



## A new species of *Lobelia* (Campanulaceae: Lobelioideae) from the Sierra Madre Oriental, Mexico

MIGUEL A. PÉREZ-PÉREZ<sup>1,3\*</sup>, TINA J. AYERS<sup>1,4</sup> & JONATHAN D. AMITH<sup>2,5</sup>

<sup>1</sup> Department of Biological Sciences, P.O. Box 5640, Northern Arizona University, Flagstaff, Arizona 86011-5640, USA

<sup>2</sup> Department of Anthropology, Gettysburg College, 300 North Washington Street, Gettysburg, Pennsylvania 17325-1400, USA

<sup>3</sup> [map758@nau.edu](mailto:map758@nau.edu); <https://orcid.org/0000-0002-5095-8482>

<sup>4</sup> [Tina.Ayers@nau.edu](mailto:Tina.Ayers@nau.edu); <https://orcid.org/0000-0002-6079-6149>

<sup>5</sup> [nahuatl.biology@gmail.com](mailto:nahuatl.biology@gmail.com); <https://orcid.org/0000-0001-7518-8456>

\*Correspondence author: [map758@nau.edu](mailto:map758@nau.edu)

### Abstract

*Lobelia alanae* sp. nov. from Puebla and Veracruz, Mexico, is described from four known populations in tropical deciduous forests from 153 to 700 m elevation. This new species is compared to the closely related *Lobelia porphyrea*, a species known only from the type collection in the state of Hidalgo. *Lobelia alanae* can be separated from *L. porphyrea* by its height, hypanthium, calyx lobes and fruit. Based on the strongly reticulate-foveolate seed coats, *L. alanae* is hypothesized to be a new member of section *Lobelia*, previously comprising 22 species nearly endemic to the eastern U.S.

### Resumen

Se describe una nueva especie del género *Lobelia* distribuida en los estados de Puebla y Veracruz, México. La nueva especie fue descrita utilizando cuatro poblaciones colectadas en bosque tropical caducifolio con elevaciones que van de los 153 a los 700 metros. *Lobelia alanae* fue comparada con *Lobelia porphyrea*. La descripción de *L. porphyrea* se basó en una única colección, proveniente de Hidalgo, México. *Lobelia alanae* puede distinguirse de *Lobelia porphyrea* por el tamaño de la planta, el hipantio, los lóbulos del cáliz y el fruto.

Hipotéticamente, *Lobelia alanae* puede ser categorizada en la sección *Lobelia* porque sus semillas están marcadamente reticuladas-faveoladas. La sección *Lobelia*, comprende 22 especies casi endémicas al este de los Estados Unidos de América.

**Keywords:** Ethnobotany, Sierra Norte de Puebla, Taxonomy, Veracruz

### Introduction

The genus *Lobelia* Linnaeus (1754: 929) is the second largest and most widely distributed genus in the Campanulaceae, comprising 423 species (Gutiérrez-Sánchez *et al.* 2018) grouped in 18 sections (Lammers 2011). The life forms range from small herbs to giant woody plants (Geleta & Bryngelsson 2012). *Lobelia* is widespread in the tropics, with centers of diversity in tropical Africa and Mexico (Santos-Vieira & Shepherd 1998).

Of the ca. 86 species of *Lobelia* in Mexico (Rzedowski 2019), there are ca. 72 species of *Lobelia* section *Stenotium* (Presl 1836: 394) Lammers in Hong & Lammers (2011: 556), including 16 spurred species, eight species in *Lobelia* section *Cryptostemmon* (Wimmer 1948: 358) Murata (1995: 15), and four species in *Lobelia* section *Homochilus* de Candolle (1839: 383), most found in the montane pine-oak mixed forests of the Mexican Transition Zone (Morrone 2015). Only one species from the section *Lobelia* (Linnaeus 1753: 929) and one species in *Lobelia* section *Tylomium* (Presl 1836: 394) Bentham & Hooker (1876: 552) occur in Mexico, generally at lower elevations in tropical moist forests. Worldwide 30 new species have been described in the past 20 years including 18 species (60%) endemic to Mexico (Gutiérrez-Sánchez *et al.* 2018; Rzedowski & Calderón de Rzedowski 2001; Rzedowski 2016; Rzedowski 2018; Senterre & Castillo-Campos 2008). Most of the newly described species are in the section *Senotium* from the Sierra Madre Occidental, the Mexican Transvolcanic Belt, and the Sierra Madre del Sur. Only one species, *L. porphyrea* Rzedowski (2001: 55), was described from the Sierra Madre Oriental in the state of Hidalgo.

