

SYNOPSIS OF THE GENUS *POLYSTEMMA* (APOCYNACEAE, ASCLEPIADOIDEAE) AND RECOGNITION OF THREE NEW SPECIES

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Abstract

Background: *Polystemma* is characterized by a mixed indumentum of glandular trichomes that turn white, rotate to rotate-campanulate corollas, a gynostegial corona with filiform appendages, and fusiform follicles. The taxon has undergone numerous taxonomic changes in recent years. In current phylogenies, *Polystemma* has been recovered as paraphyletic and many of its species require a new combination. In this study, we propose the corresponding changes and describe, map, and illustrate three new species within this genus.

Questions: Do morphological data support the transfer of *Matelea* species to *Polystemma*? Are the plants of *Polystemma* collected in Durango, Jalisco, and Sinaloa different species?

Studied species: *Polystemma*.

Study site and dates: United States, Mexico, Guatemala, El Salvador, Honduras, Nicaragua y Costa Rica, between 2014 and 2024.

Methods: More than 3,000 specimens from 20 herbaria and virtual databases were reviewed. Distribution maps were generated, and risk categories were proposed. The cohesive species concept was proposed as an explanatory hypothesis for taxon recognition.

Results: A total of 27 species of the genus were recognized, these distributed from the southeastern United States of America to Costa Rica. Eleven new combinations and three lectotypifications are made, and three new species for science are proposed. Identification key, nomenclatural type information, synonyms, habitat, images of all species and distribution maps are also included.

Conclusions: The review of this genus allowed for updating and improving the systematics within the subtribe Gonolobinae. Likewise, it highlights Mexico as the center of diversity and endemism for *Polystemma*.

Keywords: endemism, Gonolobinae, explanatory hypotheses, *Matelea*

Resumen

Antecedentes: *Polystemma* se caracteriza por el indumento mixto, con tricomas glandulares volviéndose blancos, corolas rotadas a rotado-campanuladas, corona ginostegial con apéndices filiformes y folículos fusiformes. El taxón presenta numerosos cambios taxonómicos en los últimos años. En las filogenias recientes, *Polystemma* se ha recuperado como parafilético y muchas de las especies requieren nuevas combinaciones. Se realizan los cambios correspondientes y se describen tres especies nuevas del género.

Preguntas: ¿Los datos morfológicos apoyan la transferencia de especies de *Matelea* a *Polystemma*? ¿Son especies diferentes las plantas de *Polystemma* colectadas en Durango, Jalisco y Sinaloa?

Especies de estudio: *Polystemma*.

Sitio y años de estudio: Estados Unidos de América, México, Guatemala, El Salvador, Honduras, Nicaragua y Costa Rica, entre 2014 y 2024.

Métodos: Se revisaron más de 3,000 ejemplares de 20 diferentes herbarios y bases de datos. Se generaron mapas de distribución y proponen categorías de riesgo. Se planteó como hipótesis explicativa el concepto cohesivo de especie para el reconocimiento de los taxones.

Resultados: Se reconocen 27 especies del género, distribuidas desde el sureste de los Estados Unidos de América hasta Costa Rica. Se proponen once combinaciones nuevas, tres lectotipificaciones y tres especies nuevas. Se incluye una clave de identificación e información sobre tipos, sinónimos, hábitat, imágenes de todas las especies y mapas de distribución.

Conclusiones: La revisión de este género permitió actualizar la sistemática dentro de la subtribu Gonolobinae. Asimismo, resalta a México como el centro de diversidad y endemismo para *Polystemma*.

Palabras clave: endemismo, Gonolobinae, hipótesis explicativas, *Matelea*.

Gonolobinae is one of the most diverse subtribes in the family Apocynaceae, with more than 500 recorded species distributed mainly in the Americas (Endress *et al.* 2018). This subtribe has been the subject of repeated phylogenetic analyses and systematic revisions that have changed the circumscription of the genera within it and recognized new taxa (Mangelsdorff *et al.* 2016, McDonnell *et al.* 2018, Alvarado-Cárdenas 2021, Morillo 2023a, b). The genus *Polystemma* Decne. has been subject to several changes. This taxon includes plants that are endemic to the Americas, with a distribution that spans from the southeastern United States to Costa Rica (Stevens 2009). The genus was described as monotypic nearly two centuries ago, containing only *P. viridiflorum* (Decaisne 1844), in the treatment of the tribe Asclepiadeae for the *Prodromus Systematis Naturalis Regni Vegetabilis* of Alphonse de Candolle. Brandegee later described two additional species: *P. scopolorum* Brandegee (1915) and *P. rupestre* Brandegee (1920). Subsequently, Woodson (1941) subordinated this genus and 26 others into the 16 subgenera of *Matelea* Aublet. Early in the current century, Stevens (2000, 2001, 2005) revived *Polystemma* (and other genera), proposing the following combination of characters: mixed simple and glandular trichomes, with white glandular trichomes becoming transparent with age, campanulate corolla, gynostegial corona with filiform appendages, and fusiform, smooth, and mottled follicles. Stevens only recognized two species, *Polystemma guatemalense* (Schltr.) W.D.Stevens and *P. viridiflorum* (Stevens 2000, 2001, 2005, 2009).

Recent DNA-based phylogenies have shown that the proposal of *Matelea sensu* Woodson is not monophyletic (Krings *et al.* 2008, Mangelsdorff *et al.* 2016, McDonnell *et al.* 2018). Several genera have been segregated from *Matelea* s.l. based on these phylogenetic patterns, while other previously recognized genera have been accepted as distinct taxa, including *Polystemma sensu* Stevens. However, *Polystemma* has been recovered as paraphyletic, with several species requiring a new combination (McDonnell & Fishbein 2016, Hernández-Barón 2021). Some species have since been transferred from *Matelea* s.l. (Alvarado-Cárdenas *et al.* 2021, Morillo 2023a, b) and *Gonolobus* (Cervantes-Meza *et al.* 2024) to *Polystemma* based on morphology and phylogeny, and new species have been published (McDonnell & Fishbein 2016, Steinmann & Stevens 2022, Hernández-Barón *et al.* 2023), resulting in a total of 12 species. However, the characterization and delimitation of *Polystemma* is not yet complete. It has been estimated that it could include more than 20 species (Stevens 2000, McDonnell & Fishbein 2016, Hernández-Barón 2021) and there are still species in *Matelea* that need to be transferred to *Polystemma*.

The goal of this study is to provide an updated synopsis of *Polystemma*, including a nomenclature revision, images, distribution maps, and an identification key of the species known to date. This includes the description of three new species from Durango, Jalisco and Sinaloa.

Materials and methods

To resolve the nomenclatural and taxonomic problems in the members of Gonolobinae, we reviewed the collections of the following herbaria: CHAP, ENCB, FCME, FEZA, HGOM, HUAP, IBUG, IEB, MEXU, OAX, SERO, SLPM, TEX and UAMIZ (Thiers 2021, constantly updated). We also consulted the digital collections of BR, F, G, MA, MICH, MO, NY, and US, as well as Global Plants JSTOR (2024 <https://plants.jstor.org/collection/TYPSPE>) and Tropicos (2023 www.tropicos.org) to observe digitalized type materials. As complementary material, we consulted over 3150 specimens in Naturalista (2023 www.naturalista.mx) and GBIF (2023 www.gbif.org) databases, in which we consulted over 3150 specimens of the species reviewed in this work. We reviewed the protologues and additional information associated with the species evaluated here, using the digital platform Biodiversity Heritage Library (2024 www.biodiversitylibrary.org). We also performed field work in several Mexican states between 2014 and 2024, to collect and observe individuals of several of the species under study. The morphological structure of the gynostegial corona is based on Stevens (2009) and the components of the corona are illustrated in Hernández-Barón (2021), Hernández-Barón *et al.* (2023), and Alvarado-Cárdenas *et al.* (2024). The distribution maps for each species were made with ArcMap (Esri Inc. 2020 desktop.arcgis.com) using herbarium specimen information and records found on Naturalista (2023 www.naturalista.mx). The conservation status of the proposed species was generated based on the IUCN (2023) and the GeoCAT software tool (Bachman *et al.* 2011) using 2 × 2 km cells. Information on

the biology of the species and field observations was also provided to adjust the final risk category according to the IUCN (2023) criteria.

The structure of the synopsis follows Cardiel & Muñoz-Rodríguez (2012) and Cardiel *et al.* (2022). The accepted species are cited in alphabetical order, and we include the original publications and synonymy. The format of the table was made based on the articles Alvarado-Cárdenas *et al.* (2020, 2023).

The delimitation of the genus followed Morillo (2023a, b), who updated the circumscription of *Polystemma* and allowed the proposal of a monophyletic genus. The recognition of the species proposed and recognized here was based on the cohesive species concept (Templeton 1989), which is employed as part of an explanatory hypothesis. The concept is framed in population genetics, but it does not discard other cohesion factors to explain species recognition. These include, for example, the expression of morphology (*i.e.*, restriction of individuals' phenotypic variability), which suggestions to genetic relationships among individuals with similar attributes, or distinctive habitat characters (*i.e.*, geographic distribution and ecological restrictions), which could restrict the dispersal of individuals of the population, keeping them separate from individuals of other species.

Results

Based on the morphological characters of the species of Gonolobinae and with support from phylogenetic works, we transfer 11 species from *Matelea* to *Polystemma* and three novelties are described. Therefore, we present here a total of 27 species of *Polystemma* (Table 1, Figures 1-2, 4-5, 7-10), distributed from the southeastern USA to northern Costa Rica (Figures 3, 6).

Table 1. List of *Polystemma* species and their distribution

1.	<i>Polystemma adenocardium</i> (Standl.) L.O.Alvarado & S. Islas Mexico: Chihuahua
2.	<i>Polystemma angustilobum</i> (B.L.Rob. & Greenm.) L.O.Alvarado & S. Islas Mexico: Jalisco, Nayarit
3.	<i>Polystemma atreyui</i> Pío-León, L.O.Alvarado & S Islas Mexico: Durango, Sinaloa
4.	<i>Polystemma calcicola</i> (Greenm.) Morillo Mexico: Guerrero, Morelos, Oaxaca
5.	<i>Polystemma canisferum</i> McDonnell & Fishbein Mexico: Sonora, Sinaloa
6.	<i>Polystemma cervantesii</i> (Lozada-Pérez & L.O.Alvarado) L.O.Alvarado & S. Islas Mexico: Guerrero, Oaxaca
7.	<i>Polystemma cordatum</i> (Brandeggee) L.O.Alvarado Mexico: Oaxaca, Puebla
8.	<i>Polystemma cordifolium</i> (A.Gray) McDonnell & Fishbein USA: Arizona Mexico: Baja California, Baja California Sur, Chihuahua, Sinaloa, Sonora
9.	<i>Polystemma fishbeiniana</i> V.W.Steinm. & W.D.Stevens Mexico: Michoacán
10.	<i>Polystemma fruticosum</i> (Brandeggee) L.O.Alvarado & S.Islas Mexico: Baja California Sur, Chihuahua, Sonora
11.	<i>Polystemma fuscum</i> (Decne.) C.Cervantes, S.Arias & L.O.Alvarado Mexico: Ciudad de Mexico, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacán, Morelos, Oaxaca, Puebla, Querétaro

12. *Polystemma galindoi* Pío-León, L.O.Alvarado & S.Islas
Mexico: Durango, Sinaloa
 13. *Polystemma guatemalense* (Schltr.) W.D.Stevens
Mexico: Chiapas, Colima, Guerrero, Jalisco, Mexico, Michoacán, Morelos, Nayarit, Oaxaca, Puebla
Guatemala: Baja Verapaz, Chiquimula, El Progreso, Huehuetenango, Jutiapa
El Salvador: Ahuachapán, Cabañas, Chalatenango, La Libertad, La Unión, Morazán, San Ana, San Miguel, San Salvador, Usulután
Honduras: Choluteca, Comayagua, El Paraíso, Francisco, Morazán, La Paz
Nicaragua: Boaco, Carazo, Chinandega, Chontales, Estelí, Granada, Jinotega, León, Madriz, Managua, Masaya, Matagalpa, Nueva Segovia, Rivas
Costa Rica: Alajuela, Guanacaste, Puntarenas
 14. *Polystemma horconesensis* C.D.Sánchez, L.O.Alvarado & S.Islas
Mexico: Jalisco
 15. *Polystemma leopardum* L.O.Alvarado, García-Mend., D.Sandoval, & Lozada-Pérez
Mexico: Oaxaca
 16. *Polystemma luridum* (Decne.) C.Cervantes, Flores Oliv. & L.O.Alvarado
Mexico: Guanajuato, Hidalgo, Jalisco, Morelos, Nuevo León, Querétaro, San Luis Potosí, Tamaulipas, Zacatecas
 17. *Polystemma magallanesii* (E.J.Lott.) Morillo
Mexico: Jalisco
 18. *Polystemma mirandae* Lozada-Pérez
Mexico: Guerrero, Oaxaca
 19. *Polystemma petiolare* (A.Gray) L.O.Alvarado & S.Islas
Mexico: Chihuahua, Coahuila, Durango, Jalisco, Michoacán, Sinaloa, Sonora
 20. *Polystemma pilosum* (Benth.) Morillo
Mexico: Aguascalientes, Guanajuato, Guerrero, Hidalgo, Jalisco, México, Michoacán, Morelos, Nuevo León, Puebla, Querétaro, San Luis Potosí, Tamaulipas, Zacatecas
 21. *Polystemma pueblensis* (Brandeggee) L.O.Alvarado & S.Islas
Mexico: Oaxaca, Puebla
 22. *Polystemma purpusii* (Brandeggee) L.O.Alvarado & S.Islas
Mexico: Guerrero, Oaxaca, Puebla
 23. *Polystemma quercetorum* (Standl.) Morillo
Mexico: Durango, Jalisco, Nayarit, Sinaloa, Sonora
 24. *Polystemma stevensii* G.M. Hern.-Barón, Trujillo-Juárez & V.W. Steinm.
Mexico: Michoacán
 25. *Polystemma tristiflorum* (Standl.) L.O.Alvarado & S.Islas
Mexico: Chihuahua, Sinaloa, Sonora
 26. *Polystemma umbellatum* (Brandeggee) L.O.Alvarado & S.Islas
Mexico: Baja California Sur
 27. *Polystemma viridiflorum* Decne.
Mexico: Chiapas, Guanajuato, Guerrero, México, Michoacán, Morelos, Oaxaca, Puebla, Veracruz
Guatemala: Baja Verapaz, Chiquimula, El Progreso, Zacapa
El Salvador: La Unión
Honduras: Choluteca, El Paraíso
Nicaragua: Boaco, León, Managua, Matagalpa
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Synopsis of *Polystemma*

Taxonomic synopsis.

