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Neobartsia matuy (Orobanchaceae), a new species from the Colombian Andes

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Abstract

A new species of *Neobartsia* endemic to the eastern Andes of Colombia is described, illustrated, and compared with related species. This species belongs to section *Orthocarpiflorae* and morphologically it is characterized by having floral bracts light green with glandular hairs, corolla yellowish green, the galea cucullate, longer than the lip, retrorsely glandular-puberulous, the lip three-lobed, glabrous and the corolla tube decurved. Currently, it is only known from two localities in the Colombian department of Boyacá, where it grows in the páramo ecosystem between 3528 and 3639 meters above sea level on rocky soil with grassy vegetation.

Keywords: *Bartsia*, Boyacá, Colombia, endemism, *Orthocarpiflorae*, páramo

Resumen

Una nueva especie de *Neobartsia* endémica a los Andes orientales de Colombia es descrita, ilustrada y comparada con especies afines. Esta especie pertenece a la sección *Orthocarpiflorae* y morfológicamente se caracteriza por tener brácteas florales verde claro con pelos glandulares, corola verde amarillenta, galea cuculada y mayor que el labio, glandular-pubérula con pelos retrorsos, el labio con tres lóbulos, glabro y el tubo de la corola curvado. Hasta el momento, solo se conoce de dos localidades en el departamento colombiano de Boyacá, donde crece en ecosistemas de páramo entre los 3528 y 3639 metros sobre el nivel del mar, sobre suelos rocoso con vegetación herbácea.

Introduction

Neobartsia Uribe-Convers and Tank (2016: 678) is a recently described genus in the family Orobanchaceae that is comprised of 47 species formerly belonging to the genus *Bartsia* L. (1753: 602). The genus has a South American distribution (Molau 1990, Cabrera and Botta 1992, Sylvester 2014, Uribe-Convers & Tank 2015) and its species are found at high elevations above the tree line in the Andean páramo, puna and jalca ecosystems (Uribe-Convers & Tank 2016). In Colombia, nine species occur in a range from 2100 to 4510 m above sea level in the Andean páramo ecosystem (Bernal 2019).

Molau (1990) produced the first comprehensive revision of the genus and divided *Bartsia* into seven sections based on morphological characters and geographic distributions: section *Bartsia* and sect. *Longiflorae* Molau, distributed in Europe and Northeastern Africa, respectively; sect. *Bellardia* (All.) Molau, with a Mediterranean origin but introduced in all subtropical dry areas of the world; and sections *Orthocarpiflorae* Molau, *Strictae* Molau, *Laxae* Molau, and *Diffusae* Molau distributed in the South American Andes. Uribe-Convers & Tank (2016) updated the taxonomic classification of these taxa and proposed a new classification for the South American species of *Bartsia* assigning them to the new genus *Neobartsia*. This new classification was based on biogeographic analyses, morphological and

molecular evidence, and rates of diversification. Creation of the new genus resolved the problem of paraphyly of *Bartsia*.

During various recent botanical expeditions, two populations of *Neobartsia* morphologically distinct from other species collected in the area were found. Plants in these populations differ from other species by having light green floral bracts and yellow green corollas. Based on the morphological study of live and dry material, as well as some genetic data, we describe a new species of *Neobartsia* sect. *Orthocarpiflorae*. This section is comprised of nine species distributed from N Colombia and W Venezuela to NW Bolivia, and is recognized by its growth habit, subequally cleft calyx, and a corolla with a more or less torpedo-shaped galea exceeding the lower lip (Molau 1990, Uribe-Convers & Tank 2016).

Material and methods

Morphology

The description was prepared from live material collected during the botanical expedition to El Valle Regional Natural Reserve in the Boyacá department, in September and October of 2018. Previous collections were made in El Páramo de La Rusia in the Boyacá department in May 2012 and September 2013. We reviewed the monograph and other information of the genus *Bartsia* (Molau 1990, Randle & Uribe-Convers 2019) and the digital images of the type specimens present in Colombia and the Andes at Global Plants JSTOR <https://plants.jstor.org/>. Measurements were taken from live material and herbarium material, using a digital calibrator with a precision of 0.01 mm. The measurements of the floral parts were made on fresh flowers from the type specimen using a Leica S8AP0 microscope. Photographs of leaves, stem, and flowers were taken in the laboratory from fresh material using a Leica MC190 HD camera.

Molecular data

Sanger sequence data for the chloroplast locus *matK* were generated for the type specimen following standard procedures described in Uribe-Convers & Tank (2015). Data for 43 *Neobartsia* species and three closely related taxa were obtained from Uribe-Convers *et al.* (2016) and included the 48 most variable regions in the chloroplast. Phylogenetic analyses followed standard practices described in Uribe-Convers & Tank (2015).

Results

Taxonomic treatment

Neobartsia matuy Malagón, Humberto Mend. & Uribe-Convers, *sp. nov.* (Figs. 1–3)

Type:—COLOMBIA. Boyacá: Cómbita, Vereda Santa Barbara Reserva Natural Regional El Valle, Páramo, 3528 m, N5° 44' 37" W73° 23' 02.26", 21 October 2018 (fl, fr), *H. Mendoza* & *E. Torres 22013* (holotype FMB!, isotypes UPTC!, COL!, HUA!, UDBC!, CUVC!, FMB!, JAUM!, JAUM!, MEDEL!, UIS!).

