



Four new species of *Salvia* (Lamiaceae) from central Mexico

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Abstract

Four new species of *Salvia* are described and illustrated. These come from central Mexico in the region studied in the project Flora del Bajío y de Regiones Adyacentes. The four species belong to the subgenus *Calosphace*. *Salvia carranzae* is placed in the section *Fulgentes* and is distinguished by the stem ascending at first and then pendulous, leaves that present an irregularly dentate margin, inflorescence supine, corolla tube without papillae inside, narrow lower lip of the corolla with three very short lobules on the apex, and the upper branch of the style shorter than the lower. *Salvia calderoniae* has affinity with the species of section *Angulatae* and is distinguished by being a perennial herbaceous plant, erect, with short, lax inflorescences (3.5–10 cm) With few verticillasters 12(–19) and few flowers per verticillaster (2–8), and corolla tube arched upwards of 6–13 mm long. *Salvia xolocotzii* is morphologically similar to the species of section *Uliginosae*; it is characterized by being a herbaceous perennial plant, stoloniferous, decumbent, 15–45 cm tall, terminal inflorescence, rachis and calyx with glandular pubescence, upper lip of the calyx entire, with 5 veins, blue corolla with ventricose tube and connectives with a short acute tooth. *Salvia zamoranensis* coincides with the species of section *Brandegeia*; it is characterized by abundant long trichomes, extended on stems and calyces, calyx with 5 veins, blue corolla and ventricose, invaginated and epapillate tube, and a lower lip with two lines of white marks. The four species are distributed in forests of temperate climates and are endemic to the northeast of Guanajuato and Querétaro and southeast of San Luis Potosí.

Resumen

Se describen e ilustran cuatro especies nuevas de *Salvia* provenientes de la región estudiada por la Flora del Bajío y de regiones adyacentes en el centro de México. Las 4 especies pertenecen al subgénero *Calosphace*. *Salvia carranzae* se ubica en la sección *Fulgentes* y se distingue por presentar tallos ascendentes al inicio y después péndulos, hojas con el margen irregularmente dentado, inflorescencia supina, tubo de la corola sin papilas en su interior, labio inferior de la corola angosto con tres lóbulos muy cortos en el ápice y la rama superior del estilo más corta que la inferior. *Salvia calderoniae* es afín a especies de la sección *Angulatae*, se identifica por ser una planta herbácea perenne, erecta, con inflorescencias laxas, cortas (3.5–10 cm), con pocos verticilastos (5–12 (–19) y pocas flores por verticilastro (2–8), tubo de la corola arqueado hacia arriba, de 6–13 mm de largo. *Salvia xolocotzii* es morfológicamente similar a las especies de la sección *Uliginosae*; se caracteriza por ser una planta herbácea perenne, estolonífera, decumbente, de 15–45 cm de altura, inflorescencia terminal, raquis y cáliz con pubescencia glandular, labio superior del cáliz entero, con 5 venas, corola azul con el tubo ventricoso y conectivos con diente corto y agudo. *Salvia zamoranensis* coincide con las especies de la sección *Brandegeia*, se caracteriza por presentar abundantes tricomas largos, extendidos en tallos y cálices, cáliz con 5 venas, corola azul, tubo ventricoso e invaginado, sin papilas en su interior y labio inferior con dos líneas de manchas blancas. Estas especies se distribuyen en bosques de climas templados y son endémicas al noreste de Guanajuato y Querétaro y sureste de San Luis Potosí.

Introduction

Recent botanical explorations in Mexico have led to the discovery and description of numerous new species of plants that are rare or restricted in distribution; the genus *Salvia* Linnaeus (1753: 23), with more than 300 spp. cited for Mexico (Martínez-Gordillo *et al.* 2013), is not an exception, and around 50 new species have been described in recent decades (Bedolla-García *et al.* 2011, Espejo & Ramamoorthy 1993, Fragoso-Martínez & Martínez-Gordillo 2013; González-Gallegos *et al.* 2012a, 2012b, González-Gallegos & Castro-Castro 2012, 2013, González-Gallegos 2013, González-Gallegos *et al.* 2013, González-Gallegos & Aguilar-Santelises 2014, Iltis *et al.* 2012, Klitgaard 2007, Lara-Cabrera *et al.* 2014, Martínez-Gordillo & Lozada-Pérez 2011, Ramamoorthy 1983, 1984a, 1984b, 1984c, Ramamoorthy &

Lorence 1987, Turner 1995a, 1995b, 1996a, 1996b, 2008a, 2008b, 2008c, 2009a, 2009b, 2010, 2011, 2013). It is certain that new species will continue appear in the future.

During the review of the genus *Salvia* for the project Flora del Bajío y de Regiones Adyacentes, specimens corresponding to four undescribed species belonging to the subgenus *Calosphace* (Bentham 1833: 198, 245) Epling (1939: 3) were detected in the IEB herbarium. The herbaria MEXU, QMEX and SLPM were subsequently examined in order to verify whether there was previously collected material in their collections that pertained to any of these species; however, none was found. Due to the scarcity of available material, in autumn of 2012, summer to autumn of 2013 and spring of 2015, various field trips were conducted in order to collect more samples that would allow these species to be properly described and proposed here as hitherto new to science. The species described in this study add four endemic elements of very restricted distribution to the Flora del Bajío y de Regiones Adyacentes, particularly to the Cerro Zamorano and the southern part of the Sierra Madre Oriental, which highlights the floristic importance of these regions.

Taxonomy

Salvia carranzae Zamudio & Bedolla, *sp. nov.* (Fig. 1)

Salviae fulgenti similis sed differt caule primum assurgenti postremo pendenti, foliorum laminae basi truncatis vel breviter cuneatis (vs. breviter cordatis vel rotundatis), marginibus irregulariter dentatis (vs. crenatis), apice obtuso vel longe acuminatis (vs. acutis vel breviter acuminatis), foliorum lamina subter sparse puberulis (vs. dense pubescentibus), inflorescentia supina, bracteis floralibus 6–18 (vs. 17–43) mm longis acutis vel acuminatis (vs. caudatis), calyce rubro 11–15 (vs. 15–16) mm longo, corollae tubus 22–27 (vs. 25–40) mm longus infra expapillatum, labelli inferiore apice breviter trilobato, stylo glabro ramuli superiore brevior quam inferiore.

Type:—MEXICO. Querétaro: municipality of Landa, Llano Chiquito, 1950 m, 21°23'01"N, 99°06'06"W, 29 April 2015, S. Zamudio, D. Juárez & J. Hernández 16882 (holotype IEB!, isotypes ENCB!, MEXU!).

Herbaceous perennial plant, up to 150 cm long. Stem ascending at first then pendulous, quadrangular, green, sometimes tinged with red, sparsely puberulent, with spreading short trichomes, intermixed with glandular trichomes, the densest pubescence on the grooved faces with retrorse trichomes. Petiole up to 20 mm long, articulate at the base, purple, pubescent, with spreading or antrorse trichomes and glandular trichomes, as well as yellow or orange punctiform glands. Leaf blade deltate-ovate, 4–11 × 2.5–6 cm, apex acute-acuminate to long-acuminate, base truncate, short-cuneate, sometimes oblique, margin irregularly dentate, upper surface sparsely pubescent with short, appressed trichomes, under surface sometimes tinged with purple, very sparsely puberulent, densest pubescence on the main veins, with numerous yellow or orange punctiform glands, that turn darker with age, distributed on the surface. Inflorescence supine, a terminal lax raceme, rarely paniculate, 7.5–16(–23) cm long, with 4–9 verticillasters, nodes 14–35 mm apart, each verticillaster with 2–6(–10) flowers, rachis pubescent with glandular and simple spreading trichomes. Bracts red, deciduous, ovate, 6–18 × 3.6–8 mm, with acute-acuminate apex, slightly pubescent with spreading trichomes mainly on the nerves and the margin. Calyx red, 11–15 × 7–8(–11) mm, pubescent outside, with glandular and simple trichomes, and yellow punctiform glands dispersed on the surface, strigose inside, calyx lips 2–5 mm long, upper lip ovate, with 7 veins, lower lip with two acute very close lobules. Corolla red, villous mainly on the upper lip, with simple trichomes and yellow punctiform glands, tube infundibular, 22–27 × 7–11 mm, striate, ventricose, internally epapillate, lips subequal, upper lip galeate, 17–23 mm long, lower lip extended, almost perpendicular to the upper, narrow (5–7 mm wide), with three very short lobules on the apex, the entire middle lobule larger than the two laterals. Stamens inserted close to the corolla throat, covered by the galea, filaments 4–6 mm long, connectives 21–25 mm long, with a short, acute, tooth just after the insertion with the filament, in the ventral portion, anthers 2–4 mm long, 2 linear staminodes present, ± 2 mm long. Style white, 43–60 mm long, glabrous, exerted near 7 mm in dehiscence, largely exerted after pollination, the upper branch clearly shorter than the lower one, both of them red. Mericarps ellipsoidal, triquetrous, 2.3–2.5 × 1.5 mm, variegated, yellow with brown spots.

