



A new species of *Triphora* (Orchidaceae: Triphoreae, Triphorinae) from Mexico

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Abstract

Triphora gallegosii, a new species of geophyte orchid known so far from central, western, and northwestern Mexico, is described and illustrated. This species is morphologically similar to *T. gentianoides* and *T. wagneri*, with whom it shares the presence of scale-like leaves, three longitudinal verrucose lines on the lip, and floral parts of similar sizes, but differs from both by its lip lines that vanish towards the middle of the central lobe, having 1–4 resupinate flowers, and flowering between August and September. It also differs from *T. wagneri* by having a constricted central lobe and lateral lobes with acute apex, and from *T. gentianoides* by having entire margins on the lateral lobes, column with a magenta apex and whitish towards the middle portion with a green base, magenta anther, smaller leaves, and solitary growth. A preliminary analysis of the conservation status and a dichotomous key to the species of the genus in Mexico are provided.

Key words: Epidendroideae, geophyte, Monocot, taxonomy, terrestrial orchid

Resumen

Se describe e ilustra *Triphora gallegosii*, una nueva especie de orquídea geófito conocida hasta ahora del centro, occidente y noroeste de México. Esta especie es similar morfológicamente a *T. gentianoides* y *T. wagneri* con quienes comparte la presencia de hojas escuamiformes, de tres líneas verrucosas longitudinales en el labelo y partes florales de tamaños similares, pero difiere de ambas por sus líneas del labelo que se difuminan hacia la mitad del lóbulo central, por tener 1–4 flores resupinadas y por florecer entre agosto y septiembre. También difiere de *T. wagneri* por tener un lóbulo central constreñido y lóbulos laterales con ápice agudo y de *T. gentianoides* por tener margen entero en los lóbulos laterales, columna con ápice magenta, cuerpo blanquecino y base verde, antera magenta, hojas más pequeñas y por tener crecimiento solitario. Se provee un análisis preliminar de su estado de conservación y una clave dicotómica para las especies del género en México.

Palabras clave: Epidendroideae, geófito, monocotiledónea, taxonomía, orquídea terrestre

Introduction

The genus *Triphora* Nutt (1818: 192) consists of ca. 24 species of geophyte orchids from America distributed from southeast Canada to the north of Argentina and the Caribbean islands (Johnson 2001, Rothacker 2005, Ferreira *et al.* 2010, Szlachetko *et al.* 2014, Vieira *et al.* 2017, Soto-Calvo *et al.* 2021, POWO 2023). The genus belongs together with *Monophyllorchis* Schlechter (1920: 39), and *Psilochilus* Barbosa Rodrigues (1882: 272) to the subtribe Triphorinae Szlachetko (1991: 26) of the tribe Triphoreae Dressler (1979: 204) in the megadiverse subfamily Epidendroideae Lindley ex Endlincher (1837: 193) (Dressler 1979, Chase *et al.* 2015). Molecular phylogenies support the monophyly of the subtribe Triphorinae (Cameron *et al.* 1999, Freudenstein & Chase 2015), but the relations between congeners are still unknown. The genus can be morphologically differentiated from the other two genera within Triphorinae by its thick fleshy tubers with glabrous roots (sometimes absent) and their bract-like or scale-like leaves (Rothacker 2005). Anatomically, it is differentiated by the predominance of anomocytic stomata together with the absence of sclerenchyma in the stems (Carlsward & Stern 2009).

In Mexico, seven species of the genus *Triphora* have been recorded: *T. yucatanensis* Ames (1922: 39) and *T. gentianoides* (Swartz 1788: 119) Ames & Schlechter. (1922: 5), both well-documented for the Yucatan Peninsula (Carnevali *et al.* 2001, Carnevali 2010, 2012, Andrews & Gutiérrez 1988); *T. trianthophoros* (Swartz 1800: 230) Rydberg (1901: 298) and *T. mexicana* (S. Watson 1891: 154) Schlechter (1921: 139), widely distributed across the country (Medley 1996, Espejo & López-Ferrari 1998, Soto-Arenas *et al.* 2007, Szeszko 2011, Villaseñor 2016, Solano-Gómez *et al.* 2020, Salinas-Rodríguez *et al.* 2022); *T. hassleriana* (Cogniaux 1909: 283) Schlechter (1925: 76) recorded for the state of Veracruz (Medley 1996); *T. wagneri* Schlechter (1921: 139) for the states of Michoacan and Chiapas (Medley 1996), and *T. debilis* Schlechter (1921: 139) for southern Mexico (Soto-Arenas 2006, Villaseñor 2016). Therefore, the genus is distributed throughout almost the entire Mexican territory, from the Baja California Peninsula and the state of Chihuahua to Chiapas, and from Tamaulipas and Nuevo Leon to the Yucatan Peninsula and the central states of the country, particularly Mexico City, Morelos, and the Estado de Mexico.

