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Gonolobus espejoi (Apocynaceae, Asclepiadoideae), A New Species from Veracruz, Mexico

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Abstract*—*Gonolobus espejoi, a new species from Veracruz, Mexico, is described and illustrated. The new taxon shares characteristics with *G. albiflorus* and *G. spiranthus* such as the presence of a stipitate gynostegium, but differs from these species by having campanulate corolla, corolla lobes with two lateral purple calluses with the right margin ciliate, oblong-spatulate anther appendages, and a cotyliform style apex. A comparative table and a distribution map of the new taxon and the morphologically similar species is provided.

Resumen*—**Se describe e ilustra ***Gonolobus espejoi, una nueva especie de Veracruz, México. El nuevo taxón comparte características con *G. albiflorus* y *G. spiranthus* tales como la presencia de un ginostegio estipitado, pero *G. espejoi* se diferencia de estas especies por tener corola campanulada, lóbulos de la corola con dos callos púrpuras laterales con el margen derecho ciliado, apéndices de las anteras oblongo-espatulados y ápice del estilo cotiliforme. Se proporciona un cuadro comparativo y un mapa de distribución del nuevo taxón y de las especies morfológicamente similares.

***Keywords*—**Gonolobinae, milkweed vine, Texolo.

The New World genus *Gonolobus* Michx. (Gonolobinae) includes about 150 species distributed from the southern United States to Argentina (Krings et al. 2008; Stevens 2009). The genus has been recovered as monophyletic and it is recognized by the presence of laminar dorsal anther appendages, although these are lacking in *G. denticulatus* (Vahl) W.D.Stevens and allies (Krings et al. 2008; Morillo 2015; Mangelsdorff et al. 2016; McDonnell et al. 2018). Another important character to recognize *Gonolobus* are follicles with an asymmetrical base borne at 0–90° from the pedicel (Stevens 2005; Krings et al. 2008). In Mexico, *Gonolobus* includes 38 species, of which 18 are endemic to the country (Alvarado-Cárdenas et al. 2020).

During the curation of the Apocynaceae collection of the Herbario Metropolitano, Universidad Autónoma Metropolitana Iztapalapa (UAMIZ), material from a species of *Gonolobus* (*A. Espejo y A. R. López Ferrari 4441*) could not be assigned to any known species (Stevens 2001; Stevens 2009). Subsequent to additional work in pertinent herbaria i.e. Herbario Nacional (MEXU), Instituto de Botánica (IBUG), and Instituto de Ecología AC (XAL) (Thiers 2020), we here recognize the material as belonging to a novel species.

Materials and Methods

A stereoscopic microscope (Leica EZ4 HD) was used to measure the flower parts and to take pictures, mainly of the pollinarium. Later the images of the pollinarium were measured with the ImageJ software (Abràmoff et al. 2004). A morphological description was made based on the terminology of Stevens (2009). A comparative table of the morphologically similar species was prepared based on the herbarium specimens and protologues of *Gonolobus albiflorus* W.D.Stevens and *G. spiranthus* Juárez-Jaimes, W.D.Stevens & Lozada (Stevens 2005; Juárez-Jaimes et al. 2009). With the information obtained from the herbarium specimen labels, a distribution map of the three species was made with the QGIS 2.18 program (QGIS Development Team 2020) using the layers of "División política estatal" and the digital elevation model of Mexico, to represent the main elevations of the country (Guevara and Arroyo-Cruz 2016; INEGI 2019).

Taxonomic Treatment

Gonolobus espejoi G.M.Hernández-Barón, Hern.-Barón et López-Ferr., sp. nov. Type: México. Veracruz: Xico, cascada de Texolo, más o menos 2–3 km al S de Xico, 19°24'50"N, 96°59'39.2"W, 1200 m, 5 May 1991, *A. Espejo y A. R. López Ferrari 4441* (Holotype: UAMIZ!, Isotypes: MEXU, XAL)

Gonolobus espejoi is similar to *G. albiflorus* and *G. spiranthus* but exhibits campanulate corollas, corolla lobes with two lateral purple calluses and ciliated right margins, oblong-spatulate anther appendages, and cotyliform style apex.

