleshy, the blades elliptic to oblong-obovate, glabrous, ca. $10-20(30)$ cm long and $4.5-7.5(12)$ cm wide, about 3 times as long as wide, apically acute to acuminate, basally cuneately narrowed and tapering into the petiole, marginally closely callosely denticulate or serrulate with ca. $8-10$ teeth per cm and each tooth ca. $0.5-8(1.0)$ mm long, the venation prominent below; petioles $1-3(4.5)$ cm long, glabrous. Inflorescence terminal, few- to many-flowered, subsecund, $1-3$ dm long, the rachis glabrous; pedicels spreading-ascendent but distally $\pm$ erect, $4-5$ cm long in flower, glabrous, ebracteolate, each borne in the axil of a leafy, elliptic or oblong to more typically lanceolate, shortly petiolate, serrulate bract $1-5$ cm long and $5-10$ mm wide. Flowers $4.3-6.0$ cm long; hypanthium hemispheric, glabrous, ca. $3-4$ mm high and $5-6$ mm wide, basally rounded; calyx lobes narrowly triangular, erect, acute, glabrous, denticulate, ca. $4-6$ mm long; corolla glabous, $4.0-4.6$ mm long and basally roseate with purplish lobes, the tube slightly curved, $2.2-4.0$ cm long, non-fenestrate but dorsally cleft to about the middle to almost to the base, the limb 5-parted but not 2-lipped, the lobes linear, ca. $15-20$ mm long and basally $1.5-2$ mm wide, cuspidately tipped; filaments mostly connate, $2.5-4.8$ cm long, completely free from the corolla, basally distinct and there marginally ciliate-pubescent but otherwise glabrous, the anther tube ca. 9 mm long with a dense covering of coarse tawny to brownish or even purplish trichomes $2-3$ mm long. Capsules about half inferior, $1.0-1.4$ cm long and basally $8-11$ mm in diameter, the upper half tapering and $\pm$ obconic and the lower half broadly rounded and shortly cylindric; seeds light brown to tawny, lenticular, flattened, ca. $0.5-0.7$ mm long and nearly as broad, faintly and minutely foveate-reticulate.

Although Index Kewensis (Suppl. XI p., 140, 1953) lists the combination *Lobelia tatea* (F. Wimmer) F. Wimmer, this binomial was not listed even in synonymy in Wimmer's later works (1953 and 1968) and its acceptance as validly published has been questioned. Wimmer in first treating the genus *Pratia* in Engler's Pflanzenreich (1953, p. 119) excluded it from the genus *Pratia* in the following quotation presented in its entirety: "[Pratia] *Tatea* Wimm. = ? *Lobelia Tatea* Wimm."

When Wimmer dealt with the genus *Lobelia* in the war-interrupted account of the Lobelioideae, *Lobelia tatea* was not included in any manner - it was not even mentioned as a binomial to be excluded. In his expanded treatment of the genus *Pratia*, Wimmer (1953) included *P. tatea* but did not include *Lobelia tatea* even in synonymy. This together with the initial appearance of the binomial "*Lobelia tatea*" with a question mark led an anonymous reviewer to challenge the validity of Wimmer's combination in the genus *Lobelia*. It would seem to me that Article 34. 1(a) and 34.2 of the ICBN cover the question completely and indicate that *Lobelia tatea*, although published with a question mark, was published and accepted by the author *in the original publication*. I consider it to be a validly published binomial.

Distribution: southern Mexico south into Nicaragua.

Additional specimens examined: **MEXICO. Oaxaca**: roadside along Hwy. 175 through Sierra de Juarez between Tuxtepec and Oaxaca, 6.6 miles S of bridge at Valle Nacional; 750 m, 19 Feb 1979, *Croat 47929* (DUKE); roadside 12 mi S of Valle Nacional, Hwy. 175, 22 Mar 1978, *Poole, Bain & Kerr 1259* (MICH); 14 km al S de Valle Nacional, sobre carretera a Oaxaca, 780 m, 28 Nov 1979; *Wendt, Lott & Garcia 2284* (DUKE, TEX). **GUATEMALA. Baja Verapaz**: Union Barrios, in forests, Aug 1971, *Contreras s.n.* (US). **BELIZE. El Cayo Distr.**: on high ridge on hillside, Gorge Creek Section, Humming Bird Hwy., 26 Aug 1955, *Gentle 9392* (LL); **Stann Creek Distr.**: in clearing at base of hill, Humming Bird Hwy., 13 Sept 1954, *Gentle 9382* (LL). **HONDURAS. Atlántida**: near dam on the Danta River, 4–5 km SW of La Ceiba, 200–400 m, 4 May 1979, *Hazlett 3097* (DUKE). **Cortes**: Montaña Ildefonso norte de Cofradía, 2100 m, 17–18 Apr 1957, *Molina 8221* (F); sobre bancos húmedo de Montaña San Ildefonso entre Bañaderos y Cusuco, 1400 m, *Molina 11439* (F, LL, NY); bosque húmedo entre Buenos Aires y Bañaderos, Montaña San Aldefonso, 1500 m, 27 Mar 1963, *Molina 11575* (F, LL, NY, US). **El Paraíso**: pinares de Montaña Aqua Fria, 1300 m, 14 Mar 1956, *Molina 7391* (F, LL); sobre paderones de Montaña San Cristóbal sur de Agua Fria, 1400 m, 15 Mar 1957, *Molina 7626* (F, GH, US); en paderones húmedos del bosque mixto pinoliquidambar del Higuerito, SO de Mineral de Agua Fria, 1600 m, 15 Mar 1957, *Molina 7660* (F); bancos húmedos del bosque mixto de Montaña Agua Fria, 1400 m, 14 Mar 1963, *Molina 11329* (F); bancos húmedos del bosque mixto Montaña Agua Fria, 1400 m, 14 Mar 1963, *Molina 11347* (F, LL, NY, US); bosque mixto Montaña Teupasenti entre El Junquillo y Teupasenti, 1400 m, 26–27 Apr 1963, *Molina 11855* (F, LL, NY, US); matorrales húmedos del bosque mixt., Sierra El Chile entre El Junquillo y El Robledal, 1300 m, 12 Jan 1964, *Molina 14152* (LL, NY). **Gracios a Dios**: mountain peak, Camp Tiro, 2 mi NW of Bulebar on third northern branch of Quebrada Tiro, tributary of Río Plantano, 15° 43′N, 84° 50′W, 25 Mar 1981, *Saunders 1112* (NY). **Ocotepeque**: Aldea El Portin, Agua Caliente-Santa Rosa de Copán, 18.1 mi E of Santa Fé, 26.8 mi SW of bridge over Rio Higuito near village of Cucuyagua Copán, 14° 28′N, 89° 15′W, 1800 m, 28 Jan 1987, *Croat & Hammon 63809* (DUKE). **Olancho**: road to Catacamas from Azuacalpa, pine and oak forest, 24 Feb 1982, *Blackmore & Health 1892* (MO); along Río Olancho, on road between San Francisco de la Paz and Gualaco, 7.3 mi NE of San Francisco de la Paz, 14° 58′N, 86° 12′W, 1130 m, *Croat & Hannon 64188* (DUKE). **NICARAGUA. Chontales**: vicinity of Santo Domingo near summit of Peña Blanca, 800–850 m, 9 Apr 1961, *Bunting & Licht 1179* (DUKE, F, NY, US). **Jinotega:** San Ramón, lado E de las faldas del Cerro Kilambé, 13° 34′N, 85° 40′W, 800–900 m, *Moreno 7407* (DUKE); Las alturas de Kilambé, NE del Cerro Kilambé, 13° 37′N, 85° 40′W, 600–900 m, *Moreno & Sandino 7590* (DUKE); Cerro Kilambé, falde E del Pico Pedra Pelona, 13° 34′N, 85° 40′W, 1300–1400 m, 28 Mar 1981, *Moreno 7768* (MO). **Neuva Segovia**: Los Planes, 16 Sep 1985, *Moreno 26417* (MO); gallery forest along the Río Solonli (or Río Arriba Jalapa), 5 km N of Jalapa, 700–950 m, 5 Apr 1977, *Neill 1638* (DUKE). **Zelaya**: cloud forest along trail from Cerro El Inocente toward Cerro Saslaya near source of Caño Majagua, 13° 46′N, 85° 00-01′W, 1050–1150 m, 8 Mar 1978, *Stevens 6700* (MO).

4. **Lobelia calochlamys** (J.D. Smith) Wilbur, comb. nov. — *Centropogon calochlamys* J.D. Smith, Bot. Gaz. (Crawfordsville) 46:112. 1908. *Pratia calochlamys* (J.D. Smith) F. Wimmer, Repert. Spec. Nov. Regni Veg. 29:50. 1931. — TYPE: GUATEMALA. ALTA VERAPAZ: in monte silvoso prope Cobán, 1650 m, Aug 1907, *von Tuerckheim II, 1893* (HOLOTYPE: US!; ISOTYPES: GH! NY!).

Erect, glabrous herbs 2 – 6 dm tall with unbranched stems up to 6 mm in diameter. Leaves cauline, drying papery, the blades elliptic to elliptic-oblong or lance-oblong to ovate, 5 – 16 cm long and 2.5 – 5.5 cm wide, 2 – 4 times as long as wide, apically abruptly to gradually acuminate, basally cuneate and conspicuously tapering into a partially or distally winged petiole, marginally evenly and finely serrate throughout or for the upper 2/3 to 3/4 with (1) 2 – 10 serrations per cm and the teeth purplish and ca. 0.5 – 1 mm long; petioles rather stout, 1 – 3.5 cm long. Flowers solitary in the axils of the upper leaves or much-reduced bracts, 4 – 5.5 cm long; pedicels (2)4 – 6(8) cm long (at least in fruit), slender, not more than 1 mm in diameter and bearing 2 inconspicuous, filiform bracteoles 1 – 2 mm long either basally or up to 2 cm above the base. Hypanthium broadly campanulate or hemispheric with a free rim ca. 1.5 mm high; calyx lobes triangular, elliptic or lance-ovate, about 3 times as long as the height of the hypanthium, 11 – 21 mm long and 5 – 12 mm broad basally, conspicuously serrulate with often purplish teeth, apically acute or somewhat acuminate; corolla rose-purple or bright red tinged with purple, 3.5 – 4.5 cm long, glabrous externally but internally with short, hyaline, inflated trichomes, the tube 22 – 26 mm long, slightly curved, broadest basally, dorsally cleft to within 4 – 6 mm of the base, the lobes long-attenuate with the 2 upper lobes erect, 1.5 – 2.0 cm long and with the 3 lower lobes 7 – 10 mm long and slightly recurved, fused and forming a definite lower lip; filament tube 2.5 – 3 cm long sparingly to densely puberulent with stiff, whitish trichomes ca. 0.2 – 0.4 mm long either throughout or restricted to the commissural grooves, the distal portion of the grooves completely free of the corolla, the anther tube 7 – 9 mm long, bluish gray, glabrous externally but the 2 lower anthers penicellate with stiff, whitish trichomes 1 – 2 mm. Capsule apically dehiscent by 2 valves, hemispheric, not inflated, ca. 8 mm wide and 6 mm high; seeds light brown, ellipsoid or oblongoid, flattened, shallowly pitted-reticulate, ca. 0.5 – 1 mm long and 0.5 – 0.7 mm wide.

Distribution: northern Guatemala from 900 – 2400 m elevation.

Additional specimens examined: **GUATEMALA. Alta Verapaz**: in monte silvoso prope Cobán to Chama, 3000 ft, 1 Jun 1920, *Johnson 299* (F, US); Gebirgswalder, 1650 m, Aug 1907, *von Tuerckheim II 1893* (A, MO). **Baja Verapaz**: du sylva montaña, June, *von Tuerckheim s.n.* (A). **Huehuetenango**: Cerro Huitz between Barillas and Mimanhuitz, Sierra de los Cuchumatanes, 1600 – 2600 m, 14 Jul 1942, *Steyermark 48545* (F); between

Xoxlac and Nacapuxlac, Sierra de los Cuchumatanes, 1650 – 2500 m, 17 Jul 1942, *Steyermark 48916* (F); in stream bed in ravine above San Juan Ixcoy, Sierra de los Cuchumatanes, 2400 m, 4 Aug 1942, *Steyermark 48916* (F).

5. **Lobelia zelayensis** Wilbur, sp. nov. (Fig. 1).

Herba suffructicosa, 1 – 2 m alta, glabra. Petioli glabri, 2 – 5(-7) cm longi. Lamina foliorum elliptica vel lance-elliptica, ca. (8)10 – 15(20) cm longa et 2 – 6(8) cm lata, glabra, serrulata. Flores 5.0 – 5.8 cm longi, axillaris; pedicelli glabri, ebracteolati, 4 – 7 cm longi et 1 mm diametri; hypanthium 5 – 6 mm longum et 6 – 9 mm diametrum, glabrum; lobi calicis anguste triangulares, 11 – 15 mm longi, serrulati; corolla rubra, glabra; tubus ca. 2.5 cm longus et 4 – 7 mm diametro, non fenestratus sed in dorso usque and basim fissus; lobi 20 – 25 mm longi, acuti; filamentae 3 – 3.5 cm longae, puberulentae; tubus anthearum 8 – 10 mm longi, glabri sed apices anthearum 2 barbati. Capsula 1.5 cm longa et 10 – 12 mm diam.

Suffrutescent herb or shrublet 1 – 1.5(2) m tall with glabrous stems mostly 3 – 8 mm in diameter. Leaves cauline, ± spreading and ascendent, the blades (8)10 – 15(20) cm long and 2 – 6(8) cm wide, elliptic to lance-elliptic, apically acute to more typically acuminate with a sharply tapering tip 1 – 2.5 cm long, basally rounded to moderately cuneate, marginally sharply serrulate for approximately the distal three quarters with 2 – 4 purplish teeth per cm and each of these pointing strongly towards the apex with the outer margin 0.6 – 1.2 mm long and the inner margin 0.4 – 0.8(1.0) mm long; petiole glabrous, smooth, channeled above, 2 – 5(7) cm long. Flowers ca. 5.0 – 5.8 cm long, arising from the axils of the little reduced upper leaves; pedicels slender, glabrous, ascendent, ebrateolate, 4 – 7 cm long and ca. 1 mm in diameter; hypanthium broadly campanulate to hemispheric 5 – 6 mm high and 6 – 9 mm in diameter at anthesis, glabrous, indistinctly 10-nerved; calyx lobes 11 – 15 mm long and 2 – 2.5 mm wide basally, narrowly lanceolate to linear, acute, indistinctly serrulate with 1 – 3 minute teeth per side; corolla reportedly red or reddish purple externally and white within, glabrous externally and internally, the tube ca. 2.5 cm long and 4 – 7 mm in diameter, nonfenestrate but eventually dorsally cleft to within 1 – 2 mm of the base, the lobes narrowly linear, 20 – 25 mm long and 1.5 – 2 mm wide, acute; filaments 3 – 3.5 cm long, the tube minutely puberulent throughout, the anther tube 8 – 10 mm long, externally glabrous but the 2 lower anthers tufted with stiff sordid trichomes 1 – 1.5 mm long. Capsule dehiscing apically by 2 valves, approximately 1/3 – 1/2 superior, ca. 1.5 cm high and 10 – 12 mm in diameter; seeds ca. 0.8 – 1 mm long and 0.6 mm wide, lenticular, flattened, shallowly foveolate-reticulate.

Type: Nicaragua. Depto. de Zelaya: Cerro El Hormiguerro, W range; ca. 13 44'N, 85 00'W, elev 1100 – 1183 m; dense virgin elfin forest, 15 Apr 1979, *J. J. Pipoly 5150* (holotype: MO!; isotype: DUKE!).

Distribution: known only from Nicaragua.

Additional specimens examined: **NICARAGUA. Jinotega**: Peñas Blancas, 27 Dec 1973, *Atwood, Marshall* & *Neill* 6896 (MO). **Zelaya**: Cerro La Pimienta; 13° 44′40″N, 84° 59′55″O, bosque enano, 1000 – 1200 m, *Grijalva 327* (DUKE, MO), Cerro Saslaya, 20 km W of Siuna, cloud forest, elev. 1100 – 1400 m, along eastern ridge of mountain, 5 May 1977, *Neill 1829* (MO), Cerro Saslaya, elfin forest near summit at 1650 m, *Neill 3850* (DUKE, MO), Cerro La Pimienta, northern slope facing La Garrapata, ca. 13° 45′N, 84° 59′W, elev. 900 – 1180 m, lower elfin forest, *Pipoly 6041* (DUKE, MO); same locality, *Pipoly 6060* (DUKE, MO).

6. **Lobelia guatemalensis** (B.L. Robinson) Wilbur, comb. nov. — *Centropogon guatemalensis* Robinson in J.D. Smith, Bot. Gaz. (Crawfordsville) 20:4. 1895. *Pratia guatemalensis* (B.L. Robinson) F. Wimmer, Repert. Spec. Nov. Regni Veg. 29: 50. 1931. — Type: GUATEMALA. Alta Verapaz: Pansamala forest, Jun 1885, *von Turckheim 728* (holotype: GH!; isotypes: NY!).

Erect, terrestrial herbs with usually unbranched stems 3 – 4 dm tall and up to 5 mm in diameter, glabrous throughout except for tufts of axillary puberulence in the axils of the floral bracts. Leaves cauline, drying stiff-papery, the blades broadly ovate, obovate or broadly elliptic, mostly 10 – 20 cm long and 4 – 8 cm wide, usually 2 – 2.5 times as long as wide, apically abruptly short-acuminate and basally acute and cuneately ± tapering decurrently along the petiole, marginally crenate with 3 – 4 low teeth per cm; petioles stout, narrowly margined by the decurrent blade, 2 – 6 cm long. Inflorescence terminal, appearing racemose or subcorymbose, commonly with 10 – 25 flowers, 10 – 17 cm long; pedicels borne in the axils of bracts and these sharply differentiated from the leaves, the pedicels spreading, stiff, 2 – 4 cm long, ca. 1 – 1.5 mm in diameter, occasionally purplish with 2 filiform bracteoles 1 – 2 mm long at or very near the base. Hypanthium in anthesis short-campanulate, often purplish, ca. 6 mm high and about as wide, extending above the ovary for ca. 2 mm as a free rim, notably 10-costate, enlarging slightly in fruit; calyx lobes deltoid or narrowly triangular, blunt to subacute, ca. (3)5 – 7 mm long and basally 4 – 5 mm wide, entire to obscurely denticulate with the hypanthial costae extending into the base for 2 – 3 mm; corolla purplish red when dry, 4.5 – 6 cm long, glabrous externally while internally puberulent with colorless inflated trichomes within and at the base of the lower lip, the tube 23 – 30 mm long, broadest at the base and narrowing slightly to the apex, slightly curved, the dorsal sinus deeper than the 2 lateral sini and extending to ca. 1.5 – 2 cm from base, the limb 2-lipped with the 2 upper lobes erect, narrowly subulate, 1.5 – 2.7 cm long and 4 – 6 mm wide at base, the 3 lobes of the lower lip linear or narrowly elliptic, acute, 8 – 18 mm long and 1 – 2.5 mm wide; filaments (30)35 – 41 mm long, basally distinct but connate throughout most of their length, completely free from

FIG. 1. *Lobelia zelayensis*. A. Isotype of *Lobelia zelayensis* Wilbur (*Pipoly 5150*, DUKE). B. Enlargement of isotype showing serrations of the leaf margin.

the corolla, externally densely puberulent throughout with inflated short trichomes, the anther tube 7.5 – 8.5 mm long, dark bluish gray (at least when dry) with the 2 shorter anthers densely white-tufted apically but otherwise either glabrous or sparely tufted at base and near apex or occasionally with stiff trichomes on the connective. Fruit and seeds not seen.