Distribution and ecology:—The populations of this species are found on the border between the states of Querétaro and San Luis Potosí, in the municipalities of Landa, northeast of Querétaro, and Xilitla, in the southeastern portion of San Luis Potosí (Fig. 2). It grows on vertical limestone rocks in montane cloud forest. Elevation 1800–2200 m. It is considered a rare species, only known in three nearby locations. It blossoms and bears fruit from May through October.

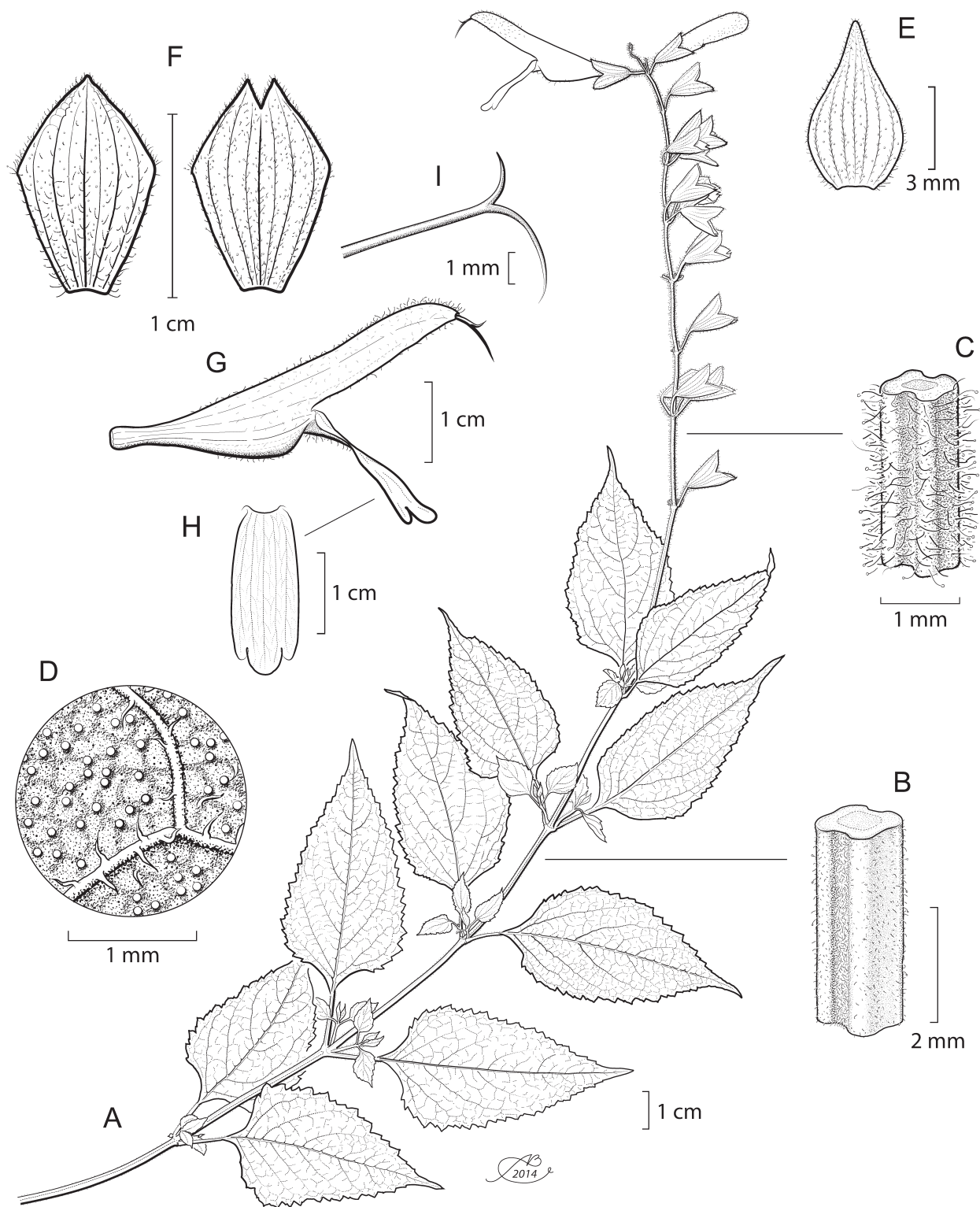


FIGURE 1. *Salvia carranzae*. **A.** Habit. **B.** Detail of the pubescence of stem. **C.** Detail of the pubescence of the rachis. **D.** Close up of the leaf lower surface. **E.** Bract. **F.** Dorsal and ventral view of the calyx. **G.** Lateral view of the corolla. **H.** Frontal view of the lower lip of the corolla. **I.** Terminal part of the style (based on *S. Zamudio & E. Carranza 11189* (IEB!), illustrated by Alfonso Barbosa).

Etymology:—The specific epithet is dedicated in honor of the Mexican botanist Eleazar Carranza González, researcher at the Instituto de Ecología, A.C., Centro Regional del Bajío, as well as an important collector and expert on the Flora del Bajío.

Taxonomic comments:—*Salvia carranzae*, is an herbaceous perennial plant with the stems ascending at first

and then pendulous, the leaves with irregularly dentate margins, inflorescence supine, corolla red, tube ventricose and epapillate, narrow lower lip (5–7 mm wide) with three very short lobules on the apex and the style glabrous with the upper branch shorter than the lower (Fig. 4A, B; Table 1); with these characters the new species did not fit within any of the sections described by Epling and collaborators (Epling 1939, 1940, 1941, 1944, 1947, 1951, Epling & Mathias 1957; Epling & Játiva 1966). Nevertheless, *S. carranzae* could be placed in section *Fulgentes* Epling (1939: 273) in view that it coincides almost exactly with the diagnosis of this section. Of the seven species that currently compose *Fulgentes*, *S. carranzae* is most similar to *S. fulgens* Cavanilles (1791: 15), they share a perennial herbaceous habit with deltate-ovate leaves, lax terminal racemes with glandular pubescence and red corollas with an infundibular (more evident in *S. carranzae*) and non-invaginate tube; however *S. carranzae* is different from all the member of this section by the corolla tube epapillate and the glabrous style.