Because of being inconspicuous plants with ephemeral flowers and fluctuating dormancy cycles (Rothacker 2005), members of the genus go unnoticed by many field botanists, which is reflected in the poor representation in herbaria. In addition, very few herbarium specimens contain dissections of flowers or additional material such as photographs or drawings showing the diagnostic characters of the flowers, which has made the study of the genus quite difficult.

Here, we describe and illustrate a new species of *Triphora* from Mexico, and discuss the differences with the closest morphologically-related species. Additionally, we present a preliminary assessment of its conservation status, a distribution map, and a dichotomous key for the species of *Triphora* that inhabit Mexico.

Material and methods

During a field trip in August 2019 to study populations of *Agave maximiliana* Baker (1877: 201) and *Pinus* Linnaeus (1753: 1000) in western Mexico, we collected a strange specimen of *Triphora* that caught our attention. After a comprehensive literature review, we noticed that the specimen did not match with any previously described species. Therefore, in order to obtain additional data of this new species and compare the differences among the members of the genus, we consulted the following herbaria: AMES, AMO, F, GUADA, IBUG, IEB, K, M, MEXU, NY, PMA, SCZ, UCA, UCH, and UVAL (acronyms according to Thiers 2023). Herbaria outside of Mexico were consulted through correspondence with curators or digitally. The F specimen cited in paratypes was found on loan at AMO while reviewing that herbarium. The digitized type specimens of *Triphora* available in Global Plants Initiative Project (GPI) (<http://plants.jstor.org>) were also consulted. During September of 2019, more field trips were made with the intention of gaining a better understanding of the habitat and phenology of this species. The description of the species is based on material of the specimens cited here as well as field observations. Measurements of all floral parts were obtained from fresh, rehydrated, or liquid conserved flowers.

The distribution map was made using ArcMap (ArcGIS) v. 10.2 (ESRI 2014) based on specimens collected for this study, specimens found in the herbaria cited above, observations from the INaturalist platform (<https://www.inaturalist.org>; see other records), and a digital elevation model INEGI v. 3 (INEGI 2017).

To estimate the risk category of *T. gallegosii*, we followed the guidelines and criteria B2 of the International Union for Conservation of Nature (IUCN Standards and Petitions Committee 2022), and used the standard 2 × 2 km

grid area from the GeoCAT tool from the Royal Botanic Gardens, Kew (Bachman *et al.* 2011) to calculate the Area of Occupancy (AOO) and the Extent of Occurrence (EOO).

To elaborate the identification key for *Triphora* species in Mexico, we constructed a character matrix of the species reported for the country based on information from specialized literature (Schlechter 1918, 1921, Ames 1922, Williams 1946, McVaugh 1985, Ackerman 1995, Medley 1991, 1996, 2003, Brown 2006), type specimens available in Global Plants Initiative (GPI) (<http://plants.jstor.org>), botanical illustrations of type specimens from AMES available at the Harvard University Herbaria & Libraries website (<https://huh.harvard.edu/>), and a review of specimens deposited in IBUG, MEXU and AMO. Although we did not find any specimen identified as *T. debilis* that truly corresponded to this species (it is commonly confused with *T. mexicana*), and we also did not find any specimens of *T. wagneri* that could be corroborated (see discussion), we decided to include both species in the key because their presence in Mexico has been reported in various studies (Medley 1996, Soto-Arenas 2006, Villaseñor 2016, POWO 2023), however, it should be taken with caution.

Taxonomy

Triphora gallegosii Figueroa, Zabalgoitia, Velázquez-R. & R. Jiménez, *sp. nov.* (Figures 1–2)

Type:—MEXICO. Jalisco: Municipio de Mixtlán, en las inmediaciones del puente “Los Tablones”, a un lado de la carretera Ameca-Mascota a 3.9 km al noreste de Mixtlán, 20°27'44.59"N, 104°22'44.01"W, alt. 1724 m, 19 September 2019, A. Zabalgoitia, *et al.* 680 (holotype: IBUG!; isotype: AMO!).