The authorities of the binomial *Centropogon guatemalensis* is unsettled or in conflict in the literature as well as in the standard indices and hence some explanation of the usage employed here is desirable (McVaugh 1943 p. 114; Wimmer 1943 p. 119; Nash 1976 p. 429; Gray Index and Index Kewensis). The binomial when first published under J.D. Smith's byline and was there attributed to [B.L.] Robinson. The original description was not accompanied by a Latin diagnosis as were all of the treatments in that paper attributed to Donnell Smith. I consider this evidence that the original account was provided by B.L. Robinson and at most edited by J. Donnell Smith. Therefore, the basionym *Centropogon guatemalensis*, following Article 46.2 of the ICBN, should be attributed to "B.L. Robinson in J.D. Smith" or when shortened to B.L. Robinson alone.

Distribution: wet montane forest of northern Guatemala and Honduras.

Additional specimens examined: **GUATEMALA. Alta Verapaz**: near Finca Sepacuité, 26 Mar 1902, *Cook & Griggs 167* (US); Finca Volcán to Cerro Sillab, Senehu, 27 Jul 1936, *Hatch & Wilson 152* (F, GH); Trece Aguas, 21 Apr 1906, *Lewton 388* (US); Sepacuité, Oct 1901, *Owen 11* (US). **Baja Verapaz**: between Purula and Panzal, 21 Apr 1905, *Pittier 149* (F, US), Wald bei Purula, 1700 m, Apr 1907, *von Turckheim II 1739* (GH, NY, US). **HONDURAS. Cortes**: en bosque lluviosos de Montaña de Cusuco, Cordillera de Ildefonso, 1500 – 2000 m, 26 May 1956, *Molina 7260* (LL).

7. **Lobelia nubicola** McVaugh, N. Amer. Fl. 32A: 94. 1943. — Type: GUATEMALA. Chiquimula: in mixed Liquidambar forest below cloud forest, middle slopes of Montaña Norte to El Jutal, on Cerro Brujo, southeast of Concepción de las Minas, 1700 – 2000 m, 2 Nov 1939, *Steyermark 31048* (holotype: US!; isotype: F!).

Shrubby plants 0.6 – 1.0(1.5) m tall, smooth, glabrous throughout. Leaves cauline, spreading, 10 – 30 per shoot and deciduous after one growing season, membranous when dry, lanceolate, apically attenuate-caudate, basally tapering, 5 – 12 cm long and 1 – 1.6 cm wide, mostly 6 – 10 times as long as wide, marginally shallowly crenate with 3 – 4 minute, serrulate, often purplish teeth per cm; petioles somewhat wing-margined, 1 – 2 cm long. Inflorescence of few-15 flowers each borne in the axil of a little-reduced, upper leaf on a purplish, spreading-ascendent pedical 3 – 3.5 cm long in fruit and ca. 0.7 mm in diameter, apparently ebracteolate. Flowers ca. 4.5 cm long; hypanthium in anthesis turbinate or cup-shaped, ca. as broad as high, 7 – 8 mm high and broad; calyx lobes narrowly triangular, obscurely denticulate, acute, 4 – 5 mm long and ca. 1.5 mm wide; corolla purple, externally glabrous, puberulent within along the base of the lower lip and along the abaxial side of the tube, the tube about 27 mm long, entire except for the dorsal slit extending to ca. 3 mm from base, cylindrical but enlarging distally to ca. 6 mm in diameter and narrowest ca. 5 mm above the base, the lobes linear-attenuate and all decurved-falcate with the 2 upper lobes ca. 15 mm long and 3 mm wide at base, the 3 lower lobes forming a lip ca. 13 mm long with each lobe ca. 7 mm long and 3 mm wide at base; filament tube ca. 28 mm long with the distal half glabrous, the filaments distinct basally but there weakly adherent to the corolla, the anther tube ca. 7 mm long, bluish-gray, the 2 shorter anthers apically white-tufted with stiff trichomes and the 3 longer anthers glabrous except for a few stiff bristle in the distal half. Capsule apically dehiscent by 2 valves; seeds not seen.

Distribution: montane forests in Guatemala and Honduras.

Additional specimens examined: **GUATEMALA. Chiquimula**: middle slopes of Montaña Norte to El Jutal, on Cerro Brujo, SE of Concepción de las Minas, 1700 – 2000 m, 2 Nov 1939, *Steyermark 31048* (F, US). **HONDURAS. Ocotepeque**: Pinares y liquidambares, 1500 – 2000 m, Camino de Yaruchel a Belén Gualcho, 2 – 15 Apr 1977, *Nelson, Romero, Rubis & Pereira 3943* (DUKE).

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ARDITTI, JOSEPH, Ed. 1990. **Orchid Biology, Reviews and Perspectives. V.** Timber Press, Portland, Oregon. Hardbound $58.00. 450 pp.

In this fifth volume, Joseph Arditti continues his excellent task of gathering contributions to orchid biology and culture. First, Frits W. Went, discoverer of auxin, writes "Orchids in My Life." It is an adventure in the history of botany, starting with his auxin discovery, CO_2 studies, through thermoperiodic studies with mention of many explorations and friends in botany, Chapter 2. The Western Australian Fully Subterranean Orchid *Rhizanthella gardneri*, by Kingsley W. Dixon, John S. Pate and John Kuo covers history, habitat, biology and morphology, endophyte and nutrition, seed morphology and germination, comparison to other Australian Achlorophyllous orchids, and conservation suggestions. Chapter 3: Water Relations in Orchids, by Russell Sinclair covers Structure and Function, Water Relations of Tissues, Transpiration, Crassulacean Acid Metabolism in Orchids, Epiphyte Distribution Patterns, and Special Cases. Chapter 4: Auto-Pollination in Orchid's, by Paul M. Catling covers Recognition of Self-Pollination and the Use of Terms, Characteristics of Auto-pollinating Orchids, Methods of Auto-Pollination Degree of Auto-Pollination, Phenotypic and Genotypic Control, Occurrence in the Orchid Family, Geographic Aspects, Evolutionary Implications and Taxonomic Implication. Chapter 5: A review of the Genus *Dactylorhiza* by Leonid V. Averyanou covers Anatomy and Morphology of *Dactylorhiza*, flowers, pollen, seeds, chromosomes, taxonomy of Genus *Dactylorhiza*, Hybridization, and Natural History of the Genus *Dactylorhiza* and its species. Chapter 6: Power and Passion: The Orchid in Literature by Martha W. Hoffman Lewis covers orchids in Nineteenth Century England, Orchids in England before World War II, French and German Orchids 1884-1921, Orchids in United States: The Nineteenth Century, Orchids in United States before World War II, and Orchids in Contemporary Literature. Chapter 7: Perspectives of Tropical Orchids In Space Research by Tatyana M. Czerevczenko and Irene V. Kosakovskayoc covers materials and Methods and Results and Discussion. Appendix: Flowering Month of Orchid Species under cultivation by Robert M. Hamilton contains a list of synonyms and their month of flowering months of species under cultivation, a list of 5,594 species. *Dottie M. Woodson*

BATES, DAVID M., RICHARD W. ROBINSON, CHARLES JEFFREY. 1990. **Biology and Utilization of The Cucurbitaceae.** Cornell University Press, 124 Roberts Place, Ithaca, New York, 14850. Hardbound. $69.50. 485 pp.

This text covers the interrelations of studies on the biology and utilization of cucurbits. It is divided into five parts dealing with systematics and evolution, comparative morphology, sex expression, utilization and crop improvement and protection. There are 36 chapters by reseachers from around the world. This book is well written and includes an appendix of the classification of the Cucurbitaceae including 118 genera and 825 species. *Dottie M. Woodson*

TYPIFICATION OF *VERNONIA TENUIFOLIA* SMALL AND *V. JAMESII* TORREY & GRAY (COMPOSITAE)

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ABSTRACT

Jones, in a study of the fasciculate group of *Vernonia*, designated the single collection *C. Wright 242* as the lectotype for both *V. jamesii* Torrey & Gray and *V. tenuifolia* Small. *Vernonia jamesii* Torrey & Gray is based on the type of *V. altissima* Nutt. β *marginata* Torrey and as such is typified by the specimen, *Dr. E. P. James* "On the Arkansa?," [sic] cited by Torrey. Although Small cited no specimens in his description of *V. tenuifolia* in 1898, he did annotate the collection *Wright 242* (NY), which can serve as the lectotype for that name.

In 1827 John Torrey prepared an account of the botanical specimens collected by Dr. E. P. James during the 1820 expedition to the Rocky Mountains commanded by Major Stephen H. Long. Among the taxa described as new by Torrey was *Vernonia altissima* β *marginata*. Torrey questioningly placed this variety under *V. altissima*, a plant that he admittedly had not seen. Rafinesque (1832) raised Torrey's variety to specific rank as *V. marginata* (Torrey) Raf., and referred back to Torrey's original description. Later, Torrey and Gray (1841), without mentioning *V. marginata* (Torrey) Raf., proposed the name *V. jamesii* Torrey & Gray. In so doing they placed Torrey's *V. altissima* β *marginata* in synonymy and also gave unmistakable reference to the same collection, "On the Arkansas? Dr. James!," on which Torrey's β *marginata* was based.

Since *Vernonia marginata* (Torrey) Raf. (1832) and *V. jamesii* Torrey & Gray (1841) are based on the same type specimen the later name, *V. jamesii* Torrey & Gray, is superfluous.

In 1898 Small named a new species of *Vernonia*, *V. tenuifolia*, from western Texas, but did not cite specimens or designate a type. Gleason (1922) recognized Small's *V. tenuifolia*, but again did not designate a type; he merely stated "Type locality: Texas. Distribution: Texas." Shinners (1950) also failed to typify *V. tenuifolia* when he reduced it to a variety of *V. marginata*.

Jones (1972; Jones & Faust 1978) placed *Vernonia altissima* var. *marginata* Torrey, *V. jamesii* Torrey & Gray, and *V. tenuifolia* Small in synonymy under *V. marginata* (Torrey) Raf. In his 1972 paper on fasciculate vernonias Jones also designated lectotypes for all three names. He correctly designated the James collection from the Long Expedition as the lectotype for *V. altissima* var. *marginata*, but incorrectly designated the *C. Wright 242* specimen as the lectotype for both *V. jamesii* and *V. tenuifolia*.

Since Torrey and Gray based their *Vernonia jamesii* on *V. altissima* β *marginata* Torrey, the James collection, the only specimen cited in their description, must also serve as the type for *V. jamesii*. According to Jones (1972), however, Torrey later annotated another specimen, *Wright 242*, as *V. jamesii*. This same sheet was later annotated by Small (Jones 1972), as *V. tenuifolia*. Jones (1972) reasoned that since Small had annotated *Wright 242* as *V. tenuifolia* Small over Torrey's annotation of the collection as *V. jamesii* Torrey & Gray that he (Small) was providing another name for *V. jamesii*. This is, however, not the case since the situation is one of taxonomy and not of nomenclature. As long as Small did not annotate the James collection, the type of *V. altissima* β *marginata* Torrey, as *V. tenuifolia* then it cannot be assumed that he was including it in *V. tenuifolia*. Also, *Wright 242* was collected in 1849, 22 years after Torrey named *V. altissima* β *marginata* and 17 years after Torrey and Gray's *V. jamesii* was published, and Wright's collection could not have been among the material on which those names were based. Furthermore, because Small did not annotate the James collection as *Vernonia tenuifolia*, that name cannot, as Jones concluded (1972), be considered superfluous.

The typification for *Vernonia altissima* Nutt. β *marginata* Torrey, *V. marginata* (Torrey) Raf., *V. jamesii* Torrey & Gray, and *V. tenuifolia* Small, should be as follows:

Vernonia altissima Nutt. β **marginata** Torrey, Ann. Lyceum Nat. Hist. New York 2:210. 1827. — Type: the specimen collected on Long's First Expedition, *"Dr. James*, On the Arkansa" (NY).

Vernonia marginata (Torrey) Raf., Atlantic J. 1:146. 1832. — Based on *Vernonia altissima* Nutt. β *marginata* Torrey.

Vernonia jamesii Torrey & Gray, Fl. N. Amer. 2:58. 1841, nom. superfl. et illeg. — Based on the same type as *Vernonia altissima* Nutt. β *marginata* Torrey.

Vernonia tenuifolia Small, Bull. Torrey Bot. Club 25:145. 1898. No specimens cited, typified by *C. Wright 242*, the specimen at NY bearing the annotation *V. tenuifolia* in Small's handwriting. — (Lectotype (as designated by Jones 1972): NY; possible isolectotypes: GH, 3 sheets.)

Vernonia marginata (Torrey) Raf. var. **tenuifolia** (Small) Shinners. — Based on *Vernonia tenuifolia* Small.

ACKNOWLEDGEMENTS

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COX, P.A. AND S.A. BANACK (eds.). 1991. **Islands, plants, and Polynesians. An introduction to Polynesian Ethnobotany.** Dioscorides Press, 9999 S.W. Wilshire, Portland, Oregon. Hardbound. $34.95 plus $3.75 shipping. 228 pp.

This interesting book is the Proceedings of a Symposium Sponsored by the Institute of Polynesian Studies, Brigham Young University-Hawaii Campus Laie, Hawaii. Ethnobotany is the study of the use of plants by indigenous peoples and in the case of this book the Polynesians. Quoting from chapter 1, by R. Raymond Fosberg, "Polynesia includes the islands scattered over a vast triangular area in the Pacific with Hawaii, Easter Island, and New Zealand as its apices, and with a scattering of outlying islands westward into Melanesia and Micronesia. All the islands are tropical or subtropical except New Zealand and its outlying islands and groups, which are temperate or even cold." The book has ten chapters and includes and index to scientific names and an index to Polynesian words.

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BROWN, CLAUD L., L. KATHERINE KIRKMAN. 1990. **Trees of Georgia and Adjacent States**. Timber Press, Inc., 9999 S.W., Wilshire, Portland, Oregon 97226. Hardbound. 292 pp.

This manual includes summer and winter keys and descriptions of 205 native taxa with 432 color photographs of leaves, flowers, fruit, and bark and 95 black and white photographs of winter twigs. After a thorough introduction, the Summer Key to genera then family and Species Descriptions are divided by angiosperms and conifers. There is a list of Introduced and Naturalized Species and a glossary. This manual could be used by naturalist, horticulturist and gardeners. *Dottie M. Woodson*

CAILLET, MARIE, JOSEPH K. MERTZWEILLER. 1988. **The Louisiana Iris**. P.O. Box 9005, Waco, Texas 76714. Hardbound. 225 pp.

Louisiana irises are rhizomatous and beardless. There are five species in Louisiana and surrounding states. This text published by The Society of Louisiana Irises covers Chapter 1: History of Louisiana Irises, Chapter 2: Classification and Species, Chapter 3: Diversity and Adaptability, Chapter 4: Natural Hybrids and Collecting, Chapter 5: Propagation of Louisiana Irises, Chapter 6: Diploids and Tetraploids, Chapter 7: Hybridizing Louisiana Irises, Chapter 8: Culture of Louisiana Irises, Chapter 9: Diseases and Pests, Chapter 10: Irises Shows, Judging and Awards, Chapter 11: Uses and Other Activities. There is a glossary and many line drawing, painting, and photographs. This book is a must for everyone interested in irises. *Dottie M. Woodson*

OAKS, ALBERT. 1990. **Ornamental Grasses and Grasslike Plants**. Van Nostrand Reingold, New York, N.Y. Hardbound $64.00. 614 pp.

An illustrated text on grasses, bamboos, grasslike plants, rushes and sedges and their ornamental uses. Chapter 1: covers types, adaptations, and uses of ornamental grasses with selected species described by botanical name, synonym, common name, origin, habitat, description, uses and cultivation. Chapter 2: describes bamboo; Chapter 3: describes grass-like plant; Chapter 4: describes rushes and sedges with the same format as Chapter 1. There are 5 appendixes for quick reference and a glossary. There are 150 illustrations. This text is a good reference for any one interested in using or identifying grasses. *Dottie M. Woodson*

EUPHORBIA JOHNSTONII (EUPHORBIACEAE), A NEW SPECIES FROM TAMAULIPAS, MEXICO, WITH NOTES ON *EUPHORBIA* SUBSECTION *ACUTAE*

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ABSTRACT

Euphorbia johnstonii, a newly recognized species from northern Tamaulipas, is described and illustrated. It most closely resembles *E. acuta*, from which it is distinct in its less upright habit, shorter, wider leaves, shorter, appressed vestiture, and geographical distribution. *Euphorbia johnstonii* is a member of Boissier's subsection *Acutae*, a group of *Euphorbia* which are morphologically intermediate between *Euphorbia* subgenus *Agaloma* and *Euphorbia* subg. *Chamaesyce*. Three species considered here to belong to subsect. *Acutae* are mapped and compared.

RESUMEN

Se describe e ilustra Euphorbia johnstonii una especie nueva del norte deTamaulipas. Esta especie es semejante a *E. acuta*, de la cual se distingue por su hábito menos erecto, menor tamaño, hojas más anchas y cortas, indumento adpreso y distribución geográfica diferente. *Euphorbia johnstonii* es miembro de la subsección *Acutae* de Boissier, un grupo de *Euphorbia* morfológicamente intermedio entre *Euphorbia* subgénero *Agaloma* y *Euphorbia* subg. *Chamaesyce*. Se mapean ycomparan las tres especies consideradas dentro la subsección *Acutae*.

Boissier (1862) placed *Euphorbia acuta* Engelm., *E. angusta* Engelm. and *E. lata* Engelm. in his subsection *Acutae* of the section *Anisophyllum* Roeper. The section *Anisophyllum* is now recognized as the genus *Chamaesyce* S. F. Gray by some recent *Euphorbia* specialists (Webster 1967; Koutnik 1987, 1984; Hassall 1976) or as *Euphorbia* subgenus *Chamaesyce* Raf. (Oudejans 1989, Carter 1988, Johnston 1975) by those who prefer a broader concept of *Euphorbia*. Three synapomorphies cited as evidence of monophylesis in subgenus *Chamaesyce* are terminal differentiation of the apical meristem with the formation of the first pair of leaves (Hayden 1988), C_4 photosynthesis (Webster et al. 1975), and the possession of obvious, nonglandular, interpetiolar stipules (Koutnik 1987). Members of the subsect. *Acutae* resemble subg. *Chamaesyce* in their entirely opposite, asymmetrical leaves and four-glanded cyathia but (excluding *E. lata*) are

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aberrant in their C_3 photosynthetic pathway (Webster et al. 1975) and glandular stipules. *Euphorbia johnstonii* Mayfield sp. nov., in common with subg. *Chamaesyce*, has opposite, asymmetrical leaves and four-glanded cyathia, but, like members of the subsect. *Acutae*, has linear, glandular stipules and no organized bundle sheath (pers. obs. at $\times 400$ without staining) indicating C_3 photosynthesis. Within *Euphorbia*, this combination of characters is unique to the subsect. *Acutae* supporting a close relationship between *E. johnstonii* and these taxa. Cytological evidence suggests a base number of $\times = 14$ for the subsect. *Acutae* (Urbatsch et al 1975), however *E. johnstonii* is yet to be counted. *Euphorbia lata* possesses persistent, interpetiolar stipules and C_4 photosynthesis and, in spite of a chromosome number based on $\times = 14$ (2n = 28II, Keil 1976), is not part of the subsect. *Acutae* as defined above. Therefore, *Euphorbia* subsect. *Acutae* includes only those three species here shown to possess glandular stipules and C_3 photosynthesis, and which, in these features, depart from other members of the subgenus *Chamaesyce*.