Twining vines, white latex present. **Stems** cylindrical with mixed indumentum, long eglandular trichomes, 2–3 mm long, multicellular, yellow with dark septa and short glandular trichomes, ca. 0.2 mm long, uniformly arranged on the stem. **Leaves** opposite; stipular colleters absent, petioles 3.5–5 cm, with the same type of indumentum present on the stem; leaf blades ovate to widely ovate, (6–)8.1–10.9 × (3–)4.5–6.7 cm, apex acuminate, base cordate, lobes diverging or converging, sinus 0.68–1.3 cm deep, abaxially pilose with trichomes of 1.05–2.3 mm, adaxially pilose with appressed trichomes, 0.8–2.33 mm long, mixed indumenta on the midvein, 7–10 pairs of lateral veins, colleters 5–7, adaxially, at the base of the main veins. **Inflorescences** extra-axillary, one per node, racemiform, quite contracted, with 6–11 flowers, indumentum mixed, peduncles 3.7–5.0 cm, floral bracts linear, 1.1–1.5 mm, pilose. **Flowers** pedicellate, pedicels 1.6–3.2 cm; calyx lobes divided almost to the base, narrowly lanceolate, 5.12–6.36 × 1.44–1.80 mm, tube 1.2–2 mm long, apex acute, reflexed, abaxially pilose, purple at their distal portion, completely purple adaxially, glabrous, colleters one per sinus; corolla campanulate, with the base slightly inflated or crateriform, greenish, aestivation contorted and dextrorse, faucal annulus a continuous ring, 0.2–0.4 mm, sinuate, glabrous, located below the sinuses of the corolla lobes, corolla tube 2–3.5 mm, glabrous, lobes narrowly lanceolate, 8.9–11.5 × 2.20–2.98 mm, acute, coiled and reflexed,

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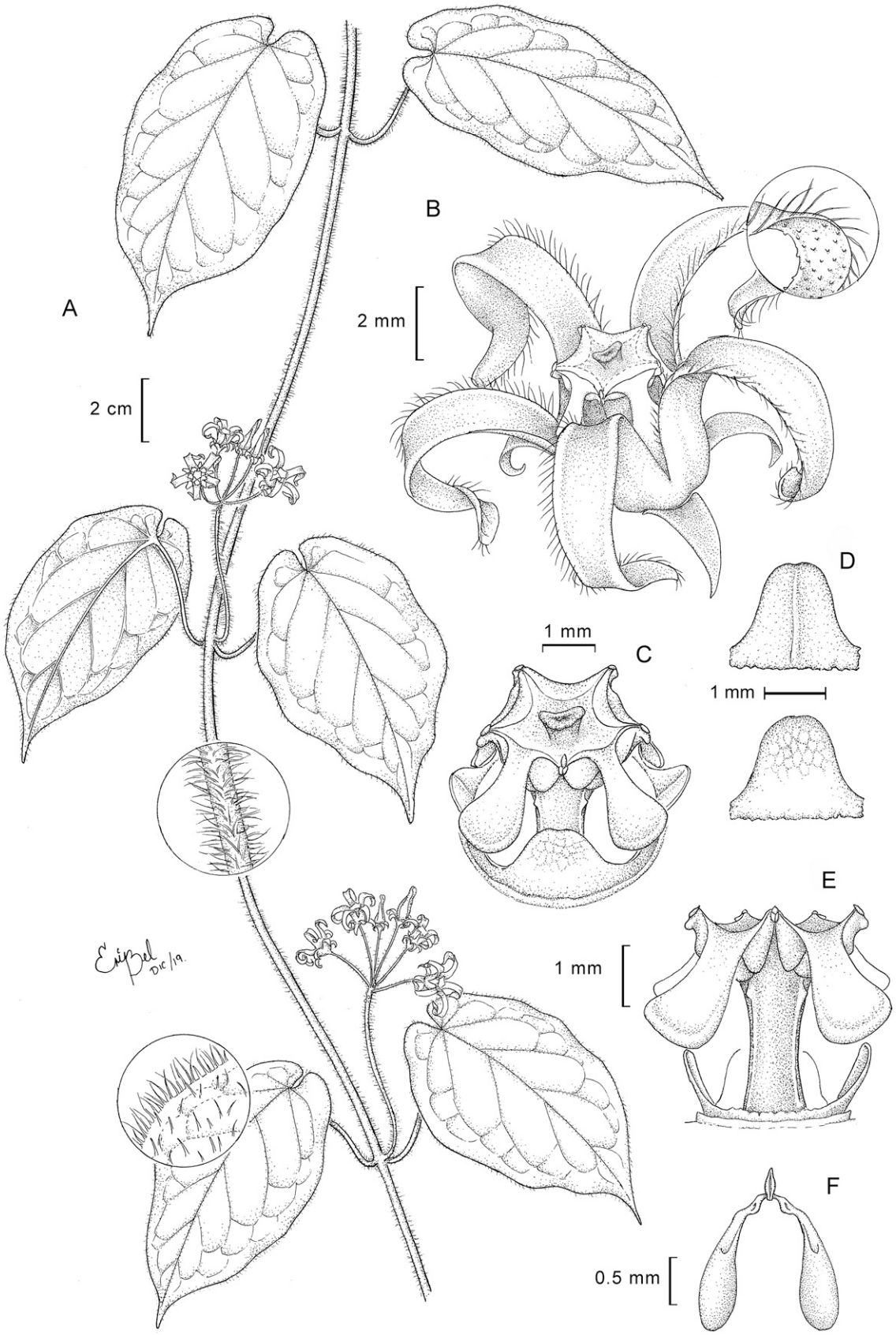