Triphora gallegosii is similar to *T. gentianoides* and *T. wagneri* in having lips with three longitudinal and verrucous lines, and in the size of floral parts. However, in *T. gallegosii* these lines vanish towards the middle of the central lobe (*vs.* reaching the apex of the central lobe), in addition, *T. gallegosii* has resupinate flowers (*vs.* non-resupinate). Furthermore, *T. gallegosii* differs from *T. gentianoides* in having 1–4 flowers (*vs.* 3–10 flowers), sepals and petals magenta at the apex, decreasing in intensity towards the middle portion and green at the base (*vs.* ranging from green to white, commonly with some brown or reddish tones on sepals), a white lip with a magenta spot at the tip of the central lobe (*vs.* white to pale green), green warts on the lip lines (*vs.* green and white warts), lateral lobes of the lip with entire margins (*vs.* erose to nearly lacerate), a column with a magenta apex and whitish towards the middle portion with a green base (*vs.* magenta to brown at the apex and the rest green or yellowish-white), a magenta anther (*vs.* yellow), leaves of 3.5–13 × 2–6 mm (*vs.* 10–18 × 5–10 mm), solitary growth habit (*vs.* growing in clusters), and blooming between August and September (*vs.* June and August). It also differs from *T. wagneri* in having 1–4 flowers (*vs.* 1 flower), lateral lobes constricted at their junction with the central lobe and with an acute apex (*vs.* unconstricted and obtuse), and blooming between August and September (*vs.* April).

Description:—Geophyte herb, inconspicuous, 10.0–20.4 cm tall. Formed by a red-like stem attached to a corm. Corm 18.5–37.5 × 9.0–15.3 mm, oblong-ellipsoid to oblong-ovoid, glabrous, fleshy, white. Roots 1–2 mm diameter, from the base of the stem, glabrous, cylindrical, eventually producing new corms. Stem 7.0–15.5 × 0.1–0.3 cm, cylindrical, fleshy, glabrous, erect, the hypogean part 4.0–6.5 cm long, with a shoot bud towards the middle of this, white, the epigeal part 4.6–15.9 cm tall, wine red. Leaves 2–3, distributed along stem, scale-like, adpressed to the stem; blades 3.5–13 × 2–6 mm, oblong-ovate, semiamplexicaul, the apex acute, the margin entire, the adaxial face wine red to slightly green, the abaxial face wine red. Inflorescence 2.5–4.0 cm long, terminal, solitary, racemose. Flowers 1–4, successive, open one at a time, short-lived, resupinate in frontal position, sepals and petals magenta at the apex, decreasing in intensity towards the middle portion, green at the base, lip white, with a magenta spot at the tip of the central lobe, with green warts. Floral bracts 5–10 × 4.0–6.9 mm, ovate, amplexicaul, acute, the margin entire, the same color as the leaves. Ovary 6–15 mm long including pedicel, 2–7 × 1–2 mm (without the pedicel), dilated towards the perianth, 6-costate, striated, slightly verrucose, growing faster after pollination; pedicel 4–6 × 0.8–0.9 mm, cylindrical, up to 12 mm long after anthesis. Sepals elliptic to narrowly elliptic, acute, the margin entire, 3-veined; dorsal sepal 6.0–13.6 × 2–3 mm; lateral sepals 8.0–11.6 × 2–3 mm, oblique, falcate, concave. Petals (7.5–) 9.0–12.3 × 1.5–2.7 mm, projecting forward covering the column, narrowly elliptic, falcate, concave, unguiculate at the base, the claw 1.2 mm long, the apex acute, the margin entire, 3-veined. Lip 6.5–10.7 × 3.8–5.8 mm, trilobate, unguiculate and cuneate at the base, claw 1.0–1.5 × 1 mm, cuneate base 2.6–4.0 × 1.5–3.5 mm, with three longitudinal green lines arising from the base towards the middle part of the central lobe, becoming undefined and verrucous without reaching the apex; lateral

lobes 1.1–1.9 × 0.9–1.5 mm, not exceeding more than a half of the length of the central lobe, semiovate to lanceolate, falcate, projected upwards surrounding the column, the apex acute, margin entire; central lobe 2.5–4.0 × 2.0–3.2 mm, constrained at the union with the lateral lobes, obovate, the apex rounded, margin undulate and minute papillose. Column 5.5–9 mm long, elongate, slightly arching, glabrous, magenta at the apex, decreasing in intensity towards the middle portion, green at the base. Anther incumbent, with a granular surface, magenta. Pollinarium ca. 1 × 1 mm, with two pollinia; pollinia oblong from frontal view, reniform from lateral view. Rostelum trilobate, the lateral lobes thinner and longer than the central one. Stigma 1.5–2.5 mm long, oblong, concave, scarcely papillae with margins slightly raised, white. Capsule 8–15 × 3.5–7.9 mm, obovoid, pendent, wine red before opening; pedicel 4.1–10.0 mm long. Seeds not seen.