Euphorbia johnstonii Mayfield, sp. nov. (Fig. 1).

Euphorbiae acutae Engelm. similis sed habitu subprostrato, foliis brevioribus latioribusque, et caulibus vestimento strigoso differt.

Perennial herbs with minute, appressed pubescence; stems arching to nearly horizontal or prostrate; vestiture mostly sparse to canescent on young growth, white, trichomes not more than 0.20 mm in length. Roots tuberous, fusiform, to ca. 8 cm long and 1.5 − 2.0 cm wide, 2 − 8 cm below the soil surface. Underground stems persistent, produced singly, ca. 1 − 15 cm long, often thickened and branching at ground level to produce 1 − 5 aerial stems. Aerial stems articulated, few to numerous, radiating from the underground stem apex, to ca. 15 cm long, 0.9 − 1.4 mm thick, stramineous at maturity; internodes (2-) 4 − 10 (-20) mm long. Stipules 2 per node, glandular, caducous (rarely evident), subulate, basally canescent, 0.9 − 1.5 mm long. Leaves opposite; petioles brief, usually 0.4 − 0.6 mm long; blades broadly ovate, (3-) 5 − 8 (-13) mm long, (4-) 6 − 8 (-12) mm wide; abaxially pubescent with evenly-distributed, outcurved trichomes ca. 0.2 mm long, these reaching the margins of the adaxial surface which is otherwise glabrous, or sometimes sparsely beset with similar, though scattered trichomes; base asymmetric, rounded, or less often cordiform; apex obtuse, produced into a shortly acuminate point. Cyathia solitary at the nodes on the distal-most 1/3 to 1/2 of the stems, strigulose, the orifice slightly constricted, ca. 2.0 mm high and 2.3 mm wide just below the glands; peduncles 0.8 − 1.2 mm long; glands 4, sessile, oblong to narrowly elliptic, slightly convex, burgundy to red-brown, 0.4 − 0.6 mm in width

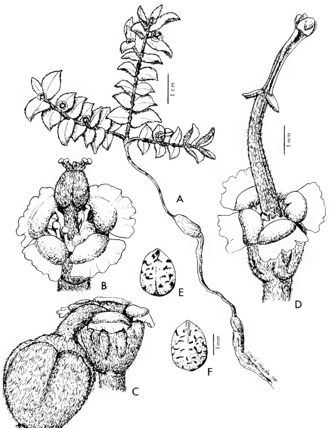

FIG. 1. A. Habit (1 cm bar); B – D. Cyathium at various stages of development (1 mm bar, upper right); B. at onset of female pedicel elongation; C. late in male flowering phase; D. after capsule dehiscence; E – F. Seed, ventral and dorsal sides, respectively (1 mm bar, lower middle). Drawn from isotype (*Mayfield et al. 762*, URV).

(in the radial plane of the cyathium), 1.1 – 1.5 mm long (tangential to the rim of the cyathium); appendages basally the same width as the glands, slightly wider at their apex, ochre-white, 0.2 – 0.6 mm long, the margins erose to crenulate, rarely deeply parted. Staminate flowers 25 – 35 per cyathium. Pistillate flowers, at anthesis, borne on pedicels ca. 2 mm long, ovary densely appressed-tomentose; styles 3, distinct from the base, ca. 0.5 mm long, bifid for 1/3 – 1/2 their lengths, stigmas as wide as or slightly wider than the styles. Capsules 2.6 – 2.8 mm long, sparsely appressed-puberulent, pedicels to 6 mm long at dehiscence. Seeds (2.1-) 2.2 – 2.3 (-2.6) mm long, 1.6 – 1.7 mm wide, ovate in outline, obscurely 4-angled in cross-section; seed surface mostly pale with broad, light to dark-brown, obscurely transverse, shallow depressions.

TYPE: MEXICO. TAMAULIPAS: 47 mi (76 km) S of the bridge at Reynosa on the San Fernando Hwy (Mex 97), 29 mi (47 km) N of the jct. with Mex 101, between the towns of Alfredo V. Bonfil and Pedro J. Mendez, caliche cuesta with dark, fine grained, loamy soils, elev. 59 m, N 25° 26′25″ W 98° 13′22″, 11 Jul 1991, *Mayfield et al. 762* (HOLOTYPE: TEX; ISOTYPES: MEXU, URV, US).

Additional collections examined: MEXICO. TAMAULIPAS: 10 mi E of Abasolo on the road to [La] Pesca, near Los Añejos, 900 ft, caliche upland of the Goliad Cuesta, 6 Feb 1960, *{Crutchfield and} Johnston 5041* (TEX); 13 mi E of the Abasolo turnoff on the Santandar Jimenez-Pesca road, 15 Dec 1960, *{Crutchfield and} Johnston 6140b* (TEX); 3 mi W of Morales, 19 mi E of the Matamoros-Victoria Hwy on the road to Loreto, calichified sand upland with short brush and prairie openings on the deeper sand, frequent perennials, Apr 26 1960, *{Crutchfield and} Johnston 5346* (TEX); km 164 on Matamoros-Victoria Hwy 101, rocky roadside, *Leucophyllum* dominant, 22 Apr 1971, *Richardson 1415* (TEX); 48 mi from Reynosa on the San Fernando road, 27mi from Matamoros-San Fernando Hwy turnoff, brush on caliche spot, 19 Oct 1959, *Johnston and Graham 4381* (TEX); 47 mi S of Reynosa on the road to San Fernando, short brush on caliche outcrop, abundant perennial herbs, 25 Apr 1960, *{Crutchfield and} Johnston 5333* (TEX). NUEVO LEON: Monterrey Hwy, 65 km S of Nuevo Laredo in hard, sandy marl and silt, 7 Apr 1962, *Dominguez M. and McCart 8243* (TEX).

Euphorbia johnstonii most closely resembles *E. acuta*, from which it is distinguished by its shorter pubescence and shorter, wider leaves. In vestiture, *E. johnstonii* is nearly identical to *E. angusta*, a plant strikingly different in its lance-linear to linear leaves and strong, woody taproots. In the field, the low stature and short, arching (sometimes prostrate) stems of *E. johnstonii* (Fig. 1) are very different from the longer, decumbent to ascending stems of *E. acuta* and *E. angusta*. *Euphorbia acuta* often has red leaves in the late part of the growing season, a character not observed the either of the other species. Mature seeds offer the best characters for differentiation of these three species. A tabular comparison of morphological differences between the three species is given in Table 1.

TABLE 1. Morphological distinctions between *E. johnstonii* and its nearest relatives.

	E. johnstonii	*E. acuta*	*E. angusta*
Vestiture	appressed; trichomes 0.3 mm long	spreading; trichomes 0.3 mm long	appressed; trichomes 0.3 mm long
Leaf shape L:W ratio	Ovate 1.3:1 or less	Lance-ovate 1.3–4.0:1	linear to lance-linear greater than 5.0:1
Aerial stems	arching strongly to prostrate; up to 15 cm long	decumbent to ascending; 20–35 cm long	always ascending; 30–40 cm long
Seeds	shallowly alveolate; depressions brown, ridges pale	smooth; concolorous	obscurely transversely rugose; concolorous
Cyathium	campanulate; ca. 2.0 mm wide	turbinate; ca. 1.5 mm wide	funnelform; ca. 1.0 mm wide
Male flowers	25–35	20–25	5

The new species is allopatric with respect to its nearest congeners (Fig. 2) and is almost exclusively confined to the state of Tamaulipas, Mexico. This was the initial clue to its distinctiveness. The only botanist to have systematically collected in this vicinity was Marshall C. Johnston and associated collectors in the late 1950's and early 1960's. Because his collections account for the majority of exsiccatae, the specific epithet is in recognition of his efforts. Lack of botanical exploration in addition to the ephemeral nature of the above ground parts may partially explain the paucity of specimens of *E. johnstonii*. Widespread habitat destruction in northern Tamaulipas since the 1950's may also be a factor. No specimens were seen from Texas, even though the nearest collection is within about 25 air miles of the border at San Ignacio in Zapata County, where similar habitat is found. The Rio Grande may provide a natural barrier for this plant which has its center of distribution farther south and east. Future collections will probably extend the range southward in Nuevo Leon and perhaps northwest into Coahuila.

Euphorbia acuta has the most westerly distribution of the subsect. *Acutae* with stations reaching northwestern Chihuahua and south-central New Mexico (Fig. 2). It seems to prefer calcareous or gypseous clayey soils of the Chihuahuan Desert. Current collections place the center of *E. angusta*'s distribution in the limestone uplands of the Edwards Plateau and adjacent Coahuila, but its occurrence far to the south in Coahuila's Sierra de la Gavia indicates a possible hiatus of collections from Coahuila. *Euphorbia johnstonii* appears to be restricted to the thornscrub of Tamaulipas, which extends into south Texas, northern Nuevo Leon, and extreme eastern Coahuila. To

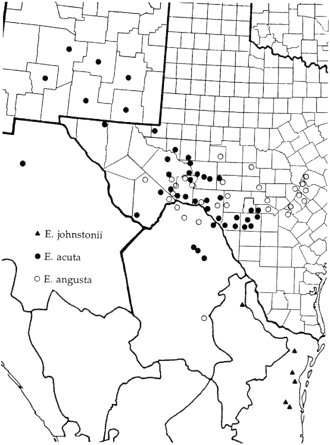

FIG. 2. Documented distribution of *Euphorbia johnstonii*, *E. acuta*, and *E. angusta*.

the north and west, Tamaulipan thornscrub blends into the Chihuahuan Desert and Edwards Plateau vegetation, where the other two species of the subsect. *Acutae* occur. The new species can be found in open areas on low, caliche-hills of the Tamaulipan coastal-plain and Rio Grande drainage in calcareous, sandy loam with *Asclepias prostrata*, *Leucophyllum frutescens*, *Guaiacum angustifolium*, *Turnera diffusa*, *Melochia tomentosa*, *Macrosiphonia lanuginosa*, *Heliotropium confertifolium*, and *Evolvulus* sp.

ACKNOWLEDGEMENTS

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UPTON T. WALTER. 1989. **Dendrobium Orchids of Australia.** Timber Press, Portland Oregon. Hardbound. 237 pp.

The genus *Dendrobium* is one of the largest in Orchidaceae. In Chapter 1: Walter Upton briefly describes the genus and with text and fine illustrations explains the subgenera and sections. Chapter 2: History of the genus *Dendrobium* in Australia. Chapter 3: Descriptions of *Dendrobium* species in Australia describes each Australian species by synonyms, description chromosome #, habitat, culture, and hybrids with illustrations and photographs by Upton. Chapter 4: Natural hybrids occurring in Australia. Chapter 5: History of hybridization. Chapter 6: Pollination and seed raising. Chapter 7: Culture Appendix 1: Main months of flowering in native habitat. Appendix 2: *Dendrobium* hybrids using only Australian indigenous parents registered to February 1988. Appendix 3: *Dendrobium* hybrids including *Phalaenopsis* and *D. schroederianum* in their parentage to March 1987. Appendix 4: Reclassifying the genus *Dendrobium*. Appendix 5: Authors of plant names and publication abbreviations. Appendix 6: Name changes of *Dendrobium* orchids as proposed November 1988. The text and illustrations will be helpful to anyone studying *Dendrobium*. *Dottie M. Woodson*

WAGNER, WARREN L., DERRAL R. HERBST, S.H. SOHMER. 1991. **Manual of The Flowering Plants of Hawaii** Volume I and II. University of Hawaii Press, Bishop Museum Press. Hardbound. 1854 pp.

This manual provides keys and descriptions for 146 families, 649 genera and 1, 817 species of native and naturized plants. Eight years and fifty contributors make this study of The Flowering plants of The Hawaiian Archipelago the most complete since Hillebrand's a century ago. The first volume includes chapters on Methods and Scope, Geology, Climate, Vegetation, Important Collections, and Abbreviations. The listings are alphabetically arranged within dicots and monocots. The glossary, literature cited, 240 illustration vouchers, and index are in volume II. This manual would be excellent for any studying plants and plant distributions as well as any one wanting to grow plants from these islands. *Dottie M. Woodson*

REVISION OF THE GENUS *CINNA* (POACEAE)

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ABSTRACT

Variational patterns and discontinuities were studied in *Cinna* (Poaceae). Nearly 4000 herbarium specimens of the genus were examined; four species were recognized on the basis of features of the spikelets. *Cinna arundinacea* inhabits moist forests in eastern North America; *C. latifolia* occupies similar sites in circumboreal regions; *C. poaeformis* occurs in mountainous areas from Mexico to Venezuela and Bolivia; and *C. bolanderi* is a central montane Californian endemic previously considered conspecific with *C. latifolia*. Keys, descriptions, illustrations, and distribution maps are provided for all species.

Cinna L. is a small but widely distributed genus of perennial grasses. It was originally described by Linnaeus (1753), who recognized *C. arundinacea* L., mostly a woodland species of eastern North America. Subsequent authors referred this species to *Agrostis* and *Muhlenbergia*, both of which differ from *Cinna* by several characters. Fernald and Griscom (1935) described *C. arundinacea* var. *inexpansa* Fern. & Grisc. as a southern Coastal Plain native supposedly differing from typical *C. arundinacea* by its more ascending panicle branches and its smaller spikelets.

A second species, the circumboreal *C. latifolia* (Trevir. ex Göpp.) Griseb. in Ledeb., was first described in 1830 as a species of *Agrostis*, *A. latifolia* Trevir. ex Göpp., by Treviranus (Göppert 1830). Trinius (Bongard 1833), however, considered the taxon to be a species of *Muhlenbergia*, *M. pendula* Trin. in Bong.; later he (Trinius 1841) transferred it to *Cinna* as *C. pendula* (Trin. in Bong.) Trin. The combination *Cinna latifolia* was made by Grisebach (Ledebour 1853). For several decades the epithet *pendula* — not *latifolia* — was misapplied to the species. Gray (1856) treated the taxon as *C. arundinacea* var. *pendula* A. Gray. Other authors named several varieties

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of *C. pendula*, and it was not until the late 19th century that the earlier specific epithet, *latifolia*, came into widespread use.

A third member of the genus, *C. poaeformis* (H.B.K.) Scribn. & Merr., is a montane species ranging from Mexico south to Venezuela and Bolivia. Originally described by Humboldt, Bonpland, and Kunth (1815) as *Deyeuxia poaeformis* H.B.K., it has also been treated as belonging to *Calamagrostis* or *Poa*. The combination *Cinna poaeformis* was eventually made by Scribner and Merrill (1901). *Cinnastrum* of Fournier (1886), based on *Deyeuxia poaeformis*, was established apparently because of Linnaeus' failure, in the original description of *Cinna*, to note the prolonged rachilla. Fournier characterized *Cinnastrum* by "*spiculus bifloris, flore superiore ad pedicellum sterile redacto*."

A collection of *Cinna* from central California was recognized by Scribner (1884) as distinct from *C. latifolia*; he named it *C. bolanderi* Scribn. in honor of H.N. Bolander, who collected it in 1866. The species was later reduced to the synonymy of *C. latifolia* by Hitchcock (1935). We are reinstating it to specific rank; it is quite distinct from *C. latifolia* (see discussion under *C. bolanderi*).

Behrens (1877) gave a brief account of nervature of the palea of *C. arundinacea* and *C. latifolia*; Brandenburg et al. (n.d.) more fully described that of *C. arundinacea*. Chase (1911a) published a short paper on subterranean organs of "*Cinna arundinacea*"; she later discovered that the specimens she studied were *Arrhenatherum elatius* (L.) Presl (Chase 1911b). Størmer (1949) observed that just below the glumes of *Cinna* is a slight collar that, upon disarticulation of the spikelets from the plant, persists as a small cupule at the apex of the pedicel; he regarded this cupule to be of diagnostic value in differentiating from *Cinna* those Norwegian grasses likely to be confused with it. Several writers have noted that grains of *Cinna* contain semi-liquid endosperm (Dore 1956; Martin 1946; Terrell 1971).

Cinna clearly belongs to the subfamily Pooideae on the basis of spikelet morphology, in conjunction with evidence obtained from root-hair development (Row and Reeder 1957), features of the embryo (Reeder 1957), leaf anatomy (Brown 1958), and chromosome number (Bowden 1960; Davidse and Pohl 1978). Hitchcock (1950) included *Cinna* as a member of the Agrostideae, a tribe not recognized by most later authors (e.g., Stebbins and Crampton 1961), who assigned the genus to Aveneae. Recently, Macfarlane and Watson (1982) reexamined the relationship between these two tribes; in their final analysis *Cinna* is placed in a recircumscribed Agrostideae. However, Clayton and Renvoize (1986) classified *Cinna* in tribe Aveneae, subtribe Alopecurinae, the latter consisting of grasses with "spikelets 1-flowered; glumes commonly enclosing florets; palea not gaping."

We define *Cinna* as having the following generic characters:(1) spikelets 1-flowered, (2) disarticulation below the glumes,(3) awn (when present) subterminal, (4) rachilla typically prolonged behind the palea as a small glabrous or scaberulous stub or bristle, and (5) palea 1-nerved, or 2-nerved and the nerves very close together.

Two characters traditionally employed to define the genus should be mentioned. The first of these, the prolonged rachilla, varies from a minute stub in *C. arundinacea* to a slender bristle half the length of the lemma in *C. poaeformis*. However, this prolongation is often difficult to detect (especially in *C. arundinacea*), occasionally absent, and is therefore a poor character to use as the principal basis for identifying *Cinna* in a generic key (cf. Hitchcock 1950). The second feature associated with the genus is the presence of monandrous flowers. Although this holds true for *C. arundinacea* and *C. latifolia*, *C. poaeformis* and *C. bolanderi* have diandrous flowers. Because there is such a clear-cut distinction among the species of *Cinna* on this basis, there is a temptation to recognize two sections within the genus (especially when one considers that *C. arundinacea* and *C. latifolia* also have stipitate florets and 3-nerved lemmas, while *C. poaeformis* and *C. bolanderi* have more or less sessile florets and normally 5-nerved lemmas). However, even though *C. bolanderi* agrees with *C. poaeformis* in these characters, on the basis of macromorphology it is markedly similar to the other two species rather than to *C. poaeformis*. Also, lemmas of both *C. arundinacea* and *C. latifolia* on rare occasion have five nerves. Hence we decided against subdivision.

This revision is based on the study of about 4000 sheets of *Cinna*. To save space, specimens are not cited; such citations are given in Brandenburg (1980).

CINNA L., Sp. Pl. 1:5. 1753; Gen. Pl. 1:6. 1754.

Abola Adans., Fam. Pl. 2:31, 511. 1763. Based on *Cinna* L. *Blyttia* Fries, Novit. Fl. Suec. Mant. Alt. 2:2. 1839 (fide Berg 1966).