Diagnosis:—This species belongs to the sect. *Orthocarpiflorae* and differs from *Neobartsia alba* (Molau) Uribe-Convers & Tank (2016: 678), *N. elachophylla* (Diels) Uribe-Convers & Tank (2016: 679), *N. filiformis* (Wedd.) Uribe-Convers & Tank (2016: 679), *N. laniflora* (Benth.) Uribe-Convers & Tank (2016:680), *N. laticrenata* (Benth.) Uribe-Convers & Tank (2016: 680), *N. orthocarpiflora* (Benth.) Uribe-Convers & Tank (2016:681), *N. santolinifolia* (Kunth) Uribe-Convers & Tank (2016: 681), *N. sericea* (Molau) Uribe-Convers & Tank (2016: 682) and *N. trichophylla* (Wedd.) Uribe-Convers & Tank (2016: 681) by the following combination of characters: stems green, retrorsely hirsute with colorless eglandular hairs in two rows; leaves linear to lanceolate, retrorsely hirsute on the veins on both sides, hairs eglandular, margins revolute, evenly crenate with 8–9 lobes on each side; floral bracts light green with glandular hairs, lanceolate, cuneate at base; calyx light green, glandular hirsute; flowers 13–13.6 mm long (without pedicel); corolla yellowish green, tube decurved, galea cucullate longer than the lip, retrorsely glandular-puberulous, hairs yellowish green.