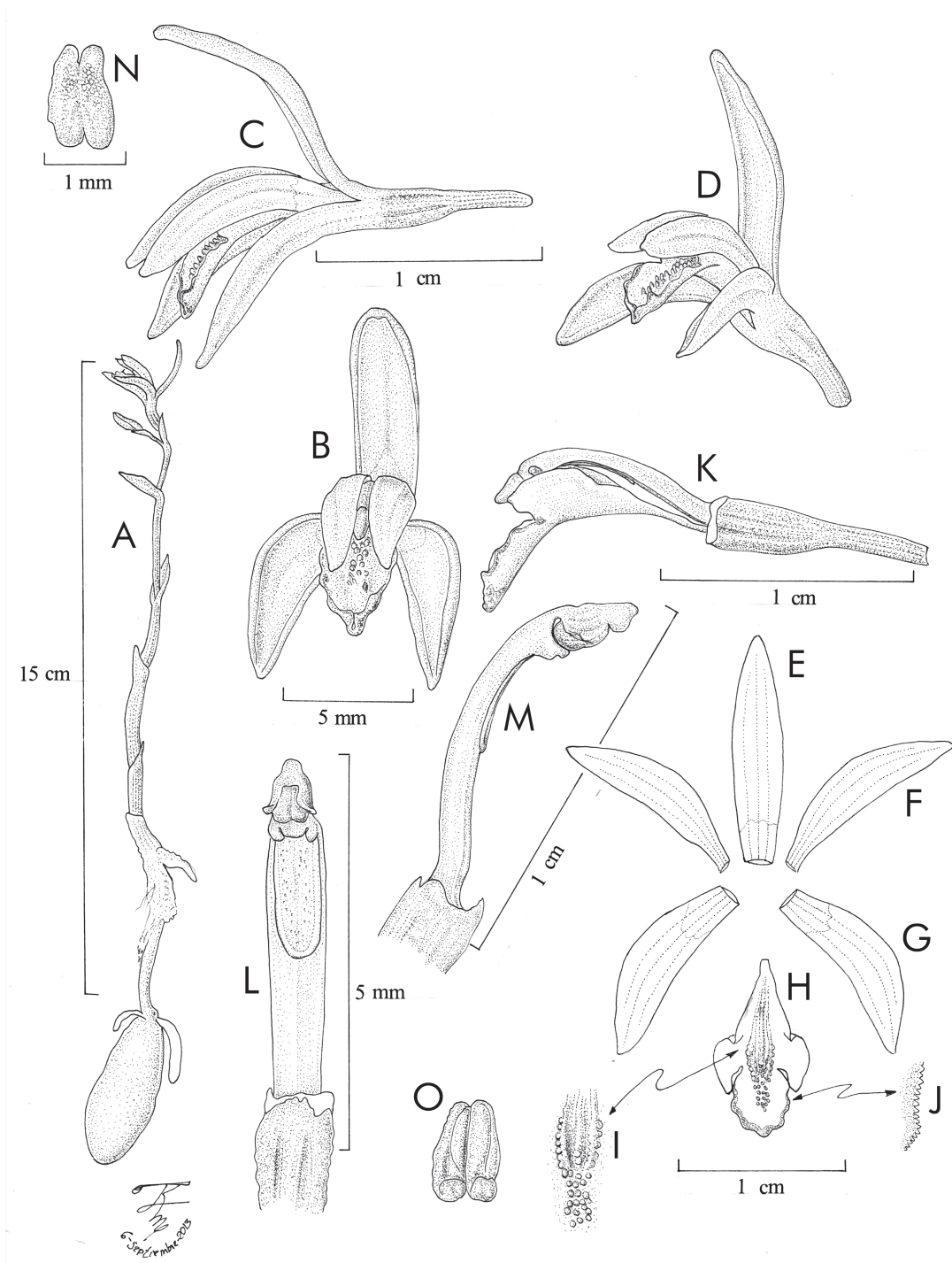


FIGURE 1. *Triphora gallegosii*. A. Flowering plant B. Flower from front C. Flower from side D. Flower in oblique view E. Dorsal sepal F. Petal G. Lateral sepal H. Lip I. Lip surface J. Margin of the central lobe K. Flower from side with petals and sepals removed showing the lip and the column in natural position L. Column from front M. Column from side N. Pollinarium from front O. Pollinarium from back. Drawing by R. Jiménez-Machorro from D. Szeszko sub R. Jiménez 2901.

