



Cunila socorroae (Lamiaceae) a new species from Sierra Madre Occidental, Durango, Mexico

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Abstract

Recent botanical explorations in Durango, Mexico, led to the discovery of a new species endemic to this state: *Cunila socorroae* (Lamiaceae), which is consequently here described and illustrated. The new species is morphologically most similar to *C. jaliscana* and *C. lythrifolia*. It can be distinguished from both in having less flowers per cyme, lanceolate floral bracts, longer calyx tube, and lanceolate calyx teeth and longer. It also deviates from *C. jaliscana* by the fewer floral internodes, longer floral bract, and generally longer corolla tube. Also, the exfoliating bark, white corollas and internally pubescent, make a clear distinction against *C. lythrifolia*. The distinctive geographic distribution of these species is an additional support to their separation; the new species is exclusive of the middle portion of Sierra Madre Occidental, whereas *C. jaliscana* is restricted to the northernmost portion of Sierra Madre del Sur, and *C. lythrifolia*, though mostly occurs in eastern Tans-Mexican Volcanic Belt, has also some localities in southern Chihuahuan Desert, Sierra Madre Oriental and Sierra Madre del Sur.

Resumen

Exploraciones botánicas recientes en Durango, México, condujeron al descubrimiento de una especie nueva endémica de este estado: *Cunila socorroae* (Lamiaceae, Mentheae), la cual es en consecuencia descrita e ilustrada aquí. La especie nueva es morfológicamente más parecida a *C. jaliscana* y *C. lythrifolia*. Puede distinguirse de ambas al poseer menos flores por cima, brácteas florales lanceoladas, tubo del cáliz más largo, y dientes del cáliz lanceolados y más largos. Además se separa de *C. jaliscana* debido a la menor cantidad de entrenudos florales, bráctea floral más larga, y tubo de la corola por lo general más largo. Además, la corteza exfoliante, las corolas blancas e internamente pubescentes, la distinguen de *C. lythrifolia*. La distribución geográfica distintiva entre estas especies es un soporte adicional a su separación; la especie nueva es exclusiva de la porción media de la Sierra Madre Occidental, mientras *C. jaliscana* se restringe a la porción más norteña de la Sierra Madre del Sur, y aunque *C. lythrifolia* habita sobre todo en el oriente de la Faja Volcánica Transmexicana, posee también algunas localidades en el sur del Desierto Chihuahuense, la Sierra Madre Oriental y la Sierra Madre del Sur.

Keywords: Canelas, disjunct distribution, poleo, subtribe Menthinae

Introduction

Lamiaceae is a highly diverse family in Mexico with 33 genera and 598 species, 66.2 % of the latter are exclusive to the country, and the addition of new species has prevailed in the last recent years (Martínez-Gordillo *et al.* 2017). *Cunila* D.Royen ex Linnaeus (1759: 1359) is one of the medium-sized genera of the labiates, belonging to the tribe Mentheae and subtribe Menthinae according to Harley *et al.* (2004), and it is restricted to the New World. This genus is characterized by comprising perennial herbs, sub-shrubs and shrubs, strong aromatic foliage, flowers arranged into

spiciform, paniculiform or capitate cymes, with a tubular calyx, 10–14-nerved, actinomorphic or slightly bilabiate with 5 free teeth, a hairy throat, sub-bilabiate corolla, and 2 exerted stamens. Particularly, the delimitation between *Cunila* species is based on inflorescence architecture, calyx and mericarp morphology (García-Peña 2008). Molecular phylogenetic evidence has confirmed the assignment of *Cunila* to the subtribe Menthinae (Drew & Systma 2012, Drew *et al.* 2017). However, Agostini *et al.* (2012) in a phylogenetic analysis revealed *Cunila* as a paraphyletic group in which the South American species were nested in two independent clades. This was also previously suggested somehow in a genetic analysis with ISSR markers in which the South American species were grouped in two different clusters, also independent to that of *C. origanoides* (Linnaeus 1753: 568) Britton (1894: 278), the only North American species sampled for the study (Agostini *et al.* 2008). A different analysis by Drew & Systma (2012) and Drew *et al.* (2017) supported also the paraphyly of *Cunila*, and only the three sampled Mexican taxa, *C. lythrifolia* Benth (1829: sub. t. 1289), *C. pycnantha* Robinson & Greenman (1894: 391) and an undetermined species (the one that is formally described here) were grouped into a monophyletic group. These latter studies also showed paraphyly in related genera to *Cunila* (i.e., *Clinopodium* Linnaeus (1753: 587), *Hedeoma* Persoon (1806: 131), *Hesperozygis* Epling (1936: 132), *Poliomintha* Gray (1870: 295) and *Rhabdocaulon* Epling (1936: 134). Further phylogenetic analyses of additional DNA sequences and taxa are required to better understand the composition and biogeography of the genus *Cunila*, and to present its natural circumscription.

The 20 species of *Cunila*, as currently circumscribed, present an interesting disjunct distribution. One group of species occurs from eastern United States to Panama, and another group inhabits southeastern Brazil, northeastern Argentina, Uruguay and Paraguay (Harley *et al.* 2004, García-Peña 2008). Mexico has six endemic species and one more which extends its range to Central America (García-Peña 2008, Martínez-Gordillo *et al.* 2017). Derived from ongoing taxonomic work in the genus *Cunila*, a new species is added to the list as the seventh endemic species of the genus from Mexico, this is here properly described and illustrated.