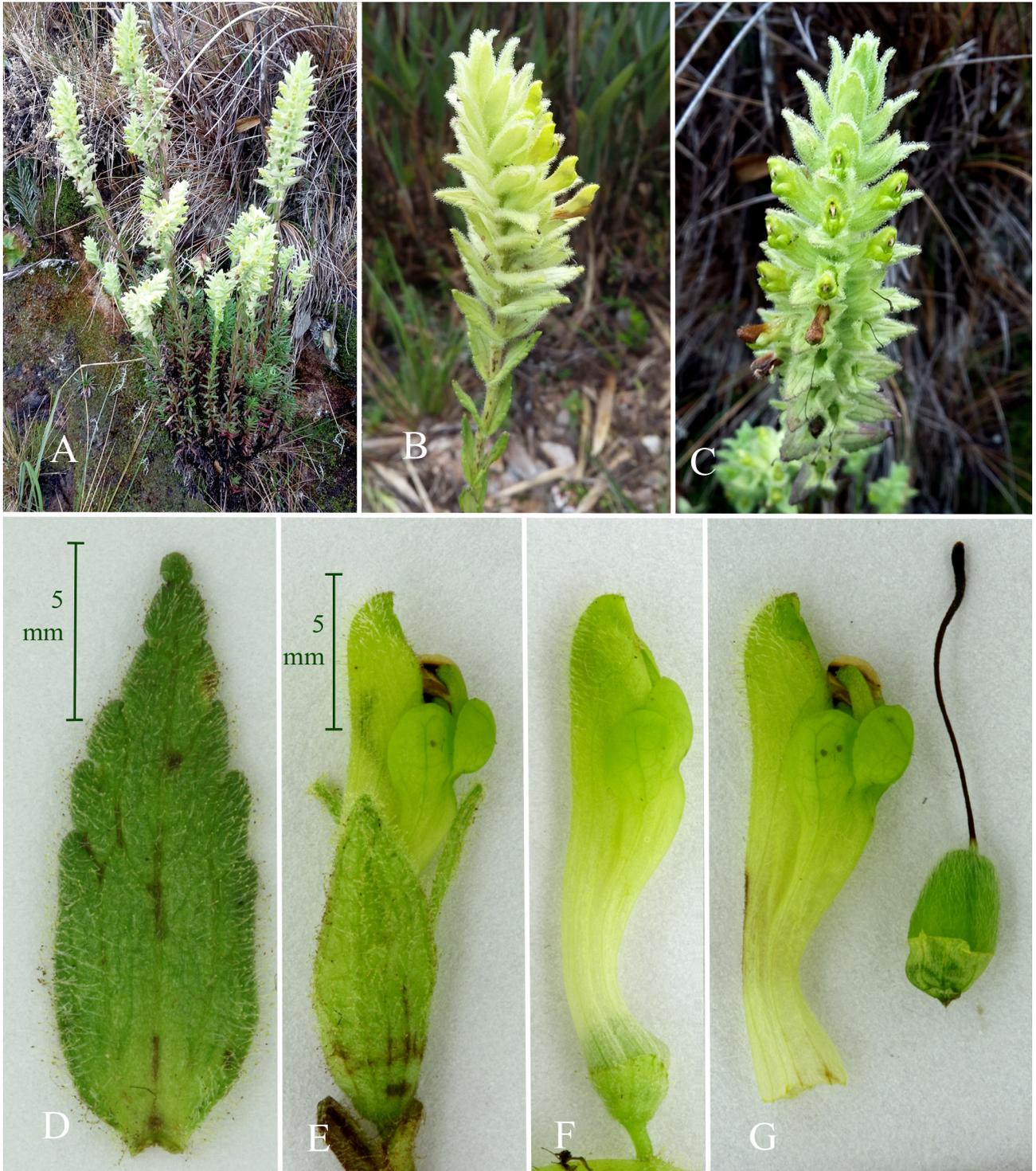


FIGURE 1. *Neobartsia matuy*. A. Habit. B, C. Inflorescence. D. Floral bract, adaxial surface. E. Lateral view of a flower including bract, calyx and corolla. F. Lateral view of the corolla with the tube decurved. G. Lateral view of corolla, style, and ovary. A–C from *S. Gómez et al.* 594 (paratype), D–G from *H. Mendoza & E. Torres* 22013 (Holotype). Photographers: Sofía Gómez (A–C), Humberto Mendoza (D–G).

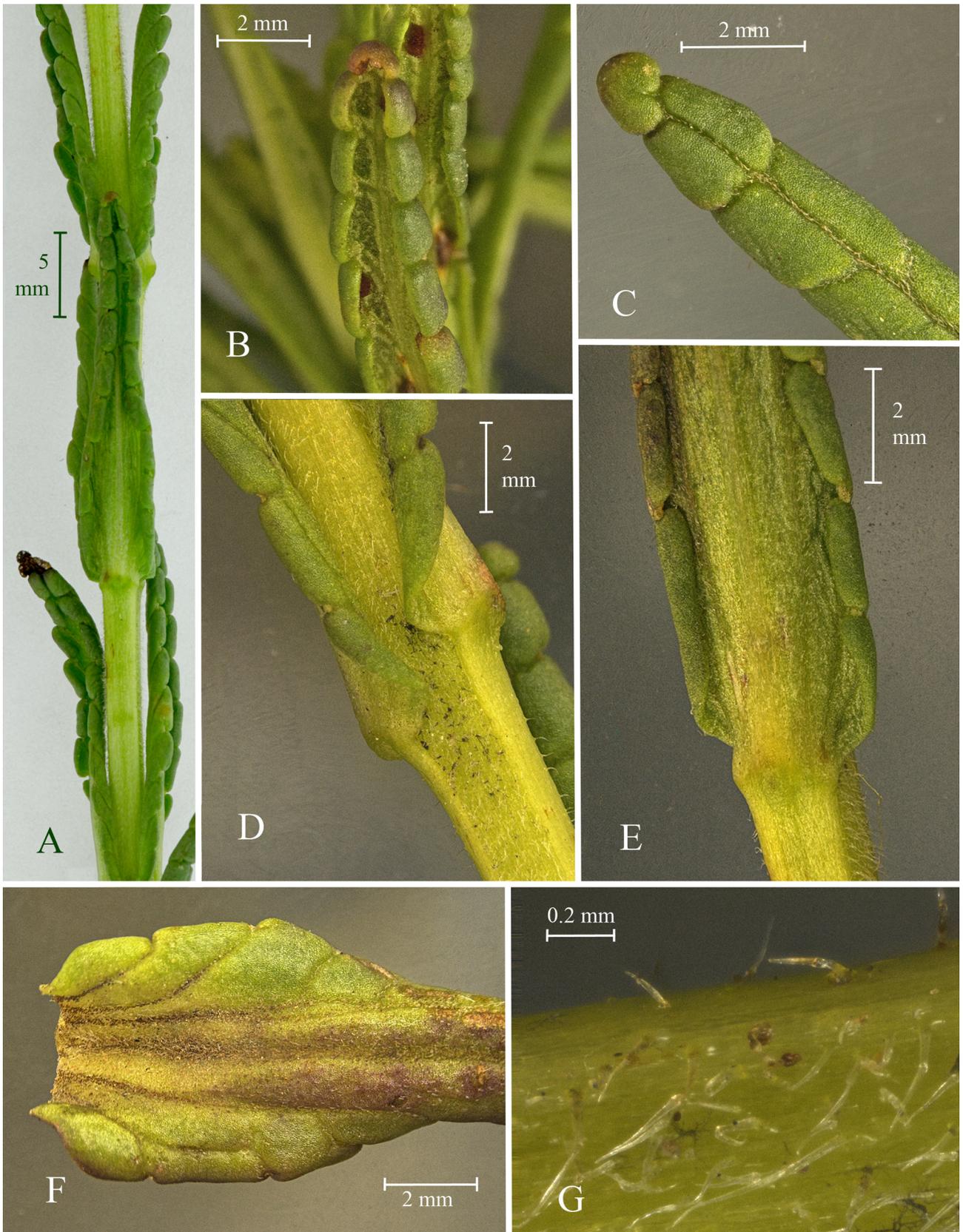


FIGURE 2. *Neobartsia matuy*. A. Stem and leaves. B. Abaxial view of leaves, detail of revolute margin. C. Adaxial view of leaf apex. D. Lateral view of the leaf base. E. Abaxial view of the leaf base. F. Adaxial view of the leaf base. G. Detail of the pubescence of stem. All from *H. Mendoza & E. Torres 22013* (Holotype). Photos by Humberto Mendoza.