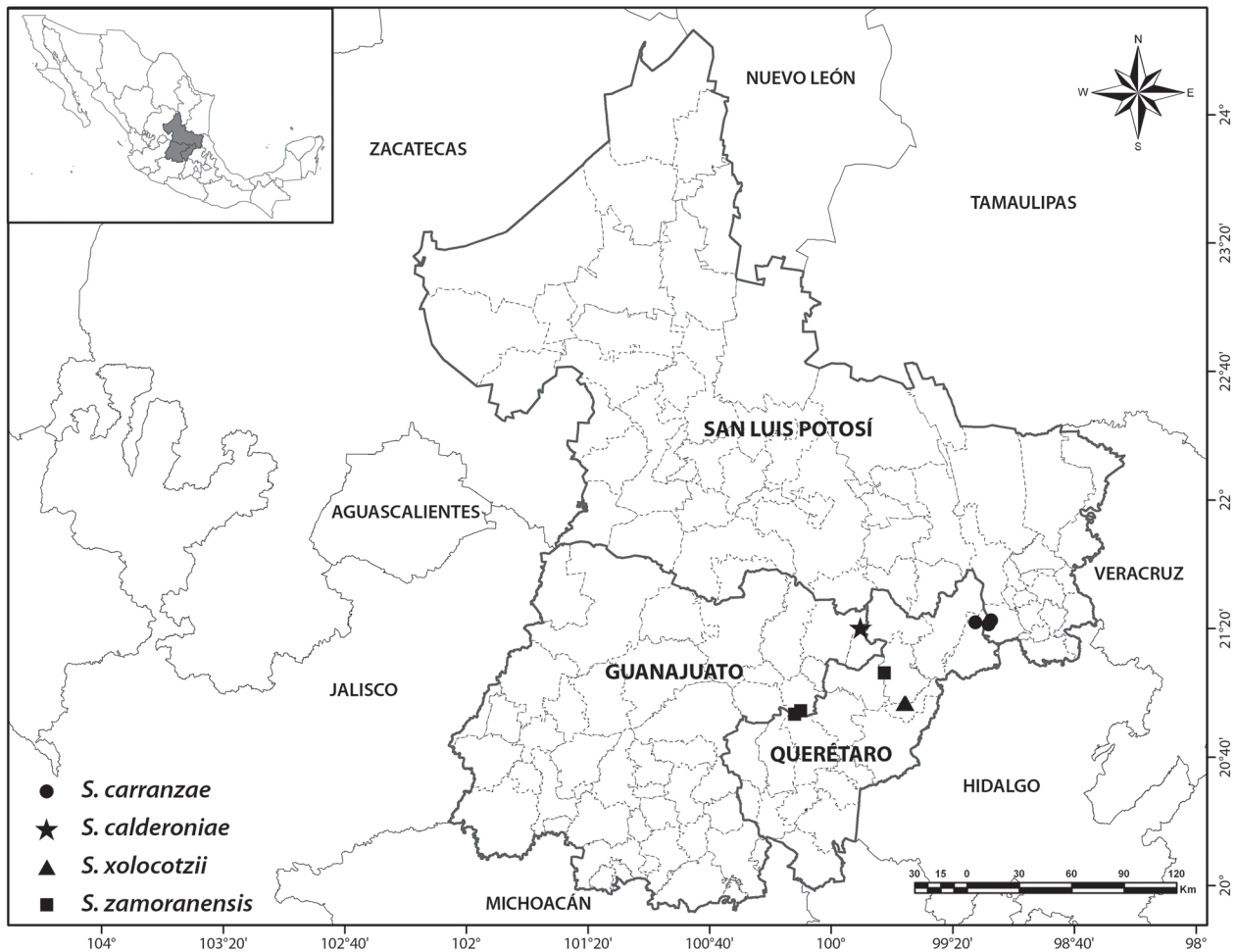


FIGURE 2. Distribution of *Salvia calderoniae*, *S. carranzae*, *S. xolocotzii* and *S. zamoranensis*.

If it is taken into account the glabrous style with the upper branch shorter than the lower (unusual character in the circumscription of the sections *sensu* Epling) and the upper calyx lip with 5 to 9 veins, *Salvia carranzae* has affinities with the sections *Blakea* Epling (1939: 94) and *Glareosae* Epling (1939: 102); however, the species of *Blakea* are characterized by the hastate to deltate leaves, upper calyx lip trimucronate, corolla blue and upper lip cymbiform, while the species belonging to the *Glareosae* have elliptic to oblong leaves, corolla tube short and cylindrical with the upper lip subfalcate, characters lacking in *S. carranzae*.

By the other hand, *Salvia carranzae* could be placed in section *Brandegeia* Epling (1939: 314) by de coincidence in having deltoid-ovate leaves, upper calyx lip with 5 to 7 veins and ventricose corolla tube, 14–38 mm long; however, *S. carranzae* do not fit with this section because it does not present setose pubescence on stem, leaves and calyx, neither corolla tube invaginated nor wide and extended lower lip nor villous style.

Considering the absence of papillae into the tube, *Salvia carranzae* could also be placed in the section *Nobiles* Epling (1939: 280), in which it is similar to *S. gesneriiflora* Lindley & Paxton (1853: 49). However, some evidence from phylogenetic studies shows that the sections *Cardinalis* Epling (1939: 295), *Flocculosae* (Epling 1935: 77)

Epling (1939: 153), *Fulgentes* and *Nobiles* form a natural group (Walker 2007, Jenks *et al.* 2013), which will require a new arrangement. Due to the agreement of *Salvia carranzae* in a greater number of characteristics with the members of the section *Fulgentes*, it is preferable to include tentatively the species in this section until the circumscription of this complex can be definitely evaluated with modern techniques.

TABLE 1. Comparison between *Salvia carranzae* and *S. fulgens*.

	<i>S. carranzae</i>	<i>S. fulgens</i>
LEAF		
Base	truncate, short-cuneate	slightly cordate to rotund
Margin	irregularly dentate	crenate
Apex	acute-acuminate to long-acuminate	acute to short-acuminate
Pubescence on lower surface	puberulent, very scattered on the main veins, without covering the surface	pubescent, dense, homogeneously scattered covering all the surface
BRACT		
Apex	acute-acuminate	caudate
Size	6–18 × 3.6–8 mm	17–43 × 5–12 mm
CALYX		
Color	red	green or red
Length	11–15 mm	15–16 mm
COROLLA		
Tube	clearly infundibular	slightly infundibular
Papillae	absent	present
Lower lip	5–7 mm wide, with three very short lobules on the apex, the middle lobule entire, 2.1–3 mm wide	8–12 mm wide, with three longer lobules, the middle lobule entire, 4–8 mm wide
Style	glabrous	densely tomentose
Upper branch length relative to lower branch	shorter	longer
DISTRIBUTION	Querétaro and San Luis Potosí	Distrito Federal, Estado de México, Guerrero, Hidalgo, Michoacán, Morelos, Puebla and Tlaxcala
ELEVATIONAL RANGE	1800–2200 m	2400–3400(–3990) m

Additional specimen examined:—MEXICO. Querétaro: municipality of Landa, 7–8 km al S de San Juan de los Durán, Punto Agua del cerro Grande, 13 June 1991, *B. Servín 1093* (IEB!). San Luis Potosí: municipality of Xilitla, Llano del Conejo, 2200 m, 21°24.182'N, 99°05.087'W, 13 October 1999, *S. Zamudio & E. Carranza 11189* (ENCB, IEB, MEXU, UAMIZ).

Salvia calderoniae Bedolla & Zamudio, *sp. nov.* (Fig. 3)

Salviae longispicatae similis sed differt inflorescentia laxa brevi [3.5–10(–21) vs. (8–)20–40 cm longa] verticillastris paucis [5–12(–19) vs. (13–)26–33] et floribus paucis [2–8 vs. (7–)12–18] per verticillastro, corolla tubus longiorum (6–13 vs. 5.5–12 mm longa), sursum arcuatum.

Type:—MEXICO. Guanajuato: municipality of Atarjea, 4 km al SW de El Toro, 2000 m, 21°22'32"N, 99°48'44"W, 12 October 2013, *S. Zamudio, B. Bedolla & E. Olvera 16545* (holotype IEB!, isotypes ENCB!, MEXU!, MO!, QMEX!).

Herbaceous perennial plant, erect, 30–50(–60) cm tall. Stem quadrangular, strigulose, with short appressed retrorse trichomes; discolorous leaves. Petiole thin, flexuous, 2–6(–9) cm long, strigulose, with short appressed retrorse trichomes. Leaf blade ovate, 3.5–8(–12) × (1.5–)3–5.5 cm, apex acuminate, base cuneate, margin serrate, upper surface sparsely strigulose, lower surface densely strigulose. Inflorescence racemose or terminal panicle, lax, 3.5–10(–21) cm long, with 5–12(–19) verticillasters, nodes 9–22 mm apart, each verticillaster with 2–8 flowers, rachis pubescent with short straight trichomes. Bracts deciduous, ovate to ovate-lanceolate, 3–6 × 2–3 mm, apex long-acuminate, strigulose on the external part. Pedicel 3–5 mm long, strigulose. Calyx 6–10 mm long, green or dorsally tinged with purple, slightly puberulent outside, with antrorse trichomes concentrated on the veins and with punctiform glands of amber color dispersed on the surface, strigulose inside; lips of the calyx unequal, the upper ovate-acuminate, 2–3 mm long,

with 3 veins, the lower 3–4 mm long, with two acute-acuminate lobules, with 6 veins. Corolla blue with the basal portion of the tube white, villous, mainly on the upper lip, tube 6–13 mm long, arching upwards, ventricose, internally epapillate, upper lip galeate, 5–6.5 mm long; the lower lip larger than the upper, 5.5–8 × 6–8 mm, extended, with three lobules, the middle invaginate and larger than the laterals, with two white lines that extend towards the throat, edge irregularly undulate. Stamens inserted close to the corolla throat, covered by the galea, filaments 3–3.5 mm long, connectives 8–10 mm long, with a short tooth, acute, retrorse, just after the insertion with the filament, in the ventral portion, anthers 1.5–2 mm long, with 2 linear to claviform staminodes, 0.3–0.7 mm long. Style white, 17.5–20 mm long, covered by the galea, bearded, the upper branch longer than the lower, both blue. Mericarps ellipsoid, triquetrous, 1.5–1.9 × 1–1.5 mm, brown.

