PHYTOLOGIA

An international journal to expedite plant systematic, phytogeographical and ecological publication

Vol. 77 November 1994 No. 5

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PHYTOLOGIA (ISSN 00319430) is published monthly with two volumes per year by Michael J. Warnock, 185 Westridge Drive, Huntsville, TX 77340. Second Class postage paid at Huntsville, TX. Annual domestic individual subscription (12 issues): $40.00. Annual domestic institutional subscription (12 issues): $44.00. Foreign and/or airmail postage extra. Single copy sales: Current issue and back issues volume 72 to present, $400; Back issues (previous to volume 72), $3.00 (add $.75 per copy postage and handling US [$1.50 per copy foreign]). Back issue sales by volume: $17.00 per volume 42-71 (not all available as complete volumes); $21.00 per volume 72-present; add $3.00 per volume postage US ($6.00 per volume foreign). POSTMASTER: Send address changes to Phytologia, 185 Westridge Drive, Huntsville, TX 77340.-8916.

Phytologia (November 1994) 77(5):381-389.

NEW NATURAL HYBRID COMBINATIONS AND COMMENTS ON INTERPRETATION OF HYBRID POPULATIONS IN *CASTILLEJA* (SCROPHULARIACEAE)

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ABSTRACT

This paper presents documentation concerning nine hybrid combinations within *Castilleja*, seven of which are new records. Published chromosome numbers for the parent taxa are summarized, and previously unpublished counts are presented for *C. flava* var. *flava*, *C. pallescens* var. *inverta*, *C. purpurea* var. *purpurea*, *C. purpurea* var. *purpurea* × *C. indivisa*, and *C. viscidula*. The hybrid records are interpreted in the light of chromosome analysis. Speculation is made concerning the significance of these records and of hybrid populations in general in understanding the evolution and taxonomy of this genus.

KEY WORDS: *Castilleja*, Scrophulariaceae, hybridization, chromosome numbers

Interspecific hybridization in the genus *Castilleja* is well known, both in natural populations (*e.g.*, Heckard 1968; Heckard & Chuang 1977) and in greenhouse studies (Heckard 1964). Hybridization is widely recognized for its role in speciation, taxonomic complexity, and the difficulty of specimen identification within this genus (Heckard 1964, 1968; Holmgren 1971, 1984; Ownbey 1959).

In the course of my field studies of the impressive diversity within *Castilleja*, I have made a number of collections of plants that appear to be hybrid combinations between various recognized taxa occurring in the given area. These plants are apparently all either single-specimen first generation hybrids or localized hybrid swarms. To my knowledge, none of these hybrid forms has been recorded previously in the literature, except for the last two hybrids listed

below. Their recognition here serves to further underscore both the ease and importance of hybridization in the evolution of this proliferating genus.

The following citations are for voucher specimens, all of which are deposited at WTU. I also cite vouchers for the putative parental species when these were found within the same local population. A few of the records listed below lack voucher specimens, but all plants mentioned are documented with detailed color photographs, which are on file in my personal collection.

1. *Castilleja peckiana* Pennell × *Castilleja oresbia* Greenm. Oregon: Grant Co.: along U.S. Hwy. 395, ca. 0.4 km N of Beech Creek Summit, in brushy field at interface of open area dominated by *Artemesia tridentata* with broken forest of *Pinus ponderosa*, T11S, R30E, sect. 32, 1,426 m, 2 June 1986, *M. Egger 191.*

At this site were at least two obvious F_1 hybrids, and the voucher sheet contains a stem from each plant. Both hybrid individuals grew within 1 m of apparently pure individuals of both *Castilleja peckiana* (*M. Egger 192*) and *Castilleja oresbia* (*M. Egger 190*). The hybrids are intermediate between the putative parents in many respects, including bract color (dull pale orange), length of beak, overall corolla length, calyx incision, and general aspect.

Castilleja peckiana is known to be a polyploid species, with published chromosome counts of n=36, n=48, and n=60 (Heckard 1968). It is thought that *C. peckiana* is, itself, of hybrid origin, possibly incorporating the genomes of several species (Heckard 1968; Holmgren 1984). As far as I know, no published chromosome counts exist for *Castilleja oresbia*, but it is thought to be involved in the hybrid origin of *Castilleja xanthotricha* Pennell (Holmgren 1971), which is known to have a count of n=24 (Heckard & Chuang 1977). The closest relatives of *C. oresbia* are *Castilleja thompsonii* Pennell and *Castilleja pallescens* (A. Gray) Greenm. The former is known to have counts of n=12 and n=24, and the latter is known from a count of n=24 (Heckard & Chuang 1977), as well as from a previously unpublished count by F.M. and T.I. Chuang of n=12 taken from my collection, Idaho: Custer Co.: Lost River/Pahsimeroi Mountains, flats of high sagebrush valley ca. 2.4 km SW of Doublesprings Pass, T10N, R22E, Sect. 16, ca. 2120 m, 22 June 1990, *M. Egger 321* (L.R. Heckard, pers. comm. 1990).

2. *Castilleja lanata* A. Gray × *Castilleja sessiliflora* Pursh. Texas: Pecos Co.: in grassy median-strip meadow along exit from eastbound I-10 onto U.S. Hwy. 190 to Iraan, ca. 800 m, 5 April 1990, *M. Egger 302 & 304.*

These two specimens represent stems from two different plants from a fairly uniform local population of 30-40 individuals, which appear to represent a self-perpetuating localized hybrid swarm. Neither putative parent species is represented in pure form in this population, though an extensive and vigorous population of very typical *Castilleja lanata* is found along U.S. Hwy. 190 about

0.4 km N of the hybrid population (*M. Egger 303*). *Castilleja sessiliflora* is also common in Pecos Co. (Nesom 1992).

The putative hybrid plants have the stature and growth form, deep secondary calyx clefts, and petaloid, shelf-like lower corolla lip of *Castilleja sessiliflora*, combined with the heavily lanate stem pubescence and the corolla tube and beak proportions of *C. lanata*. The plants are intermediate in bract shape and inflorescence coloration, the latter being an odd shade of pale rose, apparently combining the bright red of *C. lanata* with the pale pink-violet of the "purpurina" form of *C. sessiliflora* common in this portion of Texas.

The only published chromosome counts are of n=12 for *Castilleja lanata* (Ward 1983; Chuang 1993), as well as for *C. sessiliflora* (Heckard & Chuang 1977; Löve & Löve 1982; Freeman & Brooks 1988). Despite the fact that the common diploid state of these species could facilitate relatively easy hybridization, the existence of a hybrid swarm population derived from these two only distantly related species within the genus is testimony to the evolutionary plasticity and significance of hybridization in *Castilleja*. It may well be that hybrid swarms such as this led eventually to the genetic and phenotypic consolidation of such hybrid taxa as *C. dissitiflora* N. Holmgren, *C. montigena* Heckard and *C. xanthotricha*, especially when a polyploid swarm "emerges" from the hybridization of two diploid species. A thorough census of *Castilleja* in this portion of Pecos Co. for the possible existence of additional populations of this hybrid would be informative, as would a chromosome count for the documented population to determine its ploidy level.

3. *Castilleja scabrida* Eastw. var. *scabrida* × *Castilleja linariifolia* Benth. Utah: Garfield Co.: Dixie National Forest, ca. 0.8 km. E of Hell's Backbone Bridge, loose sandstone roadside bank along F.S. Rd. 153, T33S, R3E, sect. 5, ca. 2740 m, 28 June 1985, *M. Egger 114*.

This collection is from a single large multi-stemmed F_1 hybrid. Adjacent to this individual grew several apparently pure plants of both *Castilleja scabrida* (*M. Egger 113*) and *C. linariifolia* (*M. Egger s.n.*). The hybrid plant combined the stature, growth form, corolla dimensions, and pubescence of stem, herbage and inflorescence typical of *C. scabrida* with the thin, elongate leaves and strongly unequal primary calyx clefts of *C. linariifolia*.

Known chromosome counts for *Castilleja scabrida* are n=12 (Heckard & Chuang 1977), and for *C. linariifolia*, counts are of n=12 and n=24 (Heckard 1958, 1968; Heckard & Chuang 1977).

4. *Castilleja viscidula* A. Gray × *Castilleja flava* S. Watson var. *flava*. Nevada: Elko Co.: Independence Range, ridge top about 300 m NW of crest of road at Jack Creek Summit, T42N, R53E, Sect. 10, NW 1/4, 2,377 m, 24 June 1990, *M. Egger 334*.

A single apparent F_1 hybrid plant was found growing within a fairly dense

but highly localized population of *Castilleja viscidula* (*M. Egger 333*), surrounded by and occasionally intermixed with more scattered plants of *C. flava* var. *flava* (*M. Egger 329*). The hybrid plant combines several key features of both species, such as the lemon-yellow bracts of *C. flava* var. *flava* and the crisped leaf margins of *C. viscidula*. Corolla measurements are intermediate.

Previously unpublished chromosome counts of n=12 for the above-cited specimen of *Castilleja viscidula* and n=24 for *Castilleja flava* var. *flava* were obtained by F.M. and T.I. Chuang, but buds collected from the hybrid plant were too old for chromosome determination (L.R. Heckard, pers. comm. 1990). Published counts for *C. viscidula* are all of n=12 (Holmgren 1971; Reveal & Styer 1973), except for one count of n=36 (Heckard & Chuang 1977) from an area of hybridization with "*Castilleja lapidicola* Heller" (= *Castilleja nana* Eastw.). *Castilleja flava* var. *flava* is known only from counts of n=24 (Heckard 1968; Heckard & Chuang 1977). Thus, it is likely that the hybrid plant violates the generalization that different ploidy levels prevent hybridization. On the other hand, the population as a whole exhibits no noticeable introgression between the two parent taxa, so the hybrid barrier must be effective generally at maintaining species identities in this case.

5. *Castilleja lutescens* (Greenm.) Rydb. × *Castilleja hispida* Benth. var. *acuta* (Pennell) Ownbey. Oregon: Garfield Co.: Umatilla National Forest, SW of Peola, E edge of Pataha Bunchgrass Research Natural Area, T10N, R42E, sect. 1, 1,556 m, 28 June 1988, *M. Egger 229*.

The hybrid plants are scattered and rare within the local population and appear to be simply occasional F_1 hybrids. The characteristics of the hybrid plants are generally intermediate. The most obvious hybrid trait is coloration of the inflorescence, which is usually very pale orange to light pink.

Pure *Castilleja lutescens* (*M. Egger 228*) and pure *C. hispida* var. *acuta* (*M. Egger 226*) are also present in this mixed population, although *C. lutescens* is by far the most numerous species. While *C. cusickii* Greenm. is also present within 100 m of the hybrid population, it does not seem to interact reproductively with the other species.

Castilleja lutescens is known to have chromosome counts of n=24, n=48, and n=ca. 60, while those published for *C. hispida* var. *acuta* are all of n=48 (Heckard 1968; Heckard & Chuang 1977).

6. *Castilleja parviflora* Bong. var. *oreopola* (Greenm.) Ownbey × *Castilleja rupicola* Piper. Washington: Lewis Co.: Goat Rocks Wilderness Area, along Pacific Crest Trail between Elk Pass and Old Snowy Mtn., T12N, R11E, Sect. 16, SW 1/4, ca. 2,060 m, 5 August 1984, *M. Egger s.n.*, documented photographically.

A small hybrid swarm of perhaps half a dozen plants with fairly constant characteristics was found within an area of about 25 sq. m. While not growing

in the immediate vicinity, populations of both putative parent species grow within 0.25 km of the hybrid population. The hybrid plants appear to be intermediate in most characteristics, from a reddish-magenta to salmon coloration of the bracts to the measurements and proportions of the flowering parts.

Castilleja parviflora var. *oreopola* is known from chromosome counts of n=12 (Heckard 1968) and n=24 (Baker & Parfitt 1982), while I can find no published records for *Castilleja rupicola.*

7. *Castilleja peirsonii* Eastw. × *Castilleja lemmonii* A. Gray. California: Inyo Co.: John Muir Wilderness Area, upper Rock Creek Basin, on edge of tarn near trail between Chickenfoot Lake and Morgan Pass, T6S, R29E, Sect. 25, SW 1/4, ca. 3,330 m, 9 August 1993, *M. Egger s.n.*, documented photographically.