From 2014 and continuing to the present Amith and teams of field botanists have carried out floristic and ethnobotanical studies in over a dozen Nahuatl and Totonac communities in the northern sierras in the state of Puebla and in two additional Totonac communities just over the border in Veracruz. Over 10,500 plants were collected and photographed in situ. To obtain the most complete data on plant names, classification, and economic and symbolic use, the field teams generally were accompanied by three native (mostly male) speakers from each community, speakers selected for their ethnobotanical knowledge and command of their native languages. This project is distinct from most ethnobotanical efforts: (a) it is comparative, with particular attention paid to variation in nomenclature, classification, and use among both Nahuatl and Totonac communities; (2) it gathered material often not part of ethnobotanical research such as dried tissue samples, carefully taken in situ photographs (<https://demca.mesolex.org/portal/imagelib/index.php>) and extensive recordings of Indigenous knowledge that have been transcribed and translated (<https://demca.mesolex.org/portal/ethno/eaf/index.php>). Relevant to the present new species discovery, this ethnobotanical project is floristic as well, collecting plants whether or not they had local names, classification, or uses. The floristic facet of this project has yielded quite a few new species (~25) and approximately 300 new state reports for Puebla.

Given the extensiveness of collection and the challenging logistics (plants were shipped from MEXU only about every 18 to 24 months), significant delay in positive, voucher-based identification to species often occurred although preliminary IDs from photos (with probably greater than 95 percent accuracy) were obtained for approximately three-quarters of the material.

The floristic aspect of this ethnobotanical study has been important to both ethnobotanists and botanists. For the former, it gives an approximation of the percent of local flora that is linguistically and culturally salient. For botanists, we have found that most of the uncommon plants are not named, classified, or used by the Nahuatl and Totonac communities. Such is the case with the new species described here, as none of the nine different consultants in the five collecting events had any knowledge (name, classification, or use) about it. This material is described here and compared to morphologically similar species.

## Taxonomic treatment

*Lobelia alanae* *sp. nov.* M. A. Pérez-Pérez & T. J. Ayers (Figures 1–2)