Materials and methods

Herbarium specimens were collected in the field and prepared according to standard procedures (Lot & Chiang 1986). Localities in the municipalities of Canelas and San Dimas, Durango, were visited in order to collect additional material for making morphological observations to prepare the description, as well as for getting photographs of the plants. The recently collected material was deposited in the herbaria CIIDIR and MEXU. Specialized literature (García-Peña & Tenorio-Lezama 1997, García-Peña 2008, García-Peña & González-Gallegos 2013, González-Gallegos *et al.* 2016) was consulted when elucidating the status of these plants as an undescribed species and to make the morphological comparisons against those morphologically most similar.

The map in figure 5 was prepared using Mexican political divisions cartography acquired from CONABIO (2020) data portal (states and municipalities), and the biogeographic provinces defined and provided by Morrone *et al.* (2017). Specimen of the three species in the map (*Cunila jaliscana*, *C. lythrifolia* and *C. socorroae*) were compiled based on the consult of the herbaria CIIDIR, CREG, ENCB, F, IBUG, IEB, MEXU, MICH, NEBK, UC, WIS, ZEA, and complemented with those specimens reported in García-Peña (2008). The coordinates of the specimens were verified and/or estimated following Wiczorek (2001) indications but without calculation of uncertainty radio. The data matrix with coordinates is available upon author's request.

The preliminary conservation status was defined based on the distribution data and using the GeoCAT tool (Bachman *et al.* 2011) for the calculation of area of extent (EOO) and area of occupancy (AOO), the results were collated with IUCN red list criteria (IUCN 2012) in order to determine the category to be assigned.

Taxonomic treatment

Cunila socorroae García-Peña & J.G.González, *sp. nov.*, Figs. 1–4

Cunila socorroae ex affinitate morphologica *C. jaliscanae* et *C. lythrifoliae* floribus per cymam minoribus, bracteis floralibus lanceolatis, calycum dentibus lanceolatis et longioribus, corollae tubis pro parte maxima longioribus, et corollis ad fauces et trientem basalem interne recedit.

Type:—MEXICO. Durango, municipality Canelas: Cañada de El Macho, 9 km al O por la brecha a Canelas, 25.127° N, 106.499° W, 2159 m, 18 May 2017 (fl), J.G. González-G., A. Castro-Castro, L. López, P. Velázquez & R.I. Gutiérrez-Sánchez. 2225 (holotype CIIDIR!, isotypes BUAP!, HUAA!, Herbario de la Universidad Autónoma de Zacatecas!, IBUG!, IEB!, MEXU!, UAS!, USON!).

