

SYSTEMATIC STUDY OF THE MONOTYPIC GENERA *MEXIANTHUS* AND *NEOHINTONIA* (ASTERACEAE: EUPATORIEAE)

T. J. AYERS & R. W. SCOTT

*Santa Barbara Botanic Garden, 1212 Mission Canyon Road
Santa Barbara, CA 93105, U.S.A.*

B. L. TURNER

Department of Botany, University of Texas, Austin, TX 78713, U.S.A.

ABSTRACT

The generic relationships and subtribal placement of the monotypic genera *Mexianthus* and *Neohintonia* are discussed using macro and micromorphological characters as well as chromosome numbers reported here for the first time. *Neohintonia* ($x=10$) is placed in synonymy as a species of *Koanophyllon* ($x=10$). The discussion is appended with a key to the genera *Mexianthus* ($x=16$), *Decachaeta* ($x=16$), and *Koanophyllon*. Descriptions and distributions for *Mexianthus* and *Koanophyllon monanthum* are provided.

The remarkable resemblance between the monotypic genera *Mexianthus* B. L. Robinson and *Neohintonia* King & H. Robinson of the rugged volcanic mountains of western México has often been noted (Robinson 1928; King & Robinson 1971c, 1987; McVaugh 1984). Both genera possess single-flowered heads that are secondarily aggregated into "heads of heads" or synflorescences. Synflorescences are rarely found in the Asteraceae (see Stuessy 1978 for references) and are known in the Eupatorieae only in *Neohintonia* and *Mexianthus* (King & Robinson 1987). In contrast to recent workers (King & Robinson 1987), who believe that the genera are closely related, we feel the similarities between *Mexianthus* and *Neohintonia* have been independently derived. We present cytological and morphological evidence that supports a hypothesis that the two genera are allied to different genera belonging in separate subtribes of the Eupatorieae.

TAXONOMIC HISTORY

Mexianthus mexicanus was first described by B. L. Robinson (1928) and allied with his subtribe *Piqueriinae* by the presence of exappendiculate anthers. He noted a resemblance between his new genus and *Eupatorium monanthum* Schultz-Bip., but concluded that *Mexianthus* was distinct "not only specifically, but as to genus," by the possession of a fused scale-like pappus unlike the pappus of bristles found in *Eupatorium* L.

King and Robinson (1971c) gave *Eupatorium monanthum* generic ranking as *Neobintonia* based largely upon the capitulescence of single-flowered heads in spherical clusters. The recognition of this taxon at the generic level has not been accepted in recent floristic work (McVaugh 1982). King and Robinson concluded that *Neobintonia* was closely related to, but not congeneric with *Mexianthus*, because of differences in the pappus (bristle-like vs scaley) and the achene (not constricted apically vs constricted). They placed both genera in their subtribe Critonieae (Robinson & King 1977, King & Robinson 1987) where they related *Mexianthus* and *Neobintonia* to *Koanophyllon* Arruda by the presence of broadly triangular corolla lobes with capitate glands, style branches with spatulate tips and reduced anther appendages.

DISCUSSION

Initial herbarium studies tended to support King and Robinson's view that *Mexianthus* and *Neobintonia* were closely related, so much so, that the first author made the new combination (by annotation) for *Neobintonia* in *Mexianthus* on specimens borrowed from various institutions. However, further morphological and cytological studies of *Mexianthus* and *Neobintonia*, made possible by the collection and cultivation of three populations (2 of *Neobintonia*), have forced us to reevaluate the close affinity of the two taxa originally proposed by King and Robinson and to question their subtribal placement of *Mexianthus*.