Polystemma Decne., Prodr. 8: 602-603. 1844.

Type species. *Polystemma viridiflorum* Decne.

Rothrockia A. Gray, Proc. Amer. Acad. Arts. 20: 295-296. 1885.

Type species. *Rothrockia cordifolia* A. Gray

Labidostelma Schltr., Bull. Herb. Boissier, sér. 2, 6: 843-844. 1906.

Type species. *Labidostelma guatemalense* Schltr.

Microdactylon Brandegees, Zool. 5: 252. 1908.

Type species. *Microdactylon cordatum* Brandegees

Herbaceous or woody climbers, rarely small shrubs with scandent branches; latex white. Roots fibrous. Stems cylindrical, base suberous when mature, with a mixed indumentum of long multicellular trichomes, short unicellular trichomes, and translucent glandular trichomes that are thickened at the base or capitate and become white at maturity. Leaves simple, opposite, margin entire, petiolate, leaf blade ovate; base cordate with lobes convergent or divergent; apex acuminate or attenuate, glabrous or pubescent, colleters at the base of the leaf blade. Inflorescences extra-axillary, 1 per node, cymose, simple or compound dichasia, sometimes monochasia with racemiform, pedunculate, or nearly sessile appearance, pedicellate, bracteate; calyx gamosepalous, 5-lobate, divided nearly to the base, colleters present in the sinus, corolla gamopetalous, 5-lobate, rotate to rotate-campanulate, sometimes tubular, tube glabrous or pubescent, rugose or smooth, lobe aestivation imbricate and dextrorse; stamens five, epipetalous, monadelphous, surrounding two apocarpous ovaries, adnate at the apex of the style and stigma, forming a sessile or stipitate gynostegium, gynostegial corona present, adnate at the base of the gynostegium and the corolla, composed of two units, external and internal, external corona 5-lobulate, lobes opposite to the anthers (staminal) or rarely alternate (interstaminal), attached to each other at the base or nearly completely, in the form of a flattened to slightly ascendant ring or fleshy and erect urn (cyathiform), margin crenate or dentate, fimbriate or with lateral appendages of varying forms (filiate, acicular, falcate, liguliform, deltate) or rarely absent; internal corona 5-lobulate, lobes partially or completely attached to the external corona, oblong, deltoid, laminar; anthers horizontal, terminal appendage hyaline, ovate or reniform and supported by the stylar head, pollen clumped and included in pollinaria, excavated, sterile at the union of the arm or translator and attached to an adhesive corpuscle, the pollinium of one anther and a contiguous one form the pollinarium; style head pentagonal, convex, capitate, or globose. Follicles fusiform, glabrous or pilose, with irregular white, greenish, or bluish streaks or specks. Seeds with surface densely tuberculate, dark red-brown, with a set of white trichomes at the apex (coma).

Key to the species of Polystemma.

- 1a-Corollas white on some parts, with tones or reticulum pink to violet or brown or pink-violet.....2
- 1b-Corollas without white colors, sometimes with reticulum of a darker color.....3
- 2a-Flower buds compressed-pentagonal; corolla white in the center with pink, violet, or brown tones at the apex or completely violet, external corona with lobes falcate, pink; stylar head flat.....*P. guatemalense*
- 2b-Flower buds conical; corollas yellowish white sometimes with purplish or reddish veining; external corona with lobes rectangular, green to yellow-green; stylar head with a capitate columnar appendage.....*P. cordifolium*
- 3a-Plants more or less shrubby, although they may be climbers. With mature leaf blades less than 2 cm in length and width. Corolla yellow with reddish streaks.....*P. fishbeiniana*
- 3b-Climbing plants. Leaf blades larger than 2.5 cm in length and width. Corolla not yellow.....4
- 4a-Gynostegium and gynostegial corona exerted from the corolla tube.....5
- 4b-Gynostegium and gynostegial corona included in the corolla tube.....10
- 5a-Lobes of the corolla green, sometimes reddish at the base, without evident reticulum.....6
- 5b-Lobes of the corolla reddish-brown or greenish-brown, sometimes with reticulum evident.....8

- 6a-Adaxial surface of the corolla glabrescent; external gynostegial corona cyathiform and larger than the gynostegium, reddish to purplish; apex of the stylar head flat. Endemic to Oaxaca and Puebla, Mexico.....*P. pueblensis*
- 6b-Adaxial surface of the corolla densely pubescent, external gynostegial corona fused to the stipe of the gynostegium, black, or a divided flat disk, yellowish, smaller than the gynostegium; apex of the stylar head with an appendage. Endemic to Michoacán or Baja California Sur, Mexico.....7
- 7a- Adaxial surface of the corolla with dense pubescence of simple trichomes; external gynostegial corona a flat divided disk; stylar head globose, red; endemic to Michoacán, Mexico.....*P. stevensii*
- 7b- Adaxial surface of the corolla with dense pubescence of transparent white trichomes; external gynostegial corona fused to the stipe of the gynostegium; apex of the stylar head with a capitate columnar appendage, black. Endemic to Baja California Sur, Mexico*P. umbellatum*
- 8a-External gynostegial corona fused to the stipe of the gynostegium, lobes with filamentous appendages, apex of the stylar head with a capitate columnar appendage. Endemic to Baja California Sur, Mexico *P. fruticosum*
- 8b-External gynostegial corona cyathiform, lobes fimbriate or verrugose; apex of the stylar head flat. Not distributed in Baja California Sur.....9
- 9a-Lobes of the corolla narrowly oblong, reddish-brown, external gynostegial corona with margin fimbriate, black to brown, closely surrounding the gynostegium.....*P. purpusii*
- 9b-Lobes of the corolla lanceolate, greenish-brown, external gynostegial corona with margin verrugose, greenish to yellowish-green, separate from the gynostegium.....*P. horconesensis*
- 10a-Corollas red to maroons with lobes densely barbate, trichomes more than 3 mm long.....11
- 10b-Corollas not red or maroon, with lobes pubescent to glabrous, trichomes less than 1.5 mm long.....12
- 11a- Flowers with yellowish tones and reticulate purple to black pattern; convex stylar head*P. leopardum*
- 11b- Flowers with red and reticulate black pattern; flat stylar head.....*P. cordatum*
- 12a-Corolla strongly corrugate, lobes broadly ovate, less than 1 cm long.....*P. calcicola*
- 12b-Corolla smooth or slightly corrugate on the tube, lobes ovate, lanceolate, linear, or oblong, more than 1.5 cm long.....13
- 13a-External corona fused to the stipe of the gynostegium.....14
- 13b-External corona cyathiform or a flat ring.....18
- 14a-Lobes of the corolla linear or oblong, less than 2 mm wide.....15
- 14b-Lobes of the corolla ovate or lanceolate, more than 5 mm wide.....16
- 15a-Corolla green to yellowish-green sometimes with purple or reddish tones on the tube, corolla tube tubular, external gynostegial corona with filamentous appendages, endemic to Sonora and Sinaloa, Mexico.....*P. canisferum*
- 15b-Corollas greenish-brown, corolla tube campanulate, external gynostegial corona without filamentous appendages, endemic to Chihuahua, Mexico.....*P. adenocardium*
- 16a-Corolla brown to black; external gynostegial corona with acicular appendages.....*P. mirandae*
- 16b-Corollas green to yellowish-green sometimes with purple or reddish tones on the limb and the tube; external gynostegial corona with filamentous appendages.....17
- 17a-Corolla with lobes ovate to deltate; gynostegial corona with filaments in the staminal region; present in the Mexican states of Chiapas, Guerrero, Morelos, Oaxaca, and Veracruz, but also in Guatemala, Honduras, and Nicaragua.....*P. viridiflorum*
- 17b-Corolla with lobes lanceolate; gynostegial corona with filaments in the interstaminal region; endemic to Jalisco, Mexico.....*P. magallanesii*
- 18a-Lobes of the gynostegial corona with five thickened axes ovate to deltoid.....19
- 18b-Lobes of the gynostegial corona not as five axes.....21
- 19a-Flowers green without reticulum.....*P. luridum*
- 19b-Flowers black to greenish-brown with evident reticulum.....20
- 20a-Lobes of the gynostegial corona without appendages; stylar head flat.....*P. quercetorum*
- 20b-Lobes of the gynostegial corona with a dentate appendage behind the margin; stylar head convex.....*P. pilosum*

Synopsis of *Polystemma*

21a-Gynostegial corona with margins acicular or falcate in the staminal region.....	22
21b-Gynostegial corona with margins crenate, carunculate, or smooth in the staminal region ..	24
22a-Flowers yellowish-brown; corolla with lobes less than 2.5 mm wide.....	<i>P. angustilobum</i>
22b-Flowers green or blackish-brown; corolla with lobes more than 5 mm wide.....	23
23a-External corona as a flat or ascendant ring, with falcate appendages.....	<i>P. atreyui</i>
23b-External corona cyathiform, with acicular appendages.....	<i>P. galindoi</i>
24a-Flowers black; lobes of the external gynostegial corona oblong.....	<i>P. tristiflorum</i>
24b-Flowers yellowish or greenish to yellowish-brown; lobes of the external gynostegial corona semicircular.....	25
25a-Corolla with tube constrained at the apex.....	<i>P. petiolare</i>
25b-Corolla with tube not constrained at the apex.....	26
26a-Corolla with tubular tube; external gynostegial corona cyathiform, each staminal lobe smooth or crenate....	<i>P. fuscum</i>
26b-Corolla with campanulate tube; external gynostegial corona a flat ring, each staminal lobe carunculate.....	<i>P. cervantesii</i>

Polystemma adenocardium (Standl.) L.O.Alvarado & S.Islas, **comb. nov.** $\equiv$ *Vincetoxicum adenocardium* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 17: 267. 1937. $\equiv$ *Matelea adenocardia* (Standl.) Woodson, Ann. Missouri Bot. Gard. 28: 227. 1941.

Type. Mexico. Chihuahua: Chihuahua dam, 28.5° N - 106° W, 22 July 1936. *H. LeSueur* 845 (Holotype: F 49052!; Isotype: TEX 372550!).

Description. Standley (1937: 267-268).

Distribution and habitat. Endemic to Mexico and known only from northern Chihuahua in the area surrounding Presa Chihuahua ([Figure 3B](#)), growing in xerophytic scrubs at 1,500 m.

Notes. This species is poorly represented in herbaria and it is the least known in term of its morphology ([Figure 1A, B](#)).

Polystemma angustilobum (B.L.Rob. & Greenm.) L.O.Alvarado & S.Islas, **comb. nov.** $\equiv$ *Gonolobus angustilobus* B.L.Rob. & Greenm., Proc. Amer. Acad. Arts 29: 388. 1894. $\equiv$ *Vincetoxicum angustilobum* (B.L.Rob. & Greenm.) Standl., Contr. U.S. Natl. Herb. 23: 1192. 1924. $\equiv$ *Matelea angustiloba* (B.L.Rob. & Greenm.) W.D.Stevens, Phytologia 53: 405. 1983.

Type. Mexico. Nayarit: Ravine near Tepic, 10 October 1893, *Pringle C.G.* 5458 (Holotype: GH76346!).

Description. Robinson & Greenman (1894: 388-389), Standley (1924: 1192); Hernández-Barón (2021: 58-60).

Distribution and habitat. Endemic to western Mexico and restricted to the states of Jalisco and Nayarit ([Figure 3B](#)). It is reported in tropical deciduous forest, at 100-1,000 m.

Notes. *Polystemma angustilobum* has a complex gynostegial corona, which is a more or less ascending disk with five staminal lobes fused over half their length. Each staminal lobe has three divisions; two lobes of the external corona and one of the internal corona. The apex of all lobes present dentate to acicular appendages ([Figure 1C, D](#)).

Polystemma atreyui Pío-León, L.O.Alvarado & S.Islas, **sp. nov.**

Type. Mexico, Sinaloa, Culiacán municipality, trail between La Cofradía and Sanalona dam, 24° 51' 59.00" N, 107° 10' 12.00" W, 168 m, 13 Aug 2021, *J. F. Pío-León and C. Lim* 227 (Holotype: CIDIIR; Isotypes: MEXU!).