FIG. 1. *Gonolobus espejoi* G.M.Hernández-Barón, Hern.-Barón & López-Ferr. A. Habit, branch with leaves, detail of the indument on the adaxial surface of the leaf, detail of the indument of the stem. B. General aspect of the flower with detail of the abaxial indumentum of the corolla lobes. C. General view of the gynostegium and cotyliform style apex. D. Adaxial and abaxial view of the gynostegial corona lobes showing a central thickening and papillose surface. E. Lateral view of the gynostegium showing the gynostegial corona lobes, stipe with 5 ribs with a tooth near the apex, and anther appendages. F. Pollinarium. Illustration based on the holotype.

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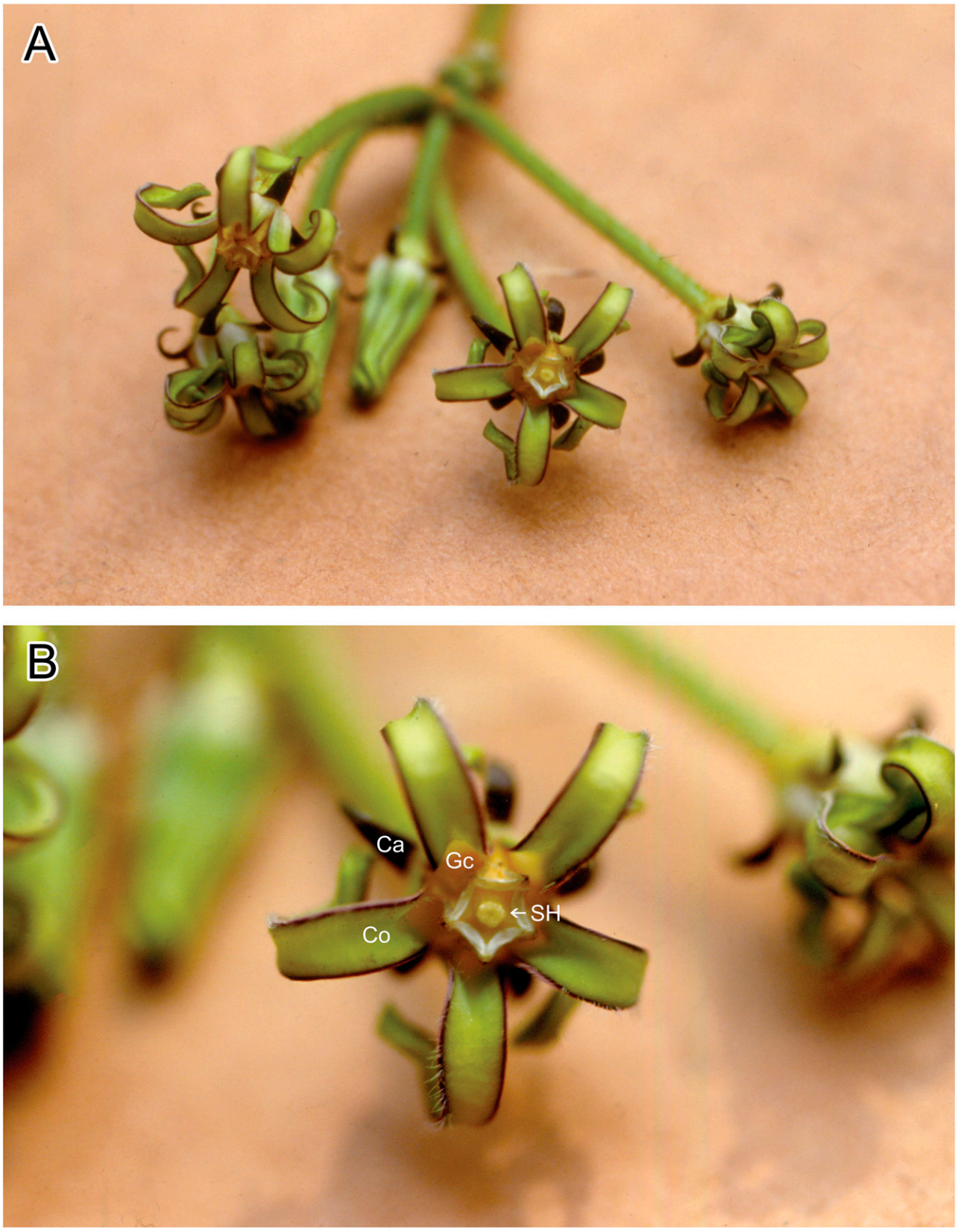