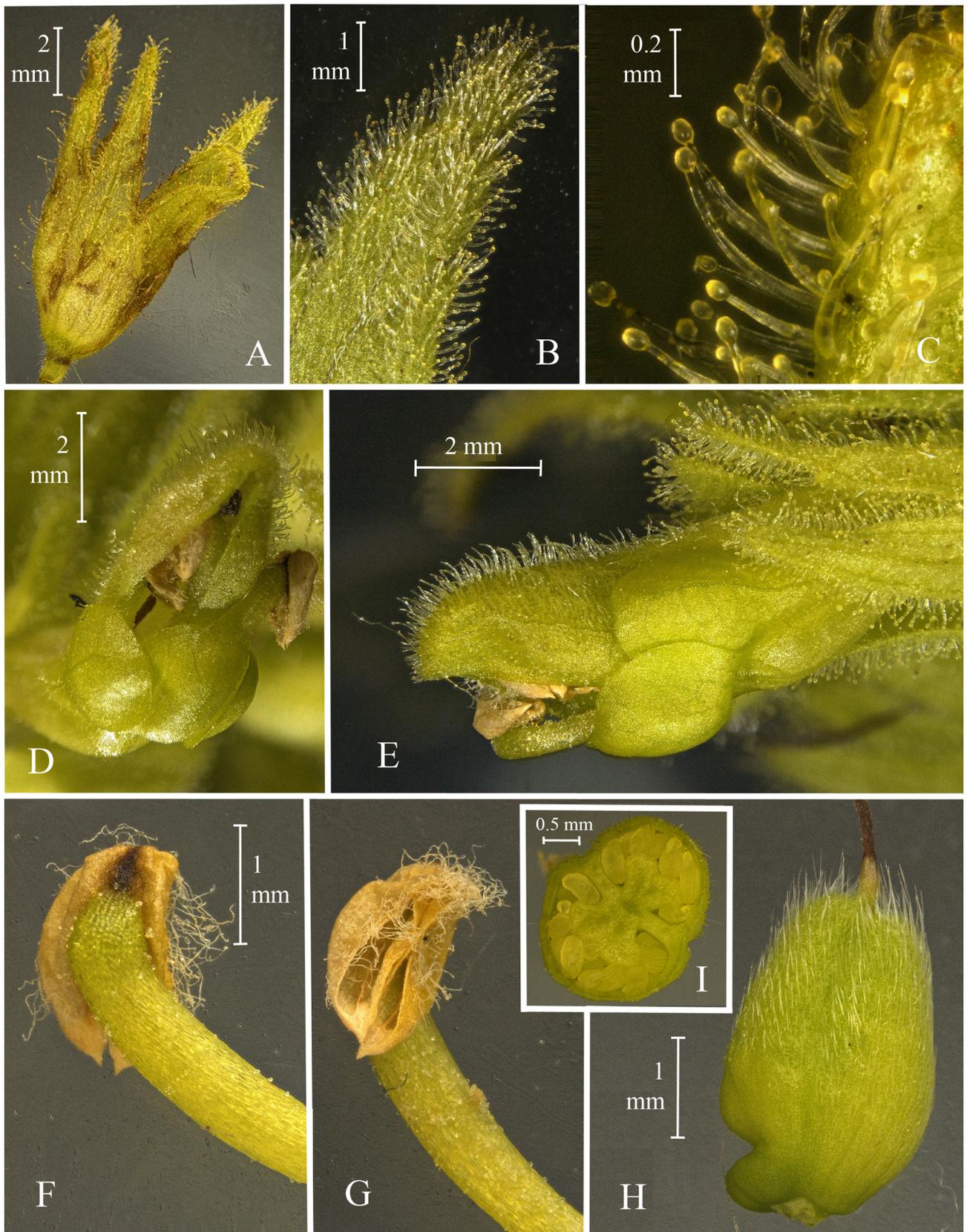


FIGURE 3. *Neobartsia matuy*. A. Lateral view of the calyx. B–C. Detail of the calyx indumentum. D. Frontal view of the galea and lip. E. Lateral view of the corolla, detailing of the galea indumentum. F. Filament and anther in adaxial view. G. Filament and anther in abaxial view. H. Lateral view of the ovary. I. Cross section of the ovary. All from *H. Mendoza & E. Torres 22013* (Holotype). Photos by Humberto Mendoza.