Chromosome counts obtained by the third author from the cultivated material proved to be an integral part of the study. No counts were obtained from field collected material due, in part, to the synchronous flowering of entire branches or plants in both genera. Under rather uniform greenhouse conditions, *Mexianthus* regularly bloomed from October to December while *Neobintonia* bloomed from February to April. The counts of $n = 16$ pairs for *Mexianthus* and $n = 10$ pairs for *Neobintonia* represent the first chromosome counts for each taxon. Examination of all macro and micromorphological characters in light of the chromosome counts supports the placement of *Neobintonia* in *Koanophyllon*, but does not support placement of *Mexianthus* near *Koanophyllon* or within the subtribe *Critoniinae* where chromosome numbers on a base of $x = 16$ are unknown. In general aspect, leaf arrangement, leaf shape, and chromosome number, *Mexianthus* has many affinities with members of the genus *Decachaeta* DC., which is placed by King and Robinson (1987) in their subtribe *Hebeclininae*. Characteristics of these four taxa are presented in Table 1. It should be noted that the generic criteria and affinities apparent in Table 1 are not clarified by the "microcharacters" but are, in a large part, based upon gross vegetative features as well as chromosome number.

TABLE 1. Comparison of characters among the four genera: *Koanophyllon*, *Neohintonia*, *Mexianthus*, and *Decachaeta*.

CHARACTERS	<i>Koanophyllon</i>	<i>Neohintonia</i>	<i>Mexianthus</i>	<i>Decachaeta</i>
chromosome number	10	10	16	16
branching (predominant)	opposite	opposite below	alternate	alternate
petioles	distinct	distinct	winged	distinct or winged
leaf	ovate-lanceolate	deltate	ovate	elliptic/ovate or suborbicular
blade shape	often deltate			acute/cuneate
blade base	truncate/cordate	truncate/cordate	cuneate	pubescent
receptacle	glabrous	glabrous	glabrous	
vestiture				
florets/head	5-20	1(-2)	1	4-30
corolla				
shape	funnelform or short campanulate	funnelform	short campanulate	funnelform
base	broadly expanded	not expanded	broadly expanded	not expanded
anther appendage	wider than long	wider than long	wider than long	wider than long
anther collar				
shape	cylindrical	cylindrical	cylindrical	cylindrical
ornamentation	annular or none	annular	none	none
stylar appendage	spatulate	spatulate	spatulate	spatulate
style base	not enlarged	not enlarged	not enlarged	not enlarged
pappus	setiferous	setiferous	broad scales	setiferous
achene shape	wedge-shaped	wedge-shaped	fusiform	wedge-shaped
carpopodium				
presence	distinct	distinct	indistinct or minute	distinct & often procurent
cell shape	subquadrate	subquadrate	subquadrate	subquadrate

GENERIC RELATIONSHIPS

The relationships of *Neohintonia* and *Mexianthus* with *Koanophyllon* were based primarily on four characters (King & Robinson 1971b, 1987): 1) corollas with broadly cylindrical bases, 2) broadly triangular glanduliferous corolla lobes, 3) slightly spatulate tips on the style branches, and 4) variously reduced anther appendages. *Neohintonia* was differentiated from *Mexianthus* on the basis of non-fusiform achenes and capillary pappus bristles, characters that were used to suggest a closer relationship between

Neohintonia and *Koanophyllon* (King & Robinson 1987). King and Robinson (1987) do not discuss possible relationships between *Decachaeta* and *Mexianthus*, *Neohintonia* or *Koanophyllon* (King & Robinson 1987) despite the fact that *Decachaeta* has the above-mentioned characters (King & Robinson 1969a) used by King and Robinson to establish relationships between *Neohintonia*, *Mexianthus* and *Koanophyllon*.

Mexianthus has many similarities with *Decachaeta* (chromosome number; broadly triangular, glandular, corolla lobes; slightly spatulate style branches and variously reduced anther appendages as well as leaf characteristics noted in Table 1). *Mexianthus* is readily distinguished from *Decachaeta* and other members of the *Hebecliniinae* by its fusiform achenes and pappus of broad scales, two characteristics that in combination with its synflorescences seem to warrant its generic recognition. Similar to *Erythradenia* (B. Robins.) King & H. Robinson, but unlike *Decachaeta*, *Mexianthus* has glabrous receptacles. In addition, King and Robinson (1969b) have used the character of unornamented anther collar cells and details of the anther appendage to confirm the relationship between *Decachaeta* and *Erythradenia* as well as to affirm their placement in the *Hebecliniinae*. The anther collar cells of *Mexianthus* (observed on florets taken from an isotype) appear unornamented in contrast to reports by King and Robinson (1987) for this genus. Both *Koanophyllon* and *Neohintonia* have weakly ornamented anther collar cells in keeping with their placement in the *Critoniinae*.