A single obvious F_1 hybrid plant was found growing in a large mixed population of about 90% *Castilleja peirsonii* and 10% *C. lemmonii.* Other than for the single hybrid, the two species appear to show no intergradation at this site. The hybrid plant was intermediate in stature and foliage characteristics, and it combined the deep rose-magenta bract coloration of *C. lemmonii* with the larger, well-exserted, yellowish corolla and characteristic broad swelling of the corolla tube at the attachment of the lower lip found in *C. peirsonii.*

Published counts of chromosome numbers are of n=12 both for *Castilleja lemmonii* (Gillett 1954; Heckard 1968) and for *C. peirsonii* (Reveal & Spellenberg 1976). Considering that these two species share a common chromosome number, in combination with the facts that they are broadly sympatric and are frequently in flower in the same meadows at the same time, the apparent rarity of hybrids is fairly remarkable. A study of the pollination ecology of these two castillejas would be informative. *Castilleja lemmonii* is placed by Chuang & Heckard (1991) in section *Pallescentes* of subgenus *Colacus*, including species usually pollinated by bees, while *C. peirsonii* is a member of subgenus *Castilleja*, which are predominately hummingbird pollinated.

8. *Castilleja applegatei* Fernald var. *pinetorum* (Fernald) N. Holmgren × *Castilleja chromosa* A. Nelson. California: Inyo Co.: brushy slope along road from Lone Pine to Horseshoe Meadow near pullout about 100 m W of crest of road where it levels out following switchback upgrade from Owens Valley, T17S, R36E, Sect. 7, NE 1/4, ca. 2,789 m, 26 June 1985, *M. Egger 96.*

This collection is of a single plant growing alone, with no other *Castilleja* in the immediate vicinity. However, both putative parent species are fairly common in this region in similar habitat. This location is near the southeastern terminus of the range of *C. applegatei* var. *pinetorum.* This hybrid combination is recorded also by Holmgren (1971).

The specimen exhibits several intermediate characteristics, while it com-

bines the divided leaves of *Castilleja chromosa* with the relatively longer corolla beak of *C. applegatei* var. *pinetorum*.

Chromosome levels recorded for the parent species include counts of n=12 and n=24 for both *Castilleja applegatei* var. *pinetorum* (Heckard 1968; Holmgren 1971) and *C. chromosa* (Heckard 1968; Heckard & Chuang 1977), so hybridization between these two species is not unexpected in the few locations where their habitat and phenology overlap.

9. *Castilleja indivisa* Engelm. × *Castilleja purpurea* (Nutt.) G. Don var. *purpurea*. Texas: Hill Co.: W side of Hwy. I-35W, about 1.6 km S of northern boundary of Hill Co. and 5.4 km N of Itasca exit in meadowy highway right-of-way, ca. 300 m, 7 April 1990, *M. Egger s.n.*, but unnumbered bud collections were made for chromosome analysis; hybrid plants and adjacent population are documented photographically.

At least two F_1 hybrid plants were found growing amidst a large mixed population of the two parent species consisting of about 80% *Castilleja purpurea*. The hybrid plants resemble *C. purpurea* more closely than they do *Castilleja indivisa*, but intermediate features include a red-purple cast to the bract coloration and a less divided and more rounded lobing of the leaves and bracts characteristic of the usually entire leafed *C. indivisa*.

A chromosome analysis of these two plants was conducted by F.M. and T.I. Chuang (L.R. Heckard, pers. comm. 1990). According to T.I. Chuang's notes, counts from these plants were of n=14 and n=16, which are highly unusual numbers for this genus. These unusual counts probably reflect chromosomal abnormalities resulting from the hybrid condition. The unique genetics of these plants may be a result of the cross of an annual *Castilleja* (*C. indivisa*) with a perennial from a different section of the genus. However, Nesom (1992) reports that hybrids of these two species are common in some locations in north-central Texas, with some populations showing strong introgression and character convergence. Such broad convergence was not apparent in the population from which the present specimens came. Further study is needed to understand the chromosomal interactions and characteristics of hybrid and non-hybrid populations of these two species.

Previous collections of *Castilleja indivisa* have yielded only chromosome counts of n=12 (Heckard 1968; Leonard *et al.* 1978), while I could find no published account of a chromosome number for *C. purpurea* var. *purpurea*. A previously unpublished count of n=12 for *C. purpurea* var. *citrina* was made from my collection (Texas: Kimball Co.: roadside strip along U.S. Hwy. 290, about 6.4 km W of Harper, ca. 515 m, 3 April 1990, *M. Egger 294*) by F.M. and T.I. Chuang (L.R. Heckard, pers. comm. 1990).

Comments on the hybrid *Castilleja* populations from the vicinity of Slate Peak, Okanogan Co., Washington

The occasionally introgressive *Castilleja* populations in this alpine area of the NE Cascades Range of Washington state (T37N, R17E, Sect. 1; T38N, R17E, Sect. 35 & 36, elev. ca. 2060 m) are of some notoriety and are the subject of several studies (Anderson & Taylor 1983; Lesher 1983; Taylor 1984). While these papers present various proposals as to the identity of the species represented in this area, the variation patterns found can be explained most efficiently by viewing these populations simply as localized assemblages of parental species (mainly *C. parviflora* Bong. var. *albida* [Pennell] Ownbey and *C. elmeri* Fernald) with occasional small patches of hybrid plants, which skew populational statistical analyses in the direction of blurring morphological species boundaries. However, based on my own admittedly non-quantitative observations of the Slate Peak populations, if one subtracts out of the statistical sample those individual plants or small groups of plants that are recognizably of hybrid nature, the problems of species character overlap appear to be minimal. With the exception of the recognizably hybrid plants, both parental species maintain their phenetic integrity reasonably well, both here and elsewhere. Thus, it seems unnecessary to evoke either a total breakdown of species boundaries or to make a tortured attempt to identify every plant strictly according to the characteristics of a published key, as proposed in Taylor (1984) and Anderson & Taylor (1993), respectively, in order to accurately represent the species composition of this area.

In the chaotic world of plant genetic systems, especially in a genus like *Castilleja* that is well known for the ease with which even species of different subgenera may hybridize, the simple fact that two species hybridize in very localized pockets where they share the same habitat need not imply that the validity of the parental species should be called into question, regardless of the outcome of statistical tests based on localized populations that may or may not reflect the nature of the species as a whole. The above conclusions regarding the nature of the Slate Peak populations are substantially in accord with the tentative conclusions of Lesher (1983) and L.R. Heckard (pers. comm. 1985).

On the other hand, it should be noted clearly that hybridization in *Castilleja* can also be more widespread, causing a nearly complete introgression of characteristics in at least portions of the zone of sympatry. The distinctions between such taxa as *C. miniata* Doug. *ex* Hook. and *C. rhexifolia* Rydb. and between *C. septentrionalis* Lindley (including the synonymous *C. sulphurea* Rydb.) and *C. rhexifolia* disappear altogether in some regions of hybridization, while in other locations, the species may appear to be fairly coherent and phenetically stable (Holmgren 1984). In the case of such species pairs or groups of species, the definition of species limits must clearly depend on one's taxonomic

philosophy combined with nomenclatural conventions.

This paper is dedicated to the memory of Dr. T.I. Chuang, whose meticulous cytological and taxonomic work over several decades has greatly increased our knowledge of the systematics of the Castillejinae.

ACKNOWLEDGMENTS

I extend my sincere thanks to Sarah Gage, manager of collections at WTU, for her friendly assistance, and to Clem Hamilton (WTU) and Guy Nesom (TEX) for providing helpful reviews of this manuscript.

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Phytologia (November 1994) 77(5):390-392.

NEW TAXA IN SECTION *PETOTA* OF *SOLANUM*

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ABSTRACT

Seven new taxa are described in *Solanum* sect. *Petota*.

KEY WORDS: Solanaceae, *Solanum*, new species

This paper is the result of a review that I have been doing of many herbarium specimens during the preparation of a monograph on Peruvian tuber-bearing *Solanum*. Although the new proposed taxa are of an intraspecific level, I considered it necessary to publish them prior to the publication of the monograph. These taxa will be fully illustrated in my forthcoming book.

Solanum series *Acaulia*

Solanum acaule Bitt. f. **incuyo** Ochoa, *forma nova*. TYPE: PERU. Dept. Ayacucho: prov. Parinacochas, Crusvuelta, 3400-3500 m alt., ca. Incuyo, Aprilis 1975, *C. Ochoa & A. Salas 9834* (HOLOTYPUS: OCH; Isotypi: CIP,OCH).

Planta rosulata. Folia simplicia et pinnatifida lobis late decurrentibus secum rachim, terminali latiori ovato-lanceolato vel late elliptico-lanceolato. Corolla pallide lilacina.

Solanum series *Conicibaccata*

Solanum chromatophilum Bitt. var. **subnivale** Ochoa, *var. nov.* TYPE: PERU. Dept. Ancash: prov. Yungay, supra Huishca, 4300 m alt., circa conterminus nivis perpetuus, Aprilis 17, 1978, *C. Ochoa 12084* (HOLOTYPUS: OCH).

Planta a species typica differs: folia modice secta tantum 1-2 paribus lateralibus foliorum, sine interfoliolis, pedicello circa media parte vel infra articulato; corollae majore praebentes, stellatae vel substellatae, lobis vix vel non nisi acuminatis.

Solanum chromatophilum Bitt. f. **sausianense** Ochoa *forma nov.* TYPE: PERU. Dept. Huanuco: prov. Huamalies, circa Sausian, 3580 m alt., Aprilis 26, 1967, *C. Ochoa 2646* (HOLOTYPUS: OCH).

A species typica primordialiter differs: forma et magnitudine foliolorum plerumque majoris et angustior lanceolatis ad apicem acutis vel acuminatis, et basi petiolulatis; itidem planta robustior, statura superans magis profuse ramosa, folia minus incisa.

Solanum series *Megistacroloba*

Solanum megistacrolobum Bitt. f. **purpureum** Ochoa, *forma nov.* TYPE: PERU. Dept. Arequipa: prov. Cailloma, Montis Yahuarmayo, 4000 m alt., ca. Pulpera, Martio 6, 1981, *C. Ochoa 14273* (HOLOTYPUS: OCH; Isotypi: CIP,MOL,USM).

Forma a typo, tuberculorum forma colore magnitudineque admodum variabilis differt. Tuberculi plerumque lati, complanati vel cylindracei cum peridermis purpureis nitidisque. Baccae copiosissime albo punctata.

Solanum series *Piurana*

Solanum chiquidenum Ochoa var. **gracile** Ochoa, *var. nov.* TYPE: PERU. Dept. Cajamarca: prov. Cutervo, Valle Grande, 2500 m alt. inter Santa Rosa de Tingo et Laguna Negra, Junius 1983, *C. Ochoa & Alberto Salas 15229* (HOLOTYPUS: OCH).

Planta gracilis, cauli tenui parce ramoso. Folia 2-3 paribus loborum sin inter rachim interlobulis. Lobi anguste longeque lanceolati apice acuminato marginibus erosis. Corolla alba, stellata vel substellata.

Solanum chiquidenum Ochoa var. **robustum** Ochoa, *var. nov.* TYPE: PERU. Dept. Cajamarca: prov. Contumaza, Montis Cunanten, 2900 m alt., inter Chorrillo et La Ramada, Maius 1982, *C. Ochoa 14760* (HOLOTYPUS: OCH; Isotypi: CIP,MOL).

Planta robusta, caule crasso valde ramoso. Folia quam typus species maiora et magis dissecta, 2-3 paribus foliorum plus 2-4 paribus interloborum; lobis elliptico lanceolatis, apice acuto breviter acuminato marginibus loborum erosis ciliatisque. Corolla albo-eburnea, rotacea.