Species similar to *Polystemma galindoi* in having green to blackish-brown, reticulate flowers; *Polystemma atreyui* differs in its external gynostegial corona with lobes having two falcate terminal and lateral appendages, medially

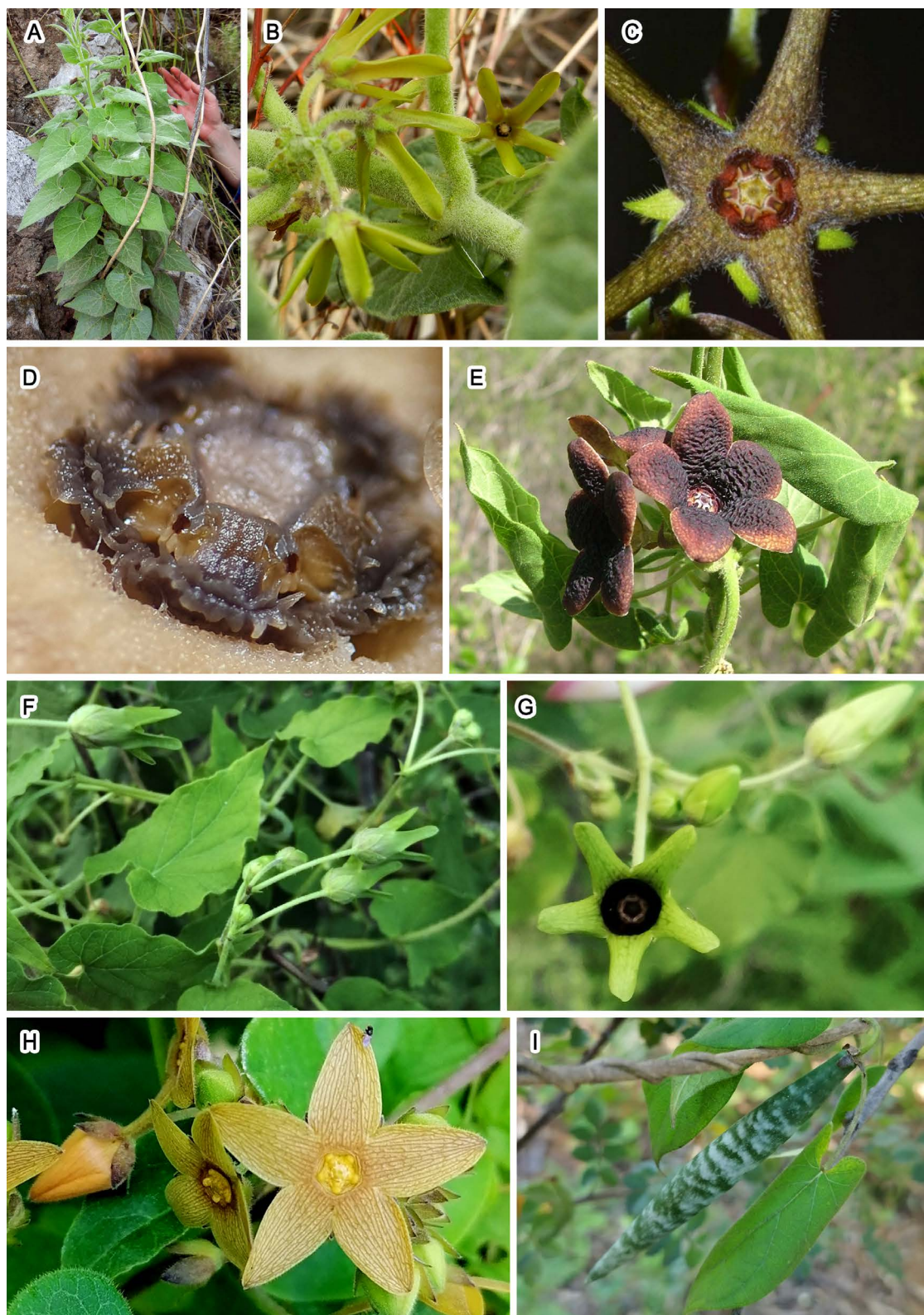


Figure 1. Vegetative and floral characters of different species of *Polystemma*. *Polystemma adenocardium*, A) habit, B) inflorescence. *Polystemma angustilobum*, C) flower, D) lateral view of the gynostegium and gynostegial corona. *Polystemma calcicola*, E) inflorescence. *Polystemma canisferum*, F) branch with leaves and inflorescence, G) flower. *Polystemma cervantesii*, H) inflorescence, I) fruit.

fimbriate, with two subulate-falcate inner appendages (vs. constricted corolla tube, gynostegial corona without teeth on the staminal lobes and smaller than the gynostegium in *P. galindoi*).

Description. Perennial climbing plants. Stems cylindrical, mixed indumentum of long simple trichomes ca. 1 mm long along two lines on the sides of the stem, and simple short ca. 0.2 mm long and glandular trichomes ca. 0.2 mm long both found over the whole surface of the stem. Leaves petiolate, petioles 4-6 cm long, leaf blade ovate, 3.2-6.4 × 2.4-5.3 cm; base cordate, lobes 6-8 mm × 1.0-1.3 cm, apex mucronate, 6-8 mm long, margins entire; adaxially with mixed indumentum of long simple trichomes over the whole leaf blade, denser on the veins, and short simple trichomes, abaxially mixed indumentum of short simple trichomes and glandular trichomes, over the whole leaf blade, denser on the veins; colleters 6-8, at the union of the leaf blade to the petiole, conical, 0.4-0.6 mm long, yellowish-brown; 5 to 6 pairs of secondary veins. Inflorescences cymose, corymbiform, one per node, extra-axillary, with 6-10 flowers; peduncles 5.5-10.0 mm long, with mixed indumentum of long simple trichomes, short simple trichomes, and glandular trichomes; bracts 1 per flower, 1.2-1.4 × 4-5 mm, linear-lanceolate, mixed indumentum of long simple trichomes, denser on the margins and middle part, short simple trichomes and glandular trichomes scattered on the whole surface. Flowers pentamerous, pedicels 2.1-3.03 mm long, with mixed indumentum of short simple trichomes and glandular trichomes with some long simple trichomes; calyx with sepals fused at the base, tube 0.6-1.0 mm long, lobes 3.3-4.1 × 1.2-1.5 mm, lanceolate, adaxially glabrous, abaxially with mixed indumentum of long simple trichomes, short simple trichomes, and glandular trichomes, colleters 4, 0.2-0.5 mm long, at the base of the sepals, alternating with them, subulate, yellow; corolla rotate, 2.7-3.2 cm in diameter, deeply lobulate, green to blackish-brown with darker green reticulum, aestivation valvate in the flower buds, tube 2.5-4.3 × 2.8-3.1 mm, with simple trichomes ca. 1 mm long, becoming glabrous towards the base, limb 2.0-2.5 mm long, lobes 1.1-1.4 cm × 4.1-4.7 mm, lanceolate, apex rounded, abaxially with mixed indumentum of simple and glandular trichomes ca. 1 mm long, adaxially glabrous; gynostegial corona higher than the gynostegium, formed by 5 lobes 1.4-1.9 mm long, 3.0-3.5 mm in diameter, reddish-black, opposite to the anthers, fused at the base forming an uninterrupted ring, lobes of the external corona staminal 1.4-1.6 × 0.6-0.8 mm, oblong, with two terminal appendages falcate, lateral, with the middle part fimbriate, with two internal appendages subulate-falcate, internal corona with lobes 0.9-1.2 × 0.2-0.3 mm, oblong, with terminal appendages falcate with the middle part fimbriate; gynostegium 1.8-2.1 in diameter, sessile, gynoeceum bicarpellary, apocarpous, glabrous, ca. 1.5 mm long, stylar head flat, 0.9-1.3 mm in diameter; androeceum with anthers horizontal, 0.5-0.7 × 0.5-0.6 mm, pollinaria with corpuscles brown, elliptical, ca. 0.2 × 0.1 mm, translator filamentous, ca. 0.29 mm long, pollinia semicircular, 0.3-0.4 mm in diameter. Fruits and seeds not seen ([Figure 2](#)).

Distribution and habitat. South-central Sinaloa, in the municipalities of Cosalá, Culiacán, Elota, Mazatlán and San Ignacio, and in the state of Durango, municipality Tayoltita, near the border with Sinaloa ([Figure 3B](#)). It grows in tropical deciduous forest and its ecotone with tropical subdeciduous forest at 30-650 m. It is associated with *Bursera grandifolia* (Schltdl.) Engl. (Burseraceae), *B. laxiflora* S. Watson, *Guazuma ulmifolia* Lam. (Burseraceae), *Haematoxylum brasiletto* H.Karst. (Fabaceae), *Jatropha curcas* L. (Euphorbiaceae), *Ipomoea arborescens* (Humb. & Bonpl. ex Willd.) G.Don (Convolvulaceae), *Lysiloma divaricatum* Hook. & Jackson (Fabaceae), *Maclura tinctoria* (L.) D.Don ex G.Don (Moraceae), and *Randia* spp. (Rubiaceae).

Phenology. flowers from late July through early September and mature fruits have been observed in October but have not been collected.

Conservation status. presents an extent of occurrence (EOO) is 8,362 km² and an area of occupancy (AOO) 28 km², using 2 × 2 km cells (GeoCat, Bachman *et al.* 2011). Its distribution area is increasingly fragmented by agriculture and mining. This species apparently has a very low tolerance for disturbance, since all known collections and observations correspond to specific sites with low disturbance, but there are no sites having previous moderate or strong disturbance. This contrasts with some other Asclepiadoideae of climbing habits with which it shares its habitat, such



Figure 2. *Polystemma atreyui*. A) habitat, B) habit, C) inflorescence, D and E) flowers showing differences in coloration, F) apical view of the gynostegium and gynostegial corona.

as *Gonolobus naturalistae* M.G.Chávez, Pío-León & L.O.Alvarado, *Macroscepis sinalobola* L.O.Alvarado, Pío-León & M.G.Chavez and *Ruehssia edulis* (S. Watson) L.O.Alvarado, which are even favored by a low to moderate degree of disturbance. We propose that this species be recognized as vulnerable (VU), in accordance with the IUCN criteria B1 b(i, iii) + 2 b(i, iii) of the IUCN.

Etymology. The name refers to the fictional character Atreyu from Michael Ende's novel "The Neverending Story." Atreyu is a member of the green-skinned tribe that lives in the Grassy Plain. He is sent to search for a cure to save the world of Fantasia. His story is similar to our own work as botanists trying to conserve our world under the threat of disappearance from multiple causes, such as climate change.

Paratypes. Mexico, Sinaloa, Cosalá municipality, ravine before the stream in the Nuestra Señora Reserve, 24° 24' 37.55" N, 106° 37' 33.95" W, 563 m, 20 Aug 2022, *J.F.Pío-León, N.León-Soto, R.Pío-León and G.León-Molina* 358 (CIIDIR!). Culiacán municipality, roadside between La Cofradía and Sanalona dam, 24° 51' 59.00" N, 107° 10' 12.00" W, 168 m, 13 Aug 2021, *J. F.Pío-León and C.Lim* 228 (CIIDIR!). Culiacán-Imala Highway, 24° 52' 31.12" N, 107° 14' 56.40" W, 119 m, 25 Jul 2022, *J.F.Pío-León and L.O.Alvarado-Cárdenas* 352 (CIIDIR!); *L.O.Alvarado-Cárdenas and J.F.Pío-León s.n.* (MEXU!).

INaturalist records. Mexico: Durango, San Dimas municipality, 24° 06' 21" N, 105° 55' 46" W, 550 m, 04 Aug 2021, *Styv De Jesús Calva* 90622325 (<https://www.naturalista.mx/observations/90622325>). Sinaloa, Elota municipality 23° 50' 32" N, 106° 45' 05" W, 96 m, 03 Aug 2016, *F.Pío-León* 3919420 (<https://www.naturalista.mx/observations/3919420>); Elota municipality, 24° 06' 38" N, 106° 42' 17" W, 156 m, 29 Jul 2020, *F.Pío-León* 55310294 (<https://www.naturalista.mx/observations/55310294>); Elota municipality, trail toward the "El Salto" dam, 24° 06' 38" N, 106° 42' 17" W, 156 m, 02 Aug 2020, *F.Pío-León* 192592147 (<https://www.naturalista.mx/observations/192592147>); Elota municipality, trail toward the "El Salto" dam, 24° 06' 38" N, 106° 42' 17" W, 156 m, 02 Aug 2020, *F.Pío-León* 192592147 (<https://www.naturalista.mx/observations/192592147>); Elota municipality, trail toward the "El Salto" dam, 24° 06' 21" N, 106° 42' 18" W, 148 m, 09 Aug 2020, *F.Pío-León* 192592149 (<https://www.naturalista.mx/observations/192592149>).

Notes. This species is very similar to *P. galindoi* in flower shape and color; in addition, the two species are sympatric in Sinaloa, Mexico and grow in similar environments. *Polystemma atreyui* has an external gynostegial corona that is shaped like an extended and ascending disk with 5 lobes, oblongs with two terminal appendages laterally falcate, with the middle part fimbriate and with two internal appendages subulate-falcate; the internal corona has lobes with falcate terminal appendages. In the case of *P. galindoi*, the external corona is cyathiform, with 5 lobes ovate with crenate margin, occasionally with two apical cornicles, and the internal corona has lobes with terminal appendages straight, corniculate.

Polystemma calcicola (Greenm.) Morillo, Mem. Fund. La Salle Cien. Nat. 81: 84. 2023b. ≡ *Gonolobus calcicola* Greenm., Proc. Amer. Acad. 40: 30. 1904. ≡ *Vincetoxicum calcicola* (Greenm.) Standl., Contr. U.S. Nat. Herb. 23: 1191. 1924. ≡ *Matelea calcicola* (Greenm.) Woodson, Ann. Missouri Bot. Gard. 28: 224. 1941.

Type. Mexico. Morelos: Jujutla, limestone hills, near Cuernavaca, 30 August 1902, *C.G. Pringle* 11367 (Holotype: GH76347!; isotypes: MO344177!, US460706!).

Description. Greenman (1904:30), Morillo (2023a: 84).

Distribution and habitat. Endemic to Mexico to the states of Guerrero, Morelos and Oaxaca ([Figure 3B](#)). It is found in tropical deciduous forest at 1000-1500 m.