Aside from the single-flowered heads of *Neohintonia*, the only differences between *Neohintonia* and *Koanophyllon*, noted by King and Robinson (1971a, 1987), were *Neohintonia*'s slender, somewhat deciduous, pappus bristles and their anther appendages that King and Robinson (1987) considered "shorter than the short form found in the typical element of the related genus *Koanophyllon*." Most species of *Koanophyllon* have scabrous pappus bristles that are stouter than those of *Neohintonia*, but this character is by no means constant within *Koanophyllon*. In short, the pappus bristles of *Neohintonia* would not be anomalous if included in *Koanophyllon*.

Variably reduced anther appendages occur in *Koanophyllon*, *Neohintonia*, *Mexianthus* and *Decachaeta*. The recognition of *Neohintonia* at the generic level on the basis that the anther appendages of *Neohintonia* are shorter than the typical element of *Koanophyllon*, particularly in light of the variation present in *Koanophyllon*, appears to be unjustified.

The acceptance of *Neohintonia* at the generic level has been based primarily on the presence of synflorescences. The capitula of various species of *Koanophyllon* (e.g., *K. ravenii* King & H. Robinson) tend to be sessile or shortly pedunculate and aggregated into tight clusters similar in structure

to the synflorescences of *Neobintonia*. The considerable similarity of capitulescence structure between *Neobintonia* and *Koanophyllon* leads us to believe that these two taxa differ primarily in the number of florets per head and do not represent separate genera. We feel the genus *Neobintonia* is best treated as a species of *Koanophyllon* and the new combination is presented below.

SUBTRIBAL RELATIONSHIPS

The subtribes *Critoniinae* and *Hebecliinae* are weakly delimited. Several genera, including *Mexianthus*, *Peteravenia* King & H. Robinson, and, perhaps, *Erythradenia*, appear to straddle the proposed boundary of these subtribes. The trends initially proposed by Robinson and King (1977) to distinguish the *Hebeclinium* and *Critonia* groups were based on the usually hirsute receptacles and the elongate anther collars comprised of mostly subquadrate cells of the *Hebeclinium* group. Otherwise, the *Hebeclinium* group was described as having "mostly Critonioid features including the subimbricate partially deciduous involucre bracts, the smooth corolla lobes and unenlarged style bases." A recent key to the subtribes of the Eupatorieae (King & Robinson 1987) claimed the *Hebecliinae* possessed anther collars usually more than five times as long as wide with quadrate cells filling the lower half or more. The receptacles were noted to be often densely pubescent. The anther collars of the *Critoniinae* were described as usually less than five times as long as wide with quadrate cells in the lower half. The receptacles were noted as usually glabrous.

The structure of the anther collars as reflected by the presence of subquadrate cells and the length to width ratio has been found to be variable in several of the taxa investigated. The anther collars of several species of *Koanophyllon* that we examined were generally less than five times as long as wide. Subquadrate cells were found filling the lower half in some species (e.g., *K. standleyi* (B. Robins.) King & H. Robinson) or restricted to the lower quarter of the anther collar in others (e.g., *K. ravenii*). The structure of the anther collars in *Neobintonia* are quite similar to those of *Koanophyllon*. In general, the anther collars are four times as long as wide with ornamented, subquadrate cells in the lower portion of the anther collar. The anther collars of *Decachaeta* are very variable in their length to width ratio. Those of *D. scabrella* (B. Robins.) King & H. Robinson are only four times as long as wide or less and have subquadrate cells filling the lower half. *Decachaeta incompta* (DC.) King & H. Robinson has longer (six to almost seven times as long as wide) anther collars with unornamented, subquadrate, cells in only the lowermost portion of the anther collar. Finally, the anther collars of *Mexianthus* are ca. five times as long as wide with

the lower half comprised of unornamented, subquadrate cells. This condition does not resolve the placement of *Mexianthus* in either the Hebecliinae or Critoniinae. For this reason, we have relied upon the chromosome count of $n = 16$ pairs to provisionally place this genus in the Hebecliinae.