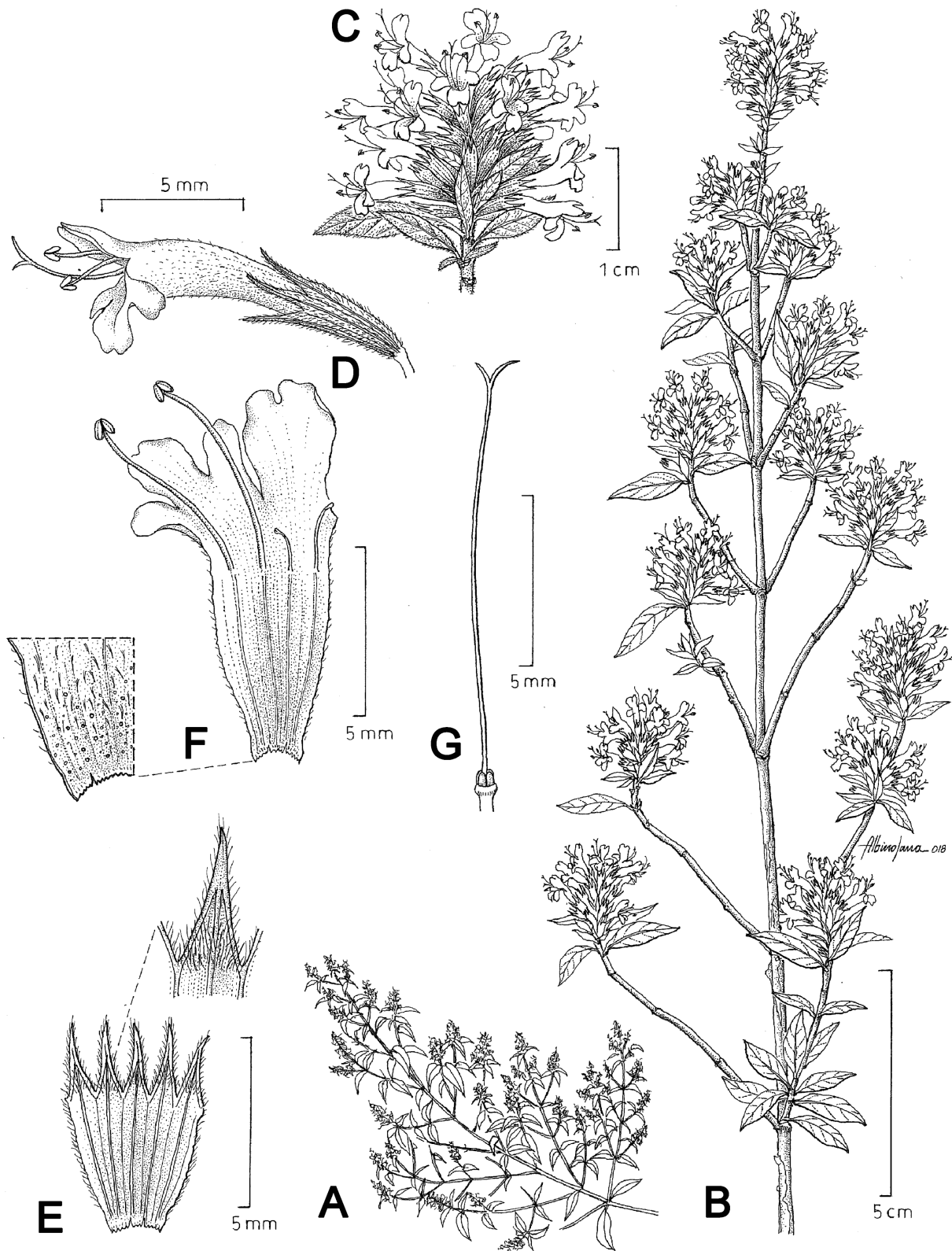


FIGURE 1. *Cunila socorroae* illustration, A. Complete flowering branch, B. Close up to the apex of a the flowering branch, C. Detail of the spiciform inflorescence, D. Flower, E. Calyx dissection showing inner surface, and a close-up with the pubescence in the tooth, F. Corolla dissection showing inner surface with stamens, staminodes, and a close-up to the basal third, G. Ovary and style (based on Ramírez 2787 and those pictures in figure 2; drawn by Albino Luna).