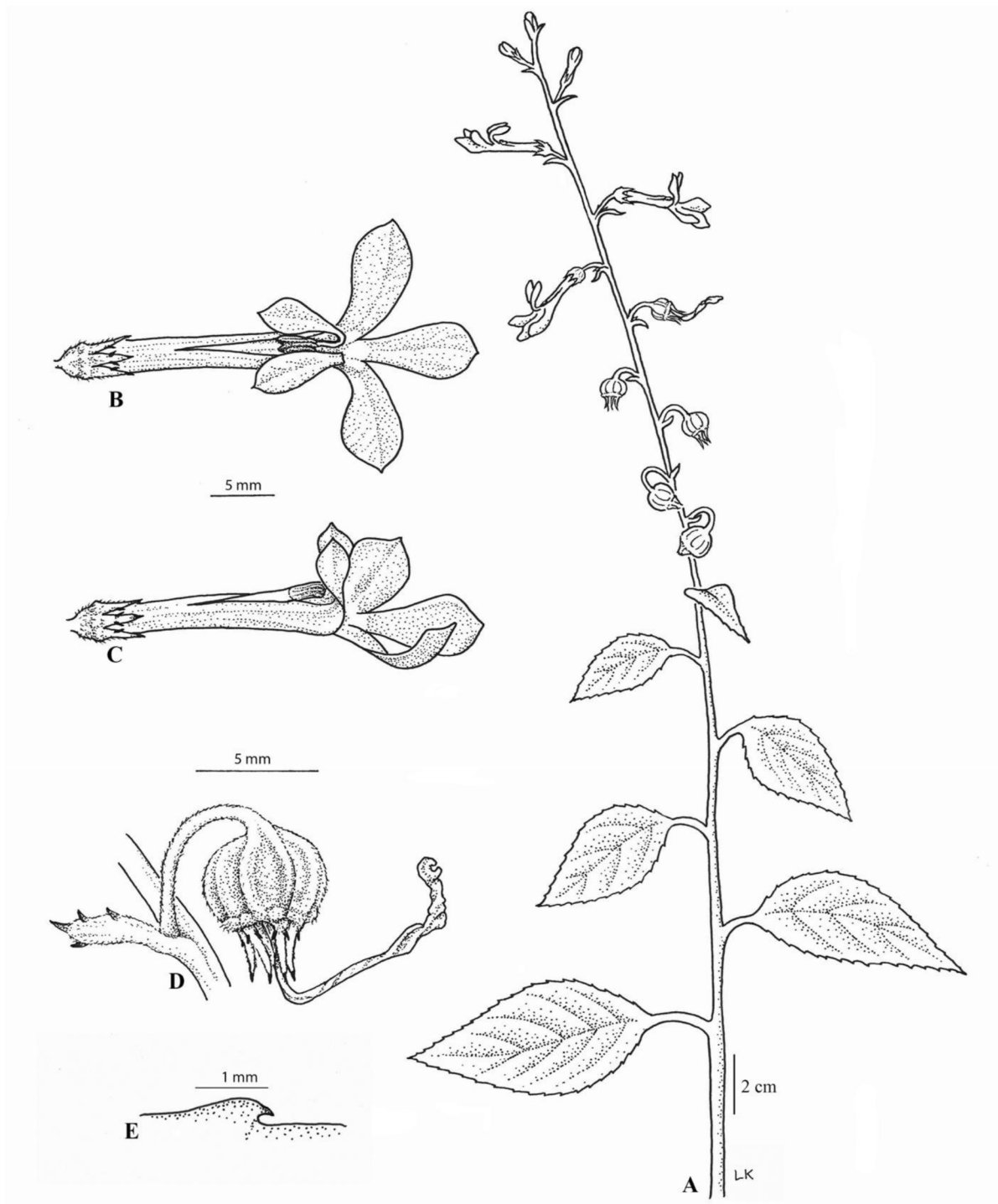
Type:—MEXICO. Puebla. Municipality of Ayototxco de Guerrero. Copales. In a site called Espinazo del Diablo, near the Apulco river, 153 m elevation, 20.09053°N, 97.45086°W. 20 September 2016, M. Jiménez-Chimil and M. Gorostiza-Salazar 31421 (holotype: US!, isotypes: HUAP, IEB!, K!, MEXU, MO!).

### Diagnosis:

Similar to *Lobelia porphyrea*, but with cauline leaves, a hemispheric hypanthium, calyx lobes with 1–2 pair of elongate, purple teeth at margins and one apical purple tooth and a spherical capsule 5–7 mm in diameter.

Perennial herb from a woody caudex. **Stems** erect, branched well above base or unbranched, to 80 cm high, greenish, hirtellous. **Leaves** cauline, alternate, subsessile or petiolate, petioles 2–22 mm long; blades ovate to ovate-lanceolate, 3–11.5 cm long, 0.9–4.3 cm wide, abruptly reduced above; base long-attenuate; apex apiculate-acuminate; margins minutely serrulate or biserrate, with white callosities at tips of teeth; glabrous to hirtellous especially along veins abaxially and near margins. **Inflorescence** racemose, bracteate; bracts sessile, linear-lanceolate, 5–9 mm long, 0.4–1.5 mm wide; apex apiculate; margins continuous with extremely small wings on stem; margins serrate, tipped with purple, elongate, callose teeth. **Flowers** pedicellate; pedicels 0.6–1.4 cm long, bi-bracteolate at base; bracteoles 1–2 mm long with a prominent purple apical gland, hirtellous or ciliate; hypanthium hemispheric, ca. 1.2–2.0 mm long, 2.3–2.9 mm wide, hirtellous, prominently veined; calyx lobes subulate, the two laterals often curved upward and overlapping the dorsal lobe in flower, 1.3–2.5 mm long, 0.5–0.7 mm wide, with 1 purple apical callosity, and 1–2 pair of marginal elongate pubescent purple callosities near base or middle; corolla bilabiate, pink; tube cylindrical, 10–16 mm long, ca. 4 mm in diameter, slit dorsally except for ca. 3 mm at base, outer surface, hirtellous; limb bilabiate, bent upward ca. 45 degrees in bud; upper lobes oblong-spatulate, 3.3–4.3 mm long, 1.4–1.6 mm wide, acute, margins entire to irregularly undulate when dry, hirtellous along veins or glabrate; lower lobes obovate, 6.9–7.3 mm long, 3.3–4.5 mm wide, cuspidate, margins entire to irregularly undulate when dry, pink with a white patch at throat, hirtellous along veins or glabrate; stamens shorter than corolla tube; filaments white, free at base for 5–7 mm then connate into a tube ca. 4 mm long, the anthers blue-black, connate, 1.6–2.0 mm long, the three upper anthers covered with minute greyish hairs, the two lower anthers glabrous except for the numerous minute linear trichomes at apex; ovary bilocular, one-