KEY TO GENERA

1. Achenes fusiform; pappus a crown of deeply erose scales. *Mexianthus*
1. Achenes wedge-shaped; pappus of bristles or bristles rarely lacking.
 2. Leaves opposite; receptacle glabrous; pappus bristles fused at base . . . *Koanophyllon*
 2. Leaves alternate (opposite in *D. perornata*); receptacle pubescent; pappus bristles free *Decachaeta*

1. **MEXIANTHUS MEXICANUS** B. L. Robinson, Contr. Gray Herb. 80:5. 1928. TYPE: MEXICO. JALISCO: Arroyo del Chorillo, hamlet of Quimixto on Bay of Banderas, ca. 7 leagues S of Puerto Vallarta, 1 Dec 1926, *Mexia* 1202 (HOLOTYPE: GH!; ISOTYPES: BH!, CAS!, DS!, MO!, TEX!).

Suffrutescent perennial 1–2 m high. **Stems** rounded, 1–5 mm in diameter, glabrate, arising from a coarse, fibrous root system. **Leaves** alternate throughout; petioles winged, 1–5 cm long; blades ovate to elliptic, 6–25 cm long, 3.5–10.0 cm wide, the base gradually or abruptly attenuate, irregularly dentate, glabrate or sparsely pubescent, especially along the veinlets, glandular throughout. **Capitulescence** an open, sparsely branched, terminal panicle. **Heads** in globose clusters, the latter on puberulent peduncles 5–35 mm long. **Involucre** 2.0–2.5 mm long; bracts 2-ranked, the outer 2 ca 0.5 mm long, the inner 2 broadly obovate, ciliate, rounded and glabrous on the adaxial surface. **Florets** 1 per head; corolla white, 1.3–2.0 mm long, tube ca 0.5 mm long, the throat abruptly flaring, 0.8–1.5 mm long, lobes glandular, ca 0.2 mm long, as wide as long or wider; anther appendages reduced to 2 small lobes; style branches linear-clavate, mammillose, ca 2.5 mm long; achene ca 1.7 mm long, ca 0.6 mm wide, abruptly narrowed at the apex and fringed with a deeply erose, deciduous, scaly crown, 0.7–1.0 mm long. **Chromosome number** $n = 16$ pairs.

ILLUSTRATION: Monogr. Syst. Bot. 22: 336, pl. 132. 1987.

DISTRIBUTION (Fig. 1): Known only from three sites about Puerto Vallarta, Jalisco, from near sea level to 500 m; occurring on volcanic rock in subtropical deciduous forest dominated by *Byrsonima* and *Curatella*. Flowering: Oct–Dec.

REMARKS: Initial efforts to find a population of *Mexianthus* at the type locality in the month of March were unsuccessful. We returned in October and found a small population growing along the old eroded burro trails leading from Quimixto to the falls frequented by tourists on the Arroyo del

Chorillo. Rootstocks and tip cuttings were gathered and plants propagated in the greenhouse at the University of Texas (TEX) from 1983 – 1988. Chromosome counts were obtained from the greenhouse stock.

Representative specimens: MEXICO. JALISCO: trail to falls just above Quimixto, a village on Bay of Banderas S of Pto. Vallarta, 24 Oct 1983, *Ayers et al.* 331 (TEX & to be distributed); gorge of the Río Horcones, ca 27 km by road S from Puerto Vallarta, 3 – 5 Nov 1971, *Dieterle* 4028 (MO, TEX); cerca de El Corte Colorado, municipio de La Resolana, 16 Nov 1960, *Rzedowski* 15040 (TEX).