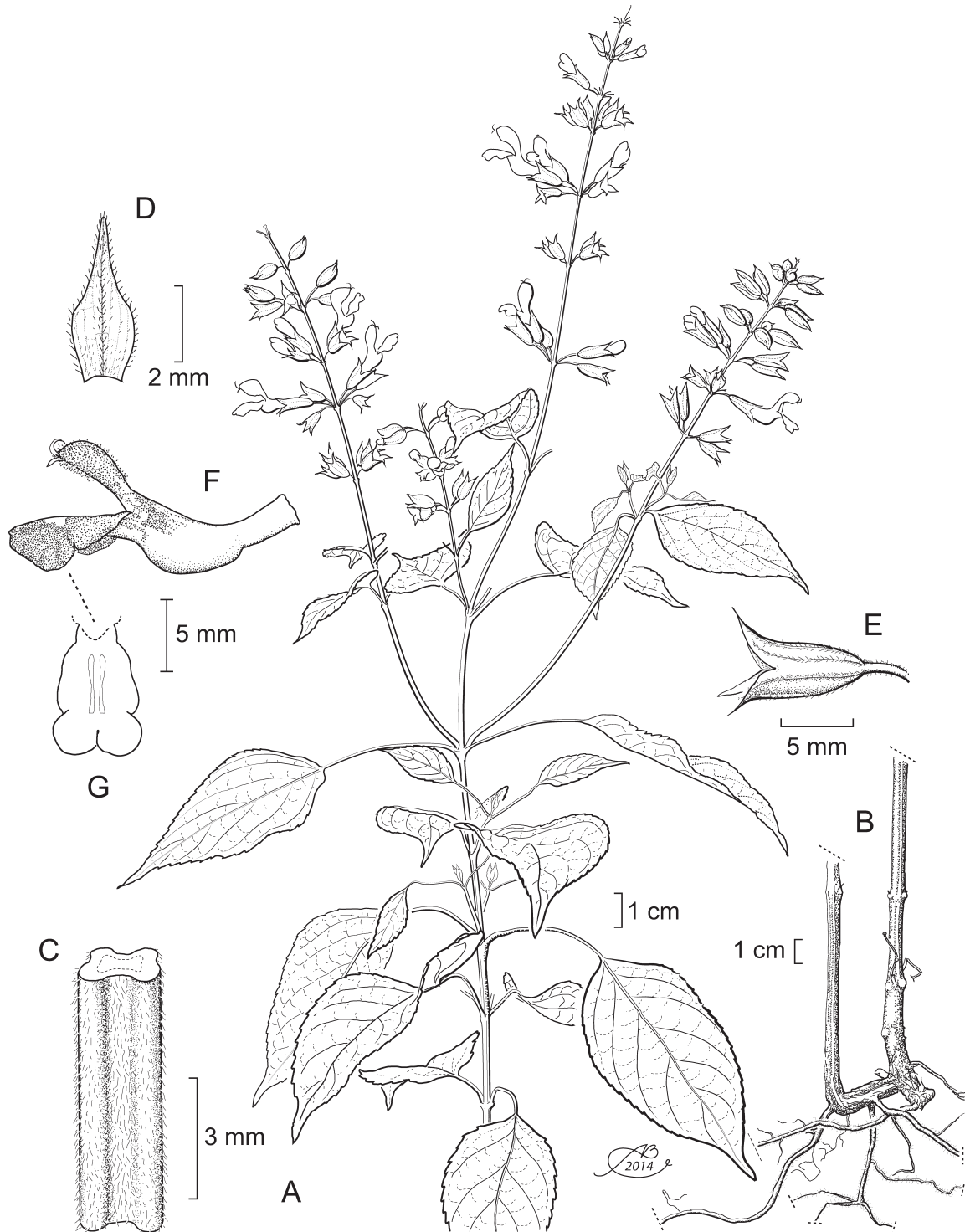


FIGURE 3. *Salvia calderoniae*. **A.** Habit. **B.** Stem branched from the base. **C.** Detail of the pubescence of stem. **D.** Bract. **E.** Lateral view of the calyx. **F.** Lateral view of the corolla, with the tube arched. **G.** Frontal view of the lower lip of the corolla (based on *S. Zamudio*, *B. Bedolla* & *E. Olvera*16547 (IEB!), illustrated by Alfonso Barbosa).

Distribution and ecology:—This plant has a very restricted distribution in the northeastern part of Guanajuato (Fig. 2). It inhabits humid ravines with *Quercus* forest and elements of montane cloud forest, on slopes of limestone rock. It is sympatric with *S. involucrata*. Elevation 1550–2000 m. It blossoms and bears fruit from October through November.

Etymology:—The specific name is dedicated with affection and admiration to the emeritus researcher of the Instituto de Ecología, A.C., Graciela Calderón de Rzedowski for her important contributions to Mexican botany and her work as a professor for more than 30 years.



FIGURE 4. *Salvia carranzae*. **A.** Habit. **B.** Portion of the inflorescence. *Salvia calderoniae*. **C.** Inflorescence. **D.** Lateral view of the corolla (photographs taken by S. Zamudio).

Taxonomic comments:—The morphology of *Salvia calderoniae* allows it to be placed in the section *Angulatae* (Epling 1935: 67) Epling (1939: 234), which is one of the most complex sections of the subgenus *Calosphace*. This section extends from northern Mexico to Brazil and Argentina and contains a large number of species (*ca.* 49), most of them having considerable morphological variation and lacking a thorough study (Epling 1939, 1940, 1941, González-Gallegos *et al.* 2013).

TABLE 2. Comparison between *Salvia calderoniae*, *S. cyanantha*, *S. longispicata*, *S. xalapensis* and *S. fluviatilis*.

	<i>S. calderoniae</i>	<i>S. cyanantha</i>	<i>S. longispicata</i>	<i>S. xalapensis</i>	<i>S. fluviatilis</i>
HABITAT	herbaceous perennial plant, erect	herbaceous perennial plant, prostrate	herbaceous perennial plant, erect	herbaceous perennial plant, erect	herbaceous perennial plant, erect
LEAF					
Form	ovate	ovate	ovate	rhomboid-ovate	ovate
Base	cuneate	rounded	cuneate	largely cuneate	cuneate
Pubescence on lower surface	densely strigulose with simple trichomes dispersed on the surface	strigulose with simple trichomes concentrated on the veins	densely strigulose with simple trichomes dispersed on the surface	tomentose or densely strigulose with simple trichomes dispersed on the surface	sparsely strigulose with simple and dendritic trichomes, the last ones densest on the main veins
INFLORESCENCE					
Length	3.5–10(–21) cm	12–22 cm	(8–)20–40 cm	11–25(–32) cm	14–23(–42) cm
Type of trichomes on the rachis	simple	glandular	simple	simple	simple
No. of verticillasters	5–12(–19)	4–7	(13–)26–33	10–23	13–19
No. of flowers per verticillaster	2–8	5–8	(7–)12–18	9–15	12–19(–22)
BRACT					
Persistence	deciduous	deciduous	deciduous	late-falling	deciduous
CALYX					
length	6–10 mm	7.5–10 mm	5–6 mm	4.6–6 mm	5–6 mm
Color	green or dorsally tinged with purple	purple	green or dorsally tinged with purple	reddish	yellowish green
Pubescence	slightly puberulent with simple antrorse trichomes concentrated on the veins	pubescent with simple trichomes spreading on the veins, other glandular dispersed on the surface	puberulent with simple antrorse trichomes dispersed on the surface	densely puberulent with simple antrorse trichomes dispersed on the surface	puberulent with simple antrorse trichomes concentrated on the veins
COROLLA					
Color	blue with the basal portion of the tube white	purple	blue or blue with the basal portion of the tube white	purple or purple with the basal portion of the tube white	blue
Length of the tube	6–13 mm	16–18 mm	5.5–8 mm	5–5.5 mm	4.2–5 mm
Form	arched upwards	arched upwards	straight	straight	straight
DISTRIBUTION	northeast of Guanajuato	Michoacán	Distrito Federal, Estado de México, Guerrero, Jalisco, Michoacán, Oaxaca and Veracruz	Veracruz	Guerrero, Michoacán y Morelos
HABITAT	<i>Quercus</i> forest with elements of the montane cloud forest	<i>Pinus</i> forest	secondary vegetation derived from <i>Pinus-Quercus</i> forest, pastureland	tropical deciduous forest, tropical subdeciduous forest	<i>Quercus</i> forest, tropical deciduous forest

The morphological characteristics proposed by Epling (1939) that define the section *Angulatae* cover quite a wide interval of variations; those that allow *Salvia calderoniae* to be placed in this section are the following: perennial herbaceous plants, ovate leaves, cuneate base, acuminate apex; inflorescence a lax raceme with separated verticillasters, flowers 2–8 per verticillaster; deciduous bracts; upper calyx lip with 3 veins; blue corolla, ventricose and epapillate tube; lower lip of the corolla larger than the upper one; stamens covered by the galea; connectives with a retrorse tooth and pubescent style. Within the section *Angulatae*, only *S. cyanantha* Epling (1940: 526) and *S. calderoniae* present the corolla tube markedly arched upwards; however, these species are very different in terms of their other morphological characteristics; for example *S. calderoniae* is an herbaceous erect plant with cuneate base of leaves and simple trichomes on the raquis of inflorescence, whereas *S. cyanantha* is an herbaceous prostrate plant, with rounded base of leaves, glandular trichomes on the raquis of inflorescence and with simple and glandular trichomes on calyx; additionally they differ in the geographical distribution and habitat (Table 2).