Description:—Perennial herb, 30–40 cm tall, woody at the base, the shoots ascending, erect, branched at the ground. Stems green, retrorsely hirsute with colorless eglandular hairs in two rows. Leaves decussate, sessile, linear to lanceolate, 7.8–18.4 × 3.4–5.5 mm, obtuse, truncate at base, green to purple (in areas exposed to sunlight), retrorsely hirsute on the veins on both sides with eglandular hairs, the margins revolute, evenly crenate with 8–9 lobes along each side, with the midribs impressed on adaxial face, elevated on abaxial face. Inflorescence, terminal raceme, dense, 3–9.1 cm long, and comprising 8–19 floral nodes, the lowermost internode 0.8–1.4 cm long; bracts 15.9–18.6 × 6.8–7.7 mm, similar to foliage leaves with 5 lobes along each side, with glandular hairs, lanceolate, cuneate at base, light green. Flowers ascending, decussate, 13–13.6 mm long (without pedicel); pedicels 1.16 mm long. Calyx 9–9.6 mm long at anthesis, light green, hirsute with glandular hairs 0.3–0.4 mm long, light yellowish green, median clefts 3/5 of the calyx length, lateral clefts 2/5 of calyx length, the lobes triangular, acute, entire. Corolla distally (upper half) yellowish green; the tube decurved, light green; the galea 7–7.5 mm long, cucullate, longer than the lip, retrorsely glandular-puberulous, hairs 0.51–0.53 mm long, yellowish green, the lip 5.4–5.7 mm long, three-lobed, lobes about 2.6 mm long, ovate, rounded, concave, or glabrous, yellowish green. Anthers 1.7–1.8 mm long, included, sparsely bearded, mucronate, yellow. Style 7.6–7.7 mm long, included; stigma 0.8–0.82 mm long, slightly bilobate, yellow-green. Ovary 3–3.1 mm long, pilose, green. Capsule 5.8–6 mm long, ovoid, pilose to setose, brown when mature; seeds 0.8–1 mm long, yellowish-white, broad-winged.

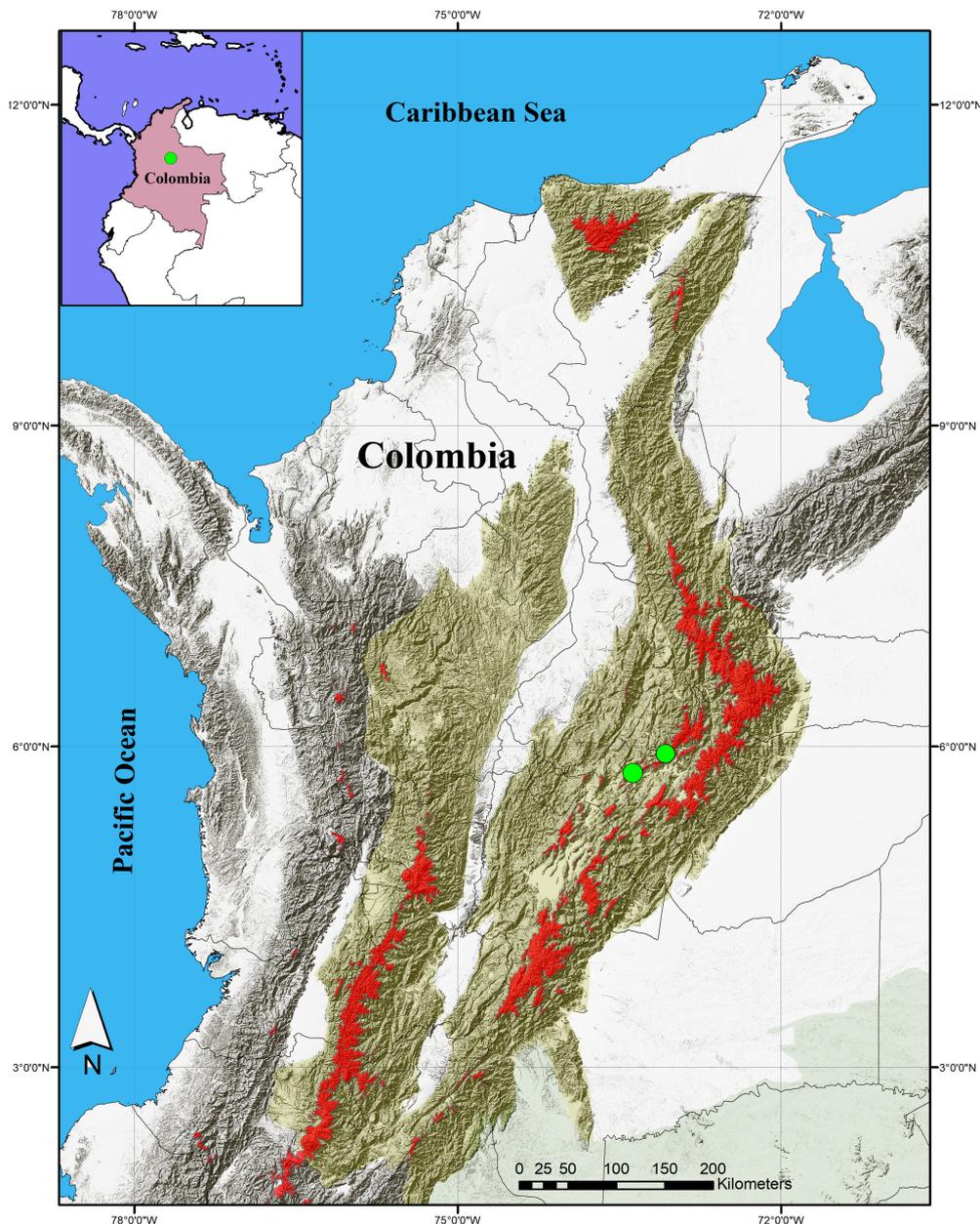


FIGURE 4. Distribution map of *Neobartsia matuyi*.