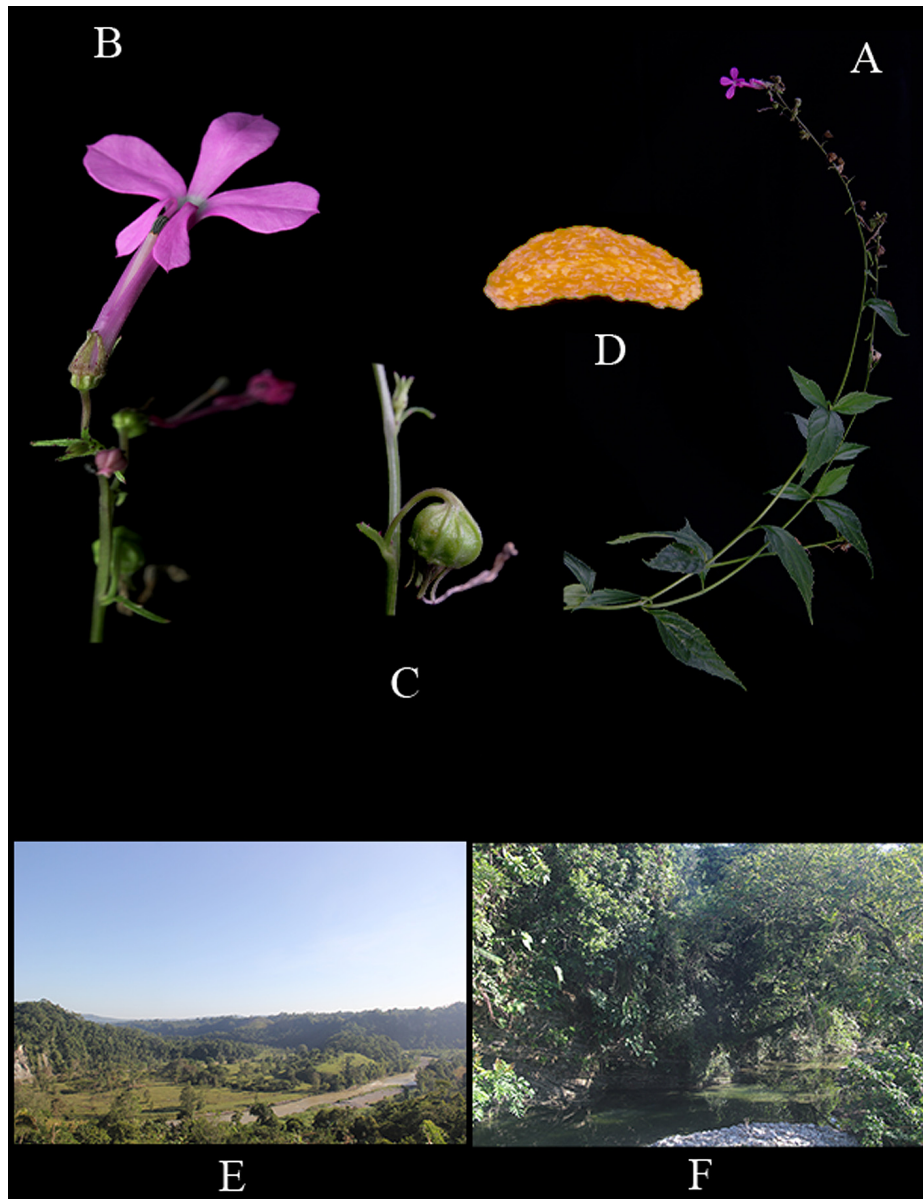
half inferior in flower, the style 10–12 mm long, the stigma lobes with minute whiteish hairs below. **Capsule** spherical, pendant on a reflexed pedicel, three-quarters or more inferior, 5–7 mm in diameter, strongly 10-veined, the veins persistent; seeds ca. 36, yellow to brown, ellipsoid, ca. 1 mm long, elongate-scabrate to reticulate-foveolate, shiny. Chromosome number: unknown.