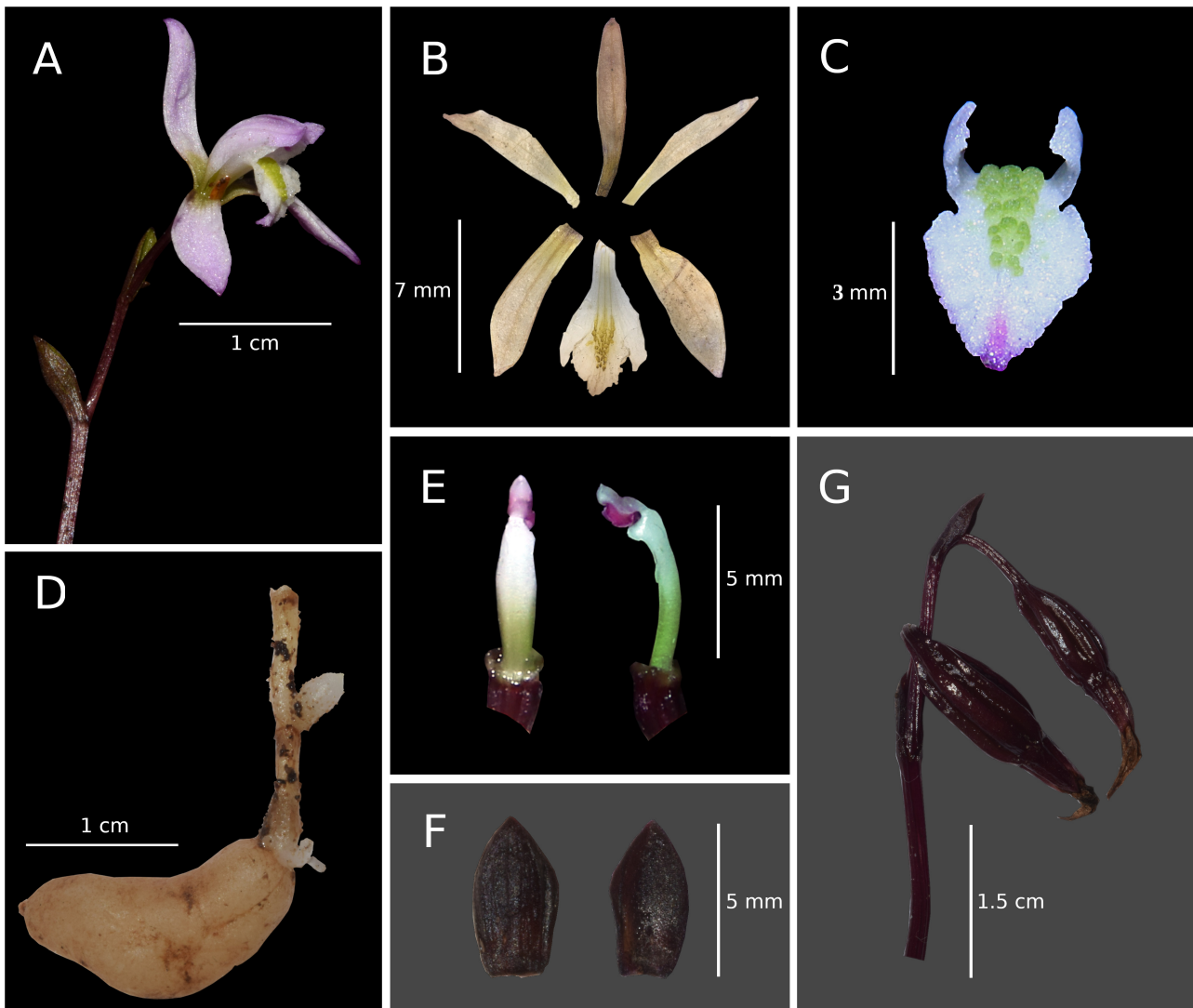


FIGURE 2. *Triphora gallegosii*. **A.** Flower at anthesis **B.** Flower dissection showing sepals, petals and lip **C.** Lip showing its shape at anthesis **D.** Corm **E.** Dorsal and lateral view of column **F.** Adaxial and abaxial surface of a leaf **G.** Fruits. Photos by A. Dávalos-Martínez (A, D, F), A. Zabalgaitia (C, E, G) and D. Figueroa (B).

Distribution and ecology:—This species is currently known from central, western, and northwestern Mexico in the states of Jalisco, Sinaloa, Michoacan, and Estado de Mexico (Figure 3), but there are probably more intermediate populations among known localities. From a biogeographic perspective, this species is distributed in the Trans-Mexican Volcanic Belt, the Sierra Madre del Sur and Sierra Madre Occidental provinces proposed by Morrone *et al.* (2017).