Distribution and habit:—*Neobartsia matuy* is only known from two localities in the Northeastern Andean Cordillera in the department of Boyacá (Colombia), suggesting it is endemic to a few closely distributed páramos (Figure 4). It is possible that this species is also found in the Flora and Fauna Sanctuary of Iguaque, a protected natural national area adjacent to El Valle. It grows in the páramo ecosystem between 3550 and 3639 m above sea level on rocky soil with grassy vegetation.

Phenology:—Collected with flowers and fruits in September, October, and December.

Etymology:—The specific epithet is established to honor Uribe-Convers' parents, Maria Luisa Convers and Ernesto Uribe, whose support was invaluable during the author's dissertation on the genus *Neobartsia*. His parents do not use their given names and are better known by their nicknames “Marilyn” and “Tuchi”, respectively, and the word “Matuy”—a combination of their nicknames—has been used for years among family and friends to refer to both of them.

Additional specimens examined (Paratypes):—COLOMBIA. Boyacá, Cómbita, Vereda Santa Barbara, Reserva Natural Regional El Valle, 05°45'06.4" N, 73°22'31.5" W, 3554 m, 12 October 2018, *S. Gómez et al.* 594 (FMB); Boyacá, Cómbita, Vereda Santa Barbara sector Valle de los ensueños, Reserva Natural Regional El Valle, 05°45'06.4" N, 73°22'30.4" W, 3550 m, 2 September 2018, *A. L. Simbaquedá-Gutiérrez et al.* 1965 (FMB); Boyacá, Duitama, Páramo de la Rusia. Road Duitama-Charalá Km 22 from Duitama, 5° 55' 39.792" N, 73° 5' 16.476" W, 3639 m, 24th September 2013, *Uribe-Convers 2013-III* (ID); Boyacá, Duitama, Páramo de la Rusia. Road Duitama-San Gil Km 29 from Duitama, right before the “Buenos Aires” arepa factory, 05°55'38.9" N, 73°05'15.8" W, 3627 m, 13th December 2012, *Uribe-Convers 2012-004* (ID).

Molecular data

The molecular dataset contained 23314 base pairs from the 48 most variable regions of the chloroplast for 47 taxa: 44 *Neobartsia* species and three closely related taxa, *Parentucellia latifolia* (L.) Caruel (1885: 480), *Bellardia viscosa* (L.) Fisch. & C.A. Mey. (1836:4), and *B. trixago* (L.) All. (1785:61). In general, phylogenetic relationships within *Neobartsia* (Figure 5) have moderate to low bootstrap support (BS) and this includes the relationship between *N. matuy* and *N. santolinifolia*, which has 62 BS. Nevertheless, the genus *Neobartsia* forms a monophyletic group with 100 BS that is sister to *P. latifolia* with 100 BS. Finally, the *Neobartsia-Parentucellia* clade is sister to a clade formed by the two species of *Bellardia*, with 100 BS.

Discussion:—*Neobartsia matuy* is characterized by the light green floral bracts with glandular hairs (Figures 1B, D), yellowish green corolla, cucullate galea longer than the lip, retrorsely glandular-puberulous indument (Figures 1E, 3D-E), the lip three-lobed, glabrous and the corolla tube decurved (Fig. 1E). Most closely resembling *N. santolinifolia* in the shape of the corolla tube but *N. santolinifolia* is distinguished by having a purple calyx, bright yellow corolla, smaller flowers and persistent glandular hairs on the whole plant. In his monograph, Molau (1990) reported that some populations of *N. laticrenata* in Ecuador had light green floral bracts and calyces but agreed in all other characters with other populations of *N. laticrenata*. *Neobartsia matuy* also differs from *N. laticrenata* by having green stems, retrorsely hirsute with colorless eglandular hairs in two rows, leaves without glandular hairs (Figure 2), and corolla tube decurved (Table 1). As with many other species in the genus, its restricted geographic distribution follows isolated mountain tops that arose in the last five to ten million years (Gregory-Wodzicki 2000). Uribe-Convers & Tank (2015) showed that *Neobartsia* diverged from its most recent common ancestor as early as 1.5 million years ago and that is diversifying up to four times faster than the Rhinanthae clade of Orobanchaceae. The biogeographic pattern of the genus, coupled with its young age and fast diversification rate, has resulted in limited genetic variation between species, as found in previous studies focused on *Neobartsia* and other Andean genera with similar histories, e.g. *Lachemilla* (Rosaceae) (Morales-Briones *et al.* 2018). For example, even though Uribe-Convers *et al.* (2016) included multiple individuals from each species (over 400 collections for the 47 species in the genus) and generated molecular data for 48 independent nuclear genes and the 48 most variable regions of the chloroplast (~50,000 base pairs total), they were unable to fully elucidate the evolutionary relationships of *Neobartsia*. Our molecular dataset is a subset of their study and, thus, shows similar patterns of low genetic variation and moderate to low phylogenetic support (Figure 5). The phylogenetic relationship between *N. matuy* and *N. santolinifolia* is only moderately supported (62 BS) but it is congruent with the morphological similarities and geographic distributions of both species. A more comprehensive molecular study incorporating nuclear genes will be necessary to shed more light on the evolutionary history of this new species.

