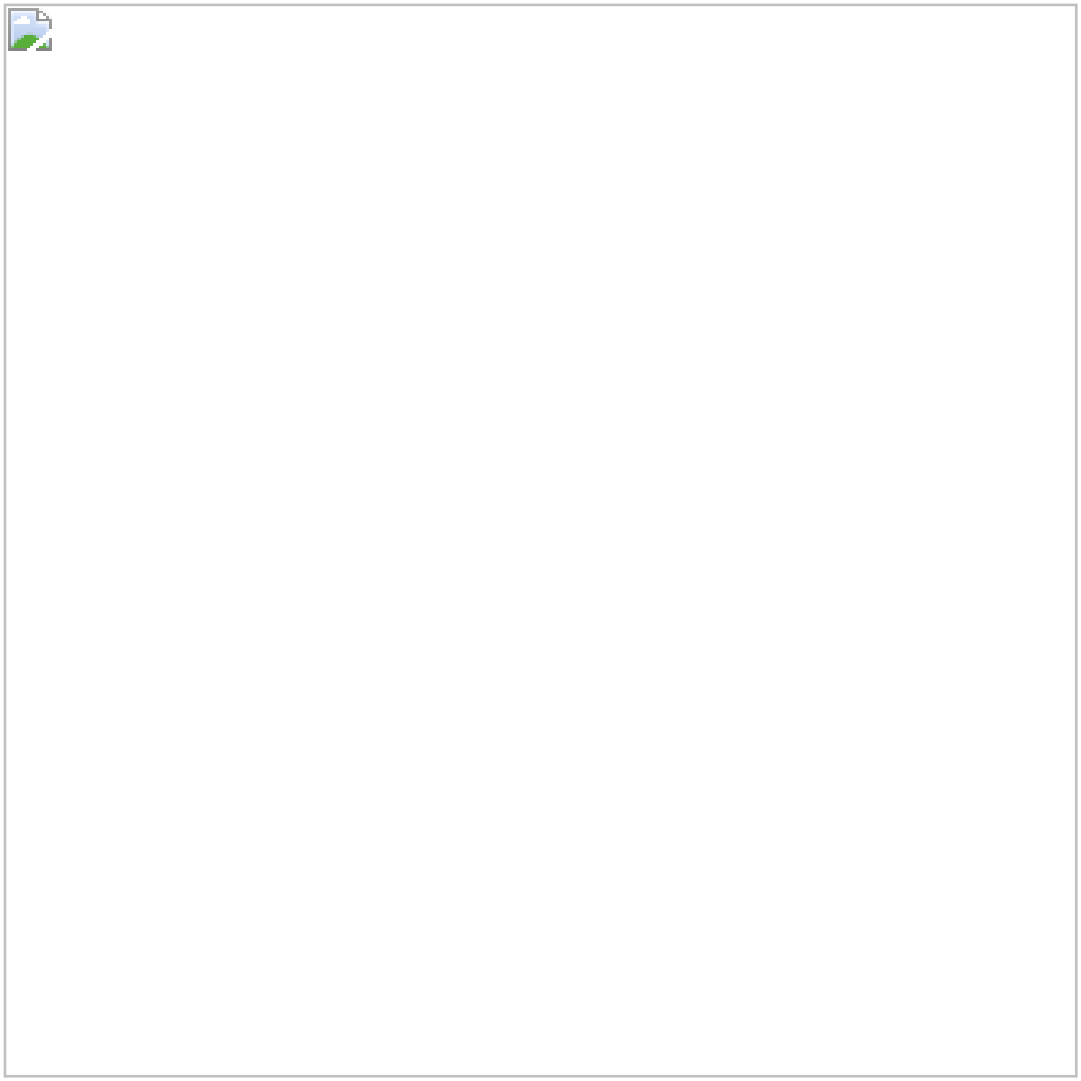

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Disentangling *Polygala obovata* Complex (Polygalaceae), with a Description of Three New Species for Brazil

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Abstract—The morphology of the *Polygala obovata* complex, with a taxonomic revision of the current names, was studied, recognizing three new species of *Polygala* for Brazil. The new species, ***Polygala capitolensis***, ***P. jardimii***, and ***P. paganuccii***, are described, along with their diagnostic characters and notes on taxonomy. Distribution maps and photographic plates, including a comparative morphology, are provided.

Keywords—Atlantic Forest, Brazilian flora, *Ericoideae*, taxonomy.

Resumo—A morfologia do complexo *Polygala obovata*, com uma revisão taxonômica dos nomes atuais, foi estudada, reconhecendo três novas espécies de *Polygala* para o Brasil. As novas espécies, ***Polygala capitolensis***, ***P. jardimii***, and ***P. paganuccii***, são descritas, juntamente com seus caracteres diagnósticos e notas sobre taxonomia. Mapas de distribuição e pranchas fotográficas, incluindo morfologia comparativa, são fornecidos.

Polygala L. (Polygalaceae) section *Timutua* DC. ser. *Ericoideae* Chodat, with 17 species (Pastore et al. 2019), is characterized by the erect to prostrate subshrub habit, short racemes, small yellow spots on floral structures, an often-elongated style, and xylopodia (Marques 1988). The ser. *Ericoideae* is not monophyletic and, together with the ser. *Trichospermae*, is part of the clade Trichospermae (Pastore et al. 2019), included in the New World clade of *Polygala*. The infrageneric delimitation of the New World clade of *Polygala* is the subject of an ongoing taxonomic revision (Pastore et al. 2019).