In the other hand, *Salvia longispicata* Martens & Galeotti (1844: 73), *S. fluviatilis* Fernald (1900: 516) and *S. xalapensis* Bentham (1848: 308) are morphologically closest, being perennial herbaceous plants, erect, with ovate to rhombic leaves, serrate margins and acuminate apex; however, they differ from *S. calderoniae* in having larger terminal inflorescences, more verticillasters per inflorescence, more flowers per verticillaster as well as shorter corollas with straight tube, of these species *S. longispicata* is the most similar (Table 2).

Salvia calderoniae can be differentiated from the other species of the section by the combination of the following characteristics: herbaceous perennial plant, erect, with lax and short inflorescences [3.5–10(–21) cm long]; with few verticillasters [5–12(–19)] and few flowers per verticillaster (2–8); blue corolla, with the tube arching upwards of 6–13 mm long (Fig. 4C, D). *S. calderoniae* is the only species of the section that is distributed in forests of *Quercus* with elements of montane cloud forest (Table 2).

Salvia calderoniae may be confused with *S. mexicana* Linnaeus (1753: 25) var. *minor* Bentham (1848: 337) (section *Briquetia* Epling (1939: 267)) because of its growth habit, shape of the leaves, upper calyx lip with 3 veins, and almost completely blue corolla; however, it can be distinguished by having shorter, lax inflorescences with a lower number of flowers per verticillaster, ovate to ovate-lanceolate bracts, the corolla tube arching upwards with no invagination, and lower lip of the corolla extended and larger than the upper one.

Additional specimens examined:—MEXICO. Guanajuato: municipality of Atarjea: 4 km al SW de El Toro, 2000 m, 21°22'32"N, 99°48'44"W, 21 November 2009, *S. Zamudio & C. A. Ramírez 14693* (IEB!); ± 2 km al W de El Toro, por el camino a Xichú, 21°22'36.9" N, 99°49'04.6" W, 12 October 2013, *S. Zamudio et al. 16547* (IEB!).

Salvia xolocotzii Bedolla & Zamudio, *sp. nov.* (Fig. 5)

Salviae galloanae similis sed differt habitu herbaceo stolonifero, caulibus decumbentibus trichomatibus curvatis retrorsis ferentibus, foliorum petiolis longioribus [(8–)15–35 vs. 2–5 mm]; inflorescentia longiore [(7–)15–28 vs. 6–12 cm]; calycis labio supero 5-venoso (vs. 7-venoso), corollae labio supero pubescenti pilis eglandulosis.

Type:—MEXICO. Querétaro: municipality of San Joaquín, 13 km por la carretera San Joaquín-La Joya, 2150 m, 20°58'56.6"N, 99°34'40"W, 2 September 2013, *S. Zamudio, E. Carranza, B. Bedolla & E. Sánchez 16443* (Holotype IEB!, isotypes EBUM!, ENCB!, MEXU!, MO!, P!)

Herbaceous perennial plant, stoloniferous, decumbent, 5–45 cm tall, branched from the base. Stem quadrangular to subterete, tomentulose, with small retrorse curved trichomes. Petiole (8–)15–35 mm long, tomentulose, canaliculate. Leaf blade discolorous, ovate, deltate to ovate-lanceolate, (1.8–)2.2–4(–6) × 1–3.6 cm, apex obtuse to rotund, base rotund to truncate, frequently cordate, margins serrate to crenate, upper surface sparsely villous, glabrescent, with antrorse trichomes, lower surface sparsely puberulent, with antrorse curved trichomes and scarce punctiform glands of amber color, in both cases the trichomes are denser close to the margin of the leaf. Inflorescence a terminal lax raceme, (7–)15–28 cm long, with 4–10 verticillasters, nodes 2–4.5 cm apart, verticillasters with 2–5(–7) flowers, rachis pubescent with two types of trichomes: some glandular of 0.5–1 mm long, concentrated in the ribs and others simple, short, retrorse, on the grooved faces. Bracts deciduous, green or purple, ovate to lanceolate, 5–8 mm long, externally puberulent with antrorse dispersed trichomes, margin ciliate with glandular trichomes. Calyx 7–10 mm long, green tinged partially or totally with purple, especially on the dorsal surface, pubescent outside with glandular trichomes up to 1 mm long, concentrated on the veins, yellow punctiform glands dispersed on the surface, the edge with two types of trichomes, some simple, short, straight and others glandular; puberulent inside with very short antrorse trichomes, lips of calyx 2–3 mm long, the upper lip ovate-acuminate, with 5 veins, the lower with two acute-acuminate lobules and 6

veins. Corolla blue, villous, mainly on the upper lip, tube 8–13 mm long, slightly ventricose, internally epapillate, the upper lip galeate, 7–8 mm long, the lower lip extended, 13–15 × 11–13 mm, trilobate, the middle lobule invaginated and larger than the two lateral lobules, with two white lines from the base of the lip to the throat. Stamens inserted in the tube of the corolla, covered by the galea, filaments 2.5–3 mm long, connectives 8–10 mm long, with a short acute tooth, just after the insertion with the filament, on the ventral portion, anthers 2.5–3 mm long, 2 linear to claviform staminodes, 0.7–1.3 mm long. Style white, terete not swollen in the distal portion, 21–23 mm long, bearded, with the branches slightly exserted, the upper branch longer than the lower, both purple. Mericarps ellipsoid, 2–2.5 × 1.5–1.8 mm, variegated, with the surface gray and the marks brown.