2. **KOANOPHYLLON monanthum** (Schultz-Bip.) Ayers & B. Turner, comb. nov. *Neobintonia monantha* (Schultz-Bip.) King & H. Robinson, *Phytologia* 22: 143. 1971; *Eupatorium monanthum* Schultz-Bip. in Seem., *Bot. Voy. Herald* 299. 1856. TYPE: MEXICO. SINALOA (?): "Sierra Madre" (probably collected near the village of Copala; cf. *Bot. Voy. Herald* 299, p. 257 – 261), Nov 1849, *Seemann* 1990 (HOLOTYPE: K, PHOTO AT MICH!; ISOTYPE: GH!).

Suffrutescent perennial 2 – 5 m high; main stem erect, the branches clambering. **Leaves** opposite below, alternate above; petioles distinct, 1 – 3 cm long; blades deltate, 4 – 10 cm long, 3 – 10 cm wide, usually 3-nerved, the lower leaves often 3-lobed, dentate, sparsely pubescent with glandular and non-glandular trichomes. **Capitulescence** an open, leafy, terminal panicle. **Heads** in globose clusters, the latter on villosulous peduncles 2 – 7 mm long. **Involucre** 2.3 – 3.0 mm long, glandular; bracts 2-ranked, the outer 2 ca 0.5 mm long, the inner 2 obovate, ciliate, glabrous on the adaxial surface. **Florets** 1 per head; corolla white, 1.8 – 2.5 mm long, tube ca 0.8 mm long, the throat abruptly flaring, 1.0 – 1.5 mm long, lobes glandular, ca 0.2 mm long, as wide as long or wider; anther appendages small, divided into 2 halves vertically, the margin reflexed; style branches linear-clavate, mammillose, ca 2 mm long; achene wedge-shaped with 5 ribs, ca 1.5 mm long, sparsely hispid, fringed with a setiferous crown, 1.8 – 2.5 mm long. **Chromosome number** $n = 10$ pairs.

ILLUSTRATION: *Monogr. Syst. Bot.* 22: 338, pl. 133. 1987.

DISTRIBUTION (Fig. 1): Occurring in low volcanic hills along the western coast of México, from Sinaloa to Guerrero, at altitudes of 200 – 1500 m. Most collections have been made in subtropical deciduous forest dominated by *Bursera*, *Tabebuia*, and arborescent *Ipomoea*.

REMARKS: In Jalisco and Nayarit during March 1982, the senior author found the species to be abundant in roadside gullies and along steep, shady, north-facing hillsides. Two populations were cultivated in the greenhouse at TEX from rootstocks collected in the field. Chromosome counts were obtained from the Jalisco population.

Representative specimens: MEXICO. Colima: Ciudad Colima, 27 – 28 Feb 1891, *Palmer* 1300 (DS, GH, MICH, UC); 9 – 10 km E by winding road from Minatitlán,