**FIGURE 1.** *Lobelia alanae* M.A. Pérez-Pérez & T. Ayers. **A.** Habit. **B.** Flower top view. **C.** Flower side view. **D.** Capsule. and **E.** Tooth on leaf margin.

Specimens examined: MEXICO. Puebla. Municipality of Jonotla, Xiloxochit. Densely wooded hillside above Apulco river at a site called “Isla” near El Porvenir, about 20 minute walk from the Copalco chapel. 176 m, 20.10131° N, 97.45608° W, 28 May 2015, Ceferino Salgado-Castañeda 2540 (HUAP, MEXU, US!). Municipality of Ayotoxco de Guerrero. Copales. At a site called Espinazo del Diablo, alongside the road to Atsalan, 177 m, 20.09024°N, 97.45182°W, 01 July 2016, M. Jiménez-Chimil and M. Gorostiza-Salazar 31381 (ASC!, HUAP, MEXU, MO, US). Veracruz, Municipality of Mecatlán, to the north of the municipality, near the location of the antennas, 663 m, 20.20633°N,

97.67272° W, 7 May 2017, Osbel López-Francisco and Ceferino Salgado-Castañeda 76078 (ASC!, HUAP, MEXU, US); Municipality of Coahuiltlán, along the major road Coahuiltlán-Crucero, at the entrance to the village of Coahuiltlán, 701 m, 20.25681° N, 97.73054° W, 10 August 2017, Osbel López-Francisco and Ceferino Salgado-Castañeda 76237 (ASC!, MEXU, US).



**FIGURE 2.** *Lobelia alanae* M.A. Pérez-Pérez & T. Ayers **A.** Flowering branch. **B.** Flower from above showing lateral calyx lobes crossed over dorsal lobe. **C.** Capsule. **D.** Seed about 1 mm in length. **E.** Landscape of Espinazo del Diablo and Apulco river. **F.** Type locality. Pictures taken from the type collection *M. Jiménez-Chimil* and *M. Gorostiza-Salazar 31421*.

**Etymology:** This species is named in the honor of Alana Amith who assisted her father, Jonathan Amith, in his work on the “Comparative Mesoamerican Ethnobiology of the Sierra Norte de Puebla”.

**Habitat and conservation:** Secondary Forest, tropical dry forest, and cloud forest. The primary botanical elements associated with *Lobelia alanae* are *Bursera* Jacquin ex Linnaeus (1762: 471), *Leucaena* Benthham (1842: 416–417), *Ceratozamia* Brongniart (1846: 7–8), *Saurauia* Willdenow (1801: 407), *Inga* Miller (1754: 498), and *Cecropia obtusifolia* Bertoloni (1840: 141). The Sierra Norte of Puebla is an important coffee region in Mexico. The coffee plantations are agroecosystems that include 256 native and 63 introduced species (Martinez *et al.* 2007).

The type locality of *L. alanae* is at 153 meters elevation in a heavily shaded area about 20 meters above the Apulco river. The two other lowland collections (176 m) were also near the same river at a distance of 100 and 50 m. The two higher elevation collections in Veracruz (663 and 701 m) were not associated with a water way and, unlike the previous collections, they occurred in a relatively disturbed environment.