Solanum chiquidenum Ochoa f. **amazonense** Ochoa, *forma nov.* TYPE: PERU. Dept. Amazonas: prov. Luya, vicinitas Cuelap, 2800 m alt., Maius 15, 1967, *C. Ochoa 2673* (HOLOTYPUS: OCH).

Planta quam species typica *Solanum chiquidenum* Ochoa multo brevior. Folia breviora, plerumque pari foliorum latioribus subsessilibus et lobo terminali latiori late elliptico-lanceolato et cum corolla albo-eburnea, stellata vel substellata a typo differt.

Phytologia (November 1994) 77(5):393-407.

SYNOPTICAL STUDY OF THE GENUS *MACROMERIA* (BORAGINACEAE)

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ABSTRACT

Macromeria, a genus of Guatemala, México, and the southwestern U.S.A., is treated as comprising eleven species, as follows: *M. alba* Nesom, endemic to Tamaulipas; *M. barbigera*, localized endemic of southern Nuevo León and closely adjacent Tamaulipas; *M. exserta*, widespread and common over much of western México; *M. guatemalensis*, a shrubby species endemic to southwestern Guatemala; **M. hintoniorum** B.L. Turner, *sp. nov.*, rarely encountered endemic of Guerrero and Oaxaca; *M. hispida*, relatively uncommon in Nayarit, Jalisco and Michoacán; *M. leontis*, endemic to southern Nuevo León and closely adjacent Tamaulipas; *M. longiflora*, common and widespread throughout much of southcentral México; *M. notata*, endemic to southeastern Coahuila and closely adjacent Nuevo León; *M. pringlei*, endemic but relatively common in Hidalgo and Veracruz; and *M. viridiflora*, relatively common in the more montane regions of northwestern México and closely adjacent U.S.A. (Arizona and New México), represented by var. *viridiflora* (mostly Mexican) and var. *thurberi* (confined to the U.S.A.). A key to species and complete synonymy is provided, along with distributional maps.

KEY WORDS: Boraginaceae, *Macromeria*, México, U.S.A.

Johnston (1954a, b) provided an overview of the genera belonging to the tribe Lithospermeae, to which he assigned *Macromeria* along with 22 other genera, six of these endemic to the New World (*Lasiarrhenum*, *Macromeria*, *Onomosa*, *Onosmodium*, *Perittostema*, and *Psilolaenus*), sixteen endemic to the Old World, and one (*Lithospermum*) common to both the New and Old Worlds. Johnston was a careful and perceptive researcher, especially when working with the Boraginaceae, and provided detailed keys to all the genera of the tribe (1954b) as well as a more elaborate key to the seven genera occurring in North America (1954a).

Johnston (1954a), correctly I think, reckoned *Macromeria* to be most closely related to *Onosmodium*, from which the former is readily distinguished by its much longer stamens which are clearly exserted from the corolla throat. He also provided a detailed description of *Macromeria* with complete synonymy, recognizing nine specific taxa in the group. Since his revisionary study, only two species have been added to the genus, *M. alba* Nesom by Nesom in 1989 and *M. hintoniorum* B.L. Turner in the present study, bringing to eleven the number of species recognized in *Macromeria*, all of these restricted to North America, and all but two confined to México.

Because of the new additions and many newly collected specimens of *Macromeria* that have accrued in herbaria since Johnston's work, I have felt it necessary to provide an overview of the genus as currently perceived. The present contribution is based upon the study of approximately 2204 specimens (including sheets of *Lasiarrhenum* and *Onosmodium*) from sixteen herbaria, as follows (numbers shown in parentheses): ARIZ (84), CAS (153), F (282), GH (208), KANU (183), LL (110), MEXU (98), MICH (217), MO (54), NY (185), OKLA (39), PH (40), TEX (150), UC (147), US (178), WIS (76).

KEY TO *MACROMERIA* SPECIES

1. Plants suffruticose shrublets mostly 1.0-1.5 m high; Guatemala. ..... 4. *M. guatemalensis*

1. Plants herbaceous, mostly 0.5-1.0 m high (to 2 m high in *M. hintoniorum*); state of Oaxaca, México and northwards. ..... (2)

2. Stamens at maturity with filaments 3-5 cm long. .... 3. *M. exserta*

2. Stamens at maturity with filaments 1-2 cm long. ..... (3)

3. Corolla lobes at maturity spreading at right angles to the tube or else these sharply reflexed. ..... (4)

3. Corolla lobes at maturity ascending to erect. ..... (5)

4. Anthers yellow; mouth of corolla tube abundantly glanduliferous; northeastern México. ..... 7. *M. leontis*

4. Anthers purple; mouth of corolla tube glabrous or nearly so, not glanduliferous; western México. ..... 6. *M. hispida*

5. Midstem leaves mostly (3-)4-6 cm wide; stems hispidulous with stiffly spreading trichomes 2-3 mm long, not at all strigose; inner surface of corolla lobes densely glanduliferous; Nuevo León. ..... 2. *M. barbigera*

5. Midstem leaves mostly 1-3(-4) cm wide; stems variously pubescent but not as described in the above; inner surface of corolla lobes not densely glanduliferous. ..... (6)

   6. Corollas orange to orange-yellow; upper surfaces of leaves with minute scabridulous hairs 0.1 mm long or less, at maturity appearing glabrous. ..... 8. *M. longiflora*

   6. Corollas yellow, pale-yellow, greenish-yellow or white; upper surfaces of leaves with well-developed, broad-based hairs 0.3-1.0 mm long. ..... (7)

7. Anthers 3-4 mm long, the filaments attached well below the middle; underside of anther sacs with at least a few hairs near the apex. ..... 11. *M. viridiflora*

7. Anthers 2-3 mm long, the filaments attached near the middle; underside of anther sacs glabrous throughout. ..... (8)

   8. Stems and foliage pubescent with mostly strigose (appressed) hairs. ..... (9)

   8. Stems and foliage pubescent with mostly pilose, widely spreading hairs. ..... (10)

9. Corollas white; leaves sparsely strigose beneath; southern Tamaulipas. ..... 1. *M. alba*

9. Corollas greenish-yellow; leaves moderately to densely strigose beneath; Hidalgo and Veracruz. ..... 10. *M. pringlei*

   10. Stiffly erect, mostly unbranched herbs 20-50 cm high; corollas greenish-yellow; leaves thick, abruptly acute to narrowly obtuse; Nuevo León. ..... 9. *M. notata*

   10. Lax, erect, mostly branched, suffruticose herbs or shrublets 1-2 m high; corollas yellow; leaves thin, gradually acuminate, Guerrero and Oaxaca. ..... 5. *M. hintoniorum*

1. *MACROMERIA ALBA* Nesom, Madroño 36:28. 1989. TYPE: MEXICO. Tamaulipas: Mpio. Gomez Farias, 5-7 km NW of Gomez Farias, just S of Agua del Indio, 30 May 1969, *A. Richardson 1763* (HOLOTYPE: TEX!).

Nesom has provided an excellent account of this taxon, including an illustration of the species, along with a map showing its distributional relationships with *Macromeria notata* I.M. Johnst., which he presumed to be its closest relative. It appears equally close, if not closer, to *M. pringlei* Greenm. (in habit, leaf shape, and vestiture) but sufficiently distinct to warrant recognition. No new collections have come to the fore since Nesom's publication; the taxon is presumably restricted to the Gomez Farias area of southern Tamaulipas (Figure 1).

2. *MACROMERIA BARBIGERA* I.M. Johnst., J. Arnold Arb. 16:189. 1935. TYPE: MEXICO. Nuevo León: N slope of Sierra Tronconal between Canyon de los Charcos and Canyon de San Miguel, ca. 15 mi SW of Galeana, "common in dense oak woods beyond pine-fir belt", 6000-9000 ft, 4 Jun 1934, *C.H. & M.T. Mueller 741* (HOLOTYPE: GH!; Isotypes: F!,MICH!,TEX!).

This species was known to Johnston (1954a) by relatively few collections (Figure 1). As indicated below, numerous collections are now available from pine-oak woodlands mostly between 2000-2200 meters. Johnston thought that the "immediate relatives for the species are obscure," which seems to be the case.

REPRESENTATIVE SPECIMENS: MEXICO. Nuevo León: *Hinton et al. 21351* (TEX), *22117* (TEX), *22912* (TEX); *Mueller 173* (F,MEXU,TEX), *174* (F,MEXU,TEX), *287* (GH,TEX), *563* (GH,TEX), *2871* (GH,LL,TEX); *Pennell 17114* (PH); *Smith M191* (TEX); *Taylor 191* (F). Tamaulipas: *Meyer 2756* (GH).

3. *MACROMERIA EXSERTA* Don, Edinb. New Phil. J. 13:239. 1832. TYPE: MEXICO. w/o locality, 1787-1804, *Sessé & Moçiño s.n.* (HOLOTYPE: Lambert Herbarium, not seen).

Echium longiflorum Sessé & Moçiño, *Pl. Nov. Hisp.* 20. 1888. TYPE: MEXICO. w/o locality, 1787-1804, *Sessé & Moçiño s.n.* (HOLOTYPE: MA; Possible fragment of holotype: GH!).

Macromeria exserta Don var. *imparata* Macbride, Contr. Gray Herb. 49:22. 1917. TYPE: MEXICO. Oaxaca: w/o locality, 1842, *M. Ghiesbreght s.n.* (HOLOTYPE: GH!; Isotype: US!).

This, the generitype, is a very distinctive widespread species (Figure 2) and was treated by Macbride (1917) as the sole member of *Macromeria*. Johnston (1924, 1954a) effectively challenged this concept, noting the many characters

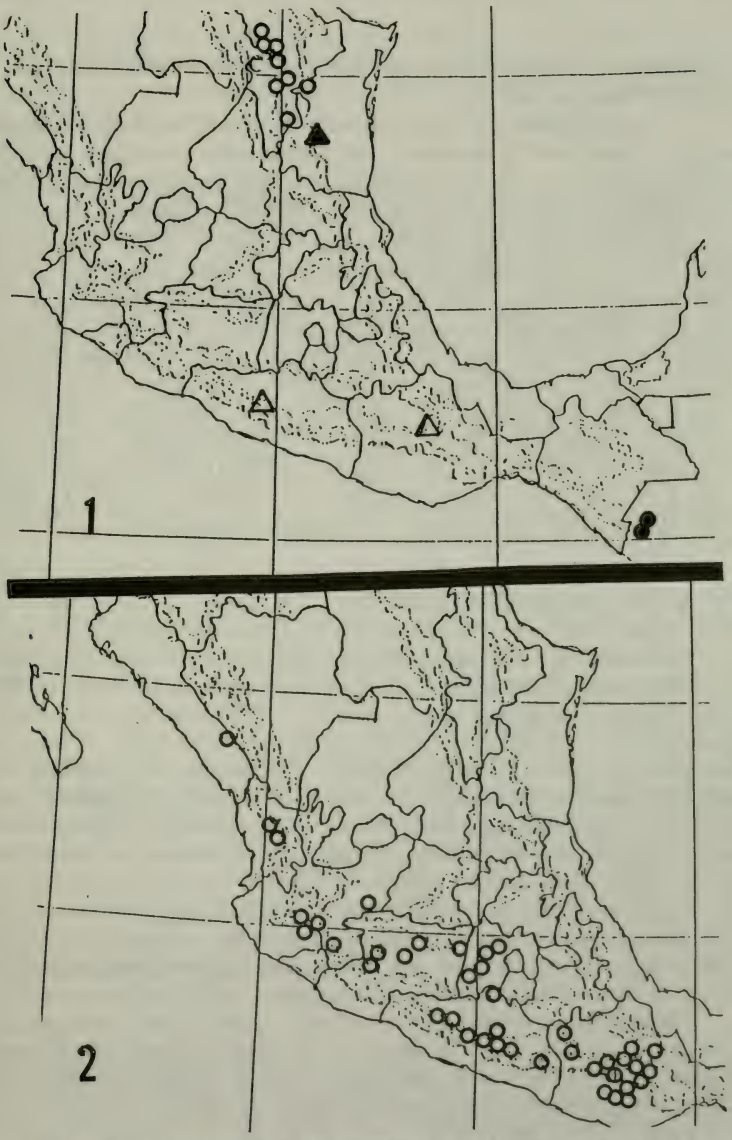

Figure 1 (above). Distribution of *Macromeria alba* (closed triangle), *M. barbigera* (open circles), *M. guatemalensis* (closed circles), and *M. hintoniorum* (open triangles).
Figure 2 (below). Distribution of *Macromeria exserta* (open circles).

that relate *M. exserta* to those species of *Macromeria* which Macbride positioned in *Onosmodium*.