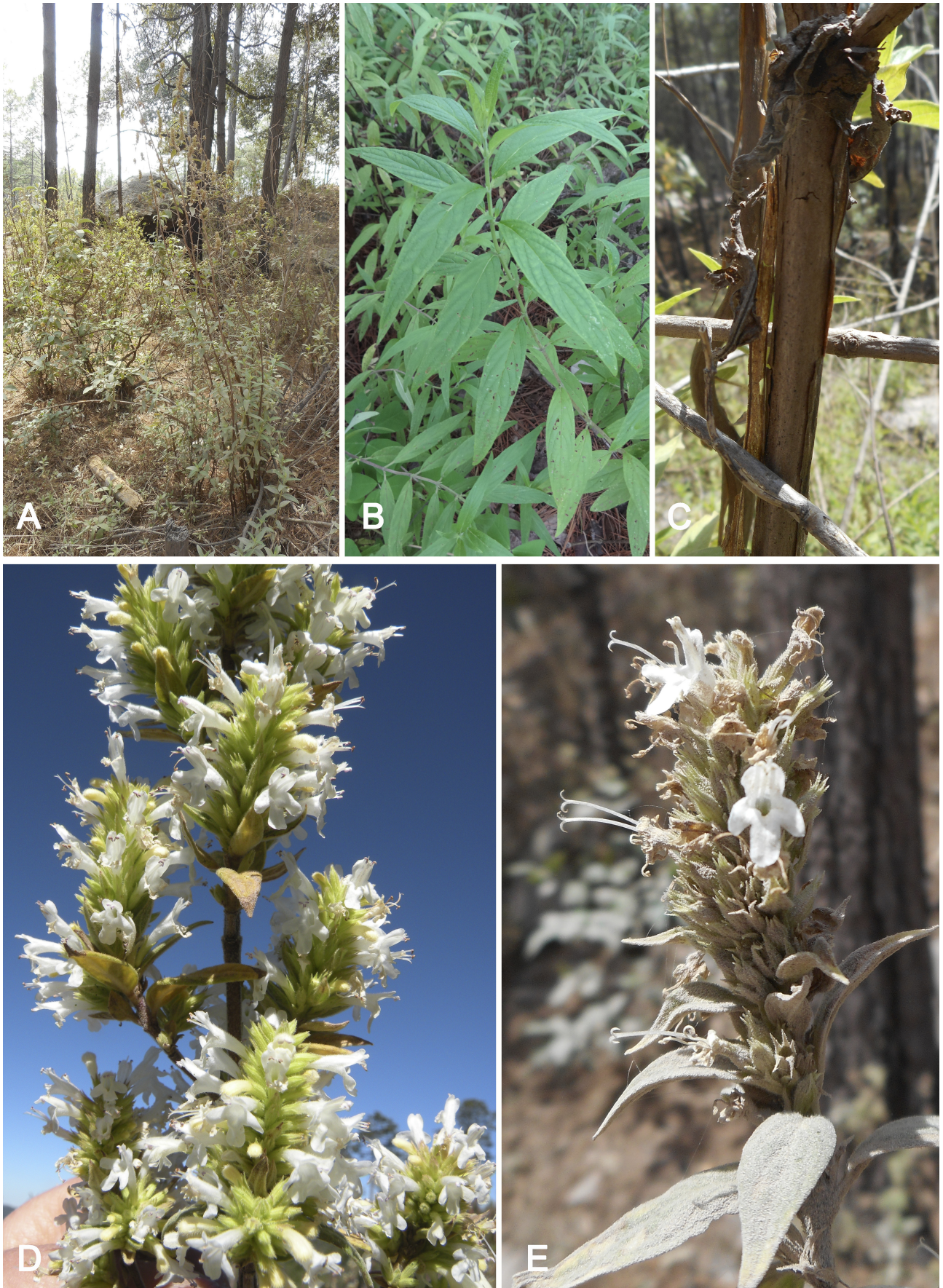


FIGURE 2. *Cunila socorroae* photographs, A. General habit and habitat, B. Leaves, C. Detail of a branch showing the exfoliating bark, D. Portion of a flowering branch, E. Detail of an inflorescence (photographs A–C and E taken by J.G. González-Gallegos in Canelas, Durango; D taken by M.S. González-Elizondo in Tamazula, Durango).



FIGURE 3. *Cunila socorroae* calyx picture (up), detail of calyx teeth and throat showing the insertion of the hairs (down) (pictures taken by S. Guzmán-Gómez; Axio Zoom Z16 APOA).

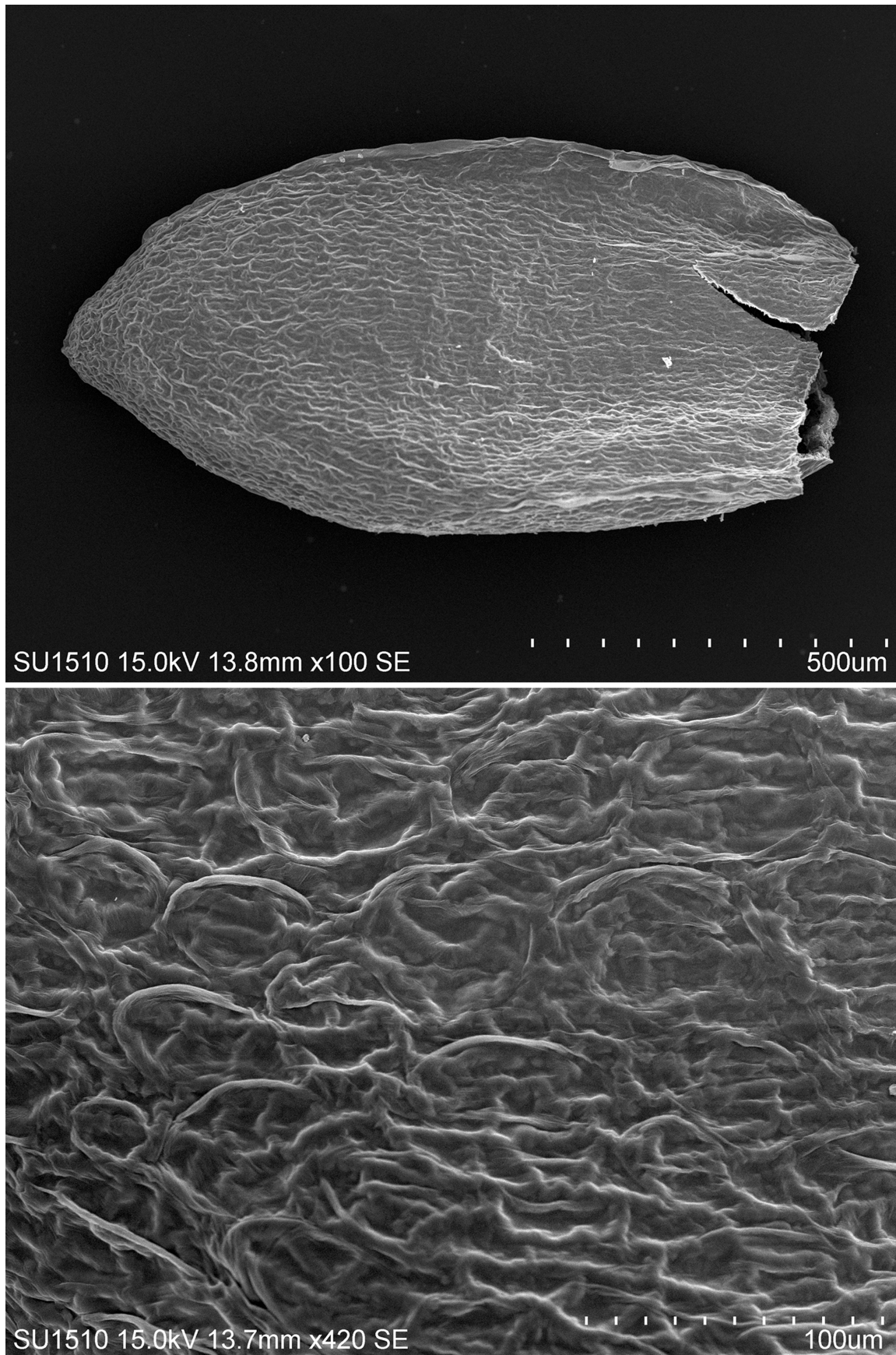


FIGURE 4. *Cunila socorroae* scanning electron photograph of the ventral surface of the mericarp (up), with a detail of mericarp surface (down) (photographs taken by B. Mendoza-Garfias; SEM Hitachi SU1510).