Notes. *Polystemma calcicola* shows some similarity to *P. pilosum* in having brown to black corollas ([Figure 1E](#)). However, *P. calcicola* is easily recognized by having flowers smaller than 2 cm in diameter with corollas brown and clearly

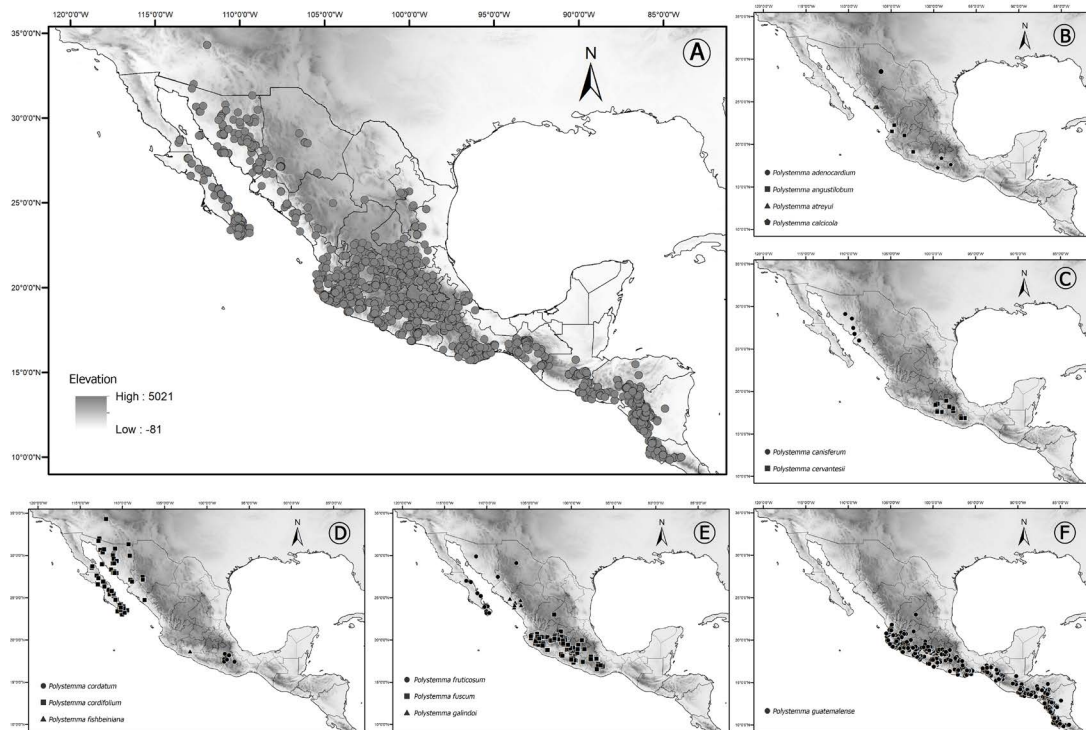


Figure 3. A) Distribution of *Polystemma* along the America's. B) Distribution of *Polystemma adenocardium*, *P. angustilobum*, *P. atreyui*, and *P. calicicola*. C) Distribution of *Polystemma canisferum* and *P. cervantesii*. D) Distribution of *Polystemma cordatum*, *P. cordifolium* and *P. fishbeiniana*. E) Distribution of *Polystemma fruticosum*, *P. fuscum* and *P. galindoi*. F) Distribution of *Polystemma guatemalense*.

corrugate and the lobes of the corolla as wide as they are long. The gynostegial corona is very distinctive in that it is smaller than the gynostegium and has five lobes fused at the base. The external corona is fleshy and carunculate, and the internal corona is laminar and attached to the external corona, with margin irregularly fimbriate to crenulate.

Polystemma canisferum McDonnell & Fishbein, Phytotaxa 246: 79. 2016.

Type. Mexico. Sonora: Alamos municipality: ENE of Los Camotes along Los Tanques-Las Chinacas road, 27.28° N 108.83° W, elev. 290 m, 18 August 1994. *P. Jenkins*, *M. Fishbein*, & *V. Steinmann* 94-59 (Holotype: OKLA; Isotype: MEXU1446525!).

Description. McDonnell & Fishbein (2016: 79-80), Hernández-Barón (2021: 61-63).

Distribution and habitat. Endemic to Mexico, restricted to the northern states of Sonora and Sinaloa (Figure 3C), growing in xerophytic scrub at 100-500 m.

Notes. The morphology and color of the flowers of this species, as well as its gynostegial corona with filamentous appendages are similar to *P. viridiflorum*; however, *P. canisferum* has very small flowers, corolla tube tubular and the lobes of the corolla oblong to linear (Figure 1F, G).

Polystemma cervantesii (Lozada-Pérez & L.O.Alvarado) L.O.Alvarado & S.Islas, **comb. nov.** $\equiv$ *Matelea cervantesii* Lozada-Pérez & L.O.Alvarado, Phytotaxa 288: 168. 2016.

Synopsis of *Polystemma*

Type. Mexico. Guerrero: Ixcateopan, 2 km from the turnoff to Amealco, 18° 25' 24" N, 99° 42' 07" W, 1,320 m., 22 June 2007, *L. Lozada & J. Rojas 3391* (Holotype FCME!; Isotypes: IEB!, MEXU!).

Description. Lozada-Pérez & Alvarado-Cárdenas (2016: 170).

Distribution and habitat. Endemic to Mexico in the states of Guerrero, Oaxaca and Puebla ([Figure 3C](#)). It is found in tropical deciduous forest and pine-oak forest at 800-2,000 m.

Notes. This species is similar to *P. crenatum* in the yellow to yellowish-brown color of its flowers with dark brown reticulum, and they grow sympatrically in some states of the country. *Polystemma cervantesii* is distinguished by having the corolla tube campanulate (vs. corolla tube tubular in *P. crenatum*) and the gynostegial corona a lobulate disk, flat to ascendant with edges carunculate (vs. gynostegial corona more or less cyathiform with lobes erect, not carunculate) ([Figure 1H, I](#)).

Polystemma cordatum (Brandeggee) L.O. Alvarado, *Phytoneuron* 2021-47: 12. 2021. $\equiv$ *Microdactylon cordatum* Brandeggee, *Zoë* 5: 252. 1908. $\equiv$ *Matelea cordata* (Brandeggee) Woodson, *Ann. Missouri Bot. Gard.* 28: 236. 1941.

Type. Mexico. Puebla: Cerro de Castillo, near Coatepec, [18.1833° N, -97.366° W], June 1908, *C.A. Purpus 2836* (Holotype: UC2378697!; Isotypes: E279129!, F0363374!).

Description. Brandeggee (1908: 252-253), Juárez-Jaimes & Lozada-Pérez (2003: 51-52); Hernández-Barón (2021: 63-64).

Distribution and habitat. Endemic to Mexico and restricted to the states of Oaxaca and Puebla ([Figure 3D](#)), growing in xerophytic scrub and tropical deciduous forest, at 700-2060 m.

Notes. This species was previously recognized as *Microdactylon cordatum* Brandeggee, the only species in a distinct monotypic genus. However, it has trichomes and fruits typical of *Polystemma*. It is recognized by its maroon and barbate corollas, as well as its gynostegial corona with lobes acicular and larger than the gynostegium ([Figure 4A, B](#)). The shape of the gynostegial corona shares some similarity to that of *P. viridiflora*, but the latter has a green corolla without pubescence, and some of the appendages of the gynostegial corona are filiform.

Polystemma cordifolium (A. Gray) McDonnell & Fishbein, *Phytologia* 99: 86. 2017. $\equiv$ *Rothrockia cordifolia* A. Gray, *Proc. Amer. Acad. Arts* 20: 295-296. 1885. $\equiv$ *Matelea cordifolia* (A. Gray) Woodson, *Ann. Missouri Bot. Gard.* 28: 222. 1941.

Type. USA. Arizona: By water-courses, Northwestern mountains, 17 August 1884, *C.G. Pringle s.n.* (Lectotype designated here: GH00040976!; Isolectotypes: E279131!, G182996!, GOET5769!, GH00040977, NY318764!).

Description. Gray (1885: 295-296), Hernández-Barón (2021: 63-64), Fishbein & McDonnell (2023: 265).

Distribution and habitat. Native to the states of Baja California, Baja California Sur, Chihuahua, Sinaloa and Sonora in Mexico and Arizona in the United States of America ([Figure 3D](#)). It is found in xerophytic scrub and tropical deciduous forest, at 322-1,690 m.

Notes. This species and *P. guatemalense* are the only two with corollas with white tones that may present violet reticulum as well as completely purple corollas. The structure of the gynostegium and gynostegial corona in *P. cordifolium* are very similar to those of *P. fruticosum* and *P. umbellatum* in that they all have quadrangular lobes of the

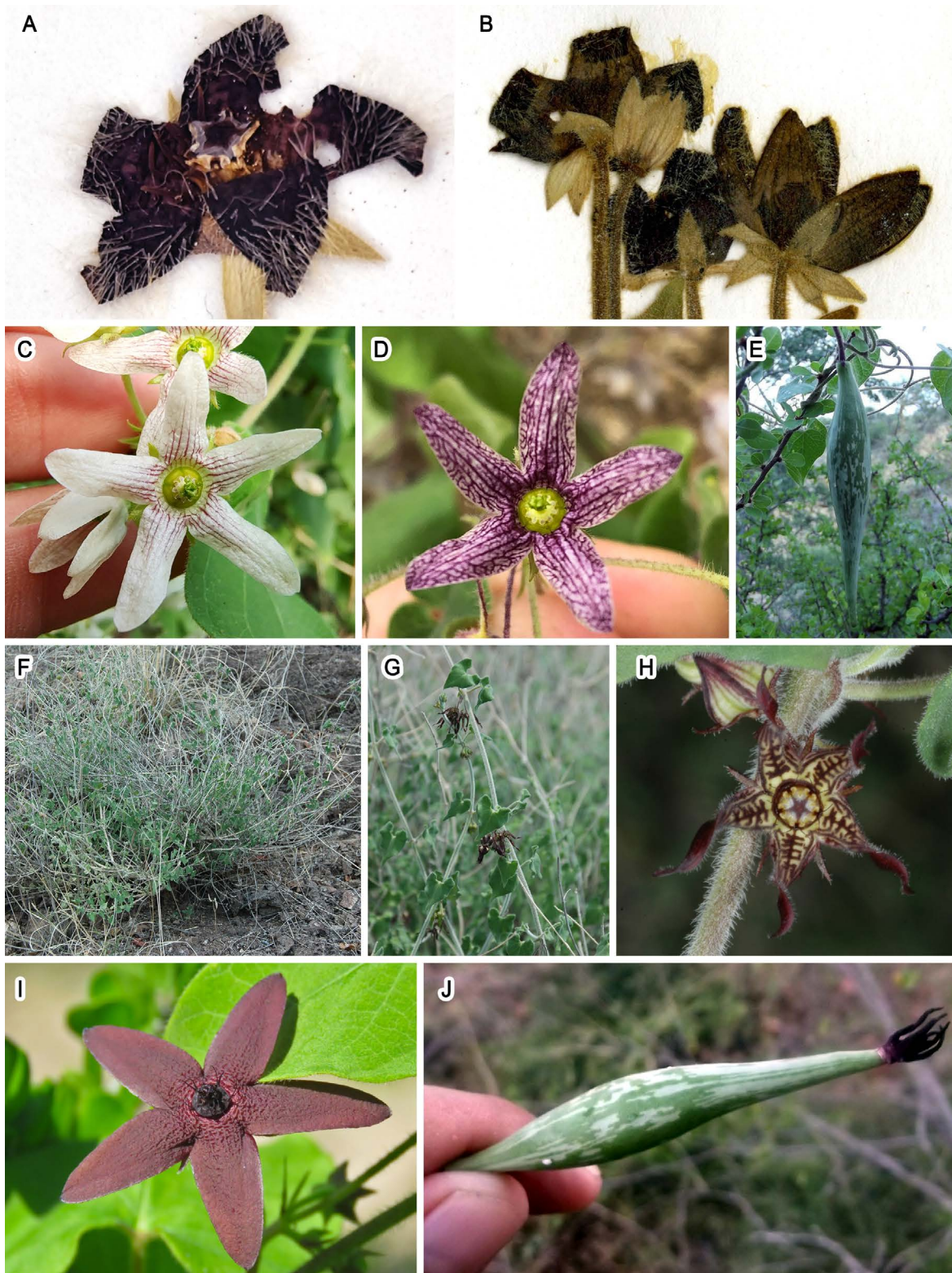


Figure 4. Vegetative and floral characters of different species of *Polystemma*. *Polystemma cordatum*, A) lateral view of the flower of the type specimen, B) external view of the flowers of the type specimen. *Polystemma cordifolium*, C and D) flowers showing differences in coloration, E) fruit. *Polystemma fishbeiniana*, F) habit, G) branch with flowers H) apical view of the flower. *Polystemma fruticosum*, I) flower, J) fruit.

external corona with filamentous appendages and a capitate appendage at the apex of the stylar head. However, *P. cordifolium* is distinguished from these species by its white or violet corolla and gynostegium included in the corolla tube ([Figure 4C, D, E](#)), vs. reddish-brown or greenish-yellow corollas in *P. fruticosum* and *P. umbellatum*, respectively, and exserted gynostegium in both species.

We selected the specimen of Pringle s.n. (GH00040976!) as a lectotype because it is part of the original material studied by A.Gray. In addition, it is the best-preserved specimen with flowers and fruit.

Polystemma fishbeiniana V.W.Steinm. & W.D.Stevens, Bot. Sci. 100: 760. 2022.

Type. Mexico. Michoacán: Arteaga municipality, along MEX 37, ca. 75 km (by road) N of Arteaga and 1 km S of El Descansadero, 18.643487° N, -101.968979° W, 08 July 2004, *V.W. Steinmann & L. Alvarado Cárdenas 4401* (Holotype: QMEX; Isotypes: ARIZ, FCME, MEXU, MO).

Description. Steinmann & Stevens (2022: 760).

Distribution and habitat. Endemic to Michoacán ([Figure 3D](#)), Mexico and restricted to the zone known as the Cuenca del Balsas. It grows in tropical deciduous forest, at 275-400 m.

Notes. This is one of the most distinctive species of the genus due to its suffrutescent habit, small leaves (less than 2 cm long) and flowers yellowish with red to dark maroon lines. Furthermore, the gynostegial corona lobes have filiform appendages ca. 0.7 mm long ([Figure 4F, G, H](#)).

Polystemma fruticosum (Brandeggee) L.O.Alvarado & S.Islas, **comb. nov.** $\equiv$ *Rothrockia fruticosa* Brandeggee, Zoë 5: 165. 1903. $\equiv$ *Matelea fruticosa* (Brandeggee) Woodson, Ann. Missouri Bot. Gard. 28: 223. 1941.

Type. Mexico. Baja California, Sierra San Lázaro, Cape Region, 18 October 1902, *J.S. Brandeggee s.n.* (Lectotype designed here: UC130958!; Isolectotype: GH76663!, NY318765!; UC124960).

Description. Brandeggee (1903: 165).

Distribution and habitat. Endemic to Mexico in three northern states: Baja California Sur, Chihuahua and Sonora ([Figure 3E](#)), growing in tropical deciduous forest and xerophytic scrub, at 500-1,500 m.

Notes. The flowers are similar to those of *P. umbellatum* in that the gynostegium is exserted from the corolla tube, the gynostegial corona has filamentous appendages and the apex of the gynostegium has a projection. In addition, the populations of the two species are sympatric in the northern part of Baja California Sur. They are distinguished by *P. fruticosum* having flowers mainly reddish-brown and glabrous on the adaxial side (vs. flowers mainly greenish and with transparent white trichomes on the adaxial side) and black gynostegial corona (vs. gynostegial corona yellowish-white) ([Figure 4I, J](#)).

We selected the specimen of Brandeggee s.n. (UC130958!) as a lectotype because it is part of the original material studied by A. Gray. In addition, it is the best-preserved specimen with flowers.