Triphora gallegosii inhabits in oak, oak-pine or pine-oak forests with a marked dry season, in low light conditions among leaf litter in well-drained soils. The elevational range of the populations known to date is between 1500 and 2000 (–2300) m a.s.l. At the type locality, it grows along with *Pinus oocarpa* Schiede ex Schlechtendal (1838: 491), *Pinus douglasiana* Martínez (1943: 4), *Quercus resinosa* Liebman (1854: 182), *Comarostaphylis* sp. Zuccarini (1837: 331), *Achimenes glabrata* (Zuccarini 1832: 99) Fritsch (1894: 174), *Calochortus occidentalis* M.A. García-Martínez & Aarón Rodríguez (2018: 133), *Prochnyanthes mexicana* (Zuccarini 1837: 319) Rose (1903: 14), *Chaetium bromoides* (J. Presl 1830: 324) Bentham ex Hemsley (1885: 503), *Habenaria* sp. Willdenow (1805: 44), and *Tristachya* sp. Nees (1829: 458). In other populations, the presence of *Quercus eduardii* Trelease (1924: 121), *Agave maximilliana*, *Calliandra hirsuta* (G. Don 1832: 395) Bentham (1875: 554), *Ximenia parviflora* Bentham (1839: 7), *Eysenhardtia* sp. Kunth (1824: 489) *Sedum jaliscanum* S. Watson (1890: 148) and *Bletia roezlii* Reichenbach (1877: 7) has been recorded.

The specimens with flowers were collected between August and October, during the rainy season. We observe that most individuals bloom simultaneously within the same population. Although we have recorded the presence of 1–4 flowers per individual, only 1–2 bloom at the same time. The aboveground vegetative parts disappear in the dry

season. Immature capsules were found in September. We have visited the type locality during the flowering time in different years and we have not found any specimens, which leads us to think that the species does not emerge every rainy season.

Etymology:—This species is named after Dr. Jesús Guadalupe González-Gallegos, dear friend and researcher of the CIIDIR herbarium who has contributed substantially to the floristic knowledge of western and northwestern Mexico.

Additional specimens examined (paratypes):—MEXICO. Estado de México: Municipio de Ocuilan, Mexicapa, 30 July 2008, *J. H. Nava Bernal* 223 (AMO!); Municipio de Valle de Bravo, camino de Temascaltepec a Valle de Bravo, 6 September 2013, *D. Szeszko* sub *R. Jiménez* 2901 (AMO!, illustration voucher); 18 October 2006, *D. Szeszko* s.n. (AMO!; non-labeled material); 9 September 2007, *D. Szeszko* 54 (AMO!; non-labeled material). Jalisco: Municipio de Atenguillo, Km 38–39 de la carretera San Vicente-Volcanes entre Tierras Blancas y Fresno Hueco, 20°15'2.5"N, 104°29'10"W, 1931 m, 17 August 2012, *A. Rodríguez et al.* 6744 (IBUG!); Municipio de Ayutla, km 19.3 del camino Ayutla-San Miguel de la Sierra, 20°07'21.1"N, 104°29'01.9"W, 1837 m, 15 September 2019, *D. S. Figueroa & R. Guerrero-Hernández* 393 (IBUG!, AMO!). Michoacán: Municipality Tancitaro, on road from Tancitaro to Apatzingan, 17 August 1940, *W. M. C. Leavenwoerth* (F!). Sinaloa: Municipio de Concordia, El Carrizo, carretera Mazatlán-Durango, 23°31'27.56"N, 105°50'11.95"W, 1926 m (georeferenced), 29 August 1988, *R. Vega et al.* 2909 (MEXU!).

Other records:—MEXICO. Jalisco: *J. G. González-Gallegos* s.n. (INaturalist observation: 1604925 image!). Sinaloa: *M. G. Millán-Othero* s.n. (INaturalist observation: 131170951 image!).

Conservation status:—*Triphora gallegosii* is only known from eight locations (Figure 3). The primary risk factors for this species and its habitats are extensive livestock grazing, expansion of the agricultural frontier, invasive species such as exotic grasses, severe forest fires, logging, drier soil conditions due to forest clearing, and global warming. Based on IUCN Red List guidelines and criteria B2ab(iii) (IUCN Standards and Petitions Committee 2022) *Triphora gallegosii* could be considered in the category of Vulnerable (VU), because the number of its known locations is <10 [condition B2(a)], its scarce eight locations have an estimated area of occupancy (AOO) of only 32 km² (<2000 km², B2 criterion), and an estimated continued decline of area and quality of habitat [condition B2(b)(iii)]. Nevertheless, there are probably more intermediate populations among the known localities in an extent of occurrence (EOO) of 127,550.4 km².