FIG. 2. Flowers of *Gonolobus espejoi* (from plants vouchered as *Espejo & López Ferrari 4441*). A. Inflorescence contracted-racemiform. B. Detail of the flowers showing purple calyx lobes (Ca), corolla lobes (Co) with two purple calluses and the right margin ciliate, gynostegial corona cup-shaped (Gc), and cotyliform style head apex (SH). Anther appendages cannot be seen, as they are deflexed. Photos by A. Espejo.

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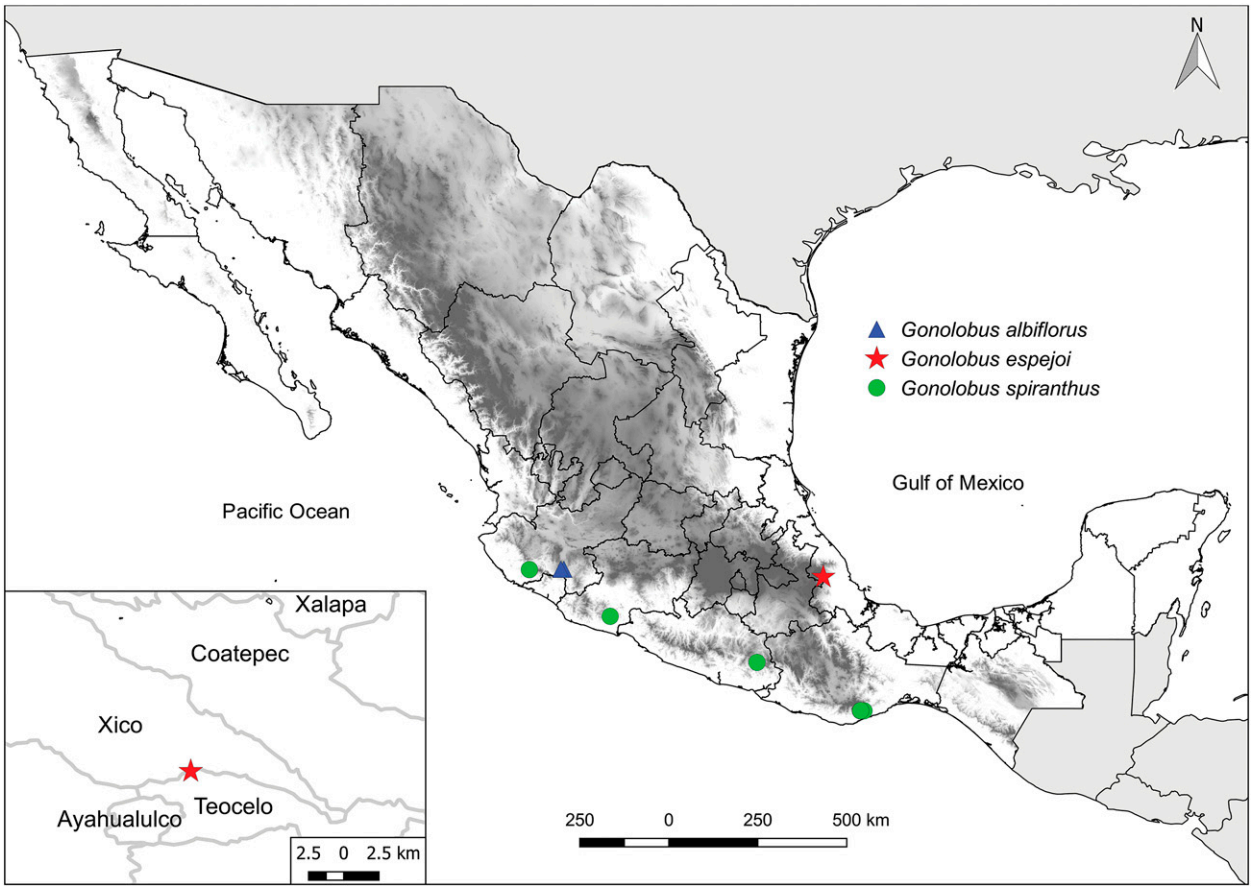