Cinnastrum Fourn., Mex. Pl. 2:90. 1886. Based on *Deyeuxia poaeformis* H.B.K.

Tall perennials with solitary or cespitose culms, sometimes tinged with purple. Nodes and internodes glabrous or rarely somewhat scaberulous. Blades flat, the margins scabrous; adaxial and abaxial surfaces scabrous or smooth. Ligules scarious. Sheaths open, glabrous. Panicle branches spreading or ascending, the axis and pedicels scabrous to smooth. Spikelets laterally compressed, 1-flowered or very rarely with a second rudimentary or fertile floret above the first. Disarticulation below the glumes. Rachilla prolonged behind the palea as a minute stub or slender bristle, this smooth or scaberulous at tip, occasionally absent. Glumes acute, 1- or 3-nerved, sometimes minutely awn-tipped; keel upwardly scabrous, body smooth or occasionally scaberulous, margins hyaline; first glume somewhat shorter than or equalling the second. Floret sessile or stipitate. Lemma similar to glumes, 3- or 5-nerved (the nerves parallel and often faint or obscure), with a short, straight, upwardly scabrous awn just below the apex (mostly awnless in *C. poaeformis*, sometimes awnless in the other species). Palea hyaline, mostly smooth, 1-nerved, or 2-nerved and the nerves very close together, upwardly scaberulous along the keel(s). Grain yellowish-brown, often beaked by the persistent style. Stamens 1 or 2. $x = 7$.

TYPE SPECIES: *Cinna arundinacea* L.

KEY TO THE SPECIES OF *CINNA*

1. First glume 3-nerved; spikelets ± obtuse .... 4. *C. poaeformis*
1. First glume 1-nerved; spikelets acute.
   2. Stamens 2; lemma 5-nerved; floret ± sessile .... 3. *C. bolanderi*
   2. Stamen 1; lemma mostly 3-nerved; floret raised on a 0.1 − 0.65 mm stipe.
      3. Second glume prominently 3-nerved; spikelets typically 4 − 6 mm in length .... 1. *C. arundinacea*
      3. Second glume 1-nerved (very rarely 3-nerved); spikelets typically 2.5 − 4 mm in length .... 2. *C. latifolia*

Spikelets of the four species of *Cinna* are shown in Fig. 1; diagnostic features of the species, in Table 1.

TABLE 1. Diagnostic features of the species of *Cinna*.

	C. arundinacea	*C. latifolia*	*C. bolanderi*	*C. poaeformis*
Length of spikelets, mm*	(3.5)4 − 6(7.5)	(2)2.5 − 4(5)	(3.6)4 − 5.5(6.3)	1.9 − 3(3.5)
Number of nerves on glume 1	1	1	1	3
Number of nerves on glume 2*	3	1(3)	1 or 3	3
Floret stipitate or sessile	stipitate	stipitate	± sessile	± sessile
Number of nerves on lemma*	3(5)	3(5)	5	5
Number of stamens	1	1	2	2
Anther length, mm	0.8 − 1.9	0.4 − 1.1	1.2 − 2.6	0.5 − 1.2

*The word "usually" should be understood here.

1. **Cinna arundinacea** L., Sp. Pl. 1:5. 1753. — (PHOTOTYPE: Linnaean Herbarium, IDC No. S-3-8! We designate this specimen as the lectotype, as a second specimen of original material, IDC No.S-3-6!, also exists.) — TYPE LOCALITY: CANADA.

Agrostis cinna Lam., Tabl. Encycl. 1:162. 1791. Based on *Cinna arundinacea* L. *Agrostis cinna* Pursh, Fl. Amer. Sept. 1:64. 1814. Based on *Cinna arundinacea* L. *Cinna agrostidea* Beauv. ex Steud., Nom. Bot. 1:20, 198. 1821. Based on *Agrostis cinna* Lam. (*C. "agrostoides"* according to Hitchcock). *Muhlenbergia cinna* Trin., Gram. Unifl. 191. 1824. Based on *Agrostis cinna* Lam.

Cinna arundinacea L. var. *inexpansa* Fern. & Grisc., Rhodora 37:135, pl. 334, fig. 1, 2. 1935.

Plants 2.8 – 18.3 dm tall, somewhat bulbous at base. Nodes 5 – 13. Blades to 34.5 cm long, 3 – 19 mm wide. Ligule 2 – 10 mm long. Panicle green, gray-green, or purplish, 6.5 – 55 cm long, 1 – 22 cm broad, loosely to densely flowered; branches ascending to spreading. Spikelets acute, (3.5)4 – 6(7.5) mm long. Floret raised on a 0.25 – 0.65 mm stipe. First glume somewhat shorter than lemma, 1-nerved, (2.7)3.5 – 5(6.1) mm long; second glume equal to or slightly longer than lemma, 3-nerved, (3.5)4 – 6(7.5) mm long. Lemma 3-nerved, occasionally with an additional nerve along one or both sides, (2.7)3.5 – 5(6.4) mm long; awn 0.2 – 1.5 mm long, rarely absent. Palea 1-nerved, 2.4 – 4.6 mm long. Grain 2.1 – 2.8 mm long. Prolonged rachilla 0.1 – 0.4 mm long, sometimes absent. Stamen 1, anther 0.8 – 1.9 mm long. $2n = 28$ (Bowden 1960), 40 (Avdulov 1928, *fide* Fedorov 1969. The report of $2n = 40$ is suspicious because all other available counts for *Cinna* are on a base number of $x = 7$). Fig. 1A.

General range: eastern North America (Fig. 2A).

Habitat: most commonly found in moist woodlands, in swamps, along streams, and in upland woods, less commonly in wet meadows, marshes, and waste ground and along roadsides; elevation ca. 0 – 850 m.

Flowering and fruiting time: late summer and fall.

Discussion: *Cinna arundinacea* may be distinguished from *C. latifolia* primarily by its strongly 3-nerved second glume and secondarily by its larger spikelets. Inflorescence characters commonly employed in floras — *C. arundinacea*: panicle dense, the branches ascending versus *C. latifolia*: panicle loose, the branches spreading — are not reliable, as it is not uncommon for *C. arundinacea* to have very open panicles and drooping branches.

Two collections seen of *C. arundinacea* have not been mapped. The first is an August 1890 collection by Sandberg (PENN 25045) labeled "Isanti Co., Idaho." There is no Isanti County in Idaho, a state west of the range of the species (the specimen may have come from Minnesota, where there *is* an Isanti County). The second sheet (*Sheldon 268*, MU), labeled "*Deschampsia caespitosa*, "is from Clear Creek Co., Colorado. As this state is also west of the range of *C. arundinacea*, it is probable that somehow a mix-up of label data occurred.

Cinna arundinacea was attributed to Montana and northern North Dakota by McGregor et al. (1977). The voucher specimen (*Stephens 67806*, KANU) for the Montana report is a species of *Calamagrostis*. We were unable to locate any voucher for the North Dakota report.

2. **Cinna latifolia** (Trevir. ex Göpp.) Griseb. in Ledeb., Fl.Ross. 4:435. 1853. — TYPE LOCALITY: EUROPE. *Agrostis latifolia* Trevir. ex Göpp., Beschr. Bot. Gart. Breslau 82. 1830.

Muhlenbergia pendula Trin. in Bong., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 2:172. 1833.

Cinna expansa Link, Hort. Berol. 2:236. 1833.

Agrostis suaveolens Blytt ex Sommerf., Kongl. Vetensk. Acad. Handl. 1837:256. 1838. *Blyttia suaveolens* Fries, Novit. Fl. Suec. Mant. Alt. 2:2. 1839. Based on *Agrostis suaveolens* Blytt ex Sommerf. *Cinna suaveolens* Rupr. ex Ledeb., Fl. Ross. 4:435. 1853. Based on *Agrostis suaveolens* Blytt ex Sommerf.

Cinna pendula (Trin. in Bong.) Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Nat. 4:280. 1841. The earlier *Muhlenbergia pendula* Trin. not mentioned. *Cinna arundinacea* L. var. *pendula* A. Gray, Man. ed. 2. 545. 1856. Based on *Cinna pendula* (Trin. in Bong.) Trin.

Cinna pendula (Trin. in Bong.) Trin. var. *glomerula* Scribn., Proc. Acad. Nat. Sci. Phila. 1884:290. 1884. (LECTOTYPE here designated: *Tweedy 664*, US!).

Cinna pendula (Trin. in Bong.) Trin. var. *glomerata* Macoun, Cat. Canad. Pl. 2(V):393. 1890. Epithet ascribed to "Scribn."; error for var. *glomerula* Scribn.

Cinna pendula (Trin. in Bong.) Trin. var. *acutiflora* Vasey ex Macoun, Cat. Canad. Pl. 2(IV):203. 1888, nom. nud.; then, in the same Macoun work (p. 393. 1890), *C. pendula* var. *acutiflora* was published as a synonym of *C. pendula* var. *glomerula* Scribn. ("*glomerata*"). (LECTOTYPE here designated: *Macoun 30004*, US!; ISOLECTOTYPE: F!)

Cinna pendula (Trin. in Bong.) Trin. var. *mutica* Vasey in Macoun, Cat. Canad. Pl. 2(IV):202, 1888, nom. nud.; name validly published in Contr. U.S. Natl. Herb. 3:57. 1892. (LECTOTYPE here designated: *Cusick s.n.*, US!; isolectotype: NY!).

Cinna latifolia (Trevir. ex Göpp.) Griseb. in Ledeb. var. *glomerata* Beal, Grasses N. Amer. 2:319. 1896. Epithet ascribed to "Scribn."; error for var. *glomerula* Scribn.

Plants 2 − 19 dm tall. Nodes 4 − 9. Blades to 28 cm long, 1 − 20 mm wide. Ligule 2 − 8 mm long. Panicle green or purplish, 3 − 46 cm long, 0.5 − 20 cm broad, loosely to densely flowered; branches spreading or sometimes ascending. Spikelets acute, (2)2.5 − 4(5) mm long. Floret raised on 0.1 − 0.45 mm stipe. Glumes ± equal, longer than to shorter than lemma, each 1-nerved (second glume very rarely 3-nerved); first glume (1.8)2.5 − 4(4.7) mm long; second glume (1.9)2.5 − 4(5) mm long. Lemma 3-nerved (rarely faintly 5-nerved), the lateral nerves often

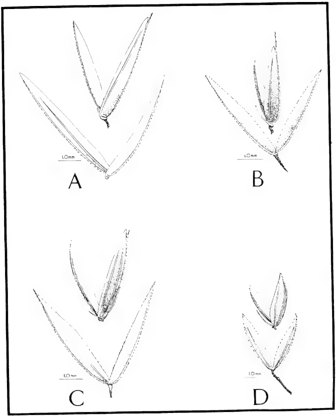

FIG. 1. Spikelets of *Cinna*. A. *C. arundinacea*. B. *C. latifolia*. C. *C. bolanderi*. D. *C. poaeformis*.

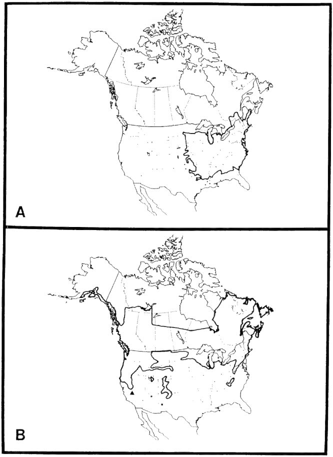

FIG. 2. Generalized range of *Cinna arundinacea*. *C. latifolia* (New World), solid line. *Cinna bolanderi*, California, triangle.

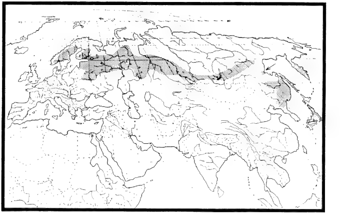

FIG. 3. Generalized range of *Cinna latifolia* (Old World). Adapted from Hultén and Fries 1986.

obscure, 1.8 − 3.8 mm long; awn 0.1 − 2.5 mm long or absent. Palea 2-nerved, the nerves very close together, or 1-nerved, 1.8 − 3.4 mm long. Grain 1.8 − 2.8 mm long. Prolonged rachilla slender, 0.1 − 1.3 mm long, sometimes absent. Stamen 1, anther 0.4 − 1.1 mm long. $2n = 28$ (Bowden 1960; Ehrenberg 1945). Fig. 1B.

General range: circumboreal (Fig. 2B, 3).

Habitat: moist to wet soil in woodlands, swamps, thickets, bogs, and streamsides; elevation ca. 0 − 2600 m.

Flowering and fruiting time: late summer and fall.

Discussion: Morphologically, this is the most variable of the species of *Cinna*, a fact doubtless accounting for the several varietal names proposed. There are no consistent differences between the Eurasian plants and those from the New World. A collection from the Aleutian Islands (*Eyerdam 1791*, UC, US) is peculiar with its abnormally large (to 5.5 mm) and often 2-flowered spikelets. These measurements are not included in the above description of *C. latifolia*.

Cinna latifolia was attributed to northeastern Montana and northwestern North Dakota by McGregor et al. (1977). We were unable to locate any vouchers to verify this report.

3. **Cinna bolanderi** Scribn., Proc. Acad. Nat. Sci. Philadephia 1884:290. 1884. — (LECTOTYPE here designated: *Bolander 6090*, US(#323939)!; ISOLECTOTYPES: DS! GH! MO! NY! US!) — TYPE LOCALITY: central montane California. *Cinna pendula* var. *bolanderi* (Scribn.) Vasey, Contr. U.S. Natl. Herb. 3:57. 1892. Based on *Cinna bolanderi* Scribn.

Plants 8.5 – 20.3 dm tall. Nodes 4 – 8. Blades to 40 cm long, 2 – 19 mm wide. Ligule 3.5 – 7 mm long. Panicle green to golden green, 7.5 – 43 cm long, 3 – 18 cm broad, loosely to densely flowered; branches spreading to loosely ascending. Spikelets acute, (3.6)4 – 5.5(6.3) mm long. Floret ± sessile. First glume longer than to shorter than lemma, 1-nerved, (3.3)3.5 – 5.2(6) mm long; second glume longer than or equal to lemma, 1- or 3-nerved, (3.6)4 – 5.5(6.3) mm long. Lemma 5-nerved, the lateral nerves sometimes faint or obscure, (2.7)3.2 – 4.6 mm long; awn 0.2 – 1.5 mm long or absent. Palea 2-nerved (the nerves approximate), (2.7)3 – 3.5(3.8) mm long. Grain 2 – 2.9 mm long. Prolonged rachilla slender, 0.4 – 0.9 mm long, sometimes absent. Stamens 2, anthers 1.2 – 2.6 mm long (rarely underdeveloped and to 0.7 mm long). No chromosome number available. Fig. 1C.

General range: central montane California (Fig. 2C).

Habitat: meadows and streamsides; elevation ca. 1900 – 2400 m.

Flowering and fruiting time: late summer and fall.

Discussion: *Cinna bolanderi* is endemic to central montane California (Fresno, Mariposa, and Tulare counties); all collections we have seen are from Sequoia National Park, Kings Canyon National Park, and the southern tip of Yosemite National Park. *Cinna latifolia* is more northern in range in California, the southernmost record being from just north of Yosemite National Park. *Cinna bolanderi*, with its two stamens, is easily distinguished from the monandrous *C. latifolia*. Another noticeable difference is the length of the anthers, those of *C. bolanderi* being much the larger. Diagnostic characters for fruiting specimens of *C. bolanderi* are the larger spikelets, the sessile florets, and the 5-nerved lemmas (though the nerves are often faint).

4. **Cinna poaeformis** (H.B.K) Scribn. & Merr., Bull. U.S.D.A., Div. Agrost. 24:21. 1901. — TYPE LOCALITY: MEXICO. *Deyeuxia poaeformis* H.B.K., Nov. Gen. Sp. 1:146. 1815. (TYPE: P!). *Poa subuniflora* Kunth, Révis. Gram. 115. 1829. Based on *Deyeuxia poaeformis* H.B.K. *Calamagrostis poaeoides* Trin. ex Steud., Nom. Bot. ed. 2. 251. 1840. Based on *Poa subuniflora* Kunth. *Cinnastrum poaeforme* (H.B.K) Fourn., Mex. Pl. 2:91. 1886. Based on *Deyeuxia poaeformis* H.B.K. *Calamagrostis poaeformis* (Fourn.) Beal, Grasses N. Amer. 2:349. 1896. Based on *Cinnastrum poaeforme* Fourn.

Cinnastrum miliaceum Fourn., Mex. Pl. 2:91. 1886.

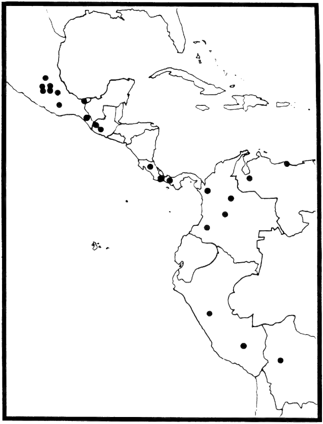

FIG. 4. Documented distribution of *Cinna poaeformis*.

Plants 2.8 − 22.2 dm tall. Nodes 4 − 9(11). Blades to 33 cm long, 1 − 18 mm wide. Ligule prominent, (1)5 − 12 mm long. Panicle green or purplish, 7 − 47 cm long, 1 − 18 cm broad, many-flowered; branches spreading. Spikelets ± obtuse, 1.9 − 3(3.5) mm long. Floret ± sessile. Glumes thick in texture, ± equal, longer than to shorter than lemma, each 3-nerved; first glume $1.8-3(3.4)$ mm long; second glume $1.9-3(3.5)$ mm long. Lemma thick in texture but tearing easily lengthwise, 5-nerved (one or both pairs of lateral nerves often obscure), $(1.6)2-2.8(3.4)$ mm long; awn normally absent, to 0.4 mm long when present. Palea ± thick in texture, tearing easily lengthwise, 2-nerved (the nerves approximate), $(1)1.7-2.4(2.9)$ mm long. Grain $1.3-1.8$ mm long. Prolonged rachilla slender, $0.3-2$ mm long, rarely absent. Stamens 2, anthers $0.5-1.2$ mm long. $2n = 28$ (Davidse & Pohl 1978; Pohl & Davidse 1971). Fig. 1D.

General range: Mexico south to Venezuela and Bolivia (Fig. 4).

Habitat: mountains, in moist or dry soil of woods, meadows, and paramos; elevation ca. $2200-4000$ m.

Flowering and fruiting time: late summer and late fall in Mexico; July through May farther south.

Discussion: *Cinna poaeformis* is the most dissimilar in outward appearance among the four species in the genus. Its spikelets are small, more or less obtuse, and normally awnless; they have a prominent prolonged rachilla. However, the species agrees wholly with the characters used to circumscribe the genus.

DOUBTFUL AND EXCLUDED SPECIES

Agrostis cinna Retz., Observ. Bot. 5:18. 1789. Originally as synonym for *Cinna arundinacea* L., but 2 years later Retzius (Observ. Bot. 6:22. 1791) concluded that his *A. cinna* was really a species of the genus now known as *Muhlenbergia*.

Calamovilfa poaeformis (Fourn.) M.E. Jones, Contr. West. Bot. 14:9. 1912. Based on *Cinnastrum poaeforme* Fourn. as to name but not as to description.