Polystemma fuscum (Decne.) C.Cervantes, S.Arias & L.O.Alvarado, Bot. Sci. 100: 2024. (Figura 1). $\equiv$ *Gonolobus fuscus* Decne., Prodr. 8: 592. 1844. $\equiv$ *Vincetoxicum fuscum* (Decne.) Standl., Contr. U.S. Natl. Herb. 23: 1189. 1924.

Type. Mexico. Michoacán, Arúmbaro, in regn. mexicano, 3500 pds., 6 Oct 1840, *H. Galeotti 1546* (Holotype: P00645705!).

=*Vincetoxicum crenatum* Vail, Bull. Torrey Bot. Club 26: 429-430. 1899 ≡ *Matelea crenata* (Vail) Woodson, Ann. Missouri Bot. Gard. 28: 233. 1941.

Type. Mexico. Morelos: Cuernavaca, Cuernavaca Ravine, [18.91° N, 99.23° W], 27 July 1895, *C.G. Pringlei* 6388 (Holotype: NY00318832!; Isotypes: AC 00313392!, F 0044760F!, GH 40979!, JE 00004727!, KFTA 0002743!, MSC 0105102!, NDG 40249!, P 04545770!, US 00112308!).

Description. Vail (1899: 429-430), Juárez-Jaimes & Lozada-Pérez (2003:40).

Distribution and habitat. Endemic to Mexico and the second most widely distributed species in the country ([Figure 3E](#)), recorded in 11 southern and central states (Ciudad de México, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacán, Morelos, Oaxaca, Puebla and Querétaro). It is found in xerophytic scrub and tropical deciduous forest at 1,900-2,000 m.

Notes. The flowers are very similar to *P. cervantesii* and *P. petiolaris* but are easy to recognize based on the attributes pointed out in the two compared species ([Figure 7A, B, C](#)).

Polystemma galindoi Pio-León, L.O.Alvarado & S.Islas, **sp. nov.**

Type. Mexico, Sinaloa, Cosalá municipality, 500 m to the southwest of the community of Las Mimbres del Padre, 24° 17' 20.40" N, 106° 45' 19.84" W, 335 m asl, 11 Aug 2021, *J. F. Pío-León and C. Lim 216* (Holotype: CIIDIR!; Isotype: MEXU!).

This species is similar to *P. petiolare* in having green flowers with 5-lobed cyathiform gynostegial corona. *Polystemma galindoi* differs by its non-constricted corolla tube and gynostegial corona with teeth on the staminal lobes and larger than the gynostegium (vs. constricted corolla tube, gynostegial corona without teeth on the staminal lobes, and smaller than the gynostegium in *P. petiolare*).

Description. Perennial climbing plants. Stems cylindrical with mixed indumentum of long simple trichomes ca. 1.02 mm long, short simple trichomes ca. 0.24 mm long, both on the whole stem, and glandular trichomes ca. 0.05 mm long, very sparse. Leaves petiolate, petioles 1.2-2.5 cm long, leaf blade ovate-lanceolate, 5.5-8.4 × 2.4-4.5 cm; base cordate, lobes 2.5-7.2 × 9.3-13.1 mm, apex acuminate, margins entire; adaxial and abaxial indumentum of short simple trichomes homogeneous across the whole surface, glandular trichomes sparse; colleters 6-8, at the union of the leaf blade with the petiole, conical, 0.28-0.39 mm long, yellowish-brown; 4 to 5 pairs of secondary veins. Inflorescence cymose, corymbiform, one per node, extra-axillary, with 5-6 flowers; peduncles 9.6-17.3 mm long with mixed indumentum of long simple trichomes, short simple trichomes, and glandular trichomes; bracts 1 per flower, 2.6-3.7 × ca. 0.4 mm, linear-lanceolate, mixed indumentum of short simple trichomes and glandular trichomes on the abaxial and abaxial sides, and long simple trichomes along the margin. Flowers pentamerous, pedicels 8.2-12.6 mm long, with mixed indumentum of short simple trichomes and glandular trichomes; calyx with sepals fused at the base, tube 0.5-1.2 mm long, lobes 3.1-4.4 × 1.7-2.2 mm, lanceolate, adaxially glabrous, abaxially with mixed indumentum of long simple trichomes, denser at the margins and glandular trichomes sparse, colleters 1-2, 0.3-0.35 mm long, at the base of the sepals, alternating with them, subulate, yellow; corolla rotate, 1.8-1.9 cm in diameter, deeply lobulate, aestivation contorted in the flower buds, tube 2.1-3.4 × 3.8-4.7 mm, with short simple trichomes, becoming glabrescent toward the base, limb 1.3-1.5 mm long, lobes 7.9-8.4 × 1.9-2.8 mm, lanceolate, abaxially with mixed indumentum of short simple trichomes and glandular trichomes, adaxially with long simple trichomes, denser toward the limb; gynostegial corona higher than the gynostegium, formed by 5 lobes, ca. 0.7 mm long, 1.8-2.1 mm in diameter, reddish-black, opposite to the anthers, fused at the base to form a continuous ring, external corona staminal ca. 0.6 × 1.2-1.5 mm, lobes with margin crenate, sometimes with two apical cornicles, internal corona 0.3-0.4

× 0.64–0.66 mm, lobes with terminal appendages corniculate, straight, with the middle part crenate; gynostegium 1.6–1.9 mm in diameter, stipitate, stipe 0.6–0.7 mm long, gynoeceum bicarpellary, apocarpous, glabrous, 1.5–1.6 mm long, stylar head flat, ca. 1.37 mm in diameter; androeceum with anthers horizontal, 0.3–0.4 × 0.6–0.7 mm, pollinaria with corpuscles brown, elliptical, ca. 0.2 × 0.09 mm, translator filamentous, ca. 0.26 mm long, pollinia semicircular, 0.3–0.4 mm in diameter. Immature fruits green; seeds not seen (Figure 5).

Distribution and habitat. *Polystemma galindoi* is distributed in the states of Durango and Sinaloa (Figure 3E), in tropical environments of the Sierra Madre Occidental. It inhabits tropical deciduous forest and its transition to subdeciduous tropical forest, at 356–565 m in Sinaloa (Cosalá municipality) and 1,200 m in Durango (Otáez municipality). It is associated with *Brosimum alicastrum* Sw. (Moraceae), *Bursera grandifolia* Engl., *B. simarouba* Sarg. (Burseraceae), *Guazuma ulmifolia* Lam. (Malvaceae), *Haematoxylum brasiletto* H.Karst. (Fabaceae), *Jatropha curcas* L. (Euphorbiaceae), *Ipomoea arborescens* Sweet (Convolvulaceae), *Lysiloma divaricatum* (Jacq.) Benth. (Fabaceae), *Maclura tinctoria* (L.) D.Don ex Steud. (Moraceae), *Margaritaria nobilis* L.f. (Phyllanthaceae), and *Randia* spp. (Rubiaceae).

Phenology. Flowers from late July through September and fruits in October.

Conservation status. It has a known extent of occurrence (EOO) of 547 km² and an area of occupancy (AOO) of 20 km², using 2 × 2 km cells. The type locality in Sinaloa has since been converted to agricultural use, while two of the three records in Naturalista are located within state-level Natural Protected Areas-Sierra de Tacuichamona and Reserva de Nuestra Señora Mundo Natural. Like *P. atreyui*, the plants of this species seem to have low tolerance for disturbance, since all of the collections and observations correspond to sites with very low disturbance (including the type locality, before its conversion to farmland), but no areas with moderate to high disturbance. We suggest that it be recognized as Endangered (En), according to IUCN criteria B1 ab(iv) + 2 ab(iv).

Etymology. The name honors the Mexican ecologist and conservationist Dr. Carlos Galindo-Leal, who was the main driver of the citizen science network NaturaLista, the Mexican node of iNaturalist, and was the first collaborating member through the National Commission for the Knowledge and Use of Biodiversity (*Comisión Nacional para el Conocimiento and Uso de la Biodiversidad*; CONABIO). The iNaturalist platform has contributed greatly to biodiversity knowledge, including the discovery of several new plant species in Mexico.

Paratype. Durango. Otáez municipality, 2 km from the town of Otáez, near La Lechuga Ranch, 1,270 m asl, 25 Jul 1990, A. Benítez 1492 (MEXU).

iNaturalist records. Mexico, Sinaloa, Cosalá municipality, Sierra de Tacuichamona, 24° 21' 32" N, 106° 52' 16" W, 363 m, 03 Sep 2021, Nayelli Rivera 94016076 (<https://www.naturalista.mx/observations/94016076>), Vado Hondo-Cosalá highway, near the La Virgen overlook, 24° 24' 10" N, 106° 45' 05" W, 507 m, 25 Sep 2022, F.Pío-León 185384568 (<https://www.naturalista.mx/observations/185384568>), Nuestra Señora Reserve, 24° 24' 15" N, 106° 36' 32" W, 558 m, 28 Sep 2023, sinaloasilvestre 185384568 (<https://www.naturalista.mx/observations/185384568>).

Notes. *Polystemma galindoi* is morphologically similar to *P. petiolare*, since it has corollas with greenish to reddish-brown tones, the gynostegium is included within the corolla tube, and the corona is cyathiform. *Polystemma galindoi* has a corolla tube that is not constrained at the apex and the gynostegium is the same size as the corolla tube; the external gynostegial corona is higher than the gynostegium, with lobes with margins crenate, sometimes with two apical cornicles. The internal corona has lobes with terminal appendages straight, corniculate, with the middle part crenate. The flowers of *P. petiolare* present a tube that is more or less constrained at the apex and the gynostegium is smaller than the corolla tube (Figure 5). The external gynostegial corona is smaller than the gynostegium, with five lobes semicircular and entire, and the internal corona is a tiny entire ligule. *Polystemma galindoi* is sympatric with *P. atreyui*, with which it shares several morphological characters, discussed previously.

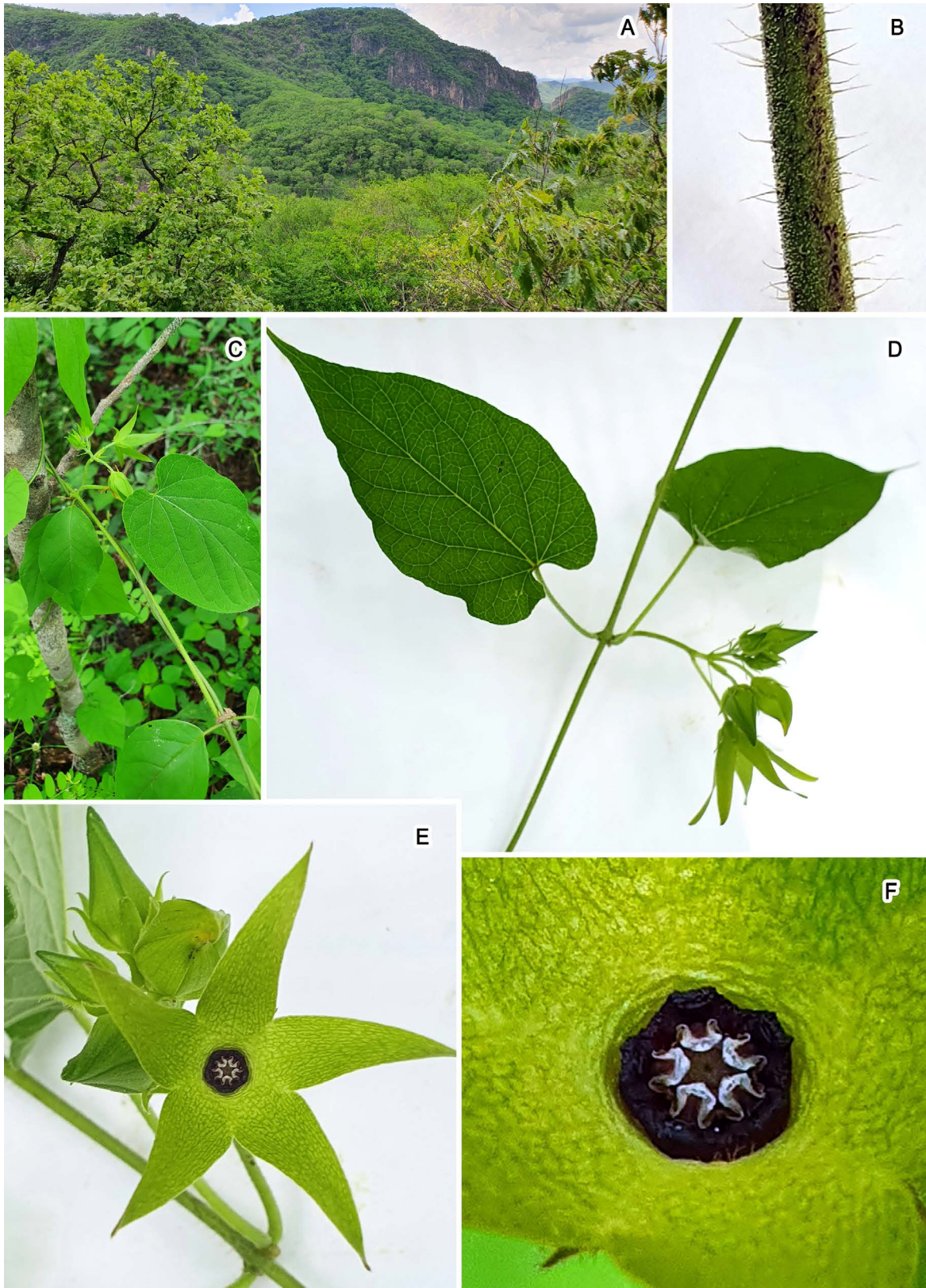


Figure 5. *Polystemma galindoi*, A) habitat, B) close-up of the trichomes on the stem, C) habit, D) leaves and inflorescence, E) flowers, F) apical view of the gynostegium and the gynostegial corona.

Polystemma guatemalense (Schltr.) W.D.Stevens, Novon 15: 618. 2005. $\equiv$ *Labidostelma guatemalense* Schltr., Bull. Herb. Boissier 6: 843-844. 1906.

Type. Guatemala. Huehuetenango: Nenton, [15.80138° N, 91.75416° W], September 1887, C. Seler & E. Seler 3279 (Holotype: B1348808; Isotype: K465656!).