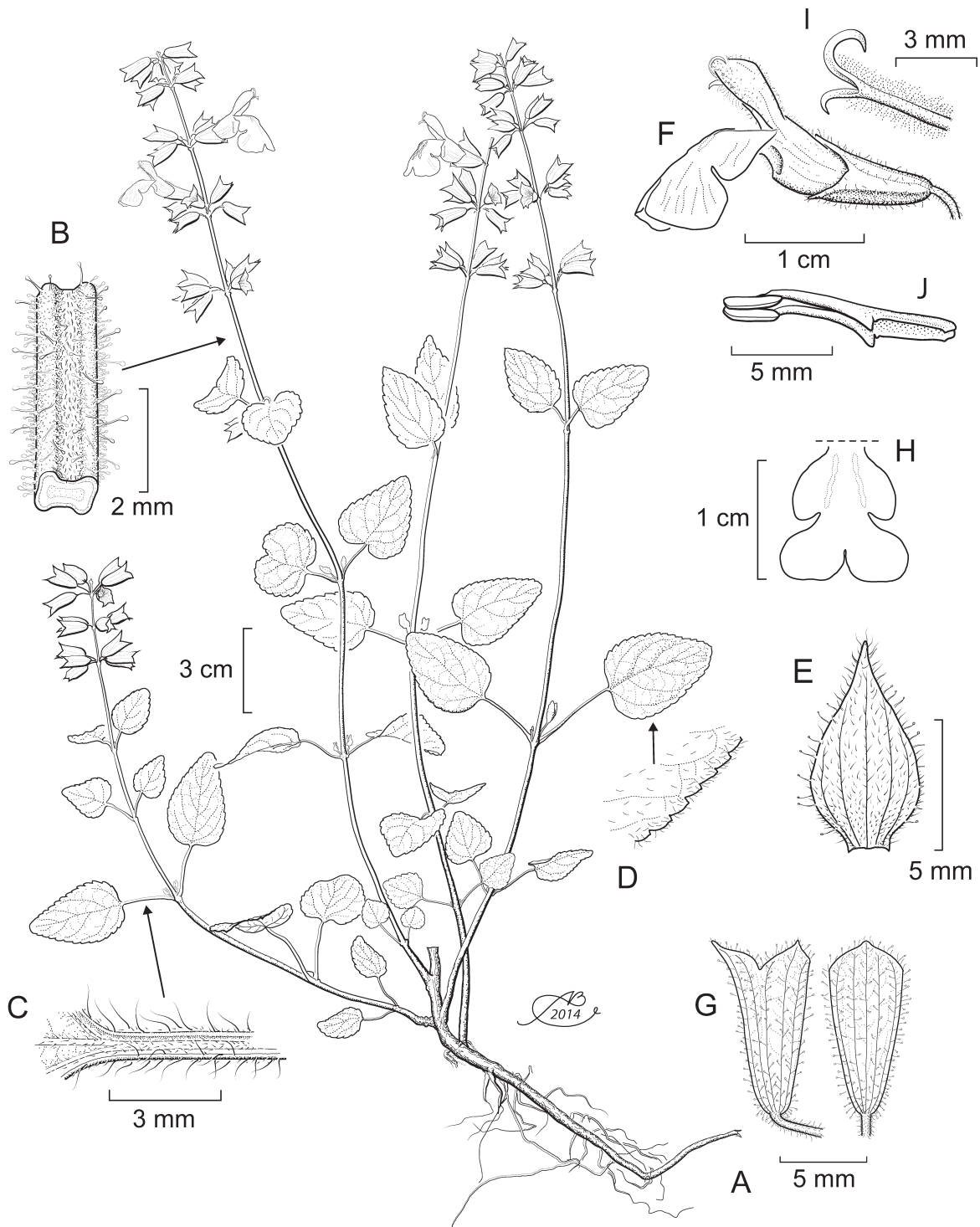


FIGURE 5. *Salvia xolocotzii*. **A.** Habit. **B.** Detail of the pubescence of the rachis. **C.** Detail of the pubescence of the petiole. **D.** Close up of the margin of the leaf. **E.** Bract. **F.** Lateral view of the flower. **G.** Lateral and dorsal view of the calyx. **H.** Frontal view of the lower lip of the corolla. **I.** Terminal part of the style. **J.** connectives and thecae (based on *S. Zamudio, E. Carranza, B. Bedolla & E. Sánchez 16443* (IEB!)), illustrated by Alfonso Barbosa).

Distribution and ecology:—The populations of this species occur in the municipalities of Landa and San Joaquín, in northeastern Querétaro (Fig. 2). It inhabits humid forests of *Quercus* with elements of montane cloud forest, on limestone rock slopes. Elevation 1550–2150 m. It blossoms and bears fruit from June through November.

Etymology:—The specific name honors the memory, 102 years after his birth, of Efraim Hernández Xolocotzi, founder of Mexican ethnobotany and a great student of the traditional agricultural systems of Mexico.

Taxonomic comments:—*Salvia xolocotzii* is a herbaceous perennial plant, stoloniferous, decumbent, 15–45 cm tall, with ovate, deltate to ovate-lanceolate leaves, terminal inflorescence, glandular trichomes on rachis and calyx, upper calyx lip entire with 5 veins, corolla blue with slightly ventricose tube and lower lip extended, patent and larger than the upper one and connectives with a short acute tooth (Fig. 6A, B) these characters do not agree with any of the sections as defined by Epling and collaborators (Epling 1939, 1940, 1941, 1944, 1947, 1951, Epling & Mathias 1957; Epling & Játiva 1966).

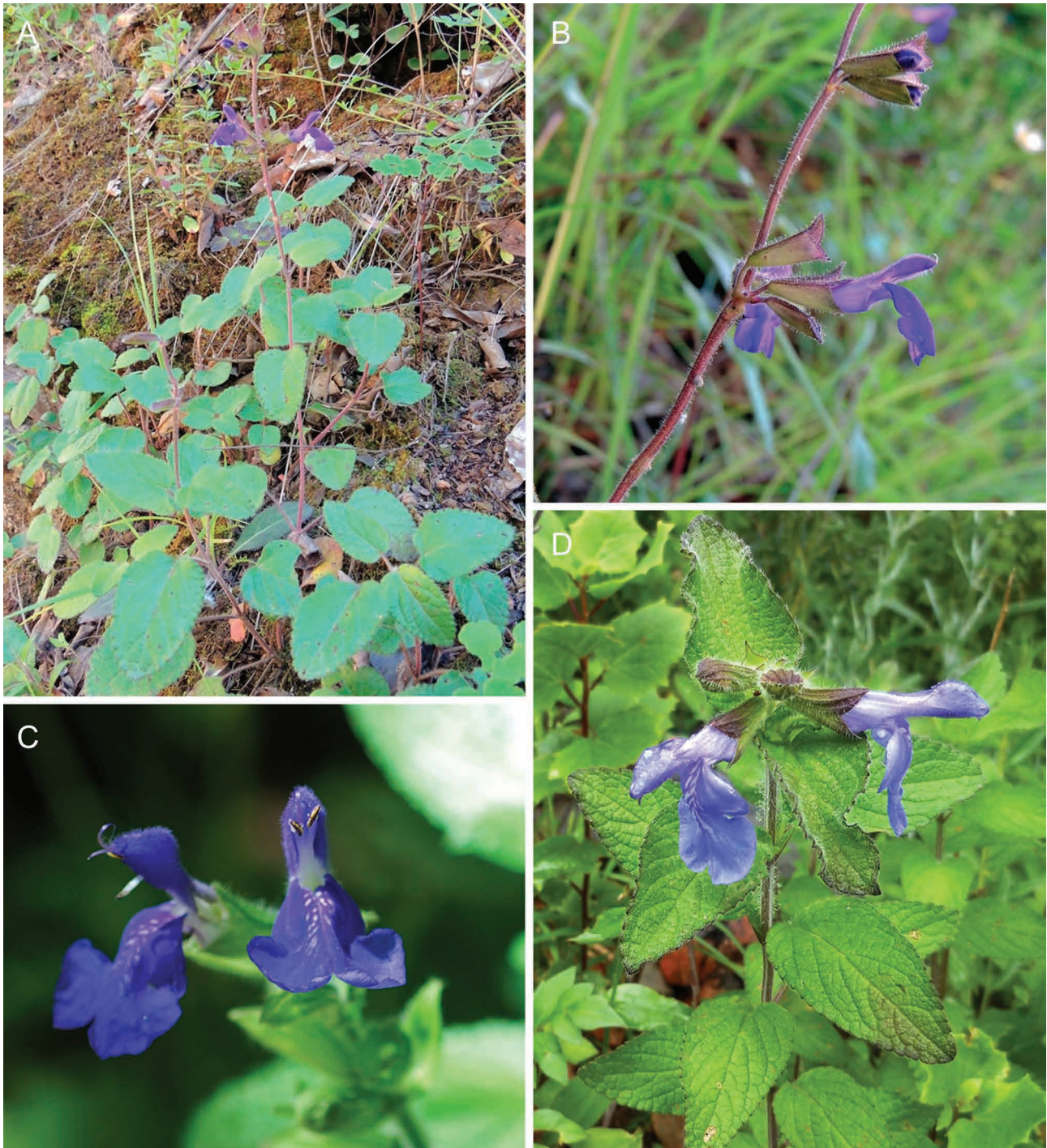


FIGURE 6. *Salvia xolocotzii*. A. Habit. B. Portion of the inflorescence. *Salvia zamoranensis*. C. Frontal view of the flower. D. Close up of the plant (photographs taken by S. Zamudio).

Following the sectional key of Epling (1939) leads to section *Scorodonia* Epling (1939:166), considering that *Salvia xolocotzii* presents the following characters: deltoid-ovate leaves, rachis of inflorescence with glandular trichomes, deciduous bracts, flowers 3–6 per verticillaster, upper calyx lip with 5 to 7 veins, blue corolla with ventricose tube, stamens covered by the galea, connectives with a short acute tooth and style bearded; however, the species included in this section, differ from *S. xolocotzii* by being shrubby, the leaves with upper surface bullate, rugose, and the lower surface with incanous to canescent pubescence, dense inflorescences, lips of calyx brief and subtruncate and papillate corollae tube, whereby the new species is excluded from this section.

Among the Mexican sages, *Salvia xolocotzii* is similar to *S. galloana* Turner (2009b: 448), species that belongs to the section *Uliginosae* (Epling 1935: 87) Epling (1939: 54). Both have lax, terminal and intermittent inflorescences, with a similar number of flowers per verticillaster, glandular trichomes in the rachis of the inflorescence and in the calyx, deciduous bracts, similar length of calyx; green calyx, partially or totally tinged with purple, entire upper lip with ovate-acuminate apex, blue corolla with ventricose epapillate tube, and the upper lip shorter than the lower one, connectives with a short acute tooth and the style terete, not swollen in the distal portion (Table 3).