The var. *imparata* has been proposed as a name for forms of the species having an appressed pubescence; such forms occur throughout most of the range of the species and do not form a meaningful morphogeographic element.

REPRESENTATIVE SPECIMENS: MEXICO. Guerrero: *Alexander XA 160* (MICH,NY); *Breedlove 15823* (CAS-DS,MICH); *Hinton 9442* (F,GH,NY, US); *Hinton 14809* (GH,NY,US); *Moore 9259* (GH,UC); *Rzedowski 18512* (MEXU, MICH,TEX). Jalisco: *Fuentes 601* (MO); *Goldsmith 103* (F,GH, MO,US); *McVaugh 12945* (GH,MICH). México: *Hinton 1296* (GH,NY,US); *Hinton 1435* (GH,NY); *Roe 1643* (MICH,UC,US,WIS); *Rzedowski 20759* (CAS-DS,LL,MICH,WIS). Michoacán: *Hinton 13107* (F,GH,LL,MICH,NY,US); *Jack 87* (LL,TEX); *Leavenworth 1773* (F,MO); *Moore 4028* (GH). Nayarit: *Mexia 625* (CAS-DS,GH,UC,US); *Pennell 19759* (GH,MEXU,PH). Oaxaca: *Anderson 4818* (GH,MICH,MO,NY); *Breedlove 12206* (CAS-DS,LL,MICH); *Conzatti 4164* (GH,US); *Davidse 9647* (MO,NY); *Marcks* (LL,WIS); *Pringle 4870* (GH,MEXU,MO,NY,PH,UC,US). Sinaloa: *Breedlove 43896* (CAS-DS).

4. *MACROMERIA GUATEMALENSIS* I.M. Johnst., J. Arnold Arb. 29:232. 1948. TYPE: GUATEMALA. San Marcos: south facing slope of Volcán Tajumulco, between Las Canojas and top of ridge, 7 mi from San Sabastián, 3300-3900 m, 16 Feb 1940, *J.A. Steyermark 35898* (HOLOTYPE: GH; Isotype: F!).

Johnston (1954) inexplicably placed *Macromeria guatemalensis* in synonymy with *M. pringlei* with the notation that the former appears to differ from the latter "only in its more elongate, more decidedly fruticose stems and smaller (to 35 mm long) corollas. Possibly it may represent a southern variety of *M. pringlei*, but hardly a species distinct from it."

Nevertheless, Gibson (1970), in her treatment of the genus *Macromeria* for the Guatemalan flora, retained the species, as do I. In addition, its corolla pubescence is relatively sparse and widely spreading (vs. dense and appressed). There is an excellent illustration of this species in Gibson's treatment.

The only other collections of this taxon known to me are those of *Steyermark 50069* (F) from the Sierra de los Cuchumatanes, Huehuetenango, Guatemala, cited in the original description and a Beaman collection (*3852* [GH,UC]), also from the same sierras (Figure 1).

5. MACROMERIA HINTONIORUM B.L. Turner, *sp. nov.* TYPE: MEXICO. Guerrero: Teotepec, ca. 12°27′N, 100°10′W, pine forest, 2750 m, 16 Jul 1939, *G.B. Hinton et al. 14439* (HOLOTYPE: NY!; Isotypes: F!,NY!,US!).

Macromeriae guatemalensi I.M. Johnst. similis sed corollis majoribus (4-6 cm longis vs. 3-4 cm longis), calycibus majoribus (12-16 mm longis vs. 7-10 mm longis), et foliis minoribus (plerumque 6-7 cm longis vs. 3-5 cm longis) differt.

Robust suffruticose herbs or shrubs 1-2 m high. Stems tan or reddish, pubescent with mostly broad-based widely incurved or spreading hairs up to 1.5 mm long. Leaves lanceolate, mostly 6-7 cm long, 1-2 cm wide, gradually reduced upwards; petioles 0.5-2.0 mm long; blades 3-nervate from above the base, rarely ± subpinnately nerved, sparsely strigose on both surfaces, the apices gradually acuminate. Flowers arranged terminal or subaxillary in cymose panicles, the pedicels mostly 5-12 mm long. Sepals linear-lanceolate, 12-16 mm long, 1-2 mm wide, strigose on both surfaces. Corollas "yellow", 4-6 cm long, pilose with spreading hairs, the lobes erect, 10-12 mm long, 5-6 mm wide, acute to narrowly obtuse, glabrous or nearly so on the inner surfaces; corolla tubes markedly narrowed at the base for 1.5-2.0 cm, abruptly flaring into a narrowly funnelform throat 1.5-2.5 cm long, the corolla glabrous within. Stamens with filaments free for 10-12 mm, the anthers ca. 2 mm long, glabrous, yellow, extending to the tips of the corolla lobes, attached to the glabrous filaments at ca. the middle. Style branches 4-5 cm long, glabrous, the apices minutely bifid, each branch terminated by an orbicular stigmatic swelling. Nutlets ca. 3.5 mm high, 2.5 mm wide, decidedly beige in color.

This taxon, because of its suffruticose shrubby habit, coarse pubescence and corolla shape seems closest to *Macromeria guatemalensis*, differing from the latter in having larger, full-yellow corollas (vs. pale yellow and 4-6 cm long vs. 3-4 cm long), longer sepals (12-16 mm long vs. 7-10 mm long), and mostly larger leaves (6-7 cm long vs. 3-5 cm long). *Macromeria hintoniorum* is known from only three collections, two from Guerrero and one from Oaxaca (cited below). The latter has somewhat smaller flowers, but otherwise matches well the other specimens.

SPECIMENS EXAMINED: MEXICO. Guerrero: W of Puerto El Gallo along road to Toro Muerto, 2530 m, *Breedlove 65042* (CAS). Oaxaca: Distr. Etla, near village of "Huanchinomgo", 1842, *Ghiesbreght 122* (GH).

6. *MACROMERIA HISPIDA* Mart. & Gal., Bull. Acad. Brux. 11:339. 1844. *Macromeria longiflorum* Sessé & Moçiño *ex* D. Don var. *hispida* (Mart. & Gal.) A.DC., *Prodr.* 10:68. 1846. *Onosmodium longiflorum* (Sessé & Moçiño *ex* D. Don) Macbride var. *hispidum* (Mart. & Gal.) Macbride, Contr. Gray Herb., n.s. 49:21. 1917. TYPE: MEXICO. Michoacán: near Morelia, Cerro de Quinzeo, 6500-8000 ft, 1840-1844, *Galleotti 1917* (HOLOTYPE: BR; Isotype fragment: GH!).

Macbride (1917) treated this taxon as a variety of *Macromeria longiflorum*, but as noted by Johnston (1945) it appears relatively closely related to *M. exserta*, largely distinguished from the latter by its less zygomorphic corollas and straight short filaments of the stamens. In my opinion it stands much closer to *M. leontis* I.M. Johnst. and *M. pringlei*, the latter relationship also suggested by Johnston.

Johnston (1954a) notes the taxon to be known "only from the state of Michoacán, especially near Morelia and Patzcuaro," but subsequent collections have shown the species to occur over a much larger area (Figure 3).

REPRESENTATIVE SPECIMENS: MEXICO. Jalisco: *Diguet s.n.* (MICH); *Gregory 208* (GH,MEXU,MICH,NY). Michoacán: *Arsene 2775* (GH,US); *Kenoyer A287* (F,MICH); *Pringle 5606* (MEXU,US); *Torke 286* (LL,NY). Nayarit: *McVaugh 16577* (GH,MEXU, MICH). Sinaloa: *Dehesa 1517* (US), *1527* (US); *Ortega 282* (MEXU).

7. *MACROMERIA LEONTIS* I.M. Johnst., J. Arnold Arb. 16:188. 1935. TYPE: MEXICO. Nuevo León: "ascent into Taray", ca. 15 mi SW of Galeana, ca. 8000 ft, 6 Jun 1934, *C.H. & M.T. Mueller 754* (HOLOTYPE: GH!; Isotype: TEX!).

This is a strikingly beautiful species what with its large yellow blossoms; indeed, recent collections from near Aramberri, Nuevo León (*Hinton et al. 23060*) have remarkably large corollas, up to 7 cm long (with lobes sharply reflexed), the lobes ca. 12 mm long, and as wide).

Johnston (1954a), while noting its "very distinct" nature, thought its relationship to be closest to *Macromeria longiflora* and *M. pringlei*. It appears to be equally close to *M. hispida*, as noted under the latter.

REPRESENTATIVE SPECIMENS: MEXICO. Nuevo León: *Hinton et al. 2520* (MICH), *17566* (TEX), *18523* (TEX), *19395* (TEX), *21026* (GH,TEX), *22277* (TEX), *23060* (TEX); *Mueller 594* (GH,MICH,TEX). Tamaulipas: *Stanford 3110* (ARIZ,CAS-DS,GH,NY,UC).

8. *MACROMERIA LONGIFLORA* Sessé & Moçiño *ex* D. Don, Edinb. New Phil. J. 13:239. 1832. *Onosmodium longiflorum* (Sessé & Moçiño *ex* D. Don) Macbride, Contr. Gray Herb. 49:21. 1917. TYPE: MEXICO. w/o locality, 1787-1804, *Sessé & Moçiño 1738* (HOLOTYPE: Lambert Herbarium; Probable photoholotype and fragment: GH!; Probable isotype: F!). Johnston (1949, J. Arnold Arb. 30:109) gives the type locality as "Mountains between Zitacuaro and Malucatepec," based upon information presented in Sessé & Moçiño's *Fl. Mex.* 32. 1893, although the type material lacks such data.

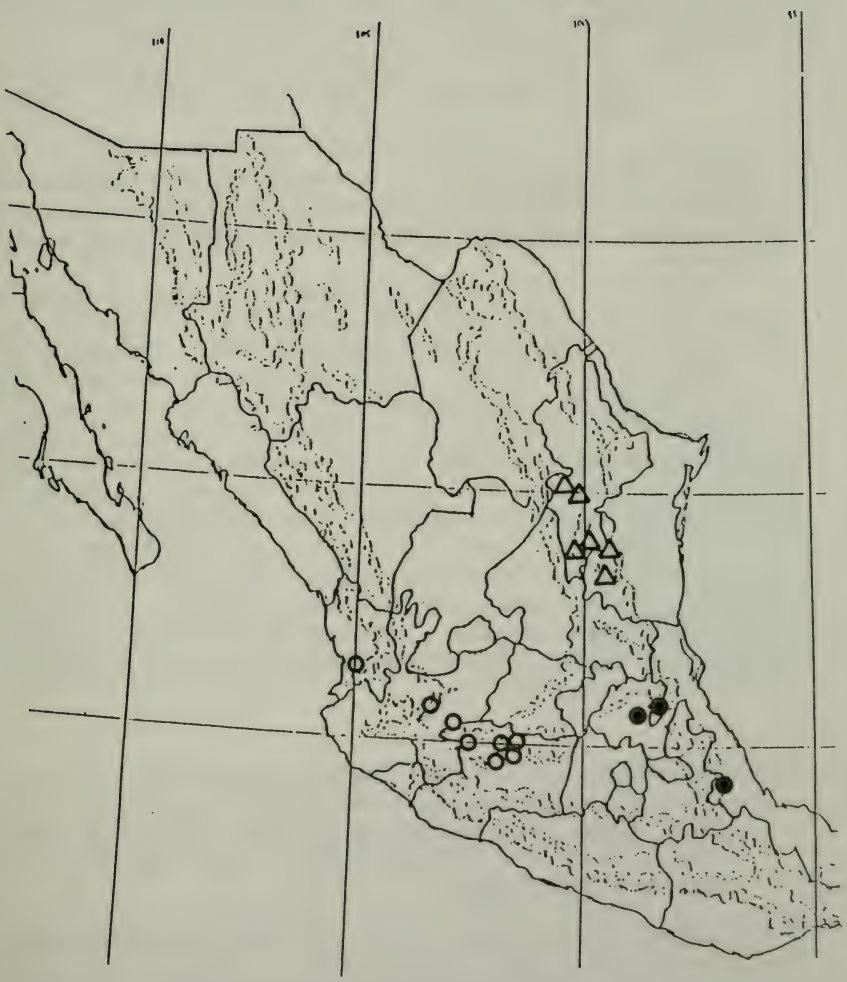

Figure 3. Distribution of *Macromeria hispida* (open circles), *M. leontis* (open triangles), and *M. pringlei* (closed circles).