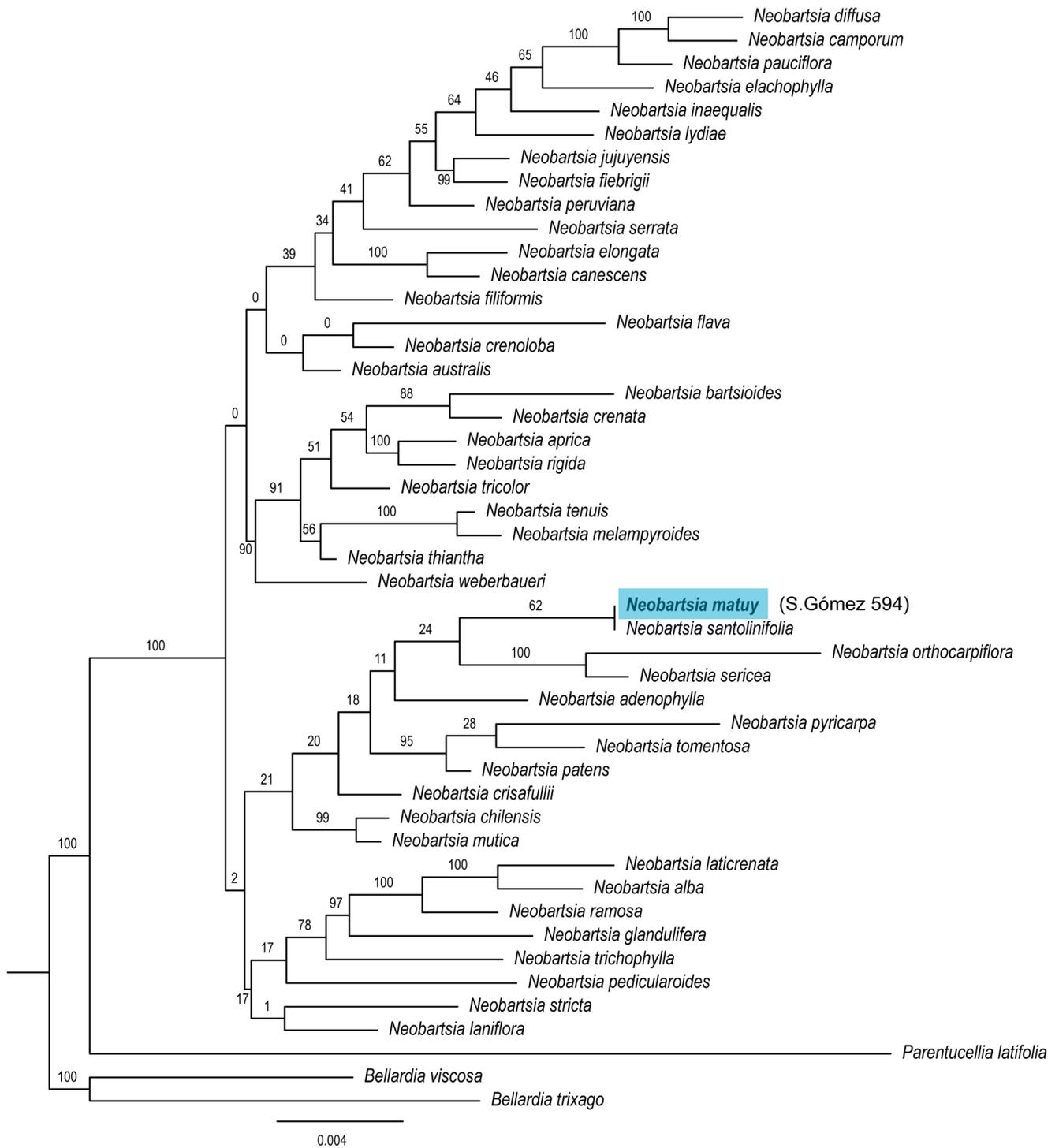


FIGURE 5. Phylogeny of *Neobartsia matuy* and closely related species based on chloroplast data. Branch lengths are proportional to the number of substitutions per site as measured by the scale bar. Values above the branches represent maximum likelihood bootstrap support. *N. matuy* is highlighted in blue.