Cinna? alba Nees ex Steud., Syn. Pl. Glum. 182. 1855. (Type: *Gillies legit* Medoza. In US! is a sheet marked "Type" that has but one spikelet in a packet. The lemma has a long, curved awn and callus hairs, which does not agree with Nees' description, "*flosculi valvula inferiore mutica acuta*.").

Cinna arachnoidea Kunth, Révis. Gramin. 1:67. 1829 = *Muhlenbergia expansa* (DC.) Trin., *fide* Hitchcock, Man. Grasses U.S. 900. 1950. Based on *Agrostis arachnoidea* Poir.

Cinna arundinacea Hook., Fl. Bor. Amer. 2:238. 1840 (non L., 1753). Listed in *Index Kewensis*, but no such combination made by Hooker.

Cinna arundinacea Retz. ex Steud., Nom. Bot. ed. 2. 1:365. 1841 (non L., 1753) = *Muhlenbergia mexicana* (L.) Trin., *fide* Hitchcock, Man. Grasses U.S. 903. 1950. As synonym of *Cinna mexicana* Beauv.

Cinna brownii Rupr., Beitr. Pflanzen Russ. Reich. 2:66. 1845 = *Arctagrostis latifolia* (R. Br.) Griseb. in Ledeb., *fide* Nash, N. Amer. Fl. 17:498. 1937. Based on *Colpodium latifolium* R. Br.

Cinna crinita Trin., Fund. Agrost. 118. 1820 = *Dichelachne crinita* (L.) Hook. Based on *Anthoxanthum crinitum* L., which = *Dichelachne crinita*, *fide* Chase and Niles, Index to Grass Species 1:202. 1962.

Cinna decipiens Kunth, Révis. Gramin. 1:67. 1829. Based on *Agrostis decipiens* R. Br. (*Vilfa decipiens* Beauv.) = *Deyeuxia decipiens* (R. Br.) Vickery, Contr. New South Wales Natl. Herb. 1:70. 1940.

Cinna filiformis (Willd.) Link, Enum. Pl. 1:70. 1821 = *Muhlenbergia mexicana* (L.) Trin., *fide* Hitchcock, Man. Grasses U.S. 903. 1950. Based on *Agrostis filiformis* Willd.

Cinna filiformis Llanos, Frag. Pl. Filip. 9. 1851 (non Link, 1821) = *Pogonatherum crinitum* (Thunb.) Kunth, *fide* Chase, J. Arnold Arbor. 31:131. 1950.

Cinna glomerata Walt., Fl. Carol. 59:1788 = *Andropogon glomeratus* (Walt.) B.S.P., *fide* Hitchcock, Man. Grasses U.S. 813. 1950.

Cinna glomerata (Link) Link, Hort. Berol. 2:237. 1833 (non Walt., 1788) = *Muhlenbergia glomerata* (Willd.) Trin., *fide* Hitchcock, Man. Grasses U.S. 902. 1950. Based on *Podosaemum glomeratum* Link.

Cinna japonica Nees ex Steud., Syn. Pl. Glumac. 182. 1854 = *Sporobolus elongatus* R. Br., *fide* Ohwi, Fl. Japan 176. 1965.

Cinna karataviensis N. Pavl., Vestn. Akad. Nauk Kazahsk. SSR 1:24. 1949 = *Agrostis gigantea* Roth ssp. *gigantea*, *fide* Tzvelev, Poaceae URSS:329. 1976. Earlier, *C. karataviensis* had been accepted as a species of *Cinna* in *Flora Kazakhstana* (Pavlov 1956). Two years later (Pavlov 1958), the taxon was referred to *Agrostis* (species not indicated). In 1968 (Kovalevskaya 1968) it was included in the synonymy of *Agrostis stolonifera* L., and, finally, in *Poaceae URSS* (Tzvelev 1976), as a synonym of *A. gigantea* Roth ssp. *gigantea*.

Cinna? lanata Kunth, Révis. Gramin. 1:67. 1829 = *Muhlenbergia pubescens* (H.B.K.) Hitchc., *fide* Soderstrom, Contr. U.S. Natl. Herb. 34:148. 1967. Based on *Agrostis lanata* H.B.K.

Cinna lateralis Walt., Fl. Carol. 59. 1788 = *Andropogon virginicus* L., *fide* Hitchcock, Man. Grasses U.S. 817. 1950.

Cinna lateriflora (Michx.) Kunth, Révis. Gramin. 1:67. 1829 = *Muhlenbergia frondosa* (Poir.) Fern., *fide* Hitchcock, Man. Grasses U.S. 901. 1950. Based on *Agrostis lateriflora* Michx.

Cinna macroura (H.B.K) Kunth, Révis. Gramin. 1:67. 1829 = *Muhlenbergia macroura* (H.B.K.) Hitchcock, *fide* Nash, N. Amer. Fl. 17:468. 1935. Based on *Crypsis macroura* H.B.K. ("*C. macroura* Kunth" misapplied by Thurber in S. Wats., Bot. Calif. 2:276. 1880 to *Muhlenbergia rigens* (Benth.) Hitchcock).

Cinna? mexicana (L.) Beauv., Ess. Agrost. 32, 148, 158. 1812 = *Muhlenbergia mexicana* (L.) Trin., *fide* Hitchcock, Man. Grasses U.S. 903. 1950. Based on *Agrostis mexicana* L.

Cinna mexicana (L.) Link, Enum. Pl. 1:70. 1821 = *Muhlenbergia mexicana* (L.) Trin. Based on *Agrostis mexicana* L., which = *Muhlenbergia mexicana*, *fide* Hitchcock, Man. Grasses U.S. 903. 1950.

Cinna ovata Kunth, Révis. Gramin. 1:67. 1829 = *Echinopogon* sp. Kunth lists in synonymy *Agrostis ovatus* Forst., *Echinopogon ovatus* Beauv., and *Echinopogon asper* Trin.

Cinna phleoides (H.B.K.) Kunth, Révis. Gramin. 1:67. 1829. Based on *Crypsis phleoides* H.B.K. = *Muhlenbergia* aff. *nigra*, *fide* T.R. Soderstrom, pers. comm.

Cinna? pubescens (H.B.K.) Kunth, Révis. Gramin. 1:67. 1829. *Muhlenbergia pubescens* (H.B.K.) Hitchcock, *fide* Soderstrom, Contr. U.S. Natl. Herb. 34:148. 1967. Based on *Agrostis pubescens* H.B.K.

Cinna? purshii Kunth, Révis. Gramin. 1:67. 1829 = *Calamagrostis canadensis* (Michx.) Beauv., *fide* Hitchcock, Man. Grasses U.S. 839. 1950. Based on *Arundo agrostoides* Pursh.

Cinna racemosa (Michx.) Kunth, Révis. Gramin. 1:67. 1829 = *Muhlenbergia racemosa* (Michx.) B.S.P., *fide* Hitchcock, Man. Grasses U.S. 904. 1950. Based on *Agrostis racemosa* Michx.

Cinna setifolia (Presl) Kunth, Révis. Gramin. suppl. XVI. 1830 = *Muhlenbergia macroura*

(H.B.K.) Hitchcock, *fide* Nash, N. Amer. Fl. 17:468. 1935. Based on *Crypsis setifolia* Presl.

Cinna sobolifera (Willd.) Link, Enum. Pl. 1:71. 1821 = *Muhlenbergia sobolifera* (Muhl.) Trin., *fide* Hitchcock, Man. Grasses U.S. 906. 1950. Based on *Agrostis sobolifera* Willd.

Cinna? stricta (Humb. & Kunth) Kunth, Révis. Gramin. 1:67. 1829 = *Muhlenbergia angustata* (Presl) Kunth, *fide* Chase and Niles, Index to Grass Species 1:507. 1962. Based on *Crypsis stricta* Humb. & Kunth.

Cinna tenuiflora (Willd.) Link, Enum. Pl. 1:70. 1821 = *Muhlenbergia tenuiflora* (Willd.) B.S.P., *fide* Hitchcock, Man. Grasses U.S. 906. 1950. Based on *Agrostis tenuiflora* Willd.

Cinna valdiviana Phil., Anal. Univ. Chile 1873:563. 1873. From description not a *Cinna*: *"callo brevi pilosa"*; *"pedicellus pilosus rudimentum secundi floris sistens tertiam partem paleae inferioris aequat"*; lower glume *"univervia, vix dimidiam paleam aequante."*

Cinnagrostis polygama Griseb., Abh. Königl. Ges. Wiss. Göttingen 19:208 – 209, fig. 7. 1874. Incorrectly listed as synonymous with *Cinna* L. by Willis (1973). Grisebach's account of a grass with unisexual spikelets, hairs on the rachilla, and articulation above the glumes is descriptive of a genus other than *Cinna*.

Muhlenbergia baicalensis Trin. ex Turcz., Bull. Soc. Imp. Naturalistes Moscou 24(1):21. 1856. Published as synonym of *Cinna latifolia* (Trevir. ex Göpp.) Griseb. in Ledeb.

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GOODLAND, ROBERT. Ed. 1990. **Race to Save the Tropics: Ecology and Economics for a Sustainable Future**. Island Press, Box 7, Covelo, CA 95428. Price unknow. 219 pp.

This seminal book promotes the field of applied ecology as it relates to humid tropical ecosystems and their varied problems. Robert Goodland is to be commended for assembling the superior array of active tropical applied ecologists who authored the nine chapters of the book. Topics include agroecology and its role in the design of agricultural projects, applied agroforestry and natural forests management, agricultural pest management, dams and development in the humid tropics, the teaching of applied ecology to nationals in developing countries, and the integration of applied ecology into national conservation and development plans.

The growing awareness of the plight of global tropical rainforests indicates that the lessons of this book are certainly on target. An excellent resource text for the applied ecologists and a valuable information source for non-scientists. *Joe F. Kuban.*

THE BLUE-EYED-GRASSES (*SISYRINCHIUM*: IRIDACEAE) OF ARKANSAS

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ABSTRACT

Data obtained from morphological characters and chromosome number indicate that seven species of *Sisyrinchium* should be recognized for Arkansas: *S. albidum* Raf., *S. angustifolium* Mill., *S. atlanticum* Bickn., *S. campestre* Bickn., *S. langloisii* Greene [*S. pruinosum* Bickn.], *S. rosulatum* Bickn. [*S. exile* Bickn.], and *S. sagittiferum* Bickn. These seven taxa are different from the eight previously recognized by Smith in that *S. sagittiferum* Bickn. was not listed and *S. langloisii* Greene and *S. pruinosum* Bickn., plus *S. rosulatum* Bickn. and *S. exile* Bickn., were listed as four distinct species. Distribution maps were produced using herbarium voucher specimens.

INTRODUCTION

The genus *Sisyrinchium* consists of both herbaceous perennials and annuals with simple or branched stems that may or may not be conspicuously winged. The flowers are epigynous, subtended by a spathe (made of two overlapping bracts), and have undifferentiated actinomorphic perianths. The mucronulate to aristulate tepals range in color from white or yellow with purple stripes and a purple eye-ring to more typically blue, purple, or white with a yellow eye-ring.

No major revision had been done on this genus in the southeastern United States since Small (1933), which did not include the state of Arkansas. Smith (1978) recognized eight species for the state: *S. albidum* Raf., *S. angustifolium* Mill., *S. atlanticum* Bickn., *S. campestre* Bickn., *S. exile* Bickn., *S. langloisii* Greene, *S. pruinosum* Bickn., and *S. rosulatum* Bickn. Therefore, as part of a taxonomic revision on this genus in the SE U.S. for the Southeastern Flora Project (Massey & Radford 1981), which includes Arkansas, special attention was paid to this state's species in order to update Smith's Atlas (1978).

This study was part of a dissertation completed at the University of Arkansas in Fayetteville in January 1987.

A) Morphology

Several hundred herbarium specimens of Blue-eyed-grass for the state were examined for 24 different characters (Hornberger 1987a). Discriminant analysis indicated that of these 24 characters, the following provided the best separation for Arkansas species: paired vs. single spathes, length of outer to inner spathe bracts (equal to subequal vs. unequal), connation of outer spathe bract, stem width (includes wing on either side of raised center portion), stem wing width (average value of both wings), and dried capsule color and shape. Flower color and shape are also important characters, but do not preserve well, and are, therefore, not readily available from herbarium specimens. However, they are included, along with the characters mentioned above, in the taxonomic key which follows this section.

Essentially there are two basic morphological groups, one with simple stems (*S. albidum* Raf., *S. campestre* Bickn., and *S. sagittiferum* Bickn.) and one with branched stems (*S. angustifolium* Mill., *S. atlanticum* Bickn., *S. langloisii* Greene, and *S. rosulatum* Bickn.). The species with simple stems are arranged in one of two ways: 1) the stems have either single spathes on a scape that has no cauline leaf, hence, there is no node or 2) the stems have paired sessile spathes (sometimes a single one) subtended by a cauline leaf. This latter type of stem is considered to have one node. Some of the simple-stemmed species may, however, occasionally branch, particularly *S. sagittiferum* Bickn. (Hornberger 1987a). Species that typically have branched stems have one or more nodes, each of which has a cauline leaf and one or more pedunculate spathes.

B) Chromosome Number

Chromosome reports in the literature indicate that the genus is based on $x=8$, with most of the species being tetraploids (Oliver & Lewis 1962; Oliver 1966; Goldblatt 1982; and others).

Among these chromosome reports were counts of $n = 16$ from flower bud material for only two species collected in Arkansas, *S. campestre* Bickn. and *S. langloisii* Greene (the latter taxon reported as *S. pruinosum*, Oliver & Lewis 1962; Lewis & Oliver 1961). I was able to confirm this number for *S. campestre* Bickn. from two different Arkansas populations, one in HotSpring Co. and the other in Washington Co. (Hornberger 1987a).

I also obtained the count of $n = 16$ from flower bud material for *S. langloisii* Greene, *S. rosulatum* Bickn., and *S. sagittiferum* Bickn., all collected, however, in Louisiana (Hornberger 1987a, b).

Sisyrinchium albidum Raf. was reported as n = 16 from Louisiana by Oliver & Lewis (1962). This number was originally reported by Bowden (1945) for a population collected in Virginia. It was further supported by Ingram (1964) for a population in Tennessee. Even though I have not had the opportunity to count the number for this species, it appears to be one of the tetraploid blue-eyed-grasses.

Sisyrinchium angustifolium Mill. has been reported as n = 48 from Louisiana by Oliver & Lewis (1962); they also reported this number for several populations in Texas. I have seen these specimens and agree with their identification. Hill (1984) recorded this same number for a Virginia population. However, Ingram (1964, 1967) reported n = 40, 44, 45 for populations in North Carolina, Tennessee, and Virginia. Goldblatt (1982) feels that these conflicting reports for the same species are probably more a reflection of misidentification or incorrect counts than cytological diversity.

Sisyrinchium atlanticum Bickn. has more reported diversity in chromosome number than the preceding taxon. Numbers range from n = 8 (Oliver 1966) to n = 16 (Ingram 1964; Oliver 1966; Hill 1984) to n = 48 (Oliver & Lewis 1962). I have seen the specimens collected by Oliver (1966) and I agree with the identifications. However, I have seen the herbarium specimen (Oliver 253, ASTC) of one of the two populations collected by Oliver & Lewis (1962) from Texas that was identified as *S. atlanticum* Bickn.; this specimen represents *S. biforme* Bickn., a species seemingly restricted to the Gulf Coast and offshore islands.

C) Synonymy

The genus *Sisyrinchium* has been misunderstood taxonomically for more than a century. Because of subtle differences in morphology, disagreements among botanists on recognition of legitimate taxa, synonymy, or the proper epithet for a taxon have led to a plethora of species' descriptions in the literature. Nomenclatural considerations, then, became a major task of the SE U.S. revision. Holotypes were requested for all taxa, and when they were determined lost or nonexistent, neotypes and lectotypes were designated. The only type specimen not seen was the one for *S. rosulatum* Bickn. because it was unavailable for this study. A complete discussion of types and synonyms is included in Hornberger (1987a). Synonyms will only be listed in this paper if they are different from Smith (1978) and would cause confusion if not included.

KEY TO THE SPECIES IN ARKANSAS

A. Outer spathe bract not connate at base, or only slightly so (1.0 mm or less) . . . . B

B. Spathes paired at top of stem; bracts of outer spathe slightly unequal; stem with a single cauline leaf subtending the spathes .... *S. albidum* Raf.
B. Spathe single at top of stem; bracts unequal with outer one 1 1/2 – 5 × length of inner one; stem with no cauline leaf subtending the spathe .... *S. campestre* Bickn.

A. Outer spathe bract connate at base (1.1 mm or more) C
 C. Spathe bracts equal to subequal .... D
  D. Outer spathe bract connate at base up to 2.0 mm .... *S. sagittiferum* Bickn.
  D. Outer spathe bract connate at base for more than 2.0 mm .... E
   E. Stems 2.5 mm or more wide, wings 0.9 mm or more wide *S. angustifolium* Mill.
   E. Stems less than 2.5 mm wide, wings less than 0.9 mm wide .... F
    F. Capsules pale beige with purple or brown sutures, globose to subglobose; tepals white or yellow with purple stripes and purple eye-ring; flowers urceolate .... *S. rosulatum* Bickn.
    F. Capsules brown to black, globose to obovate; tepals light blue to purple, sometimes white, with yellow eye-ring; flowers rotate .... G
     G. Inner spathe bract distinctly mucronate; spathes often deflected at base; capsules oblong-subglobose to obovate .... *S. atlanticum* Bickn.
     G. Inner spathe bract not mucronate; spathes not deflected at base; capsules subglobose .... *S. langloisii* Greene
 C. Spathe bracts noticeably unequal .... H
  H. Outer bract connate at base up to 2.0 mm; outer bract up to 3 × length of inner bract .... *S. sagittiferum* Bickn.
  H. Outer bract connate at base more than 2.0 mm; outer bract only 1 1/2 – 2 × length of inner bract .... J
   J. Stems 2.0 mm or more wide, wings 0.9 mm or more wide; tepals light blue to white with yellow eye-ring; flowers rotate; capsules dark brown .... *S. angustifolium* Mill.
   J. Stems less than 2.0 mm wide, wings less than 0.9 mm wide; tepals white or yellow with purple stripes and purple eye-ring; flowers urceolate; capsules pale beige with purple or brown sutures .... *S. rosulatum* Bickn.

DISCUSSION

Seven species were recognized in this study and will be briefly discussed in alphabetical order.

Sisyrinchium albidum Raf. is a simple-stemmed perennial with paired sessile spathes at the node, where a large cauline leaf is found. Flowers are usually white with yellow eye-rings and the globose capsules dry pale beige to a straw color. Populations bloom late March to April and are found in prairies, woods, and roadsides.

Sisyrinchium angustifolium Mill. is the most common and most robust species of Blue-eyed-grass in the state, with fairly wide leaves and stems with conspicuous wings. This perennial produces stems that typically have 1 node with a cauline leaf where two peduncles emerge. Flowers are light blue in color with yellow eye-rings and the globose to subglobose capsules dry dark brown. Plants are found in fields, woods, or along roadsides in April and May. This taxon has a very confusing nomenclatural history which is presented elsewhere (Hornberger 1987a), but several manuals currently in use have names considered synonyms: *S. bermudianum* L. emend. Fern. and *S. graminoides* Bickn. (Gleason & Cronquist 1963; Steyermark 1963).