Macromeria discolor Benth., *Pl. Hartw.* 49. 1840. *Onosmodium discolor* (Benth.) Macbride, Contr. Gray Herb. 49:20. 1917. TYPE: MEXICO. w/o locality, *Graham s.n.* (HOLOTYPE: K).

Lithospermum flavum Sessé & Moçiño, *Fl. Mex.* ed. 2, 32. 1893. TYPE: MEXICO. Michoacán: w/o date, *Sessé & Moçiño s.n.* (HOLOTYPE: MA).

This is a widespread variable species represented by numerous specimens in herbaria. It is readily distinguished from most other species of *Macromeria* by its orange or orangish corollas and upper leaf surfaces which are minutely scabridulous.

REPRESENTATIVE SPECIMENS: MEXICO. Colima: *Goldsmith 60* (GH,UC,US), *65* (CAS,F,GH,NY,UC); *Jones 326* (US). Durango: *Breedlove 59048* (CAS); *Maysilles 8250* (MEXU,MICH,NY,TEX). Guanajuato: *Rubio 14* (MICH). Hidalgo: *Moore 3105* (WIS). Guerrero: *Rzedowski 18513* (CAS-DS,MICH); *Straw 1084* (GH,MEXU,MICH,UC); *Tillett 637-139* (CAS-DS,GH,MICH,US). Jalisco: *Gonzáles 238* (MICH,WIS); *McVaugh 15996* (GH, MICH); *Reveal 4097* (MEXU,MICH); *Rzedowski 27516* (CAS-DS,F,LL,MO, NY,US,WIS); *Wilbur 1795* (MICH). México: *Hinton 4452* (F,GH,US); *Hinton 8257* (F,GH,LL,NY,US); *Rzedowski 28272* (CAS-DS,KANS,MICH,TEX,US); *Rzedowski 34254* (CAS-DS,MEXU,NY). Michoacán: *Hinton 15274* (ARIZ, F,GH,LL,MO,NY,US); *Hinton 15981* (MICH,NY,US); *Iltis 471* (MICH,TEX, UC,WIS); *Leavenworth 286* (F,GH,MICH,NY); *Pringle 4146* (F,GH,MEXU, PH,UC,US). Nayarit: *Breedlove 61496* (CAS); *Rose 2184* (US), *3520* (US). Oaxaca: *Anderson 4741* (GH,MICH,MO); *Conzatti 4183* (GH,US); *Diggs 2313* (WIS); *Lorence 4654* (F,MEXU).

9. *MACROMERIA NOTATA* I.M. Johnst., J. Arnold Arb. 35:13. 1954. TYPE: MEXICO. Nuevo León: Ascent of Sierra Infernillo, ca. 15 mi SW of Galeana, "Common over small areas just below the peak.", 9000-10000 ft, 16 Jun 1934, *C.H. & M.T. Mueller 830* (HOLOTYPE: GH!; Isotypes: F!,MICH!,TEX!).

As noted by Johnston (1954a) this is a very distinctive taxon what with its "densely glanduliferous plaits which extend from the upper part of the throat out upon each of the corolla lobes." He compared such plaits with the faucal appendages that characterize many species of *Lithospermum*. *Macromeria notata* also has a distinctive *Lithospermum*-like habit, the plants being low stiffly erect perennials, with unbranched stems, and arising from thick rootstocks, and with rhizomes that exude a purplish stain upon the sheets to which they are attached. This latter phenomenon is often observed in species of *Lithospermum* but I have not noted this in other species of *Macromeria*.

REPRESENTATIVE SPECIMENS: MEXICO. Coahuila: *Henrickson 16129* (TEX). Nuevo León: *Bell 17867* (UC); *Dorr 2272* (TEX); *Hinton et al. 18287* (TEX); *Mueller 2238* (F,GH,MICH,TEX,US); *Pennell 17123* (PH,US).

10. *MACROMERIA PRINGLEI* Greenm., Proc. Amer. Acad. Arts 34:570. 1899. *Onosmodium pringlei* (Greenm.) Macbride, Contr. Gray Herb. 49:20. 1917. TYPE: MEXICO. Hidalgo: Sierra de Pachuca, 10,000 ft, 4 Aug 1898, *C.G. Pringle 6949* (HOLOTYPE: GH!; Isotypes: F!,MEXU!, PH,UC!,US!).

Johnston (1954a) erroneously cited the type as *Pringle 11044*, but only a single sheet is cited in Greenman's protologue, that being *Pringle 6949*. Johnston also placed his *Macromeria guatemalensis* in synonymy with *M. pringlei* with the statement that "Possibly it may represent a southern variety of *M. pringlei*, but hardly a species distinct from it." My evaluation of the Guatemalan taxon is otherwise: it appears as distinct as most other specific taxa of the group concerned. *Macromeria pringlei* is largely confined to spruce-fir forests of Hidalgo and closely adjacent Veracruz from mostly 2000-3000 meters (Figure 3).

REPRESENTATIVE SPECIMENS: MEXICO. Hidalgo: *Cota 3008* (TEX); *Garcia 975* (CAS,F,MEXU,LL,NY,TEX); *Hernández 123* (CAS,MEXU,TEX); *Rzedowski 26767* (CAS-DS,LL,MICH); *Lyonnet 1095* (MEXU); *Pringle 11094* (F,LL,NY,US); *Puga 3000* (MEXU). Veracruz: *Hernández 19401* (F), *20890* (MEXU); *Miller 1358* (NY).

11. *MACROMERIA VIRIDIFLORA* A.DC., *Prodr.* 10:68. 1846. TYPE: MEXICO. w/o locality, 1787-1804, *Sessé & Moçiño 5131* ["Lithospermum longifolium No. 24"]. (HOLOTYPE: M; Fragment holotype: F!, GH!; Photoholotype: GH!,MICH!).

Two regional intergrading varieties of this well-marked species are recognized, as follows:

1. Corollas mostly 6-8 cm long; southernmost Arizona (Cochise, Santa Cruz, Pinal, and Pima counties) and northwestern México. ... var. *viridiflora*

1. Corollas mostly 3.5-6.0 cm long; southcentral and northern Arizona and New Mexico. ..... var. *thurberi*

a. *MACROMERIA VIRIDIFLORA* A.DC. var. *VIRIDIFLORA*

Johnston (1954a) has provided an excellent description of this taxon, the distribution of which is shown in Figure 5. In the Santa Catalina and Chiricahua Mountains of southern Arizona populations occur in which plants intermediate between the two varieties are found. Johnston in his discussion of var. *thurberi* also alludes to such intermediates.

REPRESENTATIVE SPECIMENS: MEXICO. Chihuahua: *Bye 7839* (LL,TEX); *Jones s.n.* (CAS,F,GH,US); *LeSueur 895* (ARIZ,CAS,F,TEX,UC, US); *Straw 1696* (GH,MICH,UC), *1921* (CAS,MICH); *Townsend 62* (F,GH, NY,TEX,UC,US). Durango: *Diaz 251* (NY,TEX); *Maysilles 7027* (MICH,NY), *7363* (MICH), *7515* (MICH), *8347* (MICH); *Tenorio 703* (CAS,MEXU), *1063* (NY). Sinaloa: *Gentry 6374* (ARIZ). Sonora: *Pennell 19607* (NY,PH); *Phillips 673* (GH,MICH); *White 3155* (ARIZ,GH,MICH).

UNITED STATES. Arizona: Cochise Co.: *Blumer 1817* (ARIZ,CAS-DS,F,GH,NY,US). Pima Co.: *Pringle s.n.* [23 Jul 1884] (NY,PH,WIS). Pinal Co.: *Peebles 2244* (US). Santa Cruz Co.: *McClintock 5847* (ARIZ,CAS,UC).

b. *MACROMERIA VIRIDIFLORA* A.DC. var. *THURBERI* (A. Gray) I.M. Johnst., J. Arnold Arb. 12. 1954. *Onosmodium thurberi* A. Gray, *Syn. Fl. N. Amer.* 2(1):205. 1878. *Macromeria thurberi* (A. Gray) Mackenzie, Bull. Torrey Bot. Club 32:496. 1905. TYPE: U.S.A. New Mexico. Grant Co.: "Copper Mines", Aug 1851, *C. Wright 1106* (LECTOTYPE [selected here]: GH!; Isolectotypes: GH!,NY!).

Johnston (1954a) noted that "The differences in flower size are geographically correlated and sufficiently striking to merit nomenclatorial [sic] recognition," a statement with which I agree. The distribution of each is shown in Figure 5.

REPRESENTATIVE SPECIMENS: UNITED STATES. New Mexico: Catron Co.: *Gentry 2280* (CAS-DS,KANU,NY,TEX). Grant Co.: *Metcalfe 1042* (CAS,F,GH,NY,UC). Lincoln Co.: *Wooton 217* (CAS-DS,GH,NY,UC, US). Mora Co.: *Arsene 18580* (US). Otero Co.: *Correll 39249* (LL,NY). San Miguel Co.: *Sagalyn 97* (GH). Sierra Co.: *Metcalfe 1942* (US). Arizona: Apache Co.: *Schmidt 75* (ARIZ), *104* (ARIZ), *132* (ARIZ). Coconino Co.: *MacDougal 323* (ARIZ,GH,NY,PH,UC,US). Gila Co.: *Johnson s.n.* (ARIZ). Graham Co.: *Lemmon s.n.* (UC). Greenlee Co.: *Barr 68-332* (ARIZ). Navajo Co.: *Ferris 10099* (CAS,DS,GH,MICH,UC).

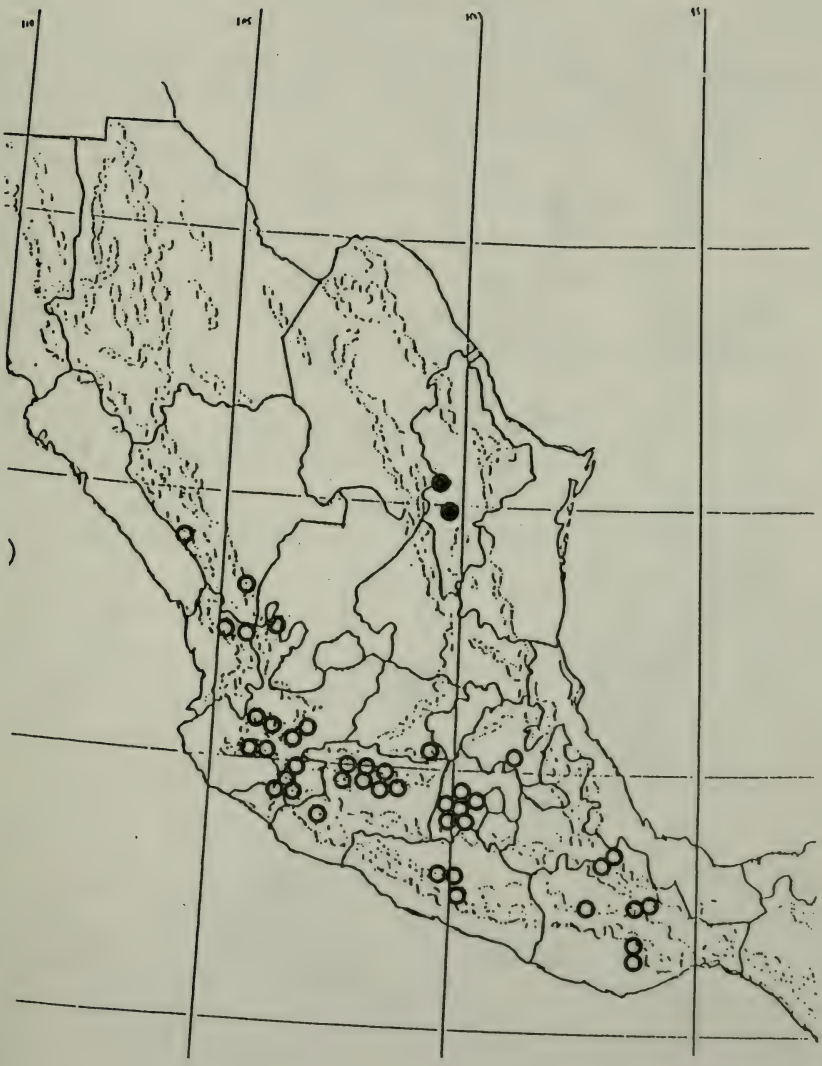

Figure 4. Distribution of *Macromeria longifolia* (open circles), and *M. notata* (closed circles).