*Lobelia alanae* is distributed in two Mexican states (Figure 3). The field teams noted that *L. alanae* grew in colonies. According to the amplitude of the range represented by the species distribution (less than 5% of the Mexican territory), this taxon is categorized as very restricted (SEMARNAT, 2010).



FIGURE 3. Geographic distribution of *Lobelia alanae* M.A. Pérez-Pérez & T. Ayers in Mexico

## Discussion

*Lobelia alanae* is recognized as a new species from the states of Puebla and Veracruz, Mexico. Five characters can be used to distinguish *L. alanae* from the morphologically similar species *L. porphyrea* (Table 1). The description of *L. porphyrea* was based on one collection from Hidalgo near the border with the state of Queretaro (Rzedowski & Calderón de Rzedowski 2001). The two type localities, of *L. porphyrea* and *L. alanae*, are almost aligned latitudinally, but separated by 237 km of linear distance.

TABLE 1. Morphological comparison between *Lobelia alanae* and *L. porphyrea*.

Character	<i>Lobelia alanae</i>	<i>Lobelia porphyrea</i>
Plant height	80 cm	35 cm
Leaves	cauline	mostly basal
Hypanthium in flower	1–1.5 mm long	2 mm long
Calyx lobes	green, with 1–2 pair of marginal purple teeth	pale white or more commonly purple, entire
Fruit	$\frac{3}{4}$ inferior, prominently veined	$\frac{1}{2}$ inferior, veins not prominent

Based on its seed coat sculpturing, *Lobelia alanae* is hypothesized to be a member of section *Lobelia* (Lammers, 2011). Apart from *L. alanae* (and perhaps *L. porphyrea*), section *Lobelia* is almost entirely endemic to the eastern United States and Canada and has a reticulate-foveolate seed coat denoted as “Type A” (Murata 1995). The seeds of *Lobelia alanae* are nearly identical to the seeds of *Lobelia cardinalis* Linnaeus (1753: 930), which is the most widespread species in section *Lobelia* occurring throughout North and Central America. The species in section *Lobelia*

generally grow at elevations below 1500 meters in mesic areas. The morphologically similar *L. porphyrea* may also be a member of section *Lobelia* although it was placed in section *Stenotium* by Gutiérrez-Sánchez *et al.* (2018).

*Lobelia alanae* is the most recently described Campanulaceae species distributed in the poorly explored Sierra Madre Oriental. The local inhabitants of this region have retained traditional knowledge and are still using the natural resources for food, herbal medicine, and construction. For example, the native *Lobelia berlandieri* de Candolle (1839: 367) is used as medicine by the local people (Martínez *et al.* 2007).

## Acknowledgments

The *Lobelia alanae* specimens were collected with support from the National Science Foundation, Documenting Endangered Languages #BCS-1401178 and the National Endowment for the Humanities, #PD-50031-14, both under the direction of Jonathan Amith. Collections were carried out by Miriam Jiménez-Chimil, Mariano Gorostiza-Salazar, Osbel López-Francisco, and Ceferino Salgado-Castañeda. The field photos of the type specimen were taken by Mariano Gorostiza-Salazar, habitat photos were taken by Ceferino Salgado-Castañeda and Osbel López-Francisco, all the aforementioned field botanists are members of Amith's field teams. The authors also thank Lisa Kearsley for the illustration and Claudia Dimartini for the closeup of the seed.