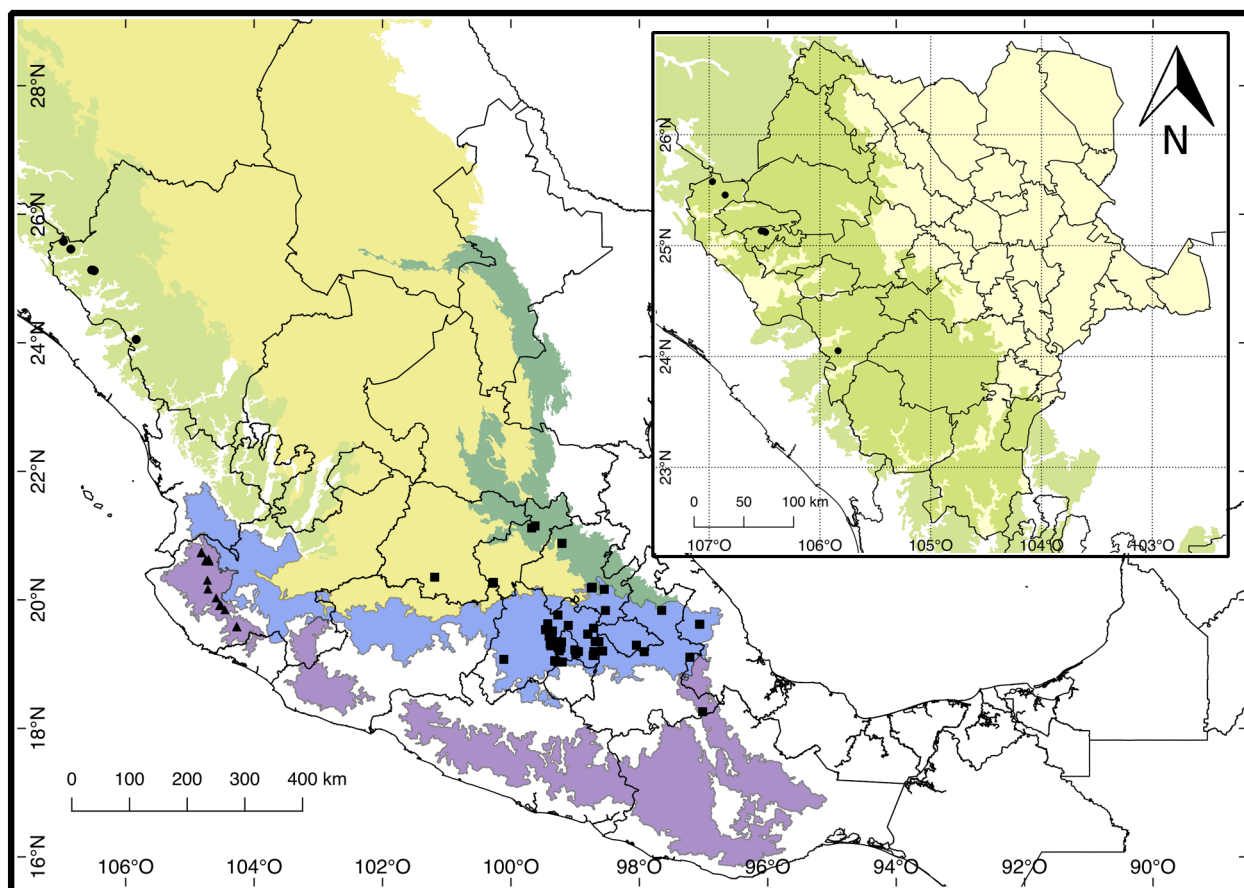


FIGURE 5. Distribution map of *Cunila socorroae* (black dots) and morphologically most similar species, *C. jaliscana* (black triangles) and *C. lythrifolia* (black squares). In the main map, biogeographic provinces (according to Morrone *et al.* 2017) implied in the distribution of these species are highlighted: Chihuahuan Desert (yellow), Sierra Madre del Sur (violet), Sierra Madre Occidental (yellowish green), Sierra Madre Oriental (green), and Trans-Mexican Volcanic Belt (bleu). A detail of the distribution of the new species is shown in the upper right corner; Sierra Madre Occidental is also highlighted in yellowish green, and Durango municipalities in sand hue.