Description. Schlechter (1906: 843-844), Stevens (2009: 766-767), Hernández-Barón (2021: 66-78).

Distribution and habitat. Mexico, Guatemala, Honduras, El Salvador, Nicaragua, and Costa Rica ([Figure 3F](#)).

This is the most widely distributed species overall and the third most widely distributed in Mexico, reported in the states of Chiapas, Colima, Guerrero, Jalisco, Mexico, Michoacán, Morelos, Nayarit, Oaxaca, and Puebla. It grows in tropical deciduous forest at 0-2,100 m.

Notes. This widely distributed species is easily recognizable from the rest. The flowers present variation in color; the corollas may be violet or white, with violet to brown reticulation on the lobes of the corolla. This species is also distinctive do to the compressed pentagonal shape of the flower buds, with the flower corollas broadly rotate and gynostegial corona pink with falcate appendages ([Figure 7D, E, F](#)).

Polystemma horconesensis C.D.Sánchez, L.O.Alvarado & S.Islas, **sp. nov.**

Type. Mexico: Jalisco, Cabo Corrientes municipality, area surrounding the Jardín Botánico de Vallarta, 485 m, C.D. Sánchez-Sánchez and J.A. Barajas-Fragoso s.n. (Holotype: MEXU; Isotype: FCME)

This species is similar to *Polystemma pilosum* in having campanulate-rotate flowers with a cyathiform gynostegial corona the same size as the gynostegium. *Polystemma horconesensis* differs in having greenish-brown flowers with purplish tones on the lobes, green to yellowish green gynostegial corona, and flat stylar head (vs. black flowers, reddish-brown gynostegial corona, and convex stylar head in *P. pilosum*).

Description. Perennial climbing plants. Stems cylindrical with mixed indumentum formed of long simple trichomes 0.2-0.4 mm long, short simple trichomes ca. 0.1 mm long, glandular trichomes 0.05-0.1 mm long, trichomes mainly along two lines along the stem. Leaves petiolate, petioles 4.0-5.5 cm long; leaf blade ovate to elliptical, 5.3-7.5 $\times$ 2.7-3.9 cm; base cordate, lobes 3.8-6.1 mm $\times$ 1.0-1.3 cm, apex mucronate, 5.9-7.3 mm long, margins entire, adaxially with short simple trichome and sparse glandular trichomes, denser at the margin, abaxially glabrescent with glandular trichomes scattered across the leaf blade and simple trichomes on the veins; colleters 6, at the base of the leaf blade, conical, ca. 0.5 mm long, brown with yellow tip; 5-6 pairs of secondary veins. Inflorescences monochasial, one per node, extra-axillary, with 1-4 flowers; peduncles 1.7-3.4 cm long, with mixed indumentum of short simple trichomes and glandular trichomes; bracts 2 per flower, 3.0-7.0 $\times$ 0.9-2.1 mm, elliptical-lanceolate, short simple trichomes along the margin. Flowers pentamerous, pedicels 4.1-11.4 mm long, mixed indumentum of short simple trichomes and glandular trichomes, the latter denser here than on the rest of the plant; calyx with sepals fused at the base; tube 1.3-2.2 mm long, lobes 7.5-8.9 $\times$ 2.1-3.6 mm, ovate-lanceolate, adaxial and abaxially glabrous, colleters 3, 0.25-0.5 mm long, at the base of the sepals, alternated with them, ovoid, yellow; corolla campanulate-rotate, 3.5-3.6 mm in diameter, deeply lobulate, greenish-brown with violet tones on the limb, aestivation valvate in the flower buds, tube ca. 2.5 $\times$ 4.8-6.8 mm, glabrous, limb 2.5-2.8 mm long, lobes 1.1-1.5 cm $\times$ 6.6-7.4 mm, lanceolate, apex acuminate, abaxial and adaxially glabrous; gynostegial corona the same size as the gynostegium, formed by 5 lobes, ca. 3.11 long, ca. 7 mm in diameter, green to yellowish-green; external corona cyathiform, staminal section oblong, ca. 1.6 mm wide, verrugate, interstaminal section formed by two oblong appendages, one on each side of the staminal section, bi- or tri-lobulate, ca. 1 mm wide, protruding ca. 0.7 mm from the staminal section, internal corona fused to the external corona at the staminal section, falcate, oblong, with 3 lobes at the apex, resting on the anthers, 0.58-

0.61 × 0.28-0.29 mm; gynostegium ca. 3.1 mm in diameter, stipitate, stipe ca. 1 mm long, gynoecium bicarpellary, apocarpous, glabrous, ca. 1 mm long; stylar head flat, 2.5-2.8 mm in diameter; androecium with anthers horizontal, papillate, ca. 0.9 × 1.5 mm, pollinaria with corpuscles brown, ovate, ca. 0.3 × 0.2 mm, translator laminate, ca. 0.4 mm long, twisting when extracted, pollinia reniform, 0.65-0.70 × 0.42-0.46 mm, laterally excavated. Fruits 9-10.8 × 1-1.2 cm, narrowly fusiform, diffusely speckled white; seeds not seen (Figure 8).

Distribution and habitat. *Polystemma horconesensis* is known only from the area surrounding the Jardín Botánico de Vallarta in the municipality of Cabo Corrientes, Jalisco, Mexico (Figure 6A). It grows in sandy soils and grows by winding around branches of *Montanoa bipinnatifida* (Kunth) C.Koch (Asteraceae) together with *Centrosema sagittatum* (Humb. & Bonpl. ex Willd.) Riley (Fabaceae). The plants grow at an elevation of 485 m, in patches of secondary vegetation of tropical subdeciduous forest with the presence of *Cnidoscolus tepiquensis* (Costantin & Gallaud) Lundell (Euphorbiaceae), *Cecropia obtusifolia* Bertol (Urticaceae) and *Bursera simaruba* (L.) Sarg (Burseraceae).

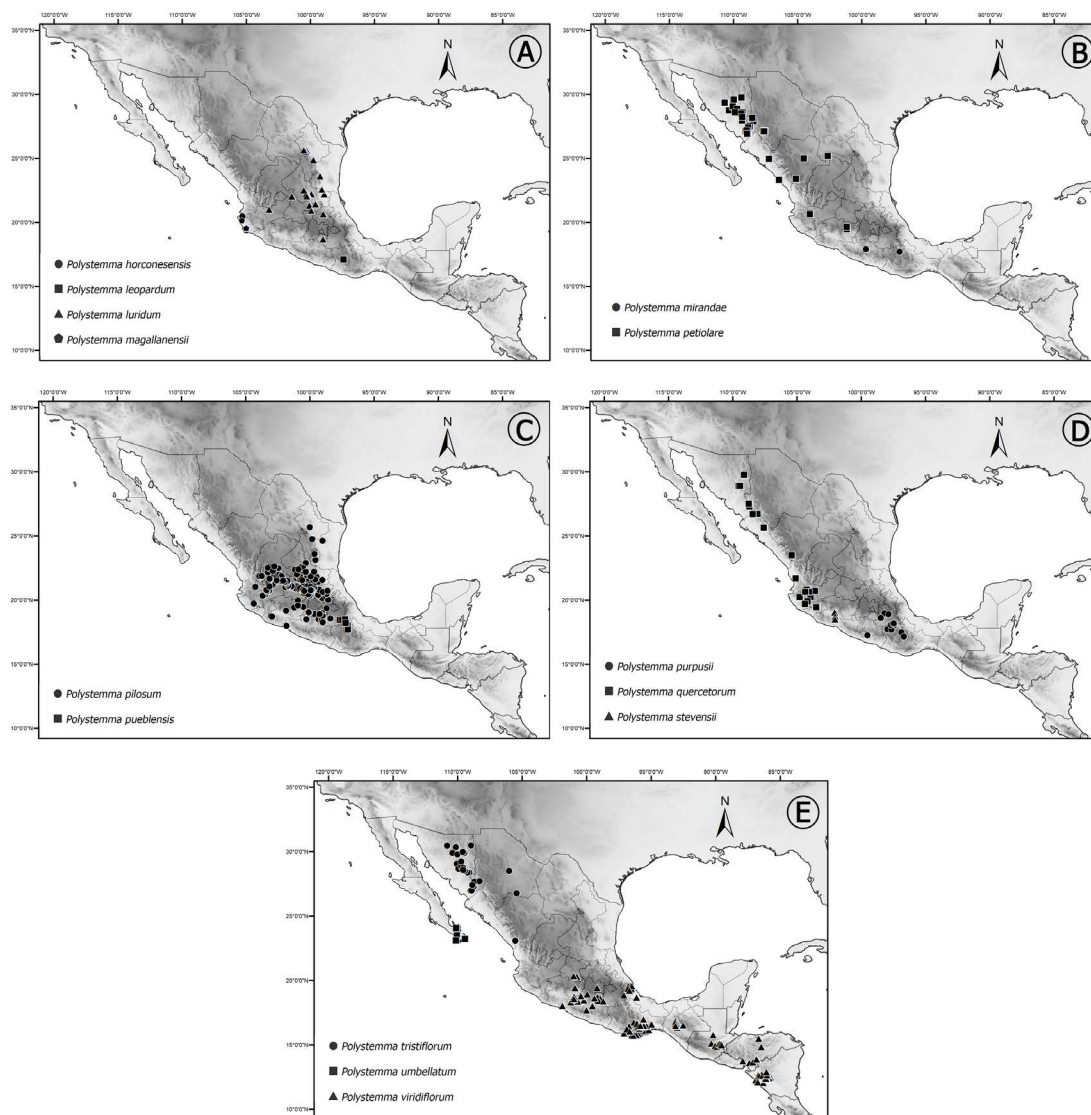


Figure 6. Map of the distribution of *Polystemma*. A) Distribution of *Polystemma horconesensis*, *P. leopardum*, *P. luridum* and *P. magallanesii*. B) Distribution of *Polystemma mirandae* and *P. petiolare*. C) Distribution of *Polystemma pilosum* and *P. pueblensis*. D) Distribution of *Polystemma purpusii*, *P. quercetorum* and *P. stevensii*. E) Distribution of *Polystemma tristiflorum*, *P. umbellatum* and *P. viridiflorum*.

Phenology. Flowering occurs from August through late November and fruiting is from October through January.

Conservation status. The only population known is the one at the type locality in the Jardín Botánico de Vallarta, Jalisco, with an area of occupancy smaller than 25 km². The surrounding areas are affected by erosion and livestock grazing, agriculture, and tourism. According to the IUCN criteria, we suggest that it be recognized as Endangered (En), according to IUCN criteria B1 ab(iv).

Etymology. The epithet refers to the Los Horcones River Basin, where the type specimen was collected. The discovery of this species contributes to the multiple efforts to declare this watershed a natural protected area, as the main course of the river is currently threatened by urbanization and the demand for water from development projects in the area to the south of Bahía de Banderas.

Notes. This taxon is a new addition for western Mexico and highlights Jalisco as an important center of diversity, with 8 species. *Polystemma horconesensis* is morphologically similar to *P. pilosum* in having flowers campanulate-rotate with the gynostegial corona cyathiform and the same size as the gynostegium. *Polystemma horconesensis* is differentiated by having flowers greenish-brown with violet tones on the limb and more or less evident brown reticulum (vs. flowers black and no evident reticulum in *P. pilosum*). In the former, the external gynostegial corona is green to yellowish green, verrugose in the staminal section, and with a bi- or tri-lobulate appendage in the interstaminal section, and stylar head flat (external gynostegial corona is reddish-brown, with margin denticulate and stylar head convex in *P. pilosum*). These morphological differences fulfill the phenotypic restrictions proposed in the established explanatory hypothesis. Both species have been reported in Jalisco, but they are located in very different zones, suggesting that they require contrasting environmental conditions. *Polystemma horconesensis* is restricted to the western, coastal part of the state at elevations below 500 m, while *P. pilosum* is found in the eastern region elevations above 1,500 m.

Polystemma leopardum L.O.Alvarado, García-Mend., D.Sandoval, & Lozada-Pérez, Phytotaxa 649: 111-120. 2024.

Type. Mexico. Oaxaca: Distrito Tlaxiaco, San Juan Teita municipality, 200 m al E de San Juan Teita, cerro del Panteón 1466 m, 17° 05' 32.51" N, 97° 24' 33.59" W, 8 August 2022, D. Sandoval-Gutiérrez & C. Flores-Fausto 1547 (Holotype: MEXU, Isotypes: FCME, IEB, MEXU, MO, OAX).

Description. Alvarado-Cárdenas *et al.* (2024: 111-120).

Distribution and habitat. Endemic to Mexico and restricted to the gypsum soils in the state of Oaxaca ([Figure 6A](#)). It is found growing in xerophytic scrub and tropical deciduous forest at 1,323-1,466 m.

Notes. It is similar to *Polystemma cordatum* in having campanulate flowers with long trichomes on the corolla lobes and similar corona appendages; *P. leopardum* differs by its yellowish flowers with a reticulate purple to black pattern ([Figure 7G, H](#)), ovate-lanceolate corolla lobes, internal gynostegial corona with four small teeth between and below the linear-lanceolate appendages, and a convex stylar head (vs. red flowers with a reticulate black pattern, internal gynostegial corona with zero, one or two teeth between the linear-lanceolate appendages and flat stylar head in *P. cordatum*).

Polystemma luridum (Decne.) C.Cervantes, Flores Olv. & L.O.Alvarado, Bot. Sci. 100: 2024. ≡ *Gonolobus luridus* Decne., Prodr. 8: 592. 1844.

Type. México. [Hidalgo, municipio Metztlán], Pres de Hacienda de Guadalupe Basin de Mextitlán [20.48136111° N, 98.69391111° W], V, A. Ghiesbreght 15 (Holotype: P00645716!).



Figure 7. Vegetative and floral characters of different species of *Polystemma*. *Polystemma fuscum*, A) habit, B and C) flowers showing differences in coloration. *Polystemma guatemalense*, D and E) flowers showing different color, F) apical view of the gynostegium and gynostegial corona. *Polystemma leopardum*, G) inflorescence, H) corolla removed and gynostegium exposed. *Polystemma luridum*, I) flower, J) apical view of the gynostegium and the gynostegial corona, K) fruit.