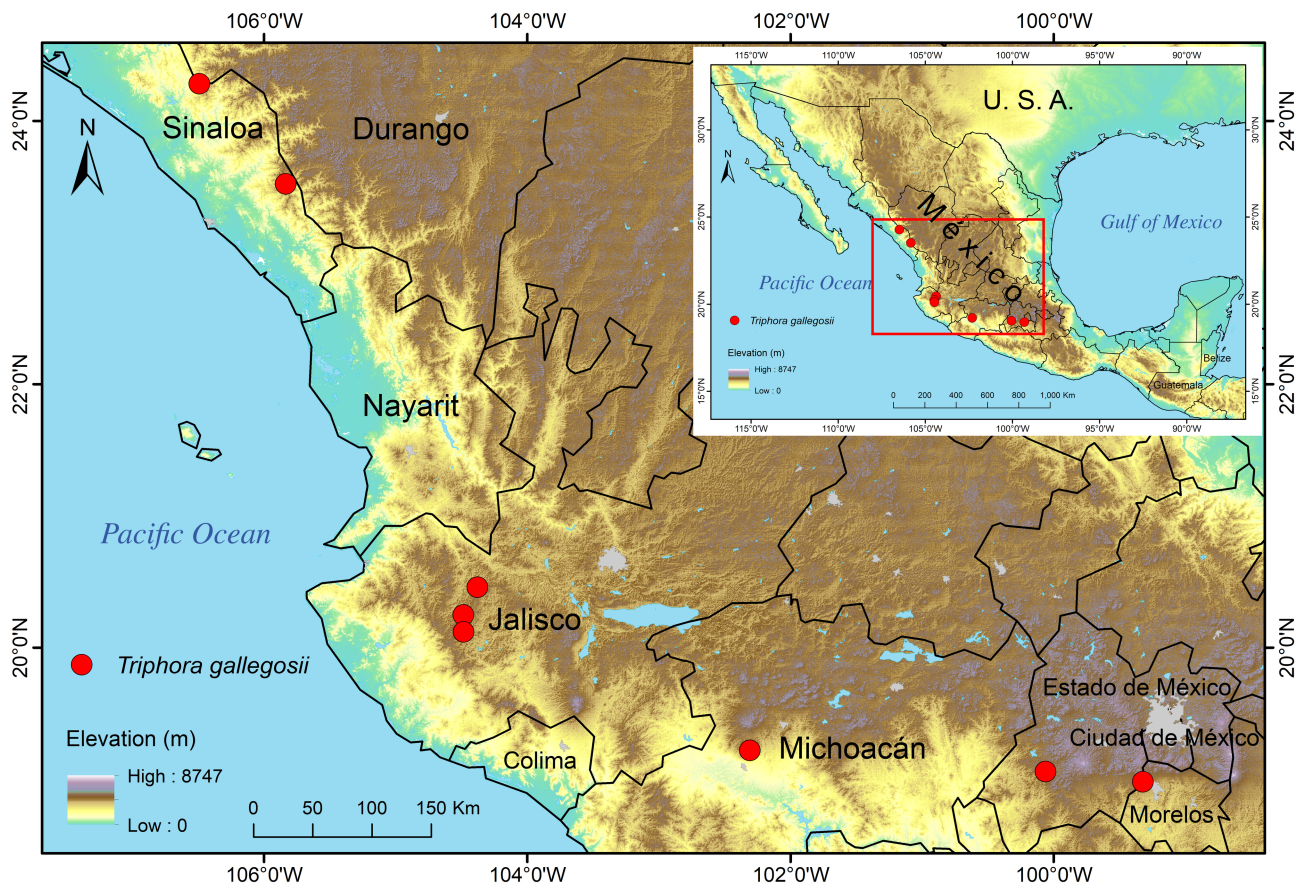


FIGURE 3. Known localities of *Triphora gallegosii*.

Taxonomic Discussion:—This new species is morphologically similar to *T. wagneri* and *T. gentianoides*, with whom it shares the presence of scale-like leaves, similar sizes in floral parts, and lips with three longitudinal and verrucous lines. However, *T. gallegosii* differs from both by many characters (see Table 1), mainly present in flowers, as the shape and length of the lines of the lip, the position and number of flowers, and their phenology. Also, it differs from *T. wagneri* by having a constricted central lobe and lateral lobes with an acute apex (*vs.* not constricted and obtuse apex), and from *T. gentianoides* by having an entire margin in the lateral lobes (*vs.* erose to nearly lacerate), a column with a magenta apex and whitish towards the middle portion with a green base (*vs.* magenta to brown at the apex and the rest green or yellowish-white), a magenta anther (*vs.* yellow), leaves of 3.5–13 × 2–6 mm (*vs.* 10–18 × 5–10 mm), and by having solitary growth (*vs.* growth in clusters). In addition, while *T. gallegosii* can be found in the highlands of central, western and northwestern Mexico, *T. gentianoides* is distributed in the lowlands of southeast Mexico, Central America, the Caribbean islands and the state of Florida in the USA. On the other hand, *T. wagneri* is distributed in Central America. In our herbarium review we could not find a single reliable specimen of *T. wagneri* due to the lack of dissected flowers or because the material was in poor condition, so our comparison between this species and *T. gallegosii* was based on a drawing of the holotype (AMES, barcode: HUH00090830 image!) and the original description of the species. Medley (1996) cites some specimens of *T. wagneri* from the state of Michoacan, but it is more probable that these specimens belong to *T. gallegosii*, since habitat description, phenology and distribution fits better with this species.