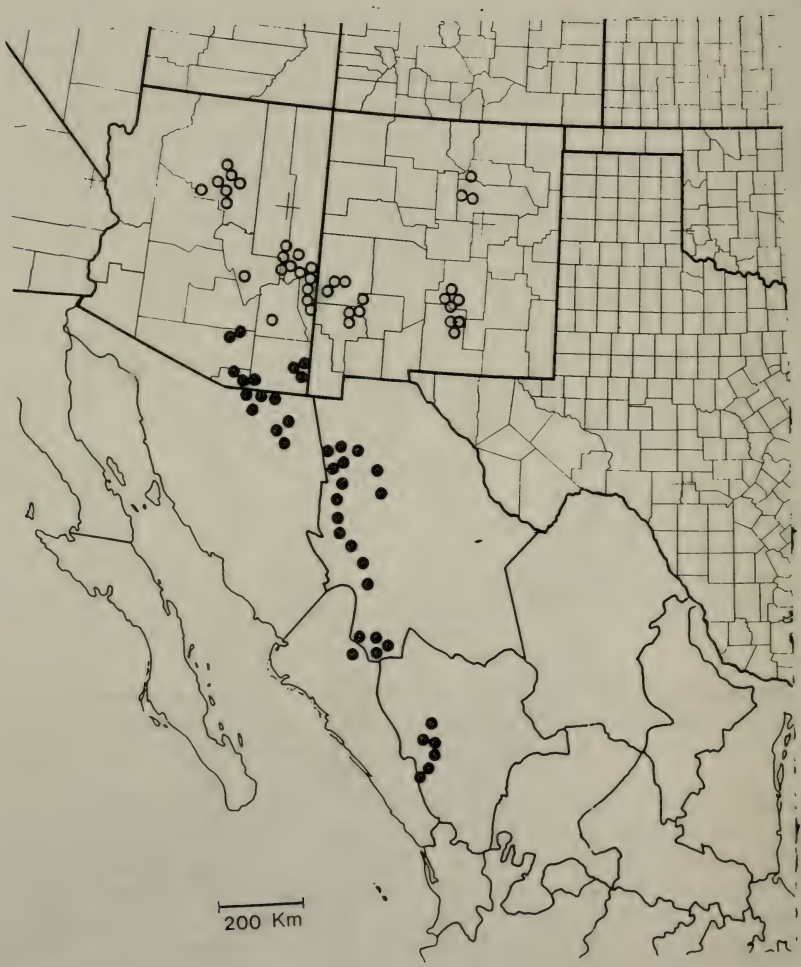

Figure 5. Distribution of *Macromeria viridiflora*: var. *thurberi* (open circles), and var. *viridiflora* (closed circles).

ACKNOWLEDGMENTS

I am grateful to Guy Nesom for the Latin diagnosis and to him and Piero Delprete for reviewing the paper.

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Phytologia (November 1994) 77(5):408-410.

TWO NEW SPECIES OF *VERNONIA* (ASTERACEAE) FROM NORTHEASTERN MEXICO

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ABSTRACT

Two new species of *Vernonia* from the Sierra Madre Oriental of northeastern México are described: **V. hintoniorum** B.L. Turner (from Mpio. Hidalgo, Tamaulipas) and **V. zaragozana** B.L. Turner (from Mpio. Zaragoza, Nuevo León and closely adjacent Tamaulipas). Both appear to belong to sect. *Vernonia*, subsect. *Paniculatae*, series *Verae*.

KEY WORDS: *Vernonia*, Asteraceae, México

Routine identification of Mexican Compositae has revealed the following new species.

VERNONIA HINTONIORUM B.L. Turner, *sp. nov.* TYPE: MEXICO. Tamaulipas: Mpio. Hidalgo, Los Mimbres, 865 m, oak woods, 25 Aug 1994, *Hinton et al. 24711* (HOLOTYPE: TEX!; Isotype: MEXU).

Vernoniae greggii A. Gray similis sed involucris cylindro-campanulatis (vs. campanulatis) et capitulis 4-5 flosculos gerentibus (vs. flosculis 15-80) differt.

Suffruticose stiffly erect much-branched perennial herbs 0.5-1.5 m high. Stems well-branched above the middle, brownish-red, sparsely to moderately puberulous with mostly appressed hairs. Midstem and upper leaves mostly 12-18 cm long, 5-6 cm wide; petioles 5-15 mm long; blades ovate-elliptic, pinnately nervate, pubescent on both surfaces, more so beneath, somewhat bicolored, the margins serrulate, the apices acute. Capitulescence a broad terminal corymbose leafy panicle 15-30 cm across, 10-20 cm high, the ultimate peduncles mostly 5-10 mm long. Involucres cylindrocampanulate, 5-8 mm high, 2.5-3.0 mm wide (pressed), 4-5 seriate; the bracts subglabrous, somewhat scarious,

acute to apiculate. Receptacle plane, ca. 1.5 mm across, adorned with short pubescent scales ca. 0.02 mm high. Florets 4-5 per head; corollas purple, glabrous, 8-9 mm long; tubes 5-6 mm long, the lobes linear-lanceolate, the 3 upper lobes connate basally. Achenes columnar, ca. 9 ribbed, ca. 3 mm long, sparsely atomiferous-glandular to glabrescent, sparsely hispidulous near the apex; pappus of numerous tawny inner bristles 4-6 mm long, the outermost bristles ca. 1 mm long.

ADDITIONAL SPECIMENS EXAMINED: MEXICO. Tamaulipas: Mpio. Hidalgo, El Mirador, 990 m, 1 Aug 1994, *Hinton et al. 24525* (MEXU,TEX); Mirador, 850 m, 3 Aug 1994, *Hinton et al. 24617* (MEXU,TEX); Cuatro Caminos to Los Mimbres, 690 m, 21 Sep 1994, *Hinton et al. 24791* (MEXU, TEX); Mimbres, 800 m, 8 Nov 1994, *Hinton et al. 25027* (MEXU,TEX).

Vernonia hintoniorum belongs to the subsect. *Paniculatae*, where it appears to have no close relatives. It can, however, be compared to *V. greggii*, especially in achene morphology, both species possessing atomiferous glandular, 8-9 ribbed achenes. *Vernonia hintoniorum* differs in having much smaller more nearly cylindrical involucres each with 4-5 florets (vs. campanulate with 15-80 florets).

It is a pleasure to name this distinct species for the remarkable Hinton family, the only collectors to assemble this plant to date.

VERNONIA ZARAGOZANA B.L. Turner, *sp. nov.* TYPE: MEXICO. Nuevo León: Mpio. Zaragoza, Los Potreritos, 1325 m, 2 Aug 1994, *Hinton et al. 24718* (HOLOTYPE: TEX!; Isotype: MEXU!).

Vernoniae greggii A. Gray similis sed differt acheniis infirme costatis dense omnino pubescentibus trichomatibus brevibus porphyreis glandulosis (vs. valde costatis sparsim hispidulis) et pappo serie exteriori setarum brevium absque (vs. serie exteriori praesenti).

Perennial stiffly erect mostly unbranched herbs to 60 cm high. Stems minutely pubescent with both crinkled eglandular and erect glandular hairs. Midstem leaves mostly 8-9 cm long, 1-2 cm wide, crowded and gradually reduced upwards, sessile or subclasping, the blades 4-8 times as long as wide, narrowly lanceolate to elliptic-linear, pinnately veined, atomiferous glandular beneath to punctate, otherwise glabrous on the surfaces, the veins hispidulous, the margins entire to irregularly serrulate. Heads arranged in stiffly divaricate terminal corymboid panicles, the ultimate peduncles 8-50 mm long. Involucres campanulate, 7-8 mm high, the bracts lanceolate, 3-4 seriate, acute, their faces minutely pubescent throughout. Receptacle convex, ca. 2 mm across, pitted, glabrous. Florets 15-20 per head (estimated), the corollas 8-10 mm long, purple, bilabiate, the tubes 3-5 mm long, the upper 3 lobes fused to their apices

or nearly so, the 2 lobes of the lower lip variously connate. Achenes columnar, 2.5-3.0 mm long, ribless or seemingly so, deep rusty-brown, densely and minutely glandular-pubescent throughout; pappus of numerous white bristles 8-10 mm long, an outer shorter series completely absent.

ADDITIONAL SPECIMEN EXAMINED: MEXICO. Tamaulipas: Sierra de Guatemala, along Mex. highway 101, road to Jaumave, top of sierra at pass, SW of Cd. Victoria, oak woodlands among limestone boulders (karstic plateau with sink holes), ca. 1500 m, 14 Aug 1991, *Iltis & Simon 30784* (TEX).

While compared with *Vernonia greggii* in the above diagnosis, *V. zaragozana* is clearly not closely related to that taxon, although it appears to belong to the subsect. *Paniculatae*, series *Verae*, as defined by Jones (1976, 1978), which includes *V. greggii* along with seventeen other taxa, largely defined by their herbaceous habit, narrow leaves, paniculate capitulescence and restriction to northeastern México and eastern U.S.A.

When first encountered (*Iltis 30784*) I tentatively dubbed the sheet concerned as an aberrant specimen of *Vernonia greggii*. With the new and better collections obtained by the Hintons I have no doubt that the plants concerned belong to an undescribed species.

ACKNOWLEDGMENTS

I am grateful to Guy Nesom for the Latin diagnoses, and to him and Justin Williams for reviewing the manuscript.

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Phytologia (November 1994) 77(5):411-413.

A NEW NAME FOR *ARISTIDA HAMULOSA* (GRAMINEAE)

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ABSTRACT

A name change is proposed in the grass genus *Aristida* to accommodate an earlier homonym: **Aristida ternipes** var. **gentilis** (Henrard) *comb. nov.* to replace *A. ternipes* var. *hamulosa* (Henrard) Trent.

KEY WORDS: *Aristida hamulosa*, nomenclature, Gramineae

In preparing the treatment for the grass genus *Aristida* for the forthcoming revision of the *Manual of the Grasses of the United States* (Hitchcock & Chase 1951) by Mary Barkworth and collaborators, an earlier homonym was discovered that must replace a later, though more familiar, name.

Hook threeawn, a common *Aristida* of the southwestern United States and México, was long known by the name *Aristida hamulosa* Henrard. Trent & Allred (1990) demonstrated the conspecific nature of the three-awned *A. hamulosa* and the single-awned *A. ternipes* Cavanilles, and effected the combination *A. ternipes* Cavanilles var. *hamulosa* (Henrard) Trent to reflect this association. They did not consider for priority, however, *A. gentilis* Henrard or *A. gentilis* var. *breviaristata* Henrard, thinking incorrectly that these did not belong to *A. hamulosa*. However, an examination of the types has since revealed that both *A. gentilis* and *A. gentilis* var. *breviaristata* fit well within the circumscription of *hamulosa*, though var. *breviaristata* has lateral awns somewhat shorter than average (only 4-6 mm long).