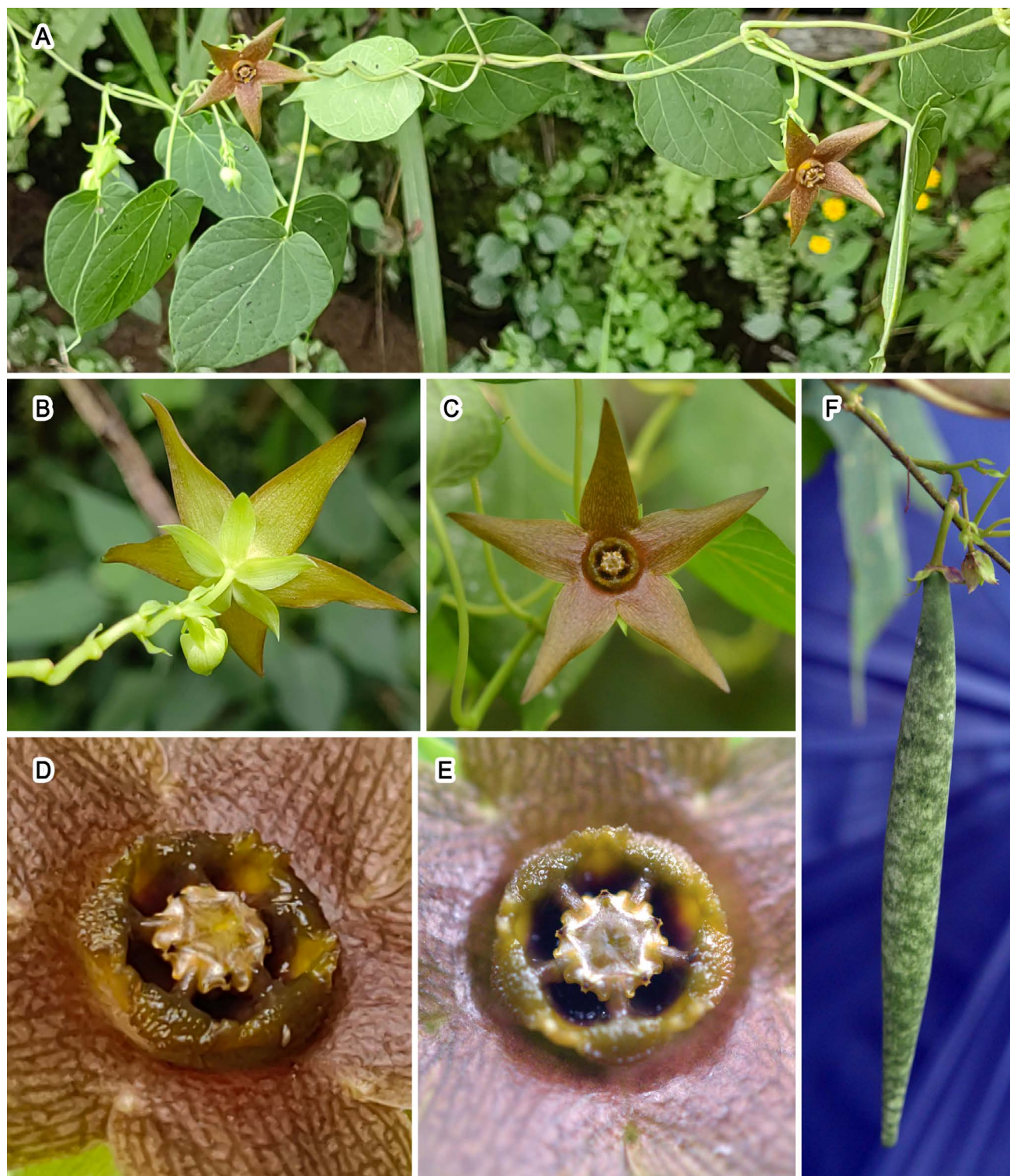


Figure 8. *Polystemma horconesensis* A) habit, B) inferior view of the inflorescence, C) flower, D) lateral view of the gynostegium and the gynostegial corona, E) apical view of the gynostegium and the gynostegial corona, F) fruit.

=*Gonolobus tingens* Decne., Prodr. 8: 592. 1844.

Type. Mexico. [Hidalgo], [municipio Zimapán], in regn. mexicano prope Zemapán, alt. 6500 pds., *H. Galeotti 1559* (Holotype: P00645730!).

=*Gonolobus suberifer* B.L. Rob., Proc. Amer. Acad. Arts 27: 181. 1893. ≡ *Vincetoxicum suberiferum* (B.L. Rob.) Standl., Contr. U.S. Natl. Herb. 23: 1189. 1924. ≡ *Matelea suberifera* (B.L. Rob.) W.D. Stevens, Phytologia 53: 405. 1983.

Type. Mexico. San Luis Potosí: San José Pass, 28 July 1890, *C.G. Pringle 3631* (Holotype: GH76353!).

=*HelioSTEMMA molesta* Woodson, Amer. J. Bot. 22: 690, t. 1, f. 5. 1935.

Type. Mexico. Tamaulipas: El Rosario, 10 August 1930, *H.H. Bartlett 10886* (Holotype: MO).

Description. Robinson (1893:181), Woodson (1935: 690).

Distribution and habitat. Endemic to Mexico in the central and northern states of Guanajuato, Hidalgo, Jalisco, Morelos, Nuevo León, Querétaro, San Luis Potosí, Tamaulipas and Zacatecas ([Figure 6A](#)). It is found growing in tropical deciduous forest and xerophytic scrub, at 1,000-1,300 m.

Notes. This species is similar to *P. viridiflorum* in its flowers green to yellowish-green, lobes of the corolla ovate to triangular, and gynostegial corona black to dark purple. It is easily recognizable by its external gynostegial corona cyathiform, internal corona with lobes thickened and oblong (vs. gynostegial corona fused to the gynostegium, external corona with five lobes with filiform appendages, internal corona with lobes flat in *P. viridiflorum*) ([Figure 7I, J, K](#)).

Polystemma magallanesii (E.J. Lott.) Morillo, Mem. Fund. La Salle Cienc. Nat. 2023, 81: 70. ≡ *Matelea magallanesii* E.J. Lott, Phytologia 73: 277. 1992.

Type. Mexico. Jalisco: La Huerta municipality, Chamela UNAM Biological Station, old road to Nacastillo, 8 km to the E of the Puerto Vallarta- Barra de Navidad highway, 19° 30' 00" N, 105° 03' 00" W, 24 Sep 1981, *E.J. Lott 552* (Holotype: MEXU; Isotype: MO101798903!, TEX155220!).

Description. Lott (1992: 277), Hernández-Barón (2021: 60-61).

Distribution and habitat. Endemic to Mexico and restricted to the state of Jalisco ([Figure 6A](#)). It is found in tropical deciduous forest at 52-122 m.

Notes: *Polystemma magallanesii* is similar to *P. viridiflorum* in its green corollas with reddish center and gynostegial corona with filiform appendages. *Polystemma magallanesii* is strongly distinctive due to its long lanceolate corolla lobes (vs. corolla lobes ovate to triangular in *P. viridiflorum*), the gynostegial corona with staminal region aciculate, and interstaminal region with filiform appendages (vs. staminal region with filiform appendages and interstaminal region without appendages in *P. viridiflorum*) ([Figure 9A, B](#)).

Polystemma mirandae Lozada-Pérez, Novon 20: 429. 2010.

Type. Mexico. Guerrero: Eduardo Neri municipality, 7.5 km from Mezcala, toward Amatitlán, 17.9 N, -99.653889 W, 15 July 1991, *M. Luna 136* (Holotype: FCME102661834!; Isotype: MEXU100329884!, MO102661835!).

Description. Lozada-Pérez (2010: 429), Hernández-Barón (2021: 78-79).

Distribution and habitat. Endemic to Mexico, distributed in only two southeastern states: Guerrero and Oaxaca ([Figure 6B](#)). It grows in tropical dry forest at 1,000-1,300 m.

Notes. This species is similar to *P. pilosum* in its brown to black corollas and five lobes of the gynostegial corona. *Polystemma mirandae* is distinguished by its external corona with five lobes rectangular, with acicular appendages and internal corona with erect ligule (vs. external corona cyathiform, with margin dentate and internal corona five thickened lobes oblong to deltoid in *P. pilosum*) ([Figure 9C, D](#)).

Polystemma petiolare (A.Gray) L.O.Alvarado & S.Islas, **comb. nov.** $\equiv$ *Gonolobus petiolaris* A.Gray, Proc. Amer. Acad. Arts 21: 396. 1886. $\equiv$ *Vincetoxicum petiolare* (A.Gray) Standl, Contr. U.S. Natl. Herb. 23: 1189. 1924. $\equiv$ *Matelea petiolaris* (A.Gray) Woodson, Ann. Missouri Bot. Gard. 28: 223. 1941.

Type. Mexico. Chihuahua: Batopilas, November 1885, *E. Palmer 7* (Lectotype **designated here**: GH barcode GH40963!; Isolectotype: US46722!). Remaining syntype: Mexico. Chihuahua: *J. Palmer 208* (GH00040964!)

Description. Gray (1886: 396).

Distribution and habitat. Endemic to northern and western Mexico, reported in Chihuahua, Coahuila, Durango, Jalisco, Michoacán, Sinaloa and Sonora ([Figure 6B](#)). It grows in tropical deciduous forest, at 200-1,600 m.

Notes. The vegetative morphology of *P. petiolarum* is very similar to other species of the genus, such as *P. crenatum* and *P. galindoi* (see discussion below), since it has corollas with greenish to reddish-brown tones, the gynostegium is included in the corolla tube, and the corona is cyathiform. As such, it can only be distinguished by examining the corolla and gynostegial corona under a microscope. The flowers of *P. petiolarum* present a tube that is more or less constricted at the apex, and the gynostegium is completely included in the tube ([Figure 9 E, F, G](#)). The gynostegial corona is smaller than the gynostegium, with five lobes semicircular and entire. In *P. crenatum*, the flowers do not have a tube constrained at the apex. The gynostegial corona is the same size as the gynostegium, with five lobes ovate to oblong with a dentate or acicular appendage on either side.

Asa Gray named *Gonolobus petiolaris* based on the specimens of *J. Palmer 7 and 208* (both GH) without selecting either as the holotype. We designate the specimen of *J. Palmer 7* (GH) as the lectotype, because it is the best conserved among these specimens.

Polystemma pilosum (Benth.) Morillo, Mem. Fund. La Salle Cien. Nat. 81: 45-90. 2023a. $\equiv$ *Gonolobus pilosus* Benth., Pl. Hartw. 289-290. 1848. $\equiv$ *Matelea pilosa* (Benth.) Woodson, Ann. Missouri Bot. Gard. 28: 233. 1941.

Type. Mexico. Guanajuato: Prope León, [21.11° N, 101.68° W], 13 Apr 1837, *K.T. Hartweg 1611* (Holotype: K1772637!; Isotype: LD1211774!).

Description. Benth (1848: 289-290), Morillo (2023a: 86-87).

Distribution and habitat. Endemic to Mexico and the most widely distributed species in the country, reported from the following 14 states: Aguascalientes, Guanajuato, Guerrero, Hidalgo, Jalisco, Mexico, Michoacán, Morelos, Nuevo León, Puebla, Querétaro, San Luis Potosí, Tamaulipas and Zacatecas ([Figure 6C](#)). It is found mainly in xerophytic scrub, thorn forest, and tropical deciduous forest, at 150-2,700 m.



Figure 9. Vegetative and floral characters of different species of *Polystemma*. *Polystemma magallanesii*, A) flower, B) fruit. *Polystemma mirandae*, C) flower, D) close-up of the corona. *Polystemma petiolare*, E) flower, F) lateral view showing the sepals, the corolla and the gynostegium, G) lateral view of the gynostegium and gynostegial corona. *Polystemma pilosum*, H) flower, I) apical view of the gynostegium and gynostegial corona, J) detail of the simple and glandular trichomes. *Polystemma pueblensis*, K) flower, L) lateral view of the gynostegium and gynostegial corona.

Synopsis of *Polystemma*

Notes. *Polystemma pilosum* is similar to *P. tristiflorum* in its black corollas and cyathiform gynostegial corona, but it is distinguished by its internal gynostegial corona with thickened lobes oblong to deltoid (vs. laminar lobes in *P. tristiflorum*). It can also be confused with *P. quercetorum* due to its black corollas and deltoid lobes of the gynostegial corona. However, *Polystemma pilosum* has a cyathiform external gynostegial corona and the internal corona lobes deltoid, while the external gynostegial corona in *P. quercetorum* has four deltoid lobes ([Figure 9H, I, J](#)).

Polystemma pueblensis (Brandeggee) L.O.Alvarado & S.Islas, **comb. nov.** $\equiv$ *Vincetoxicum pueblense* Brandeggee. Univ. Calif. Publ. Bot. 4: 9. 1910. $\equiv$ *Matelea pueblensis* (Brandeggee) Woodson. Ann. Missouri Bot. Gard. 28: 223. 1941.

Type. Mexico. Puebla: Caltepec municipality, near Tlacuilosto and San Luis Tultitlanapa, 1909, *C.A. Purpus* 4064 (Holotype: UC131328!).

Description. Brandeggee (1910: 9), Juárez-Jaimes & Lozada-Pérez (2003: 41-42).

Distribution and habitat. Restricted to the states of Oaxaca and Puebla, Mexico ([Figure 6C](#)), growing in tropical deciduous forest, at 800-940 m.

Notes. This species is endemic to Mexico and very distinctive from the rest of the known species of the genus. Although it has the green corollas, sometimes with reddish tones at the base of the corolla lobes, like *P. viridiflorum*, it is easily distinguished because the gynostegium and the gynostegial corona exerted from the corolla tube (vs. included in the corolla tube in *P. viridiflorum*), and the gynostegial corona is cyathiform, red, and larger than the gynostegium (vs. fused to the gynostegium, lobulate with filiform appendages, black and similar size to the gynostegium in *P. viridiflorum*) ([Figure 9K, L](#)).

Polystemma purpusii (Brandeggee) L.O.Alvarado & S.Islas, **comb. nov.** $\equiv$ *Gonolobus purpusii* Brandeggee, Univ. Calif. Publ. Bot. 3: 387. 1909. $\equiv$ *Matelea purpusii* (Brandeggee) Woodson. Ann. Missouri Bot. Gard. 28: 223. 1941.