Sisryinchium atlanticum Bickn. is a branched species found in scattered prairie areas in the state. Stems are terete to slightly flattened, with 1 − 2 nodes, and are narrowly winged (1 mm wide). Spathes are small, often deflected at the base; bracts are equal to subequal, and the inner bract is distinctly mucronate. The oblong-subglobose to obovate capsules dry dark brown to black. Flowers are generally light blue with yellow eye-rings, but the tepals are sometimes dark blue to purple. This perennial taxon blooms from March to April.

Sisyrinchium campestre Bickn. is commonly found in prairies, meadows, and grassy areas along roadsides in April and May. This perennial has a simple stem with a single spathe at the top of the scape. The bracts of the spathe are very noticeably unequal, with the outer one at least 1 − 1/2 to 2 times or more the length of the inner, gibbous one.

Sisyrinchium langloisii Greene is a branched perennial found along grassy roadsides, prairies, and disturbed areas in March and April. Its spathe bracts typically have a purple coloration which is often restricted to the base of the spathe. This taxon is similar in morphology to *S. pruinosum* Bickn., although the purple coloration of the spathe bracts is generally not present in the latter. Both taxa have the same chromosome number, 2n = 32 (Lewis & Oliver 1961; Oliver & Lewis 1962), and have been reported to hybridize in areas of overlapping range (Correll & Johnston 1970). Comparison of flavonoid spot profiles between a population from Texas and another from Louisiana showed similar patterns (Hornberger 1987a). Morphology, chromosome number, and flavonoid chemistry suggest that these various populations may actually be variations of one large species complex; therefore, I have synonymized *S. pruinosum* Bickn. under the older name, *S. langloisii* Greene.

Sisyrinchium rosulatum Bickn. is the only annual Blue-eyed-grass found in Arkansas, seemingly restricted to several southern counties, plus Polk County. Flowers are yellow to white with purple to maroon stripes and purple to maroon eye-rings. These flowers are urceolate, instead of rotate as displayed by the flowers of the other six taxa. Spathes are slender and foliaceous, with the outer bract slightly falcate at the apex and often $1 - 1/2$ times longer than the inner bract. Globose to subglobose capsules dry pale beige with purple to brown stripes along the sutures. Populations can be found in disturbed areas of roadsides and lawns, prairies, river bottoms, and pine woods. Synonyms include *S. exile* Bickn. (Smith 1978).

Sisyrinchium sagittiferum Bickn. is represented only from Miller County, with possible hybrids (*sagittiferum* × *langloisii*) collected in Union County. This taxon is usually represented by simple, leafless stems often with fibrous bases. Spathes are single (or sometimes paired) at the top of the scapes, being conspicuously broader than the stems. Spathe bracts are equal or the outer one can be three times the length of the inner one. Flowers are blue to purple with yellow eye-rings, bloom in March to April, and produce dark brown, globose to subglobose capsules, often with submarginal veins.

This latter taxon is most similar in morphology to *S. campestre* Bickn., but differs in several important respects: 1) *S. sagittiferum* has outer spathe bracts that are connate for several mm; *S. campestre* has non-connate outer bracts (less than 1.0 mm); 2) spathes of *S. sagittiferum* are conspicuously wider than the stems and dry brownish, often mixed with purple; *S. campestre* has bracts that dry green in color and are not conspicuously wider than the stems; and 3) *S. sagittiferum* often has fibrous leaf bases attached to the stems, *S. campestre* seldom does. *Sisyrinchium sagittiferum* Bickn. had been recorded for Arkansas by Demaree (1943), but not by Smith (1978). My study indicates that it should be considered part of Arkansas' flora.

SUMMARY

Based on data collected in this study from observation, investigation, and literature review, seven species of *Sisyrinchium* are recognized for the state of Arkansas: *S. albidum* Raf., *S. angustifolium* Mill., *S. atlanticum* Bickn., *S. campestre* Bickn., *S. langloisii* Greene, *S. rosulatum* Bickn., and *S. sagittiferum* Bickn. This information is presented in Smith (1988). Distribution maps were prepared for each taxon based on herbarium voucher specimens. A dot indicates that at least one specimen exists for a particular taxon in a particular county (Fig. 1). (Note: the dot in Union County for *S. sagittiferum* Bickn. represents possible hybrids between it and *S. langloisii* Greene).

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I thank E. B. Smith for serving as my dissertation advisor. Many thanks to Jerry Shell and his wonderful dog, Mittens, for helping me collect flower buds. I would also like to thank the Arkansas Native Plant Society for

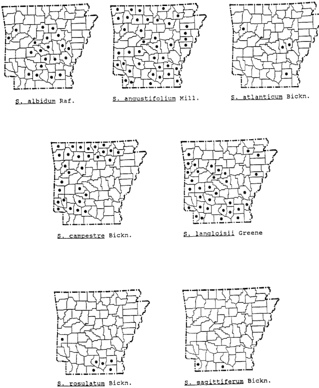

FIG. 1. Documented distribution of Arkansas *Sisyrinchium*.

awarding me the Aileen McWilliams Scholarship in Botany in 1986 which provided encouragement and financial support to finish my dissertation. Special thanks are also extended to the curators of the following herbaria for lending me specimens that made this study possible: ASTC, BH, BLH, BM, FLAS, FSU, GA, GH, LAF, MA, MIN, MO, NCSC, NCU, ND, NDG, NLU, NY, PH, SMU, TENN, UAM, UARK, US, and WIS.

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NOTES

LYCIANTHES ASARIFOLIA (SOLANACEAE), NEW TO NORTH AMERICA — In November of 1989 a colony of *Lycianthes asarifolia* (Kunth & Bouché) Bitter, was discovered growing in City Park, New Orleans, Louisiana. The plants are stoloniferous, creeping herbs with sparsely shaggy-pubescent internodes to 7 cm long. The leaves are solitary at each node, the petioles slender, to 10 cm long, laterally pubescent or glabrous, the leaf blades cordate to reniform, to 9×8 cm, obtuse to rounded at apex, cordate-auriculate at base, glabrous to subciliate. The flowers are solitary at each node, the pedicels slender, $4-7$ cm long, subglabrous, nodding at apex, subtended by a small auriculate bract at base. The calyx is cupular, to 4×5 mm at anthesis, ca. 10-costate, appressed-pubescent, 5-toothed or occasionally also with minute apiculations alternating with the teeth. The corolla is rotate-campanulate, the limb usually reflexed, $16-20$ mm broad, 5-lobed, glabrous, white. The 5 stamens are equal, the anthers $2.5-3$ mm long, apically dehiscent. The ovary is $1-2$ mm in diameter, the style $5-6$ mm long, slender, the stigma truncate to subcapitate.

The voucher collection is *Feibelman 107* (MO, NO, NY, US), comprising stems, leaves, and flowers taken from a colony covering roughly 450 sq. meters beneath *Quercus virginiana*. The colony appears to be expanding vegetatively, as no fruits have been seen at the City Park location or on plants propagated from cuttings. We surmise that the colony developed from a single introduction and is a self-sterile clone. The species is well adapted to mowing, and our plants withstood 72 hours of freezing temperatures (as low as 11° F) in 1989 without noticeable damage. *Lycianthes asarifolia* thus appears to be well adapted to the Gulf Coast climate, at least in shaded lawns, where it makes a vigorous and attractive groundcover.

Lycianthes is a genus of $150-200$ species, mostly of tropical America, but with a dozen or more species in Asia and the South Pacific. It is usually distinguished from *Solanum* by the 10-nerved calyx with 10 small teeth appearing as enations below the truncate apex, but the teeth are sometimes absent. A good discussion of generic characters is given by D'Arcy (Ann. Missouri Bot. Gard. 60: 631. 1973).

On account of its unusual habit, *Lycianthes asarifolia* was, with *L. repens* (Sprengel) Bitter, placed by Bitter (Abh. Nat. Ver. Bremen 24:422 − 426. 1920) in *Lycianthes* sect. *Asaropsis*. Both species are South American, *L.*

asarifolia reported from Venezuela, Colombia, Bolivia, Paraguay, and Argentina, while *L. repens* is apparently restricted to southeastern Brazil. Bitter distinguished the more variable *L. asarifolia* from *L. repens* on the basis of its usually longer petioles, as well as larger calyces, anthers, and fruits, among other features of indument and flower color (corollas reported as pale blue to violet in *L. repens*).

Our plants clearly fall within Bitter's concept of *L. asarifolia*, and we have compared collections from Venezuela (*Alston 6105*, USF), Colombia (*Sneidern 3121b*, GH), Bolivia (*Steinbach 6212*, GH; *Rusby 1875*, GH; *Solomon 13467*, NY; *Nee 35104*, NY), and Brazil (*Dusén 11315*, GH). Under cultivation, our plants show considerable variability in pubescence as well as leaf blade shape and dimensions. Should the two species be united, the name *Lycianthes repens* (Sprengel) Bitter, based on *Boldoa repens* Sprengel [Syst. Veg. 1: 179. 1824] would have priority. An excellent illustration of *L. repens* (as *Solanum violaefolium* Schott) can be found in Martius, Fl. Brasil. 10:52, tab. 4, fig. 44 – 46; tab. 12. 1846. A note with *Nee 35104* states that the orange, rather pleasant-tasting fruits of "motojobobo" are edible and made into preserves.

We thank Dr. M. Nee (NY) for invaluable assistance with the identification and nomenclature of this species, and Dr. M. Molvray (NO) for help with Bitter's German. The curators of GH, MO, NY, SMU, US, and USF searched their collections for North American records of *Lycianthes asarifolia*, or made other material available for our examination. — *Steven P. Darwin and Toby Feibelman, Dept. of Ecology, Evolution, and Organismal Biology, Tulane University, New Orleans, LA 70118, U.S.A.*

PALIURUS SPINA-CHRISTI (RHAMNACEAE) NEW FOR NORTH AMERICA IN TEXAS — *Paliurus spina-christi* Miller, an Eurasian rhamnaceous shrub not previously reported as naturalized in North America, has been found growing on the Edwards Plateau of central Texas. The plant is known only from Gillespie County where it was apparently introduced ca. 100 years ago. It is well established along the flood plains of two creeks and the Pedernales River and has become a pernicious weed.

In 1986, a rancher brought to the attention of Gillespie County agricultural extension agent Duery Menzies the presence of an unusual spiny shrub that was invading his pastureland along Dittmar Creek 21 km west of Fredricksburg in Gillespie County. The plant was taken to Texas A&M University in College Station by Roger Landers, Range Specialist, Texas

Agricultural Extension Service, where it was identified by Kancheepuram N. Ghandi as *Paliurus spina-christi*, known in the vernacular as Christ-thorn. Another specimen was taken to the University of Texas in Austin where Marshall Johnston also identified it as *P. spina-christi*. Ghandi (pers. comm.) stated that there has been a *Paliurus* on the TAMU campus at College Station for many years but that it has not produced other plants. Johnston (1969 and pers. comm.) who has authored publications on Rhamnaceae and traveled internationally to study the family, notes that *Paliurus* is not known in the wild as an escape in Texas or the United States. Kartesz & Kartesz (1980) does not list this taxon from the United States or Canada. James B. Phipps (pers. comm., Western Ontario Univ.) says that this plant has not been found in Canada. In addition a check of the MEXU herbarium revealed no specimens from Mexico and Rogers McVaugh (pers. comm. Univ. North Carolina, Chapel Hill) note its absence and any published report in Mexico. This plant would thus appear to be the first report of *P. spina-christi* for all of North America. Collection data are:

Collections examined: **TEXAS. Gillespie Co.**:Dittmar Creek, 5.5 km N Hwy 290, 4 May 1988, *O'Kennon 2766* (BRIT/SMU); Dittmar Creek at Hwy 290, 4 May 1988, *O'Kennon 2767* (BRIT/SMU); Spring Creek, 200 m S of Tivydale Rd, 17 Aug 1988, *O'Kennon 3117* (BRIT/SMU); Pedernales River, Boos Rd, 6.5 km S of Fredricksburg, 22 Aug 1990, *O'Kennon 7613* (BRIT/SMU).

Paliurus spina-christi is a deciduous multi-trunked shrub $3-4(-5)$ m high. The stems are spreading and armed with curved spiny stipular thorns to 1 cm. The leaves are alternate and distichous or in two ranks, short petiolate, ovate, crenate-serrate, and $2-4$ cm long. The bright yellow flowers are small but numerous in axillary cymes or terminal panicles and are striking in appearence when in full bloom. The greenish yellow fruits are flat disc-like capsules $2-3$ cm in diameter. The dried capsules often remain on the plant until the following year's flowers are blooming on new growth. This *Paliurus* is one of the legendary trees from which the Crown of Thorns was supposedly made. It has been in cultivation in Europe for over 300 years, and is sometimes cultivated in the United States (Everett 1981).

Since the first discovery of *Paliurus*, an investigation has revealed the source of the plant's introduction and the extent of its range. In the late 1800's a German homesteader planted seeds brought from Europe in order to form a spiny hedgerow along the west bank of upper Dittmar Creek 9 km north of highway 290 and 19 km west of Fredricksburg. Longtime residents of this area remember the 100 meter long hedge as having always been there. One 93 year old man who has lived on the site most of his life remembers not only the hedge but other younger thorny plants growing a short distance downstream. He states that as time passed more shrubs appeared downstream beyond sight of his ranch. Now, approximately 100 years after the plant's introduction, the Christ-thorn has proliferated extensively along Dittmar Creek 9 km south to highway 290 and well beyond. Dittmar Creek feeds into Spring Creek which flows south 11 km more before emptying into the Pedernales River south of Morris Ranch. *Paliurus* is found in large thicket-forming populations along the entire length of these creeks and is widely scattered along the Pedernales for 13 more km until just south of Fredricksburg. In time it will undoubtedly be found farther east, perhaps into Blanco County and beyond.

The capsules and their seeds appear to be carried solely by water and sprout primarily in the wide rich flood plains along the waterways. Occasional plants are found on flats just above the traditional flood plain. This can be explained by the changes in water level during torrential rains and resultant flash flooding typical of the deeply cut terrain of the central Edwards Plateau. Prior to 1978 the plants apparently remained in a restricted range from their point of introduction along upper Dittmar Creek to just north of Hwy 290 and had not yet become conspicuous pests. A 1978 flood which was associated with a stalled tropical depression, the remnants of hurricane Amelia, was most probably the force which generated the explosive proliferation of an entire generation of plants of similar size all along its present range and well outside the normal flood plain.

Because *Paliurus* heavily infests prime fertile grazing land and habitats of native wetland flora, it is now considered a pernicious weed with the potential for being as disastrous as other old world invaders such as *Lonicera japonica* Thunb. (Japenese honeysuckle), *Sapium sebiferum* (L.)Roxb. (Chinese tallow), and *Pueraria lobata* (Willd.) Ohwi. (kudzu). These plants are having devastating deleterious effects on many native plants as they take over more and more territory. Because of its rapid proliferation, a program to eradicate *Paliurus* has been initiated by the county under the direction of Mr. Menzies, and it is apparently effective.

Thanks to Barney Lipscomb of the Botanical Research Institute of Texas (BRIT) and Mr. Duery Menzies for research, helpful comments and suggestions for the manuscript. — *Robert J. O'Kennon, 30 Saint Laurent Place, Dallas, TX 75225-8111, U.S.A.*

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EUPHORBIA LATHYRIS (EUPHORBIACEAE) NEW FOR TEXAS — *Euphorbia lathyris* L., a European herbaceous euphorb not previously reported from Texas has been found naturalized on the Edwards Plateau of central Texas. The plant is known only from a single site in western Gillespie County.

Euphorbia lathyris, caper or myrtle spurge, a European euphorb has been found growing on the banks of the Threadgill Creek in western Gillespie County, Texas. This spurge is native to the Mediterranean region of southern Europe and according to Marshall C. Johnston (pers. comm.) has not been previously reported from Texas. It is not listed in the more recent Texas checklists by Johnston (1988, 1990) and Hatch et al. (1990).

Caper spurge is widely cultivated in Europe and is occasionally cultivated in the United States. It is known to have escaped cultivation in the Atlantic Northeast and in California. It is also known as "mole plant" because of its believed properties that repel moles from lawns. The seeds have cathartic properties.

Euphorbia lathyris is distinct from other Texas euphorbs in its tall, somewhat conspicuous habit. It gets up to a meter tall with narrow leaves to 14 cm long arranged in four vertical rows along the stem. The inflorescence is umbellately branched with the floral bracts lanceolate to ovate. Its crescent-shaped glands are prolonged into short horns. The subglobose capsules are 1.0 – 1.2 cm wide.

The author previously observed non-flowering plants (vegetative) in Gillespie County, but were later eaten by animals and never positively identified. The plants are found on a cattle ranch inhabited by angora goats and white-tail deer, and it is likely that few of the plants ever reach maturity. The collection site is within a deer-proof fence exclosure established for the purposes of native plant research and affords protection from these animals. Plants were first identified in May, 1990 when in full flower. Marshall Johnston visited the site with the author at that time and collected a single specimen from a colony of six plants along the creek bank. In August the author collected a fruiting specimen. The fruiting specimen was taken to SMU where the author and Wm. F. Mahler determined it to be *E. lathyris* matching European collections in the herbarium.

Eight young seedlings had appeared by November in the vicinity and remained 20 − 25 cm tall through spring and summer of 1991; apparently this being the first year's growth of the biennial.

At present there is no information as to the source of *E. lathyris* at this site. There is no report of it ever being cultivated in Gillespie County or anywhere else in Texas. It is possible that seeds were brought by the Germans who settled this area in 1846 and that the plants have escaped detection until now. Collection data are:

Collections examined: **TEXAS. Gillespie Co.**: Threadgill Creek, 11 km N of Harper, 11 km S of Doss on McGinley Ranch, 13 May 1990, *O'Kennon and M. C. Johnston* 6697 (TEX); Threadgill Creek, 11 km N of Harper on McGinley Ranch, 3 Aug 1990, *O'Kennon 7991* (BRIT/SMU).

— *Robert J. O'Kennon, 30 St. Laurent Place, Dallas, TX 75225-8111, U.S.A.*

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ULMUS PARVIFOLIA (ULMACEAE) NATURALIZED IN KENTUCKY — The exotic elm commonly naturalized in Kentucky and elsewhere in the United States is the spring-flowering Siberian elm (*Ulmus pumila* L.), often misnamed the Chinese elm. For several years we have noted many spontaneous individuals of another Asiatic species of *Ulmus*, the fall-flowering "true" Chinese elm or lacebark elm (*U. parvifolia* Jacq.) in Louisville, Jefferson County, Kentucky. Individuals of various sizes — seedlings through mature trees up to 35 cm DBH — can be found in empty lots, in fencerows, and along railroads. They are commonly associated with tree-of-heaven (*Ailanthus altissima* (Mill.) Swingle), northern catalpa (*Catalpa speciosa* Warder), Osage-orange (*Maclura pomifera* (Raf.) Schneider), and Amur honeysuckle (*Lonicera maackii* Maxim.). The voucher cited below — from a small tree 10 cm DBH and in abundant fruit — was growing between the rails of an abandoned railroad track. These is no doubt that *U. parvifolia* is well naturalized in Louisville.