At the varietal level, the epithets to be considered for hook threeawn (see synonymy below) are *Aristida humboldtiana* Trin. & Rupr. var. *minor* Vasey (1892), *A. gentilis* var. *gentilis* (1927; this is the autonym created by *A. gentilis* var. *breviaristata*, *A. gentilis* var. *breviaristata* (1927), and *A. ternipes* var. *hamulosa* (1990). The var. *minor* Vasey has priority, but is not available in combination with *A. ternipes* because of the already existing *A. ternipes* var. *minor* (Vasey) A.S. Hitchcock (based on *A. schiedeana* var. *minor* Vasey [1886]

and corresponding to the single-awned var. *ternipes* and not the three-awned form under consideration here). Both *gentilis* and *breviaristata* date from 1927, but an autonym has priority over the name that establishes it (Article 57.3, *ICBN*). The epithet gentilis thus takes priority at the varietal rank for hook threeawn and the following combination and synonymy are proposed:

Aristida ternipes Cavanilles var. **gentilis** (Henrard) Allred, *comb. nov.* BASIONYM: *Aristida gentilis* Henrard var. *gentilis* (autonym created by *Aristida gentilis* Henrard var. *breviaristata* Henrard), Meded. Rijk. Herb. Leiden 54a:255 (1927). TYPE: MEXICO. Aguascalientes: near Aguascalientes, 2 Oct 1910, *A.S. Hitchcock 7448* (Isotype: US!).

Aristida humboldtiana Trinius & Ruprecht var. *minor* Vasey, Contr. U.S. Nat. Herb. 3:47 (1892). TYPE: U.S.A. Texas: *Nealley s.n.* (HOLOTYPE: US!). Not *Aristida ternipes* Cavanilles var. *minor* (Vasey) A.S. Hitchcock, which is based on *Aristida schiedeana* Trinius & Ruprecht var. *minor* Vasey (1886). (HOLOTYPE: US!).

Aristida hamulosa Henrard, Meded. Rijk. Herb. Leiden 54:219 (1926); *Aristida ternipes* Cavanilles var. *hamulosa* (Henrard) Trent, Sida 14:260 (1990). TYPE: U.S.A. Arizona: Tucson, 30 Sep 1894, *J.W. Toumey s.n.* (Isotype: US!).

Aristida gentilis Henrard, Meded. Rijk. Herb. Leiden 54:196 (1926); *Aristida gentilis* Henrard var. *gentilis* (autonym created by *Aristida gentilis* Henrard var. *breviaristata* Meded. Rijk. Herb. Leiden 54a:255 [1927]). TYPE: MEXICO. Aguascalientes: near Aguascalientes, 2 Oct 1910, *A.S. Hitchcock 7448* (Isotype: US!).

Aristida gentilis Henrard var. *breviaristata* Henrard, Meded. Rijk. Herb. Leiden 54a:255 (1927). TYPE: U.S.A. Arizona: north slope of Santa Rita Mts, 18 Sep 1904, *D. Griffiths 7270* (Isotype: US!).

Aristida imbricata Henrard, Meded. Rijk. Herb. Leiden 54a:253 (1927). TYPE: U.S.A. Texas: near El Paso, 10 Dec 1904, *D. Griffiths 7433* (Isotype: US!).

ACKNOWLEDGMENTS

I am grateful to Joseph K. Wipff (TAES) and Richard Spellenberg (NMC) for reviewing the manuscript. Publication of this paper is supported by the New Mexico Agricultural Experiment Station.

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Phytologia (November 1994) 77(5):414-424.

FLORISTICS OF A XERIC SANDYLAND IN WESTERN LOUISIANA

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ABSTRACT

The floristics and edaphic conditions of a western Louisiana xeric sandhill woodland are described. This community, which occurs in central and northwestern Louisiana, is rare. The soil is nutrient poor and porous. Water and air move rapidly through it causing rapid drying. In presettlement times, sandylands were probably fairly common in the West Gulf Coastal Plain, but because of fire suppression, grazing, agriculture, and agroforestry, this community is now rapidly vanishing.

KEY WORDS: Sandy woodlands, xeric, Kisatchie National Forest, floristics, Louisiana

INTRODUCTION

Like so many plant communities of the West Gulf Coastal Plain, there is little published information on xeric sandylands (Ajilvsgi 1979; Watson 1979; Marietta 1979; Christensen 1988; Orzell 1990; Martin & Smith 1991; Stout & Marion 1993). In western Louisiana, xeric sandylands have been classified into two types by the Louisiana Natural Heritage Program: xeric sandhill woodland and stream terrace sandy woodland. These communities occur in east Texas (Marietta 1979; Ward 1984; Bridges & Orzell 1989; Marks & Harcombe 1981; Harcombe *et al.* in press), in central and northwestern Louisiana, and in southern Arkansas. The sandyland communities of the West Gulf Coastal Plain appear to be similar in tree species composition and structure to turkey oak sandhill forests in the East Gulf Coastal Plain except for the absence of several key species such as turkey oak (*Quercus laevis* Walt.) and wiregrass (*Aristida stricta* Michx.) (Christensen 1988; Stout & Marion 1993; Harcombe *et al.* in press) and the presence of several western elements.

Sandylands occur mainly in Tertiary marine deposits on ridge tops and upper slopes, and on Pleistocene deposits on terraces near streams. The deep

sandy soils are of low fertility and, because of their porous nature, water and air move rapidly through them causing rapid drying. Overstory, midstory, and herbaceous vegetation are often sparse, allowing sun to reach the ground, and in some areas, trees are virtually absent. Reflected glare from the white sand is often intense. Trees, typically a combination of overstory pines and midstory oaks (especially *Quercus incana* Bartr.), are often stunted. Lichens and mosses are usually plentiful on the bare soils.

The unusualness of sandylands is reflected in the fact that 10 percent of the plants listed as rare by the Louisiana Natural Heritage Program, and 20 percent of the species listed as sensitive by the Kisatchie National Forest are fidel to this community.

We made a study of the vascular flora of one xeric sandhill woodland in the Winn Ranger District of the Kisatchie National Forest. The site is located in Natchitoches Parish (T13N R6W Sec. 7) (Caldwell 1991).

METHODS

We visited one sandyland — Susan's Sandyland — every two to three weeks between the summer of 1993 and the autumn of 1994. During these visits, we collected and recorded all vascular plants found. We follow MacRoberts (1984, 1989), Gandhi & Thomas (1989), and Allen (1992) in most instances of botanical nomenclature. Voucher specimens of many of the species collected are deposited at Vanderbilt (VDB), the Range Management Research Herbarium, Southern Forest Experiment Station, United States Forest Service (SFRP), Northeast Louisiana University (NLU), and Louisiana State University (LSU).

The study area was a partly open (30% cover) 0.75 ha plot surrounded by a sandy woodland community (75% cover) dominated by *Quercus incana*, *Q. marilandica* Muenchh., *Q. stellata* Wang., *Carya* sp., and *Pinus taeda* L. Susan's Sandyland is about 90 meters above sea level.

While the specific fire history of this area is uncertain, it has not burned in years. In presettlement times before fire suppression became a normal practice, the site probably burned regularly since sandylands are embedded in the pyrogenic longleaf pine community, which probably burned every 1 to 3 years (Smith 1991).

We also made irregular observations of other sandyland sites in central and northwestern Louisiana and in east Texas.

Climatic data are given in Martin *et al.* (1990). Annual precipitation averages about 125 cm and is fairly evenly distributed throughout the year. In summer, temperatures rise to 35° C, which, combined with short droughts, translates into very hot and dry conditions. Under these conditions, especially when there are short droughts, the exposed sands become very dry.

Soil samples were taken from the upper 15 cm of Susan's Sandyland and at two other sandy woodlands in the Winn District, and were analyzed by A & L Laboratories, Memphis, Tennessee.

RESULTS

We list the vascular plants found at Susan's Sandylands in Table 1. Fruticose lichens, such as *Cladonia*, are important in this community but they have yet to be studied.

We list the soil characteristics of Susan's Sandyland and two other sandylands in the Winn District in Table 2. Two sites are upland sandhill woodlands and one is a stream terrace woodland.

The soil on which this community occurs – whether on hill tops or stream terraces – is acidic loamy fine sand of low fertility and rapid permeability (Martin *et al.* 1990).

DISCUSSION

We recorded a total of 61 taxa, representing 56 genera and 34 families for Susan's Sandyland. There appeared to be no dominant families. Sandylands have fewer species than a number of other plant communities in the Kisatchie National Forest, for example, bogs, sandstone outcrops, and prairies, which for comparable area would have had nearly twice the number of species (MacRoberts & MacRoberts 1993a, b; Smith *et al.* 1989). In fact, sandyland communities are rather austere: they rarely have continuous ground cover and always have large open patches of exposed sand (*e.g.*, see quantified information in Ward 1984:53).

Logan (1994) mentions xeric sandylands as occurring in south central Arkansas. Marks & Harcombe (1981), Harcombe *et al.* (in press), and Ward (1984) studied the woody vegetation, and Marietta (1979) studied both woody and herbaceous vegetation of xeric longleaf pine communities in east Texas. The latter two describe communities similar to, but slightly more mesic, than our study site. Matos & Rudolph (1985) surveyed the vegetation of the Roy E. Larson Sandylands Sanctuary in the Big Thicket of Texas. Their description is essentially identical to ours. Orzell (1990) briefly describes sandylands in the National Forests of Texas, emphasizing the presence of *Quercus incana*. It is this single species that we have come to recognize as the major indicator of western sandylands: its presence signals deep sands and accompanying xeric conditions.

In our area, roads are generally constructed on ridge tops and consequently it is fairly easy to survey for upland sandylands. From our experience in Natchitoches, Winn, Bienville, and Caddo parishes, it would appear that there

Table 1. Vascular plants at Susan's Sandyland.

ACANTHACEAE *Ruellia humilis* Nutt.

AGAVACEAE *Yucca louisianensis* Trel.

AMARANTHACEAE *Froelichia floridana* (Nutt.) Moq.

ANACARDIACEAE *Rhus copallina* L., *Toxicodendron radicans* (L.) Kuntz.

ASCLEPIADACEAE *Asclepias tuberosa* L.

ASTERACEAE *Conyza canadensis* (L.) Cronq., *Croptilon divaricatum* (Nutt.) Raf., *Gnaphalium obtusifolium* L., *G. purpureum* L., *Heterotheca pilosa* (Nutt.) Shinners, *Krigia virginica* (L.) Willd., *Liatris elegans* (Walt.) Michx.

BORAGINACEAE *Lithospermum caroliniense* (J.F. Gmel.) MacM.

CACTACEAE *Opuntia humifusa* (Raf.) Raf.

CAMPANULACEAE *Triodanis perfoliata* (L.) Nieuwl.

CAPPARIDACEAE *Polanisia erosa* (Nutt.) Iltis

CARYOPHYLLACEAE *Paronychia drummondii* Torrey & A. Gray.

CISTACEAE *Helianthemum georgianum* Chapm.

CLUSIACEAE *Hypericum gentianoides* (L.) B.S.P., *H. hypericoides* (L.) Crantz.

COMMELINACEAE *Commelina erecta* L., *Tradescantia reverchonii* Bush.

CONVOLVULACEAE *Stylisma villosa* (Nash) House.

CORNACEAE *Cornus florida* L.

CYPERACEAE *Bulbostylis ciliatifolis* (Ell.) Fern., *Carex tenax* Chapm., *Cyperus grayioides* Mohlenbrock, *Cyperus retrofractus* (L.) Torrey, *Rhynchospora grayi* Kunth, *Scleria triglomerata* Michx.

ERICACEAE *Vaccinium arboreum* Marsh.

EUPHORBIACEAE *Chamaesyce cordifolia* (Ell.) Small, *Cnidosculus stimulosus* (Michx.) Engelm. & A. Gray, *Crotonopsis elliptica* Willd.

Table 1 (continued).