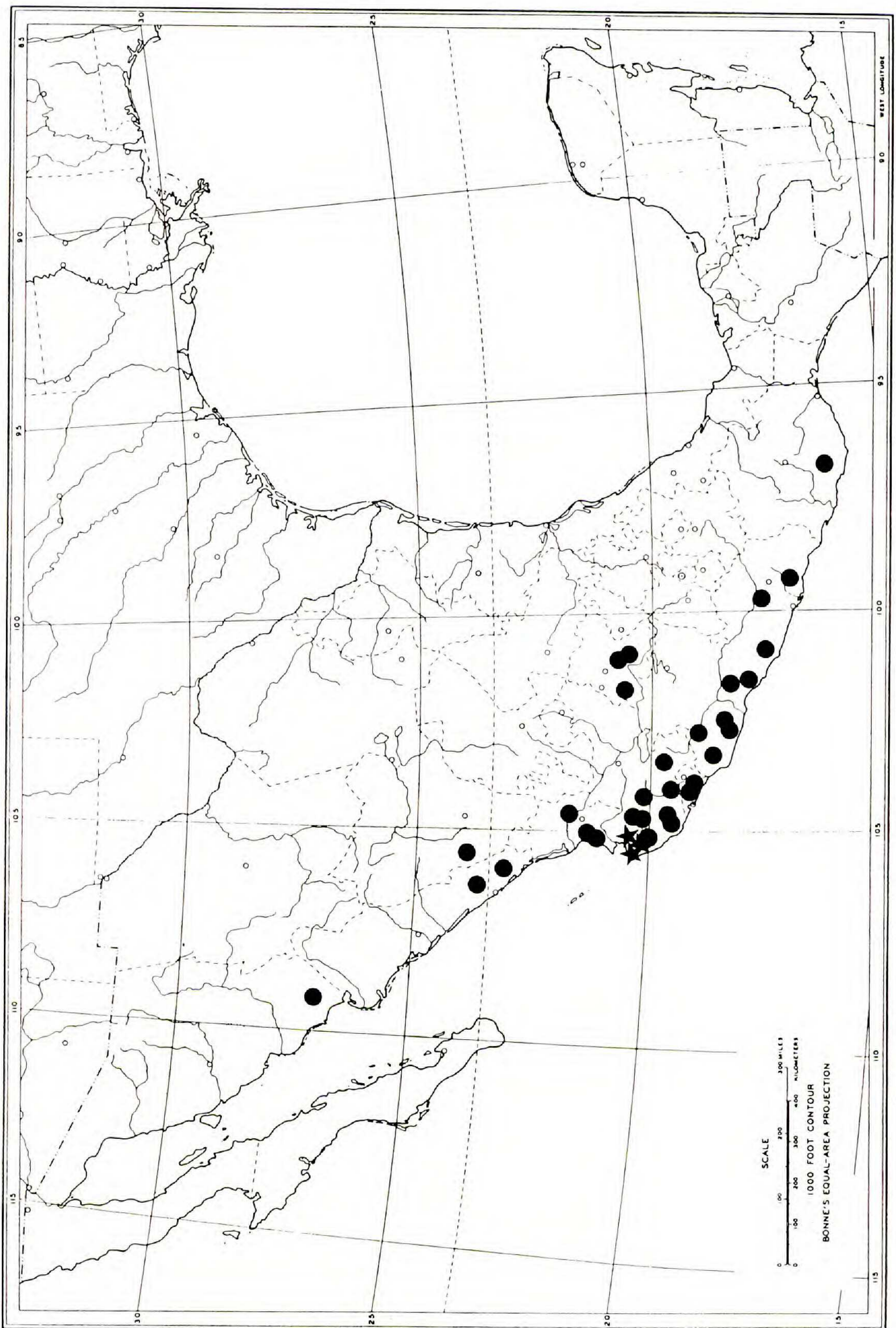


FIG. 1. Distribution of the two Mexican taxa of Eupatorieae with single-flowered heads. The circles represent populations of *Koanophyllon monanthum* and the stars represent populations of *Mexianthus*.