FIG. 3. Distribution of *Gonolobus albiflorus*, *G. espejoi*, and *G. spiranthus*.

margins purple, thickened adaxially, right margin ciliated and the left one glabrous, abaxially pilose, adaxially glabrous; gynostegium 3.03–5.27 × 1.1–3.50 mm, with stipe, stipe with 5 ribs, 2.03–3.31 × 0.86–1.26 mm, each rib with a narrow tooth near the apex, ca. 0.5 mm long, located below the anther appendages, slightly widened at the base, corona lobes 5, glabrous, 1.53–2 × 1.25–1.37 mm long, cup-shaped, fleshy, each lobe papillose abaxially with inconspicuous central thickening adaxially, the lobes fused basally forming a small ring, adnate to the base of the gynostegium and completely to the corolla; dorsal anther appendages 2.20–2.54 × 1.01–1.35 mm, oblong-spatulate, fleshy, deflexed, terminal appendages of anthers hyaline, broadly ovate, 0.28–0.41 × 1.8–2 mm; corpusculum ovoid, 0.16–0.24 × 0.05–0.1 mm, brown, caudicle 0.13–0.19 × 0.11–0.13 mm, flat; pollinia ovoid, slightly horizontal, 0.77–1.11 × 0.27–0.37 mm, excavated and translucent at their junction with the caudicles; style concave, apex cotyliform, slightly ascending with the margin slightly crenate, 0.4–0.5 × 0.6–0.7 mm at the highest ends. **Follicles** unknown. Figures 1–2.

Distribution and Habitat—*Gonolobus espejoi* is known from the surroundings of the Texolo waterfall, in the municipality of Xico, located in the state of Veracruz. It grows in secondary vegetation derived from the deciduous tropical forest at an elevation of 1200 m. There are two species with which it shares morphological characteristics: *Gonolobus albiflorus* which grows in the surroundings of the Nevado de Colima, within the limits of Jalisco and Colima at elevations between 2000 and 2100 m, and *G. spiranthus* which is distributed in the states of Guerrero, Jalisco, Michoacán, and Oaxaca, at elevations of 220 to 1500 m. As far as is known, the three species are allopatric in distribution (Fig. 3).

Phenology—The species is flowering in May.

Etymology—The specific epithet honors Dr. Mario Adolfo Espejo Serna, who collected specimens of this species during his expeditions to the state of Veracruz. Dr. Espejo is a distinguished Mexican botanist, a specialist in monocotyledons of Mexico, mainly from the Bromeliaceae and Orchidaceae families. He has dedicated his academic life to the study of botany and teaching, at the Universidad Autónoma Metropolitana Iztapalapa. Dr. Espejo is a professor committed to teaching, and also has great human qualities. For this reason, we decided to name this plant in his honor as a recognition of the passion and enthusiasm he shares for plants, which he has managed to transmit to students, who will be part of the new generations of botanists.

Conservation Status—As *Gonolobus espejoi* is currently known only from the type locality, we consider it Data Deficient (DD) (IUCN 2012).