TABLE 3. Comparison between *Salvia xolocotzii* and *S. galloana*.

Characteristic	<i>S. xolocotzii</i>	<i>S. galloana</i>
HABIT	perennial herbaceous	suffrutescent
Height	15–45 cm	150 cm
STEM		
Pubescence	tomentulose with retrorse, curved trichomes	pubescent with antrorse, curved trichomes, thickened at the base
LEAF		
Form	ovate, deltate to ovate-lanceolate	ovate
Base	rotund to truncate	rotund
Margin	serrate to dentate	serrate
Apex	obtuse to rotund	acute
PETIOLE		
Length	(8–)15–35 mm	2–5 mm
Prolongation of the stem where the petiole articulates	absent	present
INFLORESCENCE		
Length	(7–)15–28 cm	6–12 cm
No. of flowers per verticillaster	2–5(–7)	3–5(–7)
CALYX		
Length	7–10 mm	8–10 mm
No. of veins on the upper lip	5	7
COROLLA		
Length of the tube	8–13 mm	15.2–16 mm
Length of the upper lip	7–8 mm	5.5–6 mm
Length of the lower lip	13–15 mm	7–8 mm
Type of trichomes on the upper lip	simple	glandular
HABITAT	<i>Quercus</i> forest with elements of montane cloud forest	<i>Pinus</i> forest
ELEVATIONAL RANGE	1550–2150 m	2580 m
DISTRIBUTION	northeastern Querétaro	central Guerrero

Salvia xolocotzii and *S. galloana* agree with the sectional diagnostic characters of *Uliginosae sensu* Epling (1939) and Turner (2009b) by the ovate to deltate leaves, terminal elongated inflorescence, deciduous bracts, calyx with glandular short trichomes, upper lip with 5 to 7 veins, blue corolla with ventricose and epapillate tube, lower lip with white maculae, stamens covered by the galea and pilose style with the upper branch longer than the lower one; however *S. xolocotzii* and *S. galloana* differ from the rest of the species of this section for the absence of tridentate calyces with markedly divergent lips, abundant big glandular dots, deltoid connectives and the style swollen at apex, which could indicate that these do not belong to this section.

The morphological similarity between *Salvia xolocotzii* and *S. galloana* is clear; nevertheless, the affinity with the sections *Uliginosae* and *Scorodonia* is unclear. Therefore, *S. xolocotzii* might be tentatively assigned to section *Uliginosae* until new studies allow to reach a more natural classification than that proposed by Epling (1939).

Additional specimens examined:—MEXICO. Querétaro: municipality of Landa: 10 km al SW de El Madroño,

1550 m, 22 June 1988, *J. Rzedowski 46763* (IEB!); 11 km al S de El Madroño, 1515 m, 5 November 1987, *S. Zamudio 5882* (IEB!); municipality of San Joaquín: brecha San Joaquín-La Joya, 2100 m, 18 November 1998, *R. Hernández et al. 11733* (IEB!); Joyas de Bucareli, 2100 m, 19 September 1997, *J. Rzedowski 53533* (IEB!); 15 km por la carretera San Joaquín-La Joya, 20°58'57.7"N, 99°34'08.3"W, 2034 m, 2 September 2013, *S. Zamudio et al. 16450* (IEB!).

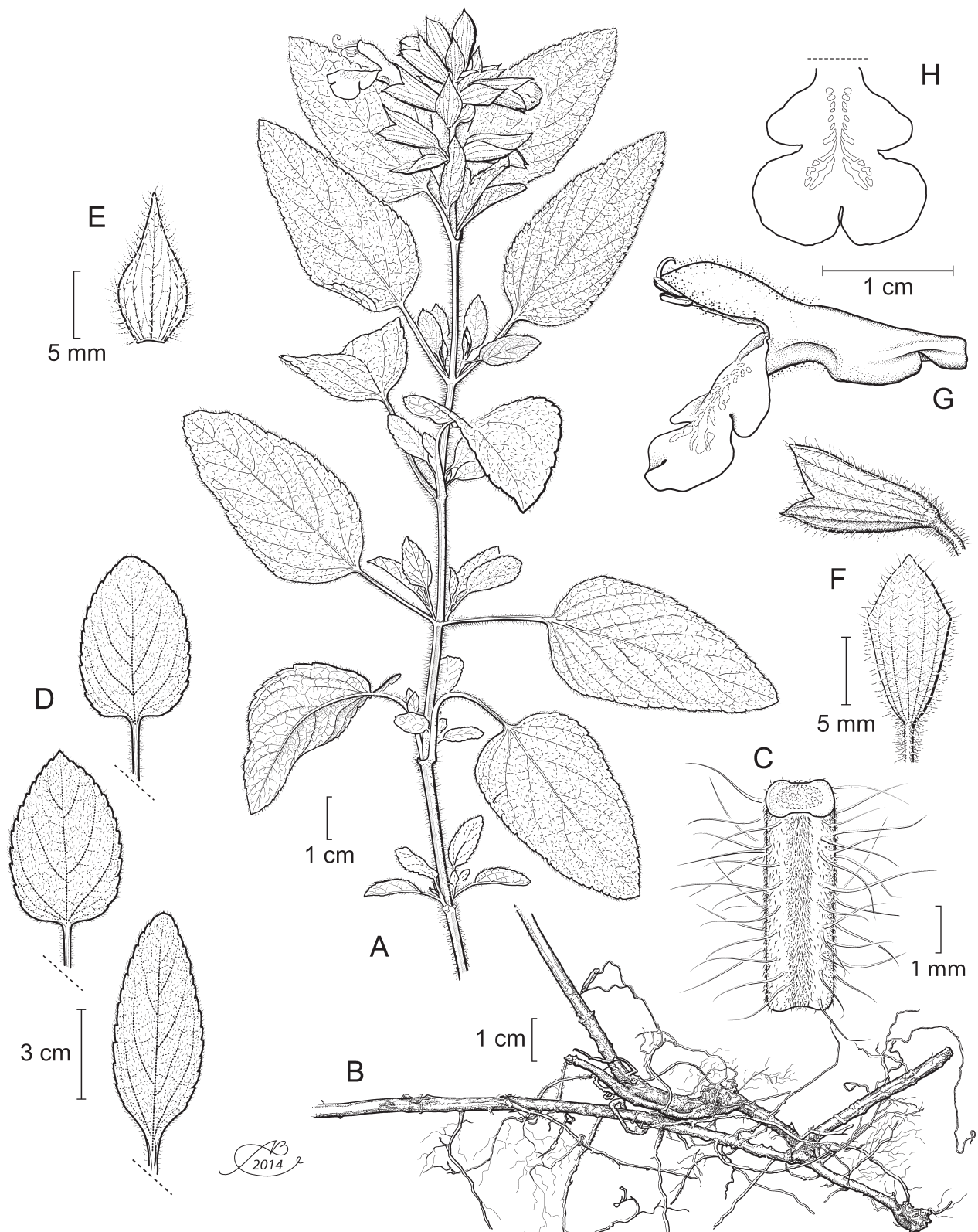


FIGURE 7. *Salvia zamoranensis*. **A.** Habit. **B.** Stoliferous stem. **C.** Detail of the pubescence of the stem. **D.** Different forms of leaves. **E.** Bract. **F.** Lateral and dorsal view of the calyx. **G.** Lateral view of the corolla, with the tube strongly invaginated. **H.** Frontal view of the lower lip of the corolla (based on *S. Zamudio, B. Bedolla & E. Olvera 16091* (IEB), illustrated by Alfonso Barbosa).

***Salvia zamoranensis* Zamudio et Bedolla, sp. nov. (Fig. 7)**

Salviae blepharophyllea similis sed differt caulis pilis 1–2.5 mm longis, foliis ovatis vel oblongis basi rotundatis, cuneatis vel breviter cordatis, bracteis ovatis tarde deciduis; calycis labio supero 5-venoso (vs. 7-venoso), corolla caerulea labio infero albo-maculato.

Type:—MEXICO. Querétaro: municipality of Colón, parte alta del cerro Zamorano, 3100 m, 20°55'57.5"N, 100°11'01.8"W, 10 November 2012, S. Zamudio, B. Bedolla & E. Olvera 16091 (Holotype IEB!; isotypes ENCB!, MA!, MEXU!, MO!, P!, QMEX!, UAMIZ!, US!, XAL!).