## References

- Bentham, G. (1842) Bentham on the Mimoseae. *The Journal of Botany, being a second series of the Botanical Miscellany* 4: 416–417.
- Bentham, G. & Hooker, J.D. (1876) Campanulaceae. *Genera Plantarum* 2: 552.
- Bertoloni, A. (1840) *Cecropia obtusifolia*. *Nuovi annali delle scienze naturali* 3: 141.
- Brongniart, A.T. (1846) Sur un nouveau genre de Cycadées du Mexique. *Annales des Sciences Naturelles, Botanique, sér 3*, 5: 7–8.
- De Candolle de, A.P. (1839) *Prodromus systematis naturalis regni vegetabilis sive enumeratio contracta ordinum generum specierumque plantarum hucusque cognitarum, juxta methodinaturalis normas digesta*. Treuttel et Würtz, Paris, 801 pp.
- Geleta, M. & Bryngelsson, T. (2012) Population genetic analysis of *Lobelia rhynchopetalum* Hemsl. (Campanulaceae) using DNA sequences from ITS and eight chloroplast DNA regions. *Scientific World Journal* 2012: 276451.  
<https://doi.org/10.1100/2012/276451>
- Gutiérrez-Sánchez, R.I., Castro-Castro, A., González-Gallegos, J.G., Lopez-Enriquez, I.L. & Frías-Castro, A. (2018) Synopsis of the spurred species of *Lobelia* section *Stenotium* (Campanulaceae) in Sierra Madre Occidental, Mexico, and the description of two new species. *Phytotaxa* 338 (1): 33–48.  
<https://doi.org/10.11646/phytotaxa.338.1.3>
- Hong, D.Y. & Lammers, T.G. (2011) *Lobelia*. In: Wu, C.Y., Raven, P.H. & Hong, D.Y. (Eds.) *Flora of China* 19. pp. 554–562.
- Lammers, T.G. (2011) Revision of the infrageneric classification of *Lobelia* L. (Campanulaceae: Lobelioideae). *Annals of the Missouri Botanical Garden* 98 (1): 37–62.  
<https://doi.org/10.3417/2007150>
- Linnaeus, C. (1753) *Species plantarum*. Salvius, Stockholm, 1200 pp.
- Martínez, M.A., Evangelista, V., Basurto, F., Mendoza, M. & Cruz-Rivas, A. (2007) Flora útil de los cafetales en la Sierra Norte de Puebla, Mexico. *Revista Mexicana de Biodiversidad* 78: 15–40.  
<https://doi.org/10.22201/ib.20078706e.2007.001.457>
- Morrone, J.J. (2015) Biogeographical regionalization of the world: A reappraisal. *Australian Systematic Botany* 28 (3): 81.  
<https://doi.org/10.1071/SB14042>
- Murata, J. (1995) A revision of infrageneric classification of *Lobelia* (Campanulaceae–Lobelioideae) with special reference to seed coat morphology. *Journal of the Faculty of Science, University of Tokyo, Section 3, Botany* 15 (5): 349–371.
- Presl, C.B. (1836) *Prodromus monographiae Lobeliacearum*. Haase, Pragae.
- Rzedowski, J. & Calderón de Rzedowski, G. (2001) Tres especies mexicanas de *Lobelia* (Campanulaceae, Lobelioideae), una redescubierta y dos nuevas. *Acta Botanica Mexicana* 55: 29–38.  
<https://doi.org/10.21829/abm55.2001.874>
- Rzedowski, J. (2018) Tres novedades de Campanulaceae–Lobelioideae del estado de Oaxaca (México). *Phytoneuron* 15: 1–9.
- Rzedowski, J. (2019) Updated inventory of the Mexican species of Campanulaceae. *Botanical Sciences* 97: 110–127.  
<https://doi.org/10.17129/botsci.2085>

- Santos-Vieira, A.O. & Shepherd, G.J. (1998) A new species of *Lobelia* (Campanulaceae) from Brazil. *Novon: A Journal for Botanical Nomenclature* 8 (4): 457–460.  
<https://doi.org/10.2307/3391874>
- SEMARNAT. (2010) Norma Oficial Mexicana NOM-059–Semarnat-2010, Protección ambiental-especies nativas de México de flora y fauna silvestres-categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-lista de especies en riesgo. *Diario Oficial de la Federación* 30 Diciembre, 2010.
- Senterre, B. & Castillo-Campos, G. (2008) A new rare species of *Lobelia* (Campanulaceae, Lobelioideae) from Mexican lowland rainforest. *Novon: A Journal for Botanical Nomenclature* 18 (3): 378–383.  
<https://doi.org/10.3417/2007020>
- Willdenow, C.L. (1801) Drei neue pflanzengattungen beschrieben. *Gesellschaft Naturforschender. Freunde zu Berlin, neue Schriften* 3: 407, pl. 4.
- Wimmer, F.E. (1948) Vorarbeiten zur monographie der Campanulaceae-Lobelioideae: II Trib. Lobelieae. *Annalen des Naturhistorischen Museums in Wien* 56: 358.