FABACEAE *Astragalus leptocarpus* Torrey & A. Gray, *Centrosema virginianum* (L.) Benth., *Lespedeza virginica* (L.) Britt., *Tephrosia virginiana* (L.) Pers.

FAGACEAE *Quercus incana* Bartr., *Q. marilandica* Muenchh., *Q. stellata* Wang.

JUGLANDACEAE *Carya* sp.

LAMIACEAE *Monarda punctata* L., *Trichostema dichotomum* L.

LAURACEAE *Sassafras albidum* (Nutt.) Nees.

LOGANIACEAE *Gelsemium sempervirens* (L.) St. Hil., *Polypremum procumbens* L.

PINACEAE *Pinus taeda* L.

POACEAE *Aristida desmantha* Trin. & Rupr., *A. lanosa* Muhl. ex Ell., *Dichanthelium sphaerocarpon* (Ell.) Gould, *Paspalum* spp., *Schizachyrium tenerum* Nees.

POLYGONACEAE *Polygonella polygama* (Vent.) Engelm. & A. Gray.

RUBIACEAE *Diodia teres* Walt.

SAPOTACEAE *Bumelia lanuginosa* (Michx.) Pers.

SCROPHULARIACEAE *Linaria canadensis* (L.) Dum.-Cours.

SELAGINELLACEAE *Selaginella arenicola* Underw. ssp. *riddellii* (Van Eselt.) Tyron.

VERBENACEAE *Glandularia canadensis* (L.) Nutt., *Stylodon carneus* (Medic.) Moldenke.

VITACEAE *Vitis mustangensis* Buckl.

Table 2. Soil characteristics of three sandylands in the Winn District.

		Exchangeable Ions (ppm)				
Sample	pH	P	K	Ca	Mg	OM%
Susan's Sandyland (upland)						
Sample 1.	5.7	12	20	500	30	3.5
Sample 2.	5.1	9	22	210	18	3.7
Sample 3.	5.4	12	25	150	21	1.3
Goldonna Sandyland (stream terrace)						
Sample 1.	5.8	7	26	240	35	1.6
Sample 2.	5.4	7	24	240	50	2.4
Opuntia Sandyland (upland)						
Sample 1.	5.4	6	28	230	17	2.3

has been concerted effort to convert sandylands to either low quality melon farms or to pine plantations. Time and again we have encountered stands of shrub-sized *Quercus incana* sprouting from cut trees interspersed with recently planted pines.

In Louisiana and Texas, xeric sandylands are rare "and [are] becoming scarcer with forest type conversion" (Martin & Smith 1991:99). Estimates for presettlement acreage, based on plant distribution relative to surface geology, are 50,000 to 100,000 acres. Today, only between 10% and 25% remain (Latimore Smith, pers. comm.) and undisturbed or minimally disturbed examples are exceedingly rare. The vast majority have been converted to low productivity watermelon fields and tree farms, and this trend is continuing.

RARE SPECIES

A number of plants rare to Louisiana and to the Kisatchie National Forest are fidel or nearly so to sandylands. The following is a brief account of those species known from the Kisatchie National Forest currently on the Forest "ETS" (endangered, threatened, sensitive) list and on the Louisiana Natural Heritage rare plant or watch lists. Parish locations outside the National Forest are also given. Additional information on these species with site locations is on file with the Kisatchie National Forest and with the Louisiana Natural Heritage Program.

Carex tenax Chapm. (*MacRoberts & MacRoberts 2282* [VDB], *2295, 2296, 2339* [SFRP], *2294, 2333* [NLU], *2334* [LSU]). Strong sedge, a southeastern

species, has been found at eighteen upland sandyland sites in the Kisatchie District, Natchitoches Parish, and three in the Winn District, Natchitoches Parish. It also occurs in Vernon Parish.

Cyperus grayioides Mohlenbrock. (*MacRoberts & MacRoberts 1801, 2072* [VDB], *2071, 1798* [SFRP], *2070* [NLU], *1803* [LSU]). Mohlenbrock's umbrella sedge, first reported from the West Gulf Coastal Plain in the early 1970's, has now been collected many times in eastern Texas and western Louisiana, and more recently in Arkansas (Logan 1994). There are seven sites for it on the Kisatchie District, Natchitoches Parish, and four sites on the Winn District, in Winn and Natchitoches parishes. Other parishes in the state where it is found are Allen, Bienville, and Vernon.

Eriogonum longifolium Nutt. (*MacRoberts & MacRoberts 1800* [VDB], *1797* [SFRP]). Long-leaved wild buckwheat, a Great Plains species, in the West Gulf Coastal Plain is a sandylands plant favoring oak/pine woodland edge. It is known from one stream terrace sandyland in an inholding on the Winn District, Winn Parish. It is also known from Caddo and Vernon parishes.

Eriogonum multiflorum Benth. (*MacRoberts & MacRoberts 1808* [VDB], *1850, 2084* [SFRP], *1820* [NLU]). Many-flowered wild buckwheat, a western species, has been located at five sites on the Winn District, Winn and Natchitoches parishes, and five sites on the Kisatchie District, Natchitoches Parish. It also is found in Bienville, Caddo, and Webster parishes.

Paronychia drummondii Torrey & A. Gray. (*MacRoberts & MacRoberts 2083* [VDB], *2344, 2281* [SFRP], *1805* [LSU]). Drummond's nailwort, a Texas near-endemic that reaches its geographical limit in western Louisiana, is known from eight locations on the Winn District, Natchitoches and Winn parishes. It also occurs in Bienville and Caddo parishes.

Penstemon murrayanus Hook. (*MacRoberts & MacRoberts 1612* [VDB], *Grelen 2052* [SFRP]). Cupleaf beardtongue, a species found in Arkansas, Oklahoma, Texas, and western Louisiana, is known from only one stream terrace sandyland on an inholding in the Winn District, Winn Parish. It is also found in Caddo Parish.

Phacelia strictiflora (Engelm. & A. Gray) A. Gray. (*MacRoberts & MacRoberts 2211* [VDB], *Thomas & Kessler 75762* [NLU]). Phacelia, a species of the southcentral U.S., is known from two stream terrace sandylands on the Winn District, Winn Parish. It has also been reported from Natchitoches and Bienville parishes.

Polanisia erosa (Nutt.) Iltis. (*MacRoberts & MacRoberts 1802* [VDB], *2340, 2341* [SFRP], *2442* [NLU], *1821* [LSU]). Clammy weed, a species apparently confined to Texas, Oklahoma, Arkansas, and western Louisiana, has been found at four sites in the Kisatchie District, Natchitoches Parish, and three sites on the Winn District, Winn and Natchitoches parishes. It also occurs in Bienville and Sabine parishes and is known historically from Rapides Parish.

Polygonella americana (Fisch. & Meyer) Small. (*MacRoberts & MacRoberts 1799* [VDB], *2428* [SFRP]). Southern jointweed, a species found in sandy woodlands from South Carolina to New Mexico, occurs at a single stream terrace sandyland inholding on the Winn District, Winn Parish. It is also known from Bienville, Sabine, and Caddo parishes.

Polygonella polygama (Vent.) Engelm. & A. Gray. (*MacRoberts & MacRoberts 2128* [VDB], *920, 2147* [SFRP]). Jointweed was first found in Louisiana in 1988 on the Winn District, Natchitoches Parish, where it is abundant in one locality (Johnson & Johnson 1990). This species, which ranges across the southern U.S. to Texas, is not known from any other locality in Louisiana.

Psoralea subulata Bush. (*MacRoberts & MacRoberts 2236* [LSU,VDB, SFRP,NLU]). Awl-shaped scurf-pea occurs in eastern Texas, southern Oklahoma, southwestern Arkansas, and western Louisiana. It was first found on the Kisatchie District, Natchitoches Parish, in a single sandyland in 1994. It is also known from Caddo Parish.

Selaginella arenicola Underw. ssp. *riddellii* (Van Eselt.) Tryon. (*MacRoberts & MacRoberts 1809* [VDB], *1779* [SFRP]). Riddell's spikemoss is a Coastal Plain species that is rare in the West Gulf Coastal Plain. Since the middle of the last century, it has been known from areas that are now probably part of the Kisatchie National Forest. On the Kisatchie District, it is known from nine sites, most of which are sandstone outcrop communities (MacRoberts & MacRoberts 1993b). On the Winn District, Natchitoches and Winn parishes, it is known from three sandylands. It is also known from Bienville, Sabine, Caddo, and Vernon parishes.

Streptanthus hyacinthoides Hook. (*MacRoberts & MacRoberts 2298* [VDB], *2332, 2347* [SFRP]). Smooth twistflower, an endemic to Arkansas, Texas, Oklahoma, and western Louisiana, has been found at two sandylands on the Winn District, Winn Parish, and one sandyland on the Kisatchie District, Natchitoches Parish. It also occurs in Bienville and Caddo parishes.

Tetragonotheca ludoviciana (Torrey & A. Gray) A. Gray. (*MacRoberts & MacRoberts 1988* [VDB], *1691* [SFRP]). Louisiana square-head, a widely distributed West Gulf Coastal Plain endemic, was not reported from the Kisatchie National Forest until 1992. There are now six known locations on the Kisatchie District, Natchitoches Parish, and one on the Vernon District, Vernon Parish (Hart & Lester 1993). This species is also found in Allen, Caddo, and Sabine parishes.

Tradescantia reverchonii Bush. (*MacRoberts & MacRoberts 1565* [VDB] *2276, 2407* [SFRP]). This species is found almost exclusively in sandylands of western Louisiana and eastern Texas, south to the Rio Grande Valley. It is common in all sandylands in both the Kisatchie and Winn Districts. It appears to especially like disturbed areas and is also known from Bienville, Beauregard, Caddo, Sabine, and Vernon parishes (MacRoberts 1980).

Zornia bracteata (Walt.) Gmel. (*MacRoberts & MacRoberts 1897* [VDB],

1807, 2413 [SFRP]). Viperina, a southeastern species that is rare in the West Gulf Coastal Plain, has been found in one stream terrace sandyland inholding on the Winn District, Winn Parish. In western Louisiana, it is also known from Caddo, Natchitoches, and Vernon parishes.

Other rare sandyland species on the Louisiana Natural Heritage list from western Louisiana that are not found on the Kisatchie National Forest are the following (parishes in parentheses): *Astragalus soxmaniorum* Lundell (Caddo, Union), *Coreopsis intermedia* Sherff (Caddo), *Crataegus uniflora* Muenchh. (many north Louisiana parishes), *Croton argyranthemus* Michx. (Caddo, Sabine, Vernon), *Dalea phleoides* (Torrey & A. Gray) Shinners (Caddo), *Dalea villosa* (Nutt.) Sprengel var. *grisea* (Torrey & A. Gray) Barneby (Caddo), *Draba cuneifolia* Nutt. *ex* Torrey & A. Gray (Caddo, Winn), *Matelea cynanchoides* (Engelm.) Woods. (Caddo), *Mirabilis albida* (Walt.) Heimerl (Caddo, Natchitoches), *Prunus gracilis* Engelm. & A. Gray (Caddo), *Psoralea digitata* Nutt. *ex* Torrey & A. Gray (Caddo), *Quercus arkansana* Sarg. (Boissier, Caddo, Union, Webster), *Scutellaria cardiophylla* Engelm. & A. Gray (Caddo, Calcasieu, Vernon), *Silene subciliata* B.L. Robins. (Allen, Sabine, Vernon), *Thelesperma filifolium* (Hook.) A. Gray (Caddo).

ACKNOWLEDGMENTS

The continuing cooperation and assistance of the staff of the Kisatchie National Forest have been instrumental in making this study possible. Especially to be thanked is Susan Carr, Forest Botanist. Financial support was provided, in part, by a Kisatchie National Forest Challenge Cost-Share Agreement and Contract No. 43-7K11-4-0456 "Sensitive Plant and Habitat Inventory Kisatchie National Forest." Robert Kral vetted a number of the plants. We thank the Louisiana Natural Heritage Program for sharing their rare plant data with us and with the Forest Service. D.T. MacRoberts, Julia Larke, and Latimore Smith made helpful comments on the manuscript.

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