Notes—*Gonolobus espejoi* is morphologically similar to *G. albiflorus* and *G. spiranthus* because the three species exhibit a gynostegium with a conspicuous stipe. With *G. albiflorus* it shares a stipe and reflexed corolla lobes. However, *G. albiflorus* has a prominently 5-winged stipe, erect calyx lobes, tubular and white corollas, and spatulate and concave dorsal anther appendages on the adaxial surface, whereas *G. espejoi* has a stipe with 5 ribs, reflexed calyx lobes, campanulate green corollas with a short tube, and anther appendages oblong-spatulate and flat on the adaxial surface.

Gonolobus espejoi and *G. spiranthus* present green corollas and a well-developed stipe. *Gonolobus spiranthus* has a cylindrical

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TABLE 1. Comparative characters of *Gonolobus espejoi*, *G. albiflorus*, and *G. spiranthus*.

Character	*G. espejoi*	*G. albiflorus*	*G. spiranthus*
Stem indumentum	Uniform, with yellow trichomes with dark septa, straight	Uniform, with white trichomes, somewhat reflexed	In two lateral lines, with ferruginous trichomes
Leaf blade shape	Ovate to widely ovate	Ovate-elliptical	Elliptical
Leaf blade size (cm)	(6)8.1–10.9 × (3)4.5–6.7	5.4–8.5 × 1.8–3.8	3.5–12 × 2.5–6.2
Number of colleters at the base of the leaf blade	5–7	2–4	2–8
Type of inflorescences	Racemiform	Racemiform to panniculiform	Racemiform
Peduncle length (cm)	3.7–5.0	0.2–1.1	0.1–1.0
Pedicel length (cm)	1.6–3.2	0.9–1.75	0.6–1.6
Number of flowers per inflorescence	6–11	1–40	1–5
Orientation of calyx lobes	Reflexed	Erect	Erect
Calyx lobe size (mm)	5.12–6.36 × 1.44–1.80	4.5–6.4 × 1–1.4	11–21 × 2.5–6
Corolla type	Campanulate	Tubular	Tubular
Corolla color	Green with purple margins	White or tinted purple at the base	Greenish yellow
Faucal annulus	0.2–0.4 mm	Absent	Absent
Corolla tube length (mm)	2–3.5	6–8.8	12–20
Orientation of corolla lobes	Reflexed	Reflexed	Erect
Corolla lobe size (mm)	8.9–11.5 × 2.2–3	9.5–12.5 × 2.6–3.4	15–30 × 2.3–7
Shape of corolla lobes	Narrowly lanceolate	Deltate to lanceolate	Falcate
Stipe shape and length (mm)	With 5 ribs, 2.03–3.31	Prominently 5-winged, 5.5–6.3	Cylindrical, 5.2–8.0
Gynostegial corona shape and length (mm)	Cup-shaped fleshy; 1.53–2	Erect ring-shaped, glabrous and striated; 1.2–1.5	Cup-shaped membranaceous, crenulate; 2.2–4.0
Anther appendages	Oblong-spatulate, flat	Spatulate, concave	Triangular-sagittate, flat
Size of anther appendages (mm)	2.20–2.54 × 1.01–1.35	1–1.6 × 0.9–1.6	1.0–1.3

stipe, erect calyx lobes, strongly spiral and erect corolla lobes as well as sagittate-triangular anther appendages; while *G. espejoi* has a stipe with 5 ribs with a tooth near the apex, reflexed calyx and corolla lobes, and oblong-spatulate anther appendages (Table 1). Some morphological characters of *Gonolobus espejoi*, such as corolla lobes with two purple callus margins with the right margins ciliated, and the style apex cotyliform, are novel characters within the genus.

Mexico is a center of diversity for *Gonolobus*, with about one-third of its species distributed in the country (Stevens 2005; Juárez-Jaimes et al. 2009). With the new taxon here described, the number of species of *Gonolobus* endemic to Mexico reaches 19. *Gonolobus espejoi* appears to be endemic to the Xico region, in Veracruz, but we cannot discount that its distribution may be wider. Likewise, it is likely that other novelties in the genus *Gonolobus* will be discovered.

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AUTHOR CONTRIBUTIONS

GMHB, LJHB, and ARLF drafted the manuscript, measured and compared the specimens, elaborated the description, and produced the comparative table. GMHB had primary responsibilities for the species identification, herbarium specimens review, and elaboration of the figures.

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