10–11 Feb 1975, *McVaugh* 26231 (MICH). **Durango**: Steep side canyons of the Río Tamazula between La Bajada and La Junta, 20 Mar 1972, *Breedlove* 24486 (CAS, MICH, MO). **Guerrero**: Calavera, 6 Apr 1937, *Hinton* 10019 (BH, GH, TEX); Acapulco, Oct 1894–Mar 1895, *Palmer* 515 (F, GH, NY, TEX, UC); Iguala Canyon, 28 Jan 1907, *Pringle* 10348 (BH, CAS, GH, MICH, NY, UC); Cañón de la Mano Negra, al N de Iguala, 15 Feb 1970, *Rzedowski* 27091 (DS, F, MICH, MO, TEX). **Jalisco**: 1.8 mi S of La Huerta on highway to Barra de Navidad, 15 Mar 1982, *Ayers, et al.* 96 (TEX & to be distributed); Arroyo La Calera, ca 9 km distancia aérea al N de Casimiro Castillo en el camino entre Autlán y la costa, 7 Jan 1985, *Judziwicz et al.* 5123 (TEX); Las Mesitas, NW of San Sebastián, 15 Mar 1927, *Mexia* 1879 (CAS, DS, F, GH, MICH, MO, NY, UC); Barranca de Chavanda, 2 km al S de Atenquique, 6 Feb 1966, *Rzedowski* 21947 (DS, MICH, TEX); **México**: Acatitlán, 21 Jan 1933, *Hinton* 3185 (GH, MO, TEX); México D., E., winter of 1893–94, *Sheldon s.n.* (GH). **Michoacán**: Coalcomán, 19 Mar 1939, *Blake* 13655 (GH, TEX, UC); 45–48 km S of Arteaga, 12–15 km N of Playa Azul, 26–27 Feb 1965, *McVaugh* 22571, 22613 (DS, MICH, NY); Monte de los Pájaros, 6 Mar 1898, *Langlasse* 16 (F, GH). **Nayarit**: between km markers 41–42 on road to Miramar, W of Jalcoctán, 18 Mar 1982, *Ayers et al.* 105 (TEX & to be distributed); La Barranca, 21 Feb 1927, *Jones* 23418 (CAS, GH, MO, NY, TEX, UC). **Oaxaca**: Vicinity of Cafetal Concordia, 1–15 Apr 1933, *Morton & Makrinus* 2361 (DS, F, MICH). **Sinaloa**: Africa, Sierra Taculchamona, 17 Feb 1949, *Gentry* 5651 (DS, GH, MICH, MO); Cañón de Tarahumara, Sierra Surotato, 17–24 Mar 1945, *Gentry* 7305 (F, GH, MICH, NY, UC); Las Breas, Mar 1931, *Ortega* 6869 (CAS, F, GH). **Sonora**: Curohui, Río Mayo, 4 Apr 1938, *Gentry* 3654 (GH, TEX, UC).

ACKNOWLEDGMENTS

This study is based in large part upon the examination of 88 sheets from the following 10 herbaria: BH (3), CAS (5), DS (9), F (7), GH (16), MICH (12), MO (10), NY (6), TEX (14), UC (6). We are grateful to the directors and curators for the loan of specimens.

REFERENCES

- KING, R. M. & H. ROBINSON. 1969a. Studies in the Eupatorieae (Compositae). XVI. A monograph of the genus *Decachaeta* DC. *Brittonia* 21: 275–284.
- _____. 1969b. Studies in the Eupatorieae (Compositae). XVII. The genus *Erythradenia*. *Brittonia* 21: 285.
- _____. 1971a. Studies in the Eupatorieae (Asteraceae). XLVIII. The genus *Critonia*. *Phytologia* 22: 46–51.
- _____. 1971b. Studies in the Eupatorieae (Asteraceae). LXIV. The genus *Koanophyllon*. *Phytologia* 22: 147–152.
- _____. 1971c. Studies in the Eupatorieae (Asteraceae). LXII. A new genus, *Neohintonia*. *Phytologia* 22: 143–144.
- _____. 1987. The genera of the Eupatorieae (Asteraceae). *Monogr. Sys. Bot.* 22: 1–581.
- MCVAUGH, R. 1982. The new synantherology vs. *Eupatorium* in Nueva Galicia. *Contr. Univ. Michigan Herb.* 15: 181–190.
- _____. 1984. *Flora Novo-Galiciana*. Volume 12. Compositae. Ann Arbor: Univ. Michigan Press.

- ROBINSON, B. L. 1928. Records preliminary to a general treatment of the Eupatorieae—VII. *Contr. Gray Herb.* n.s. 80: 3–42.
- ROBINSON, H. and R. M. KING. 1977. Eupatorieae—systematic review. In: *The Biology and Chemistry of the Compositae*, Eds. V. H. Heywood et al. London: Academic Press.
- STUESSY, T. 1978. Revision of *Lagascea* (Compositae; Heliantheae). *Fieldiana, Bot.* 38: 75–133.