Shrub, erect, 1.4–1.8 m tall; basal branches divaricate and progressively erect to the apex, stems and branches short pilose and puberulent, bark exfoliating. Leaves decussate but fasciculate at younger branches, petioles 1.8–6.2 mm long, short pilose and covered with hyaline to golden glandular dots; blade lanceolate, ovate to trullate-lanceolate, (2.1–)4.2–9 × (0.6–)1.6–2.5 cm, acuminate to acute at the apex, less often attenuate, cuneate to short cuneate at the base, margins entire, subentire to sparsely serrate, both surfaces short pilose and covered with hyaline to golden glands. Inflorescence terminal and axillary, not secund, cymes in a spiciform arrangement, 3.5–7 cm long, 8–11 internodes; cymes sessile to subsessile, peduncle 0–1 mm long, short pilose and covered with hyaline to golden glandular dots, without secondary axes, bifurcation angles 0°, 3–6 flowers per cyme. Floral bracts lanceolate, (1.5–)3.4–4.2 mm long, shorter than calyx, sometimes reddish, puberulent, short pilose and ciliate. Flowers erect, subsessile or pedicellate, 0.6–2.1 mm long, short pilose and covered with hyaline to golden glandular dots. Calyx green to reddish, tubular, erect, 4.7–6.5(–7.2) mm, tube 3.3–4(–4.6) × 1.4–1.7(–2.9), 13–14 nerved, pilose outside and with some tiny glandular-capitate hairs, covered with antrorse hairs on the veins, hyaline glands only between the veins, throat hirsute with trichomes along the outline of the teeth, these no longer than the teeth themselves; teeth isomorphic, lanceolate, erect, 1.4–2.6 mm long, a bit reflexed at apex, ciliate. Corolla white, sub-bilabiate, 7.7–10(–12.1) mm long, tube (5.7–)7.2–8.7 × 1.6–2.9, exerted from calyx, covered with short hairs on the outer surface, inner surface with hairs and glands at the throat and basal third; upper lip 2–2.4 mm long, middle lobe of the lower lip 1.8–3.4 × 1.5–3.4 mm. Stamens 2, exerted, filaments 3.6–6.6 mm long, glabrous, not spotted; thecae 0.5–0.7 mm long, purplish; staminodes 2, 0.2–0.7 mm long, inconspicuous, sometimes up to 2.6 mm long and with tissue at the apex similar in shape and color to that of the fertile thecae. Style 8–13.1 mm long, white, not spotted, lobes unequal, the upper one longer. Mericarps 4, oblongoid to ovoid, triquetrous, 1–1.5 × 0.4–0.7 mm, apex acuminate, foveolate with a sub-basal to ventral scar, 0.1–0.2 mm long, this usually farinose, uniformly light brown, smooth (under light microscope) and glabrous.

TABLE 1. Morphological comparison between *Cunila socorroae* and similar species.

Character	<i>C. jaliscana</i>	<i>C. lythrifolia</i>	<i>C. socorroae</i>
Bark	exfoliating	non-exfoliating	exfoliating
Basal branch direction	divaricate	mostly erect	divaricate
Leaf blade shape	lanceolate to ovate-lanceolate	lanceolate to ovate-lanceolate	lanceolate to trullate-lanceolate
Leaf blade size (cm)	1.8–8 × 1.2–2.6	2.5–12 × 1.8–3	(2.1–)4.2–9 × (0.6–)1.6–2.5
Inflorescence length (cm)	5–8.5	4–12	3.5–7
Peduncle length (mm)	0–0.5	0–0.5	0–1
Flowers per cyme	8–9	10–28	3–6
Internodes per inflorescence	10–22	3–10	8–11
Floral bract shape	linear	linear	lanceolate
Floral bract length (mm)	1.3–1.9	2–6	(1.5–)3.4–4.2
Pedicel length (mm)	0–1	0–0.9	0.6–2.1
Calyx tube length (mm)	2–2.6(–3)	2–3.5	3.3–4(–4.6)
Calyx teeth shape	deltoid	deltoid	lanceolate
Calyx teeth length (mm)	0.6–0.8	0.6–0.8	1.4–2.6
Calyx throat	hirsute with the hairs along the outline of calyx teeth, not surpassing them in size	hirsute with the hairs along the outline of calyx teeth, not surpassing them in size	hirsute with the hairs along the outline of calyx teeth, not surpassing them in size
Corolla color	white	lavender to pale blue	white
Corolla tube length (mm)	(4–)5–6.5(–7)	4–7.5	(5.7–)7.2–8.7
Corolla inner surface	sparsely short pilose near midportion	sparsely short pilose near midportion	short pilose and with glands at the throat and basal third portion
Filament length (mm)	4–6	4–6	3.6–6.6
Mericaip shape and surface	ovoid triquetrous, foveolate	ovoid triquetrous, foveolate	oblongoid to ovoid triquetrous, foveolate
Mericaip size (mm)	1–1.4 × 0.4–0.5	1–1.1 × 0.3–0.4	1–1.2 × 0.4–0.5
Distribution	northernmost Sierra Madre del Sur	Mexican Volcanic Belt, southern Chihuahuan desert and Sierra Madre Oriental, and northern Sierra Madre del Sur	middle Sierra Madre Occidental
Elevation range (m)	1500–2500	1500–3500	(1700–)2000–2614
Flowering season	November–May	June–May	August–mid-May

Distribution, habitat and phenology:—*Cunila socorroae* is restricted to Sierra Madre Occidental biogeographic region in Durango (Fig. 5). It is registered only from the municipalities Canelas, San Dimas and Tamazula. *Cunila socorroae* grows mostly in pine-oak forest and marginally in pine forest, sharing habitat with *Abies durangensis* Martínez (1942: 621), *Agastache sandersiana* J.G.González in González-Gallegos & López-Enríquez (2017: 97), *Alnus acuminata* Kunth (1817: 20), *Arbutus madrensis* S.González in González-Elizondo & González-Elizondo (1992:

8), *Pinus douglasiana* Martínez (1943: 4), *P. durangensis* Martínez (1942: 23), *P. engelmannii* Carrière (1854: 227), *P. herrerae* Martínez (1940: 76), *P. strobiformis* Engelm. in Wislizenus (1848: 102), *Prunus serotina* Ehrhart (1783: 285), *Quercus rugosa* Née (1801: 275) and *Q. sideroxyla* Bonpl. in Humboldt & Bondpland (1809: 39). It occupies an elevational range between (1700–)2000–2614 m. It flowers and fructifies from August to mid-May.

Preliminary conservation status:—*Cunila socorroae* is currently known based on 8 collections from the same number of localities, though some of them very close to each other. None of these are nested within any Natural Protected Area; nonetheless, there are not particular signs of immediate vulnerability of the habitat based on general observations made at the field. According to the extent of occurrence (EOO) and area of occupancy (AOO) calculated based on cells of 2 × 2 km, 1,168.286 km² and 24 km² respectively, the species would qualified as endangered (EN). However, it is necessary to conduct systematic observations on the population size, habitat conditions and threats, as well as to expand botanical exploration in the area, in order to provide a well-supported assessment.

Folk name:—This plant is known by local people as *poleo*, a term that in Mexico is applied to other labiates with a minty smell such as *Clinopodium macrostemum* (Moc. & Sessé ex Bentham 1834: 395) Kuntze (1891: 515) (Ortega-Ortega *et al.* 2014, Martínez-Gordillo *et al.* 2019), *Cunila jaliscana* García-Peña & González-Gallegos (2013: 17) (González-Gallegos *et al.* 2016), *Cunila lythrifolia* Bentham in Lindley (1829: sub t. 1289) (González-Elizondo *et al.* 2004), *Hedeoma drummondii* Bentham (1834: 368) (González-Elizondo *et al.* 2004), and to a lesser degree, *Salvia lavanduloides* Kunth (1817: 287) (González-Elizondo *et al.* 2004). This term could have been applied to American plants similar in properties and smell to the original European *poleo*: *Mentha pulegium* Linnaeus (1753: 577). And the origin of the word itself seems to be a direct derivation from the Latin work, *pulegium* or *puleium*, which was the common name for the latter plant, which perhaps refers to the use that was given to this as flea (*pulex* in Latin) repellent (Muñoz 1996). In particular, infusions of *Cunila socorroae* are referred by local people as useful for relaxing and treating respiratory and digestive ailments.

Etymology:—The epithet of this species honors Dra. María del Socorro González-Elizondo for her outstanding work contributing to the knowledge of the floristics in Durango, as well as her role in the foundation and development of the herbarium CIIDIR.

Additional specimens examined (paratypes):—MEXICO. Mun. Canelas: Canelas, 3.5 km al E, 25°7'N, 106°31'W, 1700 m elev., 28 December 1985(fl), *M. Vizcarra 161* (ANSM!, CIIDIR!, MEXU!); Canelas, 10 km por el camino a Cuevecillas, 25°7'99"N, 106°30'99"W, 2060 m elev., 10 May 1987(fl), *S. Acevedo & D. Bayona 208* (IBUG!); dirt road E of Canelas, 25°12'29"N, 106°49'26"W, 2330 m elev., 14 August 2015(fr), *B.T. Drew et al. 577* (NEBK!); La Cañada del Macho, 2 km en línea recta al O de la localidad, 13 km al E de Canelas, 25°7'16.98"N, 106°29'28.63"W, 2309 m elev., 14 August 2015(fr), *J.G. González-Gallegos et al. 1921* (CIIDIR!, MEXU!). Mun. San Dimas: La Línea, 11 km al E de la localidad, 35–36 km al SE de Tayoltita rumbo a San Luis Villacorona, 24°3'5.38"N, 105°50'10.29"W, 2300 m elev., 2 August 2015(fr), *J.G. González-Gallegos et al. 1856* (CIIDIR!, HUAA!, IBUG!, IEB!, MEXU!, ZEA!). Mun. Tamazula: San Juan, El Tecuán, El Durazno, 25°34'38"N, 106°58'12"W, 2442 m elev., 21 April 2008(fl), *D. Ramírez-N. 2787* (CIIDIR!); El Durazno, al ESE, rumbo a Las Milpas, 25°27'24"N, 106°51'19"W, 2614 m, 10 April 2013(fl), *F.I. Retana et al. 172* (ANSM!, CIIDIR!, IEB!, MEXU!).