TABLE 1. Comparison of *Triphora gallegosii* with morphologically similar species.

Characters	<i>T. gallegosii</i>	<i>T. wagneri</i>	<i>T. gentianoides</i>
Number of flowers	1–4	1	3–10
Position of the flowers	Resupinate, not erect	Not resupinate, erect	Not resupinate, erect
Flower color	Sepals and petals magenta at the apex, decreasing in intensity towards the middle portion, green at the base. Lip white, with a magenta spot at the tip of the central lobe, with green warts.	Unknown	Sepals and petals ranging from green to white, commonly with some brown or reddish tones on sepals. Lip white to pale green, with green and white warts.
Apex of the lateral lobes	Acute	Obtuse	Acute
Margin of the lateral lobes	Entire	Entire	Erose to nearly lacerate
Union between lateral and central lobes	Constricted	Not constricted	Constricted
Length of the lines of the lip	From the base of the lip vanishing to the middle of the central lobe	From the base of the lip to the apex of the central lobe	From the base of the lip to the apex of the central lobe
Column color	Magenta at the apex, decreasing in intensity towards the middle portion, green at the base.	Unknown	Magenta to brown at the apex, the rest green to yellowish-white.
Anther color	Magenta	Unknown	Yellow
Leaf size	3.5–13 × 2–6 mm	10–12 mm long (unknown width)	10–18 × 5–10
Growth form	Solitary	Solitary	In clusters
Phenology	In anthesis between August–September	In anthesis in April	In anthesis between June–August

Sympatric populations of *T. gallegosii* and *T. trianthophoros* or *T. mexicana* may exist, since distribution ranges overlap. The flowers of these three species may appear similar, but *T. gallegosii* can be easily distinguished from these two by its reddish stems and its scale-like leaves.

The presence of mycorrhizae has been reported in some species of *Triphora* (including *T. gentianoides*) and other genera in Triphorinae (Carlsward & Stern 2009). Ongoing research on mycoheterotrophy in *T. trianthophoros* using isotopic evidence has also shown that this species is partially mycoheterotrophic (Brandon Corder, pers. comm., 2023). Scale-like leaves and reddish colorations on stems and leaves may indicate some degree of mycoheterotrophy (Cameron & Leake 2007), as in other groups of orchids (Merckx *et al.* 2012, Feng *et al.* 2016), so it is possible that *T. gallegosii* also has some type of relationship with fungi. Further studies (e.g. analyzing isotope signatures) could corroborate this hypothesis.

Key to the determination of species in the genus *Triphora* in Mexico

1.	Leaves with extended lamina	2
1'.	Leaves scale-like	5
2.	Lip slightly three-lobed, presence of scattered subulate fleshy projections in the central lobe	<i>T. debilis</i>
2'.	Lip conspicuously three-lobed, presence of fleshy projections of different shapes arranged in lines along the lip	3
3.	Flowers not resupinate, central lobe of lip rectangular	<i>T. yucatanensis</i>
3'.	Flowers resupinate, central lobe of lip suborbicular to deltoid or obovate	4
4.	Central lobe of the lip with purple spots	<i>T. mexicana</i>
4'.	Central lobe of the lip without purple spots	<i>T. trianthophoros</i>
5.	Lip with five lines with fleshy projections	<i>T. hassleriana</i>
5'.	Lip with three lines with fleshy projections	6
6.	Lateral lobes of the lip with obtuse apex, union with central lobe not constricted	<i>T. wagneri</i>
6'.	Lateral lobes of the lip with acute apex, union with central lobe constricted	7
7.	Solitary plants, flowers resupinate, margin of lateral lobes of lip entire	<i>T. gallegosii</i>
7'.	Grouped plants, flowers not resupinate, margin of lateral lobes of lip erose to lacerate	<i>T. gentianoides</i>

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