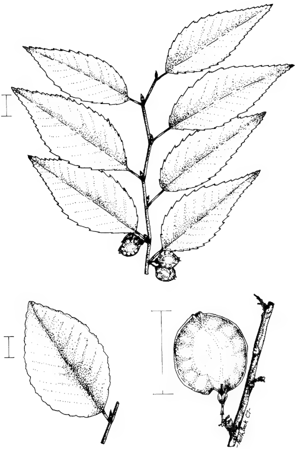

FIG. 1. *Ulmus parvifolia*. Upper, fruting branch with broadly elliptic fruits. Lower left, leaf non-fruiting branch; lower right, nearly orbicular fruit. The vertical lines represent 1 cm. Drawings by Keith Book.

The species is not included in the standard northeastern U.S. manuals (Fernald 1950; Gleason and Cronquist 1963) or in floristic works of most states adjacent to Kentucky: Illinois (Mohlenbrock 1982), Indiana (Crovello et al. 1983), West Virginia (Strausbaugh and Core 1953), Virginia (Harvill et al. 1981), Tennessee (Sharp et al. 1960), and Missouri (Steyermark 1963, Yatskievych and Turner 1990). Weishaupt (1971), however, listed it for Ohio. It is not accounted for by Elias (1980) and receives but passing mention, as a tree "in cultivation," in Little (1979). In the account of *Ulmus* for *Vascular flora of the southeastern United States* (Nicely, in press) the species is said to be "occasionally escaped and established locally" in Georgia, Illinois, Maryland, Ohio, and Virginia. It has also been noted to be "growing without cultivation" in California (Howell 1966).

Though rather similar to *U. pumila* in leaves, *U. parvifolia* is distinguished by its autumnal flowering and by its bark, which exfoliates in irregular scales and appears mottled, often beautifully so, in patches of brown, green, gray, and orange. Trees as small as 10 cm DBH may begin to show the mottling. For the winter interest of its bark alone, the tree is well worth growing. We were able to recognize individuals of the species from afar after leaf fall by the brown-hazy appearance of the crown brought about by the abundant fruits, which bedeck the branchlets and may persist until mid-winter.

A voucher specimen (*Thieret & Medley 56780*) collected on 14 December 1990 has been deposited in KNK and UNC. — *Max E. Medley, Department of Biology, University of Louisville, Louisville, KY 40292, U.S.A., and John W. Thieret, Department of Biological Sciences, Northern Kentucky University, Highland Heights, KY 41076, U.S.A.*

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BRACHIARIA PLANTAGINEA, *IMPERATA CYLINDRICA*, AND *PANICUM MAXIMUM*: THREE GRASSES (POACEAE) NEW TO LOUISIANA AND A RANGE EXTENSION FOR *ROTTBOELLIA COCHINCHINENSIS*. — Three tropical or subtropical grasses (*Brachiaria plantaginea* (Link.) Hitchc., *Imperata cylindrica* (L.) Beauv., and *Panicum maximum* Jacq.) not reported by Allen (1980) nor Thomas and Allen (1984) are now known to occur in Louisiana.

Brachiaria plantaginea (Link.) Hitchc. (Plantain signal grass) is native from Mexico to Brazil and Bolivia. Hitchcock (1950) reported it as adventive in Georgia, New Jersey, and Pennsylvania. Collections from the southern part of Louisiana apparently represent the first for the State. Collection data are:

Lafourche Par.: along beach and edge of marsh at the Gulf of Mexico S of the end of La. 3090 S of Fourchon City S of Leeville; Sec. 24, T23S, R22E, 7 Nov 1987, *Thomas 103240* (NLU). **St. Charles Par.**: along road near Illinois Central Railroad and I-10 in the Bonnet Carre Spillway, 21 Sep 1974, *Montz 3161* (LSU, NO).

Imperata cylindrica (L.) Beauv. (Cogon grass) has been reported from Florida and from ballast in Oregon (Hitchcock, 1950). Although Clewell (1985) considers the closely related taxon (*Imperata brasiliensis* Trin.) to be synonymous with this species; the two taxa are separated by Gabel (1982), Hitchcock (1950), Kartez and Kartez (1980), and Wunderlin (1982). Louisiana specimens of the two taxa can usually be separated by using the following key:

Spikelets 3.5 mm or longer; anthers two; cauline blades wider than 5 mm
. . . . *Imperata cylindrica*
Spikelets shorter than 3.5 mm; anthers one; cauline blades narrower than 5 mm
. . . . *Imperata brasiliensis*

Imperata brasiliensis Trin was reported new to Louisiana by Allen (1974) from Washington Parish. Current records indicate that it has spread to Ascension, Orleans, St. Tammany, and Tangipahoa parishes. *Imperata cylindrica* (L.) Beauv. has been collected from three sites in St. Tammany Parish including: west bank of La. 1129, 0.5 mi N of La. 40 E of Blond; Sec 22, T5N, R11E, very large expanding population, 24 May 1979, *Thomas 64869* (NLU).

Panicum maximum Jacq. (Guinea grass) is a widely distributed grass of tropical areas and is native to Africa (Gould 1975). It has been reported from Florida and Texas, and a collection from New Orleans is apparently the first record of this grass from Louisiana. Collection data are:

Orleans Par.: waste area along railroad at Bienville Street Wharf on the Mississippi River in New Orleans, 21 Jun 1979, *Thomas 66207* (NLU).

These three grasses new to Louisiana should be monitored to see if they become as widespread and noxious as *Rottboellia cochinchinensis* (*R. exaltata* L. f.) (itch grass) in the State. *Rottboellia cochinchinensis* (Lour.) W. Clayton is a noxious weed that was reported from Louisiana by Thieret (1963). Allen (1980) reported it from Lafayette, Pointe Coupee, St. Martin, and St. Tammany parishes. During the preparation of an atlas of the Monocotyledons of the State and of a revision of "Grasses of Louisiana", the authors added records of *R. cochinchinensis* from twelve additional parishes (Acadia, Allen, Cameron, East Baton Rouge, Evangeline, Iberia, Lafourche, St. Charles, St. Landry, St. Mary, Terrebonne, and Vermilion). On September 6, 1991, Allen located a large population of this weed along U.S. 165 in the pine uplands of North Louisiana at least 65 miles north of any previous known locality. This population is significant in that it is not in an agricultural area and is only about 70 miles south of the Arkansas State line. The collection data are:

Caldwell Par.: roadbank of U.S. 165 on hill in pine woods at La. 844 near Clarks, 3.9 mi S of Grayson; heavily herbicided roadside with a nearly pure stand of *Sida spinosa* L., population including several hundred plants, 10 Sep 1991, *Thomas 125135* (NLU, and duplicates to be distributed).

— *Charles M. Allen and R. Dale Thomas, Herbarium, Dept. of Biology, Northeast Louisiana University, Monroe, LA 71209, U.S.A. and Michel G. Lelong, Dept. of Biological Sciences, University of South Alabama, Mobile, AL 36688, U.S.A.*

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ADDITIONAL RECORDS OF *CYPERUS ENTRERIANUS* (CYPERACEAE) IN THE UNITED STATES. — *Cyperus entrerianus* Böckeler was first reported in the United States by Carter (1990). Initially, it was cited from 15 counties in the Atlantic and Gulf coastal plains ranging from Georgia to eastern Texas. Subsequently, additional collections of *C. entrerianus* have been made in Florida, Georgia, and Texas, which are cited below.

U.S.A. **Florida. Holmes Co.**: 1.8 mi W of Westville, mowed ditch along Hwy US 90, locally common, 4 Aug 1990, *Carter 8393* (FLAS, FSU, VDB, VSC). **Jackson Co.**: 1.9 mi N of Round Lake, ditch along south-bound lane of Hwy US 231, locally common, 4 Aug 1990, *Carter 8392* (FLAS, FSU, IBE, MICH, MO, NY, US, VDB, VSC). **Washington Co.**: Caryville, south side of town, ditch beside Hwy FL 279, between Hwys US I-10 and US 90, locally abundant, 4 Aug 1990, *Carter 8397* (FLAS, FSU, GH, IBE, MICH, MO, NY, NYS, TAES, US, VDB, VPI, VSC). **GEORGIA. Echols Co.**: disturbed barrow pit and ditch bottom along Hwy GA 94, 1.8 mi E of jct. with US 129 in Statenville, flatwoods, 9 Jul 1991, *Carter and Jones 8806* (FLAS, FSU, GH, IBE, MICH, MO, NY, NYS, TAES, US, VDB, VSC). **TEXAS. Jackson Co.**: jct. of Hafernick Rd. (County Rd. 267) and US 59, NE of Ganado, open mesic roadside with black clayey soil, frequent, 30 Oct 1990, *S. & G. Jones 6038* (TAES, VSC). **Newton Co.**: 150 m S on Hwy 87 from its jct. with FR 2829, S of Trout Creek, open hydric roadside ditch with sandy mucky soil, frequent, 27 Jul 1990, *S. & G. Jones 5645 & J.K. Wipff* (TAES, VSC).

While these new records do not extend the range of *Cyperus entrerianus* in the United States, they do fill distributional gaps in its known range. Each is a new county record. Thus, the number of counties where *C. entrerianus* is known in the United States is increased by 40% to a total of 21 counties.

Appreciation is expressed to Mr. W.K. George, Valdosta, Georgia, for supporting field work in Florida during 1990 and to the Valdosta State College Faculty Research Fund for meeting publication expenses. — *Richard Carter, Herbarium (VSC), Department of Biology, Valdosta State College, Valdosta, GA 31698, U.S.A. and Stanley D. Jones, S.M. Tracy Herbarium, Department of Rangeland Ecology and Management, Texas A&M University, College Station, TX 77843, U.S.A.*

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A FIRST REPORT OF *LEPTOCHLOA SCABRA* NEES (POACEAE) FROM ALABAMA. — Recent examination of herbarium material of *Leptochloa* Beauv. has revealed the presence of *Leptochloa scabra* Nees in Alabama, which we report for the first time. It now appears to be established in south Alabama along the Tombigbee River, the Mobile River, and in the Mobile Delta.

Commonly called Rough Sprangletop, this is first report for the species in the United States outside of Louisiana, where it apparently became adventive in the New Orleans area and was collected there by A. B. Langlois as early as 1884. It has since spread throughout much of Louisiana (Allen 1980), where it can form large populations. For example, *L. scabra* is common in localized areas of the Bonnet Carre Spillway in St. Charles Parish, where it occurs with *Leptochloa panicoides* (Presl) Hitchc. (N. Snow, pers. obsv. 1990).

Leptochloa scabra can be easily confused with *L. panicoides*. The former is distinguished by its shorter, tightly imbricate spikelets, the keeled lemmas, its distinctly flexuous panicle branches, and culms that are somewhat flattened near the base. The earlier report by Lelong (1988) for *L. panicoides* in south Alabama is here amended to *L. scabra*.

Rough sprangletop is native to tropical America, occurring from Michoacan, Mexico, south to Argentina and Brazil, and in the West Indies (Hitchcock 1936). It seems likely that it will continue to spread slowly in the semitropical humid regions in the United States.

Specimens examined: **ALABAMA. Mobile Co.**: by truck bypass 98-90 across river from Mobile, sandy dock area, 20 Sep 1975, *Kral* 56597 (MO); T2N, R1E, E boundary of Sect. 20, sandbar of small island along W bank of Tombigbee River, directly N of its confluence with the Alabama River, with *Cyperus erythrorhizos*, *Eragrostis glomerata*, *Fimbristylis vahlii* and *Aster lateriflorus*, 25 Oct 1980, *M. G. Lelong 11,732* (MO; USAM). **Washington Co.**: T2N, R1E, SE corner of Sect. 6, common along N bank of Tombigbee River, with *Sphenoclea zeylanica*, *Spermacoce glabra*, *Cyperus erythrorhizos*, 25 Oct 1980, *M. G. Lelong 11,759* (MO; USAM). **Baldwin Co.**: T3N, R2E, SW 1/4 of Sect. 40, clay bluff along S bank of Alabama River cutoff, with *Spermacoce glabra*, *Fimbristylis vahlii*, *Cardiospermum halicacabum*, 25 Oct 1980, *M. G. Lelong 11,774* (MO; USAM); T1N, R1E, near E boundary of Sect. 54, wooded banks of Bottle Creek, about 0.25 mi E of Indian mounds, Indian Mound Island, Mobile Delta, with *Leonotis nepetaefolia*, *Apios americana*, *Matelea gonocarpa*, 15 Nov 1980, *M. G. Lelong 11,892* (MO; USAM).

Neil Snow, Box 1137, Department of Biology, Washington University, St. Louis, MO 63130, U.S.A. and Michel G. Lelong, Department of Biological Sciences, University of South Alabama, Mobile, AL 36688, U.S.A.

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OCCURRENCE OF *POTAMOGETON PERFOLIATUS* L. (POTAMOGETONACEAE) IN LOUISIANA — Louisiana collections of *Potamogeton perfoliatus* are few in number and are restricted to the northern and eastern shorelines of Lake Pontchartrain and adjacent marsh areas. Ogden (1943) listed a specimen collected by Riddell from the Tchefuncte River lighthouse at Lake Pontchartrain on 16 August 1838. Haynes (1968) reported a specimen collected by Clair A. Brown (LSU 5676) from St. Tammany Parish at Mandeville in 1945. Montz (1978) observed that *P. perfoliatus* was abundant in 1973 near Pointe aux Herbes in Orleans Parish. However, Mayer (1986) noted the conspicuous absence of *P. perfoliatus* from the Lake Pontchartrain estuarine system in 1985. Lester (1988) listed the current status of the species in Louisiana as unknown and reported that recent attempts to locate populations as unsuccessful.

On 21 June 1990, we found a 7 × 17 m submerged bed of *P. perfoliatus* along the northern shoreline of Lake Pontchartrain, ca. 1500 m west of Bayou Lacombe, south of the St. Tammany State Wildlife Refuge, St. Tammany Parish, Louisiana. The St. Tammany State Wildlife Refuge is classified as brackish marsh according to Chabreck (1972). The bed was ca. 20 m from the shoreline in water ca. 0.6 m deep. This location is about 11 km northeast of the last reported site for this species in Louisiana (Pointe aux Herbes). A subsequent investigation at this location on 18 August 1990 yielded fruiting specimens, and additional smaller beds of *P. perfoliatus*. Voucher specimens have been deposited in the herbaria of Louisiana State University-Baton Rouge (LSU 78177, LSU 78178; *Brantley & Platt s.n.*) and University of New Orleans (NOLS 5378). The exact cause for the periodic occurrence of *Potamogeton perfoliatus* within Lake Pontchartrain is unknown. — *Christopher G. Brantley and Steven G. Platt, Wettanda Ecological Services, P.O. Box 701, Madisonville, LA 70447, U.S.A.*

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RECENT COLLECTIONS OF *HELIOTROPIUM EUROPAEUM* (BORAGINACEAE) FROM TEXAS — *Heliotropium europaeum* L. is an annual native to southern and central Europe, northern Africa, and regions of the Caucasus and Iran (Johnston 1960). In the United States, *H. europaeum* has become sporadically naturalized along roadsides and in waste places from New Jersey to the Carolinas, southward to Florida, and westward to Texas and California (Small 1903; Radford et al. 1968; Correll and Johnston 1970; Fernald 1970; Munz 1968). The single historical record of the species from Texas was a 19th century collection from Hays County (San Marcos and vicinity, Spring 1897, *Stanfield s.n.* (NY)).

In the fall of 1989 and summer of 1990, *H. europaeum* was collected at three separate locations in and around San Marcos, Texas. Two of the collection sites were gravel terraces of the Blanco River, where the species was locally abundant and growing in association with *Polanisia dodecandra* (L.) DC., *Sesbania macrocarpa* Muhl. ex Raf., *Euphorbia serpens* Kunth, *E. nutans* Lag., *Phyla nodiflora* (Michx.) Greene, *Leucospora multifida* (Michx.) Nutt., and *Justicia americana* (L.) Vahl. The third site was a disturbed flower bed on the campus of Southwest Texas State University in San Marcos, where only a few individuals were found.

Voucher specimens: **TEXAS. Hays Co.**: west campus of Southwest Texas State University, behind San Saba Hall, San Marcos, 12 Oct 1989, *Hutzler 23* (SWT, TEX); 4.0 mi N of San Marcos on county road 140 at the Blanco River crossing, 17 Oct 1989, *Hutzler 122* (SMU, SWT); gravel terrace of the Blanco River 0.1 mi upstream from the I-35 hwy bridge, N of the city of San Marcos, 19 Sep 1990, *Lemke 3327* (NY, SMU, SWT, TEX).

Heliotropium europaeum is readily distinguished from all other Texas species of *Heliotropium* by its nutlets, which are typically 4 in number, 1.5 – 2 mm long and distinctly tuberculate on the abaxial surface. — *Patrick L. Hutzler and David E. Lemke, Herbarium, Department of Biology, Southwest Texas State University, San Marcos, TX 78666, U.S.A.*

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EDSKO JERRY DYKSTERHUIS
(1908 — 1991)

Dr. Edsko Jerry Dyksterhuis, age 82, of Bryan, Texas since 1964 died in Bryan on August 10, 1991.

Dr. Dyksterhuis had been professor of rangeland ecology in the Department of Rangeland Ecology and Management, Texas A&M University, 1964-1970 and was named professor emeritus in July 1970.

He was born on December 27, 1908 and raised on a farm near Hospers, Iowa. He received the BS degree in forestry and range management from Iowa State University in 1932 and the Ph.D. in Plant Ecology and Soil Science from the University of Nebraska in 1945.

Before joining Texas A&M University he had retired from the federal civil service after 10 years with the U.S. Forest Service and 20 years with the U.S. Soil Conservation Service. Following work with the University he was employed as Ecologist by Diamond Head Corporation of New Jersey; and later by the U.S. Department of State as Consultant on Natural Forages entailing two trips to Turkey and Iran.

Author of many scientific and popular articles, he received the Mercer Award of the Ecological Society of America for his monograph on the "Western Cross Timbers of Texas" and the authorship award of the U.S. Department of Agriculture for his "Savanna Concept and Its Use". He is credited in Compton's Encyclopedia for the five pages on ecology.

His field experience began as Range Examiner on National Forests of Utah, Arizona, and New Mexico and finally included administrative, staff, and research positions ranging from Forest Ranger, and Supervisor's Assistant in charge of grazing on the Carson National Forest out of Taos, New Mexico to Sr. Forest Service Representative on Watershed Flood Control Surveys in Texas, Oklahoma, Kansas, Arkansas, and Missouri while with the Southern Forest Experiment Station in New Orleans.

He then joined the Soil Conservation Service at Fort Worth as Range Conservationist for the Western Gulf Region and later served 15 years as Head Range Conservationist for the Northern Plains Region out of Lincoln, Nebraska, receiving the USDA award for Outstanding Leadership. During brief leaves he had held visiting professorships at the State Universities of Montana, South Dakota, Kansas and Colorado, and served as first Extension Range Specialist for South Dakota.

He was installed as President of The Society for Range Management in Calgary, Canada in 1968 having received the society's highest awards as

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well as those of the Texas Section of that society. As a result of developing a quantitative ecological approach to inventory and management of rangelands making it possible to quantify range degeneration and to predict potentials, his full biography appears in "World Who's Who in Science; from Antiquity to the Present". He was a Fellow of the Association for the Advancement of Science.