The members of ser. *Ericoideae* are, for the most part, endemic to the savannas of central Brazil and rocky field areas of southern Brazil (Pastore et al. 2019), but with a few species in its Atlantic Forest. The species are distributed from the northwestern state of Rondônia to Argentina, with *P. obovata* A.St.-Hil. & Moq. and *P. regnellii* Chodat the only two widely distributed species (Marques 1988; Pastore pers. comm.).

Polygala obovata had been broadly delimited by Bernardi (2000), who included *P. multiceps* Mart. ex A.W.Benn. as its synonym, resulting in an indiscriminate application of the two names to herbarium specimens. Bernardi's delimitation, however, was not accepted by Pastore (2013), who showed in a later molecular phylogenetic study (Pastore et al. 2019) that the two species were not even in sister groups.

In our detailed morphological study on *P. obovata* s. l., three new species of *Polygala* sect. *Timutua* ser. *Ericoideae* were identified. They are here described and illustrated with photo plates of their fertile structures and vegetative morphology. Taxonomic typifications and geographic distribution notes are also included.

Materials and Methods

Access to Specimens—The specimens were obtained by field expeditions conducted to Minas Gerais and Bahia state. We also analyzed specimens in herbaria or duplicates that were sent to CTBS and/or SI herbarium: ALCB, BA, BAB, BHCB, CEN, CTES, HUEFS, HUFU, LP, MBM, P, RB, SP, UB, UEC, and W. Additionally, digital images of specimens from other herbaria were examined at INCT - Virtual Herbarium of Flora and Fungi (2021) and Reflora - Herbário Virtual (2021).

Morphological Analysis—Descriptions and measurements were made using a magnifier binocular stereoscope (Tecnival) with an attached camera, and photographed using Toup View®. Resulting images were then edited in Corel® PHOTO–PAINT™ X7 and used to make the photographic plates. The terminology used to describe the species follows Bennet (1874) and Chodat (1893). The length of seeds and the crest were used to show graphically the delimitation and the end of the continuum of variation of these characters in these species (Fig. 1).

Geographic Distribution—The distribution map was built using QGIS 2.18.13 (QGIS Development Team 2016). The coordinates were obtained from herbarium labels or, when not available, estimated by the proximity to nearest municipalities.

Results and Discussion

Revising specimens identified in herbaria as *Polygala multiceps* and *P. obovata* allowed us to recognize three new species: *P. capitolensis*, *P. jardimii*, and *P. paganuccii*.

Polygala multiceps is here circumscribed as endemic to the southeast of Minas Gerais state, with most of the specimens previously identified as *P. multiceps* or *P. obovata* now recognized as the new species *P. paganuccii.* The two narrowly endemic species, *P. jardimii* and *P. capitolensis*, are also described.

Taxonomic Treatment

Polygala multiceps Mart. ex A.W.Benn., Fl. Bras. [Martius] 13(3): 43. 1874. "Habitat in prov. Minas Geräes: Martius, Pohl 586, 598." Type: Brazil. Minas Gerais: Ibiá, former 'São Pedro de Alcântara', 8 Sep 1818, *J.B.E. Pohl 598* (Lectotype, here designated: W[0075190]!).

Erect to decumbent herbs, to 20 cm tall. **Roots** lignified. **Stems** slender, with a few to many arising from the base,

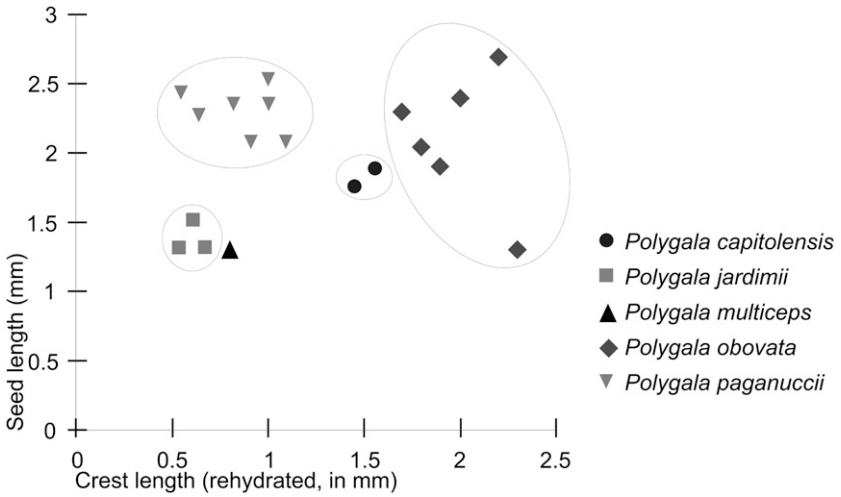

FIG. 1. Specimens of the complex *Polygala obovata* forming groups when comparing the crest length (X axis) and seed length (Y axis).

cylindrical, green, without yellowish glands forming spots, densely puberulous, trichomes short-clavate. **Leaves** subopposite or alternate, petiole ca. 1 mm long, chartaceous, laminas (0.6–)0.9–1.4 × (0.2–)0.3–0.4 cm, elliptic to narrow-obovate, apex apiculate, margins slightly thicker, base acute, densely covered by small glandular trichomes. **Racemes** spiciform, 0.6–1.2 × 0.8–1.1 cm, reaching 1.5 cm after fruits fallen, flowers congested; peduncle short