Identification key to *Cunila* species growing in Durango

1. Leaf blade rounded to subcordate at base, petiole 1.5–2.5 mm long; inflorescence capituliform; calyx lobes narrowly triangular to linear, erect *C. pycnantha*
1. Leaf blade cuneate to short cuneate at base, petiole 1.8–8 mm long; inflorescence paniculiform or spiciform cymes; calyx lobes broad triangular to lanceolate, erect to reflexed 2
2. Inflorescence lax paniculiform cymes, peduncle 4–7 mm long; floral bract linear, 1.1–1.6 mm long; calyx throat hirsute with trichomes in a line below the teeth; corolla tube 3–4.5 mm long *C. crenata*
2. Inflorescence cymes in a spiciform arrangement, peduncle 0–1 mm long; floral bract lanceolate, (1.5–)3.4–4.2 mm long; calyx throat with trichomes along the outline of the teeth; corolla tube (5.7–)7.2–8.7 mm long *C. socorroae*

Discussion:—Between Mexican *Cunila*, the new species clearly is part of a morphological alliance together with *C. jaliscana* and *C. lythrifolia*. The latter share a similar habit and height (mostly as shrubs or sub-shrubs, and overlapping their height range between 1–2 m tall), pubescent stems (short pilose and puberulent), petioles shorter than 1 cm long, similar leaf shape and size (mostly lanceolate to ovate lanceolate, and between 2–12 cm long), leaf margin entire to inconspicuously serrate, compact spiciform inflorescences with sessile to sub-sessile cymes, flowers with pedicels shorter than 3 mm long, frequently sessile to sub-sessile, hairs along calyx lobes outline, but not overpassing them, corolla tube exerted from the calyx, and similar size in stamens, style and mericarps. Particularly, the leaf blade

shape and size together with inflorescence architecture are the main characters distinguishing these species from the other encountered in Mexico (García-Peña 2008).

Cunila socorroae differs from both, *C. jaliscana* and *C. lythrifolia*, by having less flowers per cyme (3–6 vs. 8–28), lanceolate floral bracts (vs. linear), mostly longer calyx tube (3.3–4(–4.6) mm vs. 2–3.5 mm), lanceolate calyx teeth (vs. deltoid) and longer (1.4–2.6 mm vs. 0.6–0.8 mm), and corolla internally short pilose and with glands at the throat and basal third portion (vs. sparsely short pilose near midportion). Moreover, the new species differs from *C. jaliscana* in having less internodes per inflorescence (8–11 vs. 10–22), longer floral bract ((1.5–)3.4–4.2 mm vs. 1.3–1.9 mm), and generally longer corolla tube ((5.7–)7.2–8.7 mm vs. (4–)5–6.5(–7) mm). And it also distinguishes from *C. lythrifolia* by the exfoliating bark (vs. persistent), divaricate basal branches (vs. erect), shorter floral bracts than the calyx (vs. longer), white corollas (vs. lavender to pale blue), and mostly longer corolla tube ((5.7–)7.2–8.7 mm vs. 4–7.5 mm long). In fact, this new species has the longest corolla of all *Cunila* species (Epling 1936, García-Peña 2008). Additionally, there is also a differentiation in geographic distribution between the three species. All of them are endemic to Mexico, but, whereas *C. jaliscana* occurs in the northernmost portion of Sierra Madre del Sur in Jalisco, and *C. lythrifolia* in the mountains of the Trans-Mexican Volcanic Belt, southern portions of the Chihuahuan Desert and the Sierra Madre Oriental and Sierra Madre del Sur (Ciudad de México, Guanajuato, Hidalgo, México, Michoacán, Morelos, Puebla, Querétaro, Tlaxcala and Veracruz); *C. socorroae* is exclusive to the middle portion of Sierra Madre Occidental in Durango (Fig. 5).

Furthermore, there are two more species of *Cunila* occurring in Durango, *C. crenata* García-Peña & Tenorio-Lezama (1997: 2) and *C. pycnantha* Robinson & Greenman (1894: 391). The first is distinguished by its exfoliating bark (similar in this aspect to *C. socorroae*), paniculiform inflorescences, pedunculate cymes, with two axes and pedicellate flowers, calyx throat hirsute with trichomes in a line below the teeth, and the presence of trichomes and glands on the inner surface of the corolla (character shared with *C. socorroae*), and it is also endemic to Durango. *Cunila pycnantha* is distinguished by its capituliform inflorescences, pedunculate cymes and pedicellate flowers, calyx throat hirsute, trichomes inserted along the outline of the teeth, and also an exfoliating bark; nonetheless, the distribution of this last species is much broader, including the states Chiapas, Durango, Guanajuato, Guerrero, México, Michoacán, Morelos, Nayarit, Oaxaca and Sinaloa.

Acknowledgments

The good disposition and help given by the curators of the herbaria consulted, including those that kindly sent specimens on loan to the first author (ANSM, ARIZ, CAS, CIIDIR, CREG, ENCB, F, G, GH, HUAA, IBUG, IEB, MEXU, MICH, NEBK, NY, PH, TEX, UC, US, WIS, AND ZEA), is acknowledged. We appreciate the help of the following colleagues from the Instituto de Biología, Universidad Nacional Autónoma de México: Berenit Mendoza-Garfias for the scanning photographs of the mericarp (SEM Hitachi SU1510), and to Susana Guzmán-Gómez, for the calyx photographs (Axio Zoom Z16 APOA). Also, we thank Albino Luna for the excellent illustration provided. JGGG thanks CONACYT financial support through the project CB-2015-01-255165. Socorro González-Elizondo kindly shared with us picture D in figure 2.

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