Type. Mexico. Oaxaca: Monte San Felipe, 17.166945 N, -96.66444 W, Jul 1834, *G. Andrieux* 244 (Holotype: P1162584!; Isotype: F48920!, GH76351!, MO101770458!, NY318625!, US840911).

Description. Brandeggee (1909: 387), Juárez-Jaimes & Lozada-Pérez (2003: 42-43).

Distribution and habitat. Endemic to Mexico and restricted to the states of Guerrero, Oaxaca and Puebla ([Figure 6D](#)). It is found in *Juniperus* forest, tropical deciduous forest and xerophytic scrub, at 2,100-2,300 m.

Notes. The flowers are highly distinctive from the rest of the species of the genus ([Figure 10A, B, C](#)). It shares with *P. pueblensis* a gynostegium and gynostegial corona exerted from the corolla tube, but the gynostegial corona is the same size as the gynostegium, striated and black in color (vs. gynostegial corona larger than the gynostegium, verrucose, red in *P. pueblensis*). In addition, the corolla lobes are oblong linear and brown reticulate (vs. corolla lobes ovate and green in *P. pueblensis*).

Polystemma quercetorum (Standl.) Morillo, Mem. Fund. La Salle Cienc. Nat., 2023, 81: 72 $\equiv$ *Vincetoxicum quercetorum* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 17: 271. 1937. $\equiv$ *Matelea quercetorum* (Standl.) W.D.Stevens, Phytologia 53: 405. 1983.

Type. Mexico. Sonora: Sierra Charuco, Río Mayo, [23° N, 102° W], 22 Jul 1936, *H.S. Gentry* 2297 (Holotype: F49064!; Isotype: GH40981!, MO101770456!).

Description. Standley (1937: 271-272).

Distribution and habitat. Endemic to northern and western Mexico, in the states of Durango, Jalisco, Nayarit, Sinaloa and Sonora ([Figure 6D](#)). Recorded growing in tropical deciduous forest and xerophytic scrub, at 800-1,860 m.

Notes. The species has a very distinctive morphology from other species, since it only presents the external corona, conformed of 5 lobes deltoid, connate at the base, and partially covering the anthers ([Figure 10D](#)). *Polystemma quercetorum* (= *Matelea quercetorum*) was included by McDonnell *et al.* (2018) in a phylogeny based on morphological data, in which this and other species of *Matelea* s.l. were recovered in one of the resulting trees (A) as part of a clade with other species of *Polystemma*.

Polystemma stevensii G.M.Hern.-Barón, Trujillo-Juárez & V.W.Steinm., Phytotaxa 613: 194-200. 2023.

Type. Mexico. Michoacán: Mpio. Múgica, 5.8 km NNE of the exit to Nueva Italia, along a path that extends from the Morelia-Lázaro-Cárdenas Highway to Río Marqués; 19° 02' 01" N, 102° 02' 54" W, 7 Sep 2010, *V.W. Steinmann & Y. Ramírez-Amezcu*a 7159 (Holotype: IEB; Isotype: MEXU).

Description. Hernández-Barón *et al.* (2023: 195-196).

Distribution and habitat. Endemic to Mexico and restricted to the state of Michoacán ([Figure 6D](#)), growing in tropical deciduous forest, at 350-750 m.

Notes. *Polystemma stevensii* differs highly from other species in the genus ([Figure 10E, F](#)). It presents green corollas like *P. viridiflorum* and *P. pueblensis*, but it is differentiated by having a gynostegial corona in the form of a flat ring with five lobes fused at the base (vs. not forming a flat discontinuous ring in *P. viridiflorum* and a cyathiform corona in *P. pueblensis*) and a globose red stylar head (vs. flat stylar head in the other species).

Polystemma tristiflorum (Standl.) L.O.Alvarado & S.Islas, **comb. nov.** ≡ *Vincetoxicum tristiflorum* Standl. Publ. Field Mus. Nat. Hist., Bot. Ser. 17: 272. 1937. ≡ *Matelea tristiflora* (Standl.) Woodson. Ann. Missouri Bot. Gard. 28: 223. 1941.

Type. Mexico. Chihuahua: Guasaremos, Río Mayo, [27.6623° N, 108.7097° W], 23 Aug 1936, *H.S. Gentry* 2415 (Holotype: F49068!; Isotype: MO101770457!).

Description. Standley (1937: 272).

Distribution and habitat. Endemic to Mexico and restricted to the northwestern states of Chihuahua, Sinaloa and Sonora ([Figure 6E](#)). It is found in tropical deciduous forest and gallery forest at 200-1,500 m.

Notes. There are few collection records for this species, and it is frequently confused with *P. quercetorum* due to its black corollas and cyathiform coronas. *Polystemma tristiflorum* is distinguished by having two gynostegial coronas, the external of which is cyathiform and the internal, laminar (vs. only external corona with five deltoid lobes in *P. quercetorum*) ([Figure 10G, H](#)).

Polystemma umbellatum (Brandege) L.O.Alvarado & S.Islas, **comb. nov.** ≡ *Rothrockia umbellata* Brandege, Zoë 5: 165. 1903. ≡ *Matelea umbellata* (Brandege) Woodson, Ann. Missouri Bot. Gard. 28: 223. 1941.

Synopsis of *Polystemma*



Figure 10. Vegetative and floral characters of different species of *Polystemma*. *Polystemma purpusii*, A) flower, B) apical view of the gynostegium and gynostegial corona, C) lateral view of the gynostegium and gynostegial corona. *Polystemma quercetorum*, D) flower. *Polystemma stevensii*, E) inflorescence, F) apical view of the gynostegium and gynostegial corona. *Polystemma tristiflorum*, G) flower, H) lateral view of the gynostegium and the gynostegial corona. *Polystemma umbellatum*, I) flower J) lateral view of the gynostegium and the gynostegial corona. *Polystemma viridiflorum*, K) flower L) lateral view of the gynostegium and the gynostegial corona.

Type. Mexico. Baja California: El Tasta, Cape Region, November 1903, *T.S. Brandegees n.* (Holotype: UC105429!; Isotype: NY318766!).

Description. Brandegees (1903: 165).

Distribution and habitat. Endemic to Mexico and restricted to Baja California Sur ([Figure 6E](#)). Found in tropical deciduous forest at 200-1,500 m.

Notes. This species shares morphological similarities with *P. fruticosum* and *P. cordifolium* in that its gynostegium is exserted from the corolla tube, the gynostegial corona has filamentous appendages, and the apex of the gynostegium has a projection. *Polystemma umbellatum* is distinguished from the other two species by its flowers mostly greenish and with dense pubescence of transparent white trichomes on the adaxial surface and its yellowish-white gynostegial corona ([Figure 10I, J](#)).

Polystemma viridiflorum Decne., Prodr. 8: 602. 1844. $\equiv$ *Matelea decaisnei* Woodson, Ann. Missouri Bot. Gard. 28: 232. 1941.

Type. Mexico. Veracruz: Montes au l'E de l'Orizaba (bois et taillis de Santiago de Huatusco, pres Mirador), [18.84° N, 97.1° W], s.d., *H.G. Galeotti 1517* (Holotype: P1161326!; Isotype: BR696671!, G1831130!).

$\equiv$ *Matelea rupestris* (Brandegee) Woodson, Ann. Missouri Bot. Gard. 28: 232. 1941. $\equiv$ *Polystemma rupestre* Brandegees, Univ. Calif. Publ. Bot. 7: 330. 1920.

Type. Mexico. Veracruz: Barranca de Panoya, Jul 1919, *C.A. Purpus 8451* (Holotype: UC200855!; Isotype: MO859683!).

$\equiv$ *Matelea scopulorum* (Brandegee) Woodson, Ann. Missouri Bot. Gard. 28: 232. 1941. $\equiv$ *Polystemma scopulorum* Brandegees, Univ. Calif. Publ. Bot. 6: 189. 1915.

Type. Mexico. Oaxaca: San Geronimo, Jul 1914, *C.A. Purpus 7275* (Holotype: UC174875!; Isotype: MO763359!).

Description. Decaisne (1844: 60-603), Brandegees (1915: 189), Brandegees (1920: 330), Stevens (2009: 767), Hernández-Barón (2021: 79-83).

Distribution and habitat. Native to Mexico, Guatemala, El Salvador, Honduras, and Nicaragua. In Mexico, it is found in the center and southeastern portion of the country, in the states of Chiapas, Guanajuato, Guerrero, Mexico, Michoacán, Morelos, Oaxaca, Puebla and Veracruz ([Figure 6E](#)). Grows mainly in tropical deciduous forest at 0-1,800 m.

Notes. It shares some similarity with other species in its green corollas, such as *P. canisferum*, *P. luridum*, and *P. pueblensis* (see discussion of each species), but it is distinguished by its gynostegial corona fused to the gynostegium with acicular and filiform appendages on the lobes of the external corona (*vs.* corona cyathiform without appendages, [Figure 10K, L](#)). The internal corona is an oblong ligule with apex irregularly lobed and larger than the gynostegium (*vs.* deltoid or oblong lobes of similar size of the gynostegium).

Discussion

In recent phylogenies of Gonolobinae based on DNA, *Polystemma* has been recovered as paraphyletic, since some taxa were retrieved in a clade with species of *Polystemma* (Keller & Liede-Schumann 2020, Hernández-Barón 2021, González-Martínez *et al.* 2024). Previous efforts to resolve the systematics of the group transferred several species to *Polystemma*, such as *Polystemma calcicola* (Greenm.) Morillo, *P. magallanesii* (E.J.Lott) Morillo, *P. pilosum* (Benth.) Morillo, and *P. quercetorum* (Standl.) Morillo (Morillo 2023a, b). In the current work, we transfer the species mentioned in the literature (McDonnell *et al.* 2018, Keller & Liede-Schumann 2020, Hernández-Barón 2021) and those that have the morphological attributes of the genus (Stevens 2009, Morillo 2023a, b), which results in *Polystemma* being monophyletic.

In addition, in the phylogenies of members of Gonolobinae, the genus *Dictyanthus* and *Urostephanus* (González-Martínez 2022, González-Martínez *et al.* 2024), have been recovered as sister to *Polystemma* + *Matelea* (McDonnell *et al.* 2018, Keller & Liede-Schumann 2020, Hernández-Barón 2021). The members of *Dictyanthus* and *Urostephanus* were distinguished from *Polystemma* by their lack of glandular trichomes with transparent incrustations that are typical of *Polystemma*. Furthermore, *Dictyanthus* presents corollas that are mainly campanulate sacciform in shape, gynostegium included in the corolla tube, and external gynostegial corona only, with spatulate, linear, or vesicular lobes nearly completely fused to the corolla. In the case of *Urostephanus*, the flowers are rotate, gynostegium exserted from the corolla tube, external and internal gynostegial corona attached to the gynostegium. In *Polystemma* the corollas are rotate or rotate-campanulate, the gynostegium can be exserted or included in the corolla tube, external and internal gynostegial corona, with the lobes of the gynostegial corona attached to the gynostegium. The fruits in *Dictyanthus* have evident prickles and irregular white streaks, whereas in the *Urostephanus* group the prickles are very small and the fruits are reddish-brown; in *Polystemma*, the fruits are smooth and mottled with irregular white streaks (González-Martínez 2022, González-Martínez *et al.* 2023, 2024). The gynostegial corona is the most variable structure and is of great importance for taxon recognition within the Asclepiadoideae (Endress *et al.* 2018). This structure is highly heterogeneous within *Polystemma* relative to the other genera of Gonolobinae, such as *Gonolobus* and *Talayotea*, in which there is relatively little variation in the gynostegial corona across species. Detailed studies of the morphology and development of this structure have yet to be performed.

The known distribution of the members of the genus spans from the southeastern USA through Mexico and Central America to northern Costa Rica (Figure 3A). Mexico has the highest *Polystemma* diversity, with the highest species diversity present in the western part of the country, particularly in the states along the Pacific coast including all known species and has an endemism rate of 88 %. El Salvador, Guatemala, Honduras, and Nicaragua have two recorded species. Mexico is considered a center of diversity for Apocynaceae in general and several genera within the family, including *Dictyanthus*, *Gonolobus*, *Ruehssia*, and *Tabernaemontana* (Alvarado-Cárdenas *et al.* 2019, 2020, 2023, Pío-León *et al.* 2023).

The states of Oaxaca and Jalisco have the highest diversity with nine species, followed by Guerrero and Puebla with eight. These states contain several areas that are recognized for their high biodiversity. The Balsas Depression in Guerrero is considered one of the most floristically rich regions in the world (Rzedowski 1978), and the Sierra Madre del Sur, Trans-Mexican Volcanic Belt, and Isthmus of Tehuantepec in Oaxaca have been recognized as centers of diversification, endemism, and biogeographical transition (Esquerré *et al.* 2019, Flores-Tolentino *et al.* 2023, Gámez *et al.* 2012, Rzedowski & Calderón de Rzedowski 2013). In addition to being important geographic barriers, the intricate orography and environmental gradients of these regions generate microhabitats that limit the distribution of populations, which together with other evolutionary processes, could be involved in the diversification of the group.

The species of *Polystemma* prefer tropical deciduous forest and xerophytic scrub. The former is highly heterogeneous in Mexico, and it is estimated that it may contain nearly 5,000 plant species (Rzedowski & Calderón de Rzedowski 2013). In addition, tropical deciduous forest abuts and forms ecotones with *Quercus* forest, xerophytic scrub, thorn forest, and subdeciduous tropical forest (Rzedowski & Calderón de Rzedowski 2013), where species of *Polystemma* are also distributed. This heterogeneity throughout their distribution and vegetation types could explain

the highest incidence and endemism of *Polystemma* species in deciduous forest, and why these are restricted to certain portions of Mexico.

It is worth pointing out that several *Polystemma* species are poorly collected and represented by a small number of specimens (*e.g.*, *P. adenocardia* and *P. angustiloba*); other species have restricted distributions and threatened populations (*e.g.*, *P. fishbeiniana*, Steinmann & Stevens 2022). Preliminary assessments of the conservation status of some species are available (McDonnell & Fishbein 2016, Hernández-Barón 2021, Steinmann and Stevens 2022, Hernández-Barón *et al.* 2023), but more fieldwork is needed to clarify the status of many taxa.

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