Herbaceous perennial plant, stoloniferous, decumbent, slightly branched from the base, 30–60 cm tall. Stem quadrangular, green, sometimes tinged with purple, pubescent with two types of trichomes, some long, spreading, 1–2.5 mm long on the ribs, others short 0.2–0.4 mm, retrorse, very dense on the grooved faces. Petioles slightly clasped, (7–)16–25 mm long, green, sometimes tinged with purple, canaliculate, pubescent with three types of trichomes, some long *ca.* 1.5–2 mm, others short throughout the canal and a few short, glandular. Leaves opposite-decussate, with young sprouts on the axils, green, surface sometimes tinged with purple, ovate to oblong, 5–7(–8.5) × 1–2(–5) cm, apex obtuse to acute, base rotund to cuneate, sometimes slightly cordate, margin serrate, venation pinnate, reticulate, semicraspedodromous, upper surface sparsely pubescent with antrorse trichomes, lower surface with antrorse trichomes concentrated on the veins, both faces with translucent or yellow punctiform glands dispersed on the surface. Inflorescence a terminal lax raceme, (2–)4–9(14) cm long, with 2–4(–7) verticillasters, nodes 8–30 mm apart; each verticillaster with 2–5 flowers. Bracts late falling, ovate, (6–)10–13 × 3–5(–8) mm, apex acute acuminate, pubescent with spreading trichomes mainly on the veins and the margin. Calyx 11–14 × 4.5–6 mm, green, occasionally tinged with purple on the back, covered with translucent punctiform glands dispersed on the surface, puberulent on the external face, with two types of trichomes, some long and spreading on the veins, others short dispersed on the surface, puberulent on the internal face with antrorse, very short trichomes, lips of the calyx 4–6 mm long, the upper lip ovate acuminate, with 5 veins, the lower with two lobules acute-acuminate, 6 main veins and one secondary. Corolla blue, villous, mainly on the upper lip, with trichomes of 0.3–0.5 mm long and translucent punctiform glands on the external part of the lower lip, tube 15–20 × 5–6 mm, slightly ventricose and strongly invaginate close to the base, internally epapillate, the upper lip galeate, 7.5–11.5 mm long, the lower lip 11–16 × 10–15 mm, extended, trilobate, the middle lobule and larger than the laterals, with two lines of white marks on the base of the lip, extending towards the throat. Stamens inserted in the tube of the corolla, covered by the galea, filaments 4–5 mm long, connectives 15–18 mm long, with a short, acute, retrorse tooth on the ventral portion, just after the insertion with the filament, anthers 2.8–3.5 mm long, 2 linear staminodes widened towards the apex, *ca.* 1.6–2 mm long. Style white, slightly exserted, 21–30 mm long, bearded on the upper branch, upper branch clearly longer than the lower, both purple. Mericarps ovate, ± triquetrous, 2.8–3.6 × 1.8–2.1 mm, brown or grey speckled with black.

Distribution and ecology:—Populations of this species occur at high elevations of Cerro Zamorano, in the municipalities of Tierra Blanca, Guanajuato and Colón, Querétaro. In the latter state, they are also known on Cerro Pingüical in the municipality of Pinal de Amoles (Fig. 2). It inhabits forests of *Abies religiosa* and of *Quercus* with *Arctostaphylos*, *Forestiera* and *Dodonaea*, on soils derived from igneous or sedimentary rocks. Elevation 2700–3100 m. It blossoms and bears fruit in the months of June through November.

Etymology:—The specific name refers to the Cerro Zamorano, located on the border between Guanajuato and Querétaro, in the municipalities of Tierra Blanca and Colón, respectively. It is an isolated mountainous peak, the summit of which reaches 3300 m, and is surrounded by xerophyllous vegetation, although at 3000 m a forest of *Abies religiosa* predominates (Rzedowski & Calderón 1989). The highest part of this peak is one of the four areas with the greatest concentration of endemic species in the state of Querétaro (Rzedowski *et al.* 2012), including *Cirsium zamoranense* Rzedowski (1994: 104), *Rubus macvaughianus* Rzedowski & Calderón (1989: 1) and *Baccharis zamoranensis* Rzedowski (1972: 400).

Taxonomic comments:—*Salvia zamoranensis* can be placed in the section *Brandegeia* based on the following characteristics: it is a perennial herbaceous plant, with a branched stem from the base, pubescent, with long, spreading trichomes; ovate leaves, short-petiolate; inflorescence a terminal raceme, late-falling bracts, calyx with long and spreading trichomes concentrated on the veins, partially tinged with purple; upper lip with 5 main veins; ventricose tube of the corolla and invaginate close to the base, lower lip wider and longer than the upper, bearded style. In addition, the plant is distributed in the central part of Mexico. This section is formed by four species: *S. angustiarum* Epling

(1939: 315), *S. blepharophylla* Brandege ex Epling (1939: 314), *S. oresbia* Fernald (1900: 536) and *S. buchananii* Hedge (1963: 430) (Epling 1939, Zamudio & Bedolla-García 2013). *Salvia zamoranensis* has greatest affinity with *S. blepharophylla* as it presents spreading pubescence on the stem ribs (less dense in *S. blepharophylla*), leaves with serrate margins, young leaf sprouts on the axils, terminal inflorescences of similar length, equivalent number of verticillasters per inflorescence and flowers per verticillaster, as well as similar sizes of flower (Table 4). However, it can be distinguished from all the species of the section by its leaves with a sparsely pubescent surface, antrorse trichomes, blue corolla with two lines of white marks on the lower lip directed towards the throat (Fig. 6C, D) and restricted distribution in the center of the Bajío region at elevations greater than 2700 m.

TABLE 4. Comparison between *Salvia zamoranensis* and *S. blepharophylla*.

	<i>S. zamoranensis</i>	<i>S. blepharophylla</i>
STEM		
Pubescence on the ribs	pubescent with spreading trichomes 1–2.5 mm long	glabrous to sparsely puberulent with spreading trichomes 2–3 mm long
LEAF		
Form	ovate to oblong	ovate-lanceolate to deltate
Base	rotund, cordate to cuneate	truncate to cuneate
Pubescence of the upper surface	sparsely pubescent with antrorse trichomes	puberulent, with sparse, antrorse, short trichomes, concentrated on the veins
Pubescence of the lower surface	pubescent with antrorse trichomes concentrated on the veins	glabrous
Margin	glabrous	with long, spreading trichomes
INFLORESCENCE		
Length	(2–)4–9(14) cm	5–17 cm
No. of verticillasters	2–4(7)	4–8
No. of flowers per verticillaster	2–5	2–6
BRACT		
Persistence	late-falling	deciduous
Form	ovate	lanceolate
CALYX		
No. of veins on the upper lip	5	5–7
Pubescence	simple, long and spreading trichomes on the veins, others short, dispersed on the surface	glandular trichomes concentrated on the veins, and others simple, long and spreading on the edge
COROLLA		
Color	blue	red
Length of the tube	15–20 mm	18–25 mm
Size of the lower lip	11–16 × 10–15 mm	10–17 × 8–16 mm
White maculae on the lower lip	present	absent
HABITAT		
	<i>Abies</i> and <i>Quercus</i> forest	<i>Pinus-Quercus</i> forest
DISTRIBUTION		
	Guanajuato and Querétaro	Nuevo León and San Luis Potosí
ELEVATIONAL RANGE		
	2650–3250 m	1460–2440 m

Additional specimens examined:—MEXICO. Guanajuato: municipality of Tierra Blanca: Pinal del Zamorano, Área Natural Protegida, Puerto el Madroño, 2705 m, 20°57'1.8"N, 100°9'0.6"W, 7 October 2012, *M. Martínez 8520* (QMEX!); parte alta del cerro Zamorano, 3100 m, 25 November 1988, *J. Rzedowski 47886* (IEB!). Querétaro: municipality of Colón: parte alta del cerro Zamorano, 19 July 2009, *E. Pérez C. & C. Medina 4969* (IEB!); parte alta del Cerro Zamorano, 3250 m, 1 September 1987, *J. Rzedowski 44369* (IEB!); Cerro Zamorano, 2800 m, 27 August 1989, *J. Rzedowski 48773* (IEB!); parte alta del cerro Zamorano, 3250 m, 22 September 2002, *J. Rzedowski 54007* (IEB!); parte alta del cerro Zamorano, 3191 m, 20°55'57.9"N, 100°11'01.8"W, 25 September 2012, *S. Zamudio et al. 15792* (IEB!); municipality of Pinal de Amoles, San Gaspar, 2850 m, 13 September 1989, *S. Zamudio et al. 7477* (IEB!); cañada del Agua Fría, ladera E del cerro Pingüical, 2650 m, 21°08'28"N, 99°41'04"W, 14 June 2002, *S. Zamudio & V. Steinmann 11995* (IEB!).

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