Survivors include wife Margarett A. (Cox) Dyksterhuis, son Dr. Jerry E. Dyksterhuis, and daughters, Jantina Kay Clegg and Edna Leona Marge Selee, their spouses and eight grandchildren. — *F.E. Smeins, Texas A&M University, College Station, TX 77843.*

Edsko Jerry Dyksterhuis
(1908 — 1991)

ANNOUNCEMENT

RONALD L. STUCKEY INITIATES ENDOWMENT FUND FOR THE OHIO STATE UNIVERSITY HERBARIUM

Ronald L. Stuckey, Professor of Botany at The Ohio State University, presented a gift of $30,000 to the University Foundation to initiate an endowment for the support of the University Herbarium. The presentation was made as a final surprise announcement at Professor Stuckey's retirement party celebrating 26 years of teaching at the University. The event, held at the University Ramada Hotel, Olentangy River Road, Columbus, was attended by 130 colleagues, former students, relatives, and close friends. They came from the central Ohio area, elsewhere in the state, and eight other states.

Designated as the Ronald L. Stuckey Herbarium Fund, the gift was accepted by Drs. Tod F. Stuessy, director of the University Herbarium; Ralph E.J. Boerner, chairperson of the Plant Biology Department; and Gary L. Floyd, Dean of the College of Biological Sciences. Anne K.P. Kochman, College representative to the University Foundation and Development Fund, accepted for the Foundation by reading a letter from its Executive Director, Donald D. Glower.

Dr. Stuessy stated that the endowment was a "wonderful gift" that will aid in the studies of the flora of Ohio, which are of particular concern of the donor. Director Stuessy also praised Prof. Stuckey for his dedication, thoughtfulness, and genuine care for the future development of the Herbarium. Chairperson Boerner pointed out that the donor, who had worked so long and so hard for the students, cared enough to make this kind of gift to help future students. Dean Floyd referred to the donor's qualities of being sensitive, dedicated, committed, loyal, and generous. He wished the donor "good luck" in his second career.

The establishement of the endowment fund for the University Herbarium not only marks the occasion of Dr. Stuckey's retirement from teaching, but also commemorates the 100th anniversary of the Herbarium. The fund creates a foundation for its future as a part of the Biological Sciences' new Museum of Biological Diversity.

Celebrating 100 years of continued operation, The Ohio State University Herbarium was founded in 1891 by the University's first Professor of Botany, William A. Kellerman, Ph.D. Initially the Herbarium was housed in Botanical Hall (site of the present-day Faculty Club Building) and moved in 1914 to the Botany and Zoology (B&Z Building), 1735 Neil Avenue. Beginning its second century of operation, the Herbarium will be relocated in the former food facility building (1315 Kinnear Road) now being renovated to house all of the biological collections in the University. Prof. Stuckey served as curator from 1967 through 1976. — *Ronald L. Stuckey.*

FLORENCE MONTGOMERY GIVENS
(1933 — 1990)

Florence Montgomery Givens was born 19 April 1933 in County Tyrone, Northern Ireland, but grew up in the United States. She graduated from high school in Sherrill, New York.

In 1958 she earned an associate degree in science (AAS) in Ornamental Horticulture and Biological Technology from the State University of New York, Agricultural and Technological Institute, at Farmingdale, New York. To earn money for college, she worked as a senior scientific assistant for the American Cyanamid Company in Princeton, New Jersey. She then was able to attend the University of Georgia at Athens where she obtained her bachelor of science degree in botany in 1964. She continued on there, undertaking postgraduate work under Wilbur Duncan. It was also at Georgia that she met and married Ray Givens. Her master's degree was awarded in 1971 for her thesis "Vascular Flora of Echolls Mill Granitic Outcrop." As a result of this work, Florence had an abiding love for these granitic outcrop areas of the southeastern states.

From 1969 to 1972, Florence worked as a scientific assistant at the Academy of Natural Sciences of Philadelphia, Pennsylvania, doing curatorial work and providing identifications of local plants. She also worked with Alfred Schuyler and Wayne Ferren on a survey of aquatic plants of the Delaware River and its tributaries. For the next four years, Florence was employed as botanist at the Henry Foundation for Botanical Research in Gladwyn, Pennsylvania, where she performed curatorial work and conducted tours for visitors.

In 1976, Florence and her husband, Ray, moved to Louisiana where Ray took a faculty position in geology at Nicholls State University in Thibodaux. Four years later, Florence began her association with the Department of Botany at Louisiana State University in Baton Rouge when she was chosen for the position of assistant curator of the herbarium, working under the direction of Lowell E. Urbatsch. One of her first duties was to organize Professor Clair Brown's various plant collections which had been in storage since his death.

Florence's dedication to her botanical work went far beyond routine herbarium work. She made many collecting excursions to all parts of Louisiana, often to botanically interesting and unusual sites, thereby augmenting the general collections of the herbarium. These trips were often made in the company of her colleagues at Louisiana State University

FIG. 1. Field trip to St. Tammany Parish, Louisiana. Left to right: Florence Givens, Margaret Stones, and Shirley Tucker. Photograph by Lowell Urbatsch.

and other institutions. She and Ray also took many trips associated with Ray's geological research. During 1983 and 1984, she went on two trips to Costa Rica with geologists from Louisiana State University. Even though Florence's primary duty on these trips was to collect specimens for pollen analysis, she found time to collect many interesting plants. Over the years, Florence collected many fine specimens; these have included not only flowering plants and ferns but also lichens and mosses. At the time of her death, her collection numbers totaled over 5000 specimens, many of which are represented in the herbarium of Louisiana State University and, through exchange, in other herbaria.

Another part of Florence's botanical work will have enduring significance. In 1977, the noted botanical artist, Margaret Stones, was engaged by Louisiana State University to prepare watercolor drawings of 200 plants for the Flora of Louisiana project. Spanning more than ten years, the final number of plant drawngs came to slightly more than 200. Florence became a close friend of Margaret Stones and provided interesting and unusual

FIG. 2. Florence at Leeds Castle, England, 1989. Photograph by Ray Givens.

plants for her to draw. Approximately one fifth of the drawings are based on collections made by Florence alone or in association with others. The Stones' watercolor drawings have received high praise and have been exhibited at the Smithsonian Institution in Washington, D.C.; three British institutions exhibited them in 1991.

The year before Florence died, she and Ray travelled to Northern Ireland to see her native country. During this trip they also spent time in England where Florence was able to fulfill her dream of visiting the Royal Botanic Garden at Kew. There she saw in cultivation some of the plants — living representatives of the Flora of Louisiana project — which she had donated over the years. She was pleased to find that some of the plants, such as *Trillium recurvatum* and *Pachysandra procumbens*, had done very well in cultivation.

Florence died on 15 November 1990 after a long struggle with cancer. She will be remembered by members of the Department of Botany here and by her colleagues at other institutions.

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— *Alan W. Lievens, Marie S. Standifer, and Shirley C. Tucker, Department of Botany, Louisiana State University, Baton Rouge, LA 70803, U.S.A.*

Gilbert Onderdonk. The Nurseryman of Mission Valley, Pioneer Horticulturist by Evelyn Oppenheimer. 1991. University of North Texas Press, P.O. Box 13856, Denton, TX 76203; Fax (817)565-4590. Distributed by University Distribution, Drawer C, College Station, TX 77843. 200 pp, 16 b&w illus. $22.50 (cloth) ISBN 0-929398-24-6; $12.95 (paper) ISBN 0-929398-23-8.

Pioneer Horticulturist in Texas and Mexico

Gilbert Onderdonk, born in Sharon, New York, came to Texas in 1851. He was twenty-two. Soon he wrote home "I often forget that I was sick . . . chasing deer on horseback over the prairie." He was working on a ranch on the San Antonio River about twenty miles from the Gulf of Mexico. At first the cattlemen opposed Onderdonk's planting trees on what they considered prime range land. Years later he told David Fairchild that the cattle barons were the curse of Mission Valley, Victoria Co. U. P. Hedrick called him "the only [fruitgrower] by profession in Texas before the Civil War." Prof. L. H. Bailey said that he introduced the native Golden Beauty plum in 1874, and Samuel Wood Geiser, historian of Texas horticulture, wrote that Onderdonk did "very distinguished work on peach breeding and selection." Onderdonk wrote articles for Meehan's *Gardener's Monthly,* and he received a bronze medal at the Louisiana Purchase Exposition in 1904. In his *The World was my Garden* David Fairchild tells of his visit with the "genial Dutchman" at his nursery. He wrote that "Onderdonk was a true plant enthusiast at heart."

Miss Oppenheimer has ransacked the Onderdonk family papers; records of the Old Dutch Church at Flatbush, New York; and university collections in Texas and Delware, to give us a triptych "of a man to remember." The first panel is a brief biography; the second, Onderdonk's Mexican experiences in his own words; and his third, the most interesting for the historian of Texas horticulture, his account of his nursery business, as quoted from his *Descriptive Catalogue of Mission Valley Nurseries* for 1888, and from his *Pomological Possibilities of Texas*, published in Austin in 1911 when he was eighty-two. Besides a portrait of Onderdonk and reproductions of title pages, there are photographs of figs, grapes, and bananas, the last two from the farm of H. G. Stillwell in San Benito near Brownsville. Altogether this is another chapter in Professor Geiser's call for "what shall someday be written — a comprehensive historical account of horticulture in Texas."

The author's comment is not distinguished by type font from the Onderdonk text, and there is no effort to identify plants mentioned. Some of Onderdonk's early nursery sale items are especially interesting. For example, he was offering the native bignoniaceous *Chilopsis*, "flowering willow," and *Ziziphus jujuba*, "jujube." We would have welcomed more on "umbrella China" — the Chinaberry, *Melia azedarach*, and in particular the appearance of the cultivar "umbraculiformis" reputedly of Texan origin dating from 1874. (What a fun-thing for some future essayist to document the history of this valued shade tree of the Southern States from its Persian (?) or Indian origins!). "Camphor trees" (p. 55) are mentioned, "reputedly brought to Louisiana during the 1840's" and noticed in *Southern Garden* in 1894 (Charlotte Seidenberg, *The New Orleans Garden*, New Orleans, 1990, p. 100). When did it come to south Texas?

Onderdonk's notes on his travels in Mexico will interest readers beyond horticulture. His trips were made on behalf of The U. S. Department of Agriculture in a search for overlooked fruits suitable for Texas orchards and home gardens. He is known to have brought back sixteen varieties of Mexican peaches. It is presumptuous, however, to say "no other American had reported on travel in Mexico except William Cullen Bryant in 1872." For an example, Frederick Albion Ober, "a prolific writer" and ornithologist, published *Travels in Mexico and Life among the Mexicans* (Boston, 1884). His Chapter 17 on Monterey, Saltillo, and the silver mines were described later by Onderdonk. (*American Travellers Abroad* by Harold F. Smith (1969) is a reader's Baedeker).

Fortunately Onderdonk's family kept copies of the Cuero, Texas, newspapers that serialized his Mexican travels. These and his "private journal" have been excerpted, rarely with inclusion of year dates, but they tell us, for example, how it was to ride the Mexican National Railway in 1898. His enthusiasm comes through: "Such apricot trees!" and it is evident that he regretted that he passed the "bushes new and nameless to us" (P. 31). Now and then we may name his plants: his "red pepper trees" (p. 35) are easily identified as *Schinus molle*. There are some highly readable paragraphs: "you may never before then have felt that you would hug a burro . . . Oh! How you love that burro." You will learn about a *cayuse*, how Catorce was named, the "grandest" wilderness of mountains he had ever seen; and there is an index for the curious. — *Joseph Ewan, Missouri Botanical Garden, P.O. Box 299, St. Louis, MO 63166-0299, U.S.A.*

ANNOUNCEMENT

OPENING OF THE BOTANICAL RESEARCH INSTITUTE OF TEXAS, INC. IN FORT WORTH

FORT WORTH, TEXAS — When the Botanical Research Institute of Texas, Inc. (BRIT) opened Friday, October 4, 1991, individuals and organizations as well as the scientific community were provided access to one of the nation's 25 National Resource Centers, featuring an herbarium with a collection of more than 450,000 dried and pressed plant specimens representing most of the earth's plant families, and a botanical library with more than 50,000 volumes.

BRIT is a nonprofit international botanical resource center organized in 1987. It serves as a primary plant information center for scientists and professionals and a primary interpretation center for people interested in learning more about the plant world.

Explaining the importance of BRIT, George Sumner, chair of BRIT's 15-member board of trustees, said, "The human race is totally dependent upon plants for existence. We must have information that BRIT provides about the identities, characteristics and requirements of organisms to sensibly manage this vital resource we take for granted."

Edward P. Bass, vice chair of BRIT's board of trustees, said, "These are trying times for our earth, and more than ever the plant world serves as a primary resource to help us understand the changes occurring and seek solutions for improving our environment. Fortunately, BRIT's facilities are available to support everyone interested in accomplishing these goals."

In size, BRIT is in the top 25 of the nation's 628 collections. Significantly, BRIT's research facility, together with the Fort Worth Botanic Garden's display gardens and educational programs, places the Metroplex among the nation's leading botanical centers.

BRIT's collection of specimens, books and periodicals — valued at more than $10 million — are primarily the Lloyd H. Shinners' Collection started in 1943 at Southern Methodist University, which the University has placed on permanent loan to BRIT. Periodicals published by BRIT include *Sida, Contributions to Botany*, and *Sida, Botanical Miscellany*.

Scientists and other professionals from thoughout the world regularly borrow the mounted specimens — the earliest dating back to 1791 — for study and comparison. Individuals and organizations using BRIT include teachers, students, plant enthusiasts, veterinarians, physicians, ranchers and farmers, businesses, governmental agencies, museums, schools, arboreta, hospitals and poison control centers.

BRIT is open Monday through Friday, 9 a.m. to 5:00 p.m. Appointments are encouraged. As a nonprofit organization, BRIT is funded through tax-deductible contributions.

Director: Wm. F. Mahler
Executive Director: Andrea Pistorius McFadden
Curator: Barney L. Lipscomb

Editor's Note and Reviewers for Volume 14

Sida, Contributions to Botany has a new home with the Botanical Research Institute of Texas, Inc. (BRIT) in Fort Worth. In 1962 Lloyd H. Shinners started the publication at Southern Methodist University (SMU) as a private journal. Even after Lloyd's death in 1971 Wm. F. Mahler continued privately publishing Sida at SMU up through 1990. Beginning with this issue Sida is now a publication of BRIT. This brings to close an era of some 30 years as a privately published journal. May the next 30 years at BRIT serve the botanical community even better.

The following individuals have kindly supported Sida through their time and efforts in reviewing manuscripts submitted and/or published in volume 14, 1990 – 1991. Without your interest and support, Sida would not be the journal that you have come to expect.

I do not take reviewers for granted. Your support is vital and very much appreciated and with continued support Sida can remain a top quality journal of systematic botany. Sida's subscription base continues to expand each year with subscriptions approaching 800 in 80 countries. Thanks to all authors, reviewers, subscribers, and readers for your continued interest and support.

Anderson, Loran C.
Ayers, Tina J.
Bates, Vernon
Beaman, John H.
Beauchamp, R. Mitchel
Beetle, Allan A.
Bruederle, Leo P.
Bryson, Charles T.
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Diggs, George
Eckenwalder, James E.
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Fletcher, Reggie A.
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Lewis, Walter H.
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Pullen, Thomas M.
Rabeler, Richard K.
Rembert, David H.
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Rogers, George K.
Rowell, Jr., Chester M.
Schultz, Leila M.
Simpson, Benny J.
Smith, Alan R.
Smith, Edwin B.
Smith, James P.
Stuckey, Ronald L.
Taylor, John
Thieret, John W.
Thomas, R. Dale
Thompson, Rahmona A.
Timme, Steve L.
Tucker, Gary
Utech, Fred H.
Villarreal Q., Jose A.
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Warnock, Michael J.
Whitaker, Thomas W.
Wilbur, Robert L.
Windham, Michael
Worthington, Richard D.
Wunderlin, Richard P.

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Names of contributing authors are in CAPITAL letters. New names and combinations are in **boldface**.

Titles of Articles

Sida Guidelines For Contributors

Sida, Contributions to Botany is an international journal of systematic botany containing primary research papers sensu lato, including anatomy, biogeography, chemotaxonomy, cladistics, ecology, floristics, genetics & evolution, numerical taxonomy, paleobotany, and palynology. Sida is open to all authors anywhere; coverage is not restricted to any geographical area.

All manuscripts submitted to Sida are considered by at least two reviewers. Manuscripts will be considered in either English or Spanish. Page costs of $35 per page are charged. If this creates a problem please contact the editor and make arrangements before publication. Submit manuscripts and editorial questions to Barney Lipscomb, Botanical Research Institute of Texas, 509 Pecan Street, Fort Worth, TEXAS 76102-4059, U.S.A.; (817)332-4441; (817)332-4112 fax.

Manuscripts must be double spaced throughout and three copies sent to the editor. Upon acceptance for publication please return two copies along with a copy in your word processing program format (with format commands) and a copy in an ASCII/Text file (without format commands) on a 5 1/4", 2S, 2D, low density diskette. Use the latest issue for format of articles and notes regarding title, author, and address. References, footnotes and legends should be typed on separate pages and inserted at end of manuscript.

Abstract

Every paper should include both an English and Spanish, or another major language abstract. Sida is now approaching a subscription base of 800 individuals and institutions in about 80 countries with almost half outside the United States.

Specimen Citations

Use the collectors last name and number or s.n. and italize. Abbreviate the months of the year by the first three letters of the month without a period. Example: Texas. Jeff Davis Co.: 1 mi W of Fort Davis, 3 Jan 1972, *Smith 118* (SMU).

Author Citations

Use the author abbreviations as given in the *Draft Index of Author Abbreviations* compiled at the Herbarium Royal Botanic Gardens, Kew (1980). Use et or the ampersand (&) between two authors and for more than two authors, restrict to the first one followed by et al. Do not italize or underline in the manuscript, et, et al., ex, or in.

Latin Descriptions or Diagnoses

A description or diagnosis of a new taxon should mention the taxonomic characters that distinguish the taxon from its allies. These diagnostic characters should be *italized* in the description. Since a diagnosis of a new taxon only refers to the taxonomic characters distinguishing it from other taxa, no *italization* in the manuscript is necessary. The ICBN (Rec. 32B.1) recommends that the main points in which the taxon differs from its allies should be mentioned and italizing (ms) these in the description is in accordance with that recommendation.

Figures

A scale should be in or on the illustration or photograph and reduction will automatically reduce the scale and subject proportionately. When this is not feasible, the proofs will be returned with the galleys for the author to determine the magnification of the final reduction. In half-tones, sharp glossy photographs with good contrast are necessary for good reproduction.

References

This includes all of the literature cited in the text and may include other article citations the author may deam desireable. Only the first letter of the initial word, proper nouns, and adjectives of titles should be capitalized. For journal abbreviations, use *Botanico-Periodicum-Huntianum*.

Abbreviations

When using the following abbreviations, the period is omitted. Distance: mm, dm, cm, m, km, ft, mi; directions: S, N, E, W, (in caps); months: first three letters only, Jan, Feb, etc. Example: Potter Co.: 2 km W of Dot, 5 Jun 1971, *Smith 118* (SMU).

Notes

When references are few in number, cite them in the text and omit reference section. Text citations of literature are in parentheses and should state the journal abbreviation, volume, pages and year. The citation of a book includes the last name of the author, if not mentioned previously, the full unabbreviated title of the book, and the year published in parentheses.

Documentated Plant Chromosome Numbers

The year and number of each is assigned by the editor. Refer to SIDA 14(3):501 – 503. 1991.

(Continued from front cover)