TABLE 1. Morphological comparison between *Neobartsia matuy* and related species, based on Molau (1990).

| Character | <i>N. matuy</i> | <i>N. santolinifolia</i> | <i>N. laticrenata</i> |
|------------------------------------|---|--------------------------------|---|
| Glandular hairs on stems | Absent | Present | Present |
| Leaf length (mm) | 7.8–18.3 | 8–19 | 12–29 |
| Leaf shape | Linear to lanceolate | Linear to lanceolate | Ovate to lanceolate |
| Leaf surface | Retrorsely hirsute on the veins (both sides) | Glandular hirsute (both sides) | Hirsute (both sides) |
| Pedicel length (mm) | 1.6 | 2–4 | 2–5 |
| Floral bract indumentum | Glandular light yellowish green hairs | Glandular hairs | Glandular purplish hairs |
| Flower length (cm) | 13–13.6 | 8–12 | 10–13 |
| Calyx colour | Light green | Purple | Purpel, rarely yellow green |
| Calyx length (mm) | 9–9.6 | 6.0–6.8(–9) | 5.0–7.5 |
| Calyx indumentum | Glandular-hirsute | Glandular-hirsute | Spreading glandular-hirsute |
| Corolla colour | Yellowish green | Yellow to yellow-green | Light yellow to yellow-green |
| Corolla tube | Decurved | Decurved | Slightly bent |
| Galea length (mm) | 7–7.5 | 4–6 | 5–7 |
| Galea indument and hairs colour | Retrorsely glandular-puberulous, yellowish green | Glandular-tomentose | Glandular-puberulous, the hairs often purplish |
| Lip length (mm) | 5.4–5.7 | 2.5–4 | 3–4 |
| Anthers length (mm) | 1.7–1.8 | 1.0–1.6 | 1.0–1.3 |
| Style length (mm) | 7.6–7.7 | 5–7 | 5–7 |

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References

- Bernal, R. (2015) *Bartsia*. In: Bernal, R., Gradstein, S.R. & Celis, M. (Eds.) *Catálogo de plantas y líquenes de Colombia*. Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá. Available from: <http://catalogoplantasdecolombia.unal.edu.co> (accessed 22 October 2019)
- Cabrera, A.L. & Botta, S.M. (1992) Novedades para la Flora de Jujuy (Argentina). *Hickenia* 2: 1–4.
- Caruel, T. & Parlato, F. (1885). *Flora italiana; ossia, Descrizione delle piante che crescono spontanee o vegetano come tali in Italia e nelle isole ad essa adiacenti; disposta secondo il metodo naturale*, 6. Firenze, Tip, Le Monnier, 480 pp.
<https://doi.org/10.5962/bhl.title.6341>
- Fischer, F.E. Lvon., Meyer, C.A.A. von. & Trautvetter, E.R. von. (1836) *Index Seminum, quae Hortus Botanicus Imperialis Petropolitanus pro Mutua Commutatione Offert. Accedunt Animadversiones Botanicae Nonnullae*. Botanicheskiĭ institut im. V.L. Komerova, St. Petersburg, Russia.
- Gregory-Wodzicki, K. (2000) Uplift history of the Central and Northern Andes: a review. *Geological Society of America Bulletin* 112, 1091.
[https://doi.org/10.1130/0016-7606\(2000\)112%3C1091:UHOTCA%3E2.0.CO;2](https://doi.org/10.1130/0016-7606(2000)112%3C1091:UHOTCA%3E2.0.CO;2)
- Linnaeus, C. (1753) *Species Plantarum* 2. Impensis Laurentii Salvii, Holmiae, Sweden, pp. 561–1200.

<http://dx.doi.org/10.5962/bhl.title.669>

- Molau, U. (1990) The genus *Bartsia* (Scrophulariaceae: Rhinanthoideae). *Opera Botanica* 102: 1–99.
- Morales-Briones, D.F., Romoleroux, K., Kolář, F. & Tank, D.C. (2018) Phylogeny and Evolution of the Neotropical Radiation of *Lachemilla* (Rosaceae): Uncovering a History of Reticulate Evolution and Implications for Infrageneric Classification. *Systematic Botany* 43: 17–34.
<https://doi.org/10.1600/036364418X696897>
- Randle, C.P. & Uribe-Convers, S. (2019) *Bartsia*. In: Flora of North America Editorial Committee (Org.) *Flora of North America North of Mexico*, Vol. 17. Oxford, New York, pp. 488–489.
- Sylvester, S.P. (2014) *Bartsia lydiae*, a new species of *Bartsia* sect. *Laxae* (Orobanchaceae) from the southern Peruvian Andes with a revised key to *Bartsia* sect. *Laxae*. *Phytotaxa* 164: 41–46.
<http://dx.doi.org/10.11646/phytotaxa.164.1.4>
- Uribe-Convers, S. & Tank, D.C. (2015) Shifts in diversification rates linked to biogeographic movement into new areas: an example of disparate continental distributions and a recent radiation in the Andes. *American journal of Botany* 102: 1854–1869.
<https://doi.org/10.3732/ajb.1500229>
- Uribe-Convers, S. & Tank, D.C. (2016) Phylogenetic Revision of the Genus *Bartsia* (Orobanchaceae): Disjunct Distributions Correlate to Independent Lineages. *Systematic Botany* 41: 672–684.
<https://doi.org/10.1600/036364416X692299>
- Uribe-Convers, S., Settles, M.L. & Tank, D.C. (2016) A Phylogenomic Approach Based on PCR Target Enrichment and High Throughput Sequencing: Resolving the Diversity within the South American Species of *Bartsia* L. (Orobanchaceae). *PLOS ONE* 11 (2): e0148203.
<https://doi.org/10.1371/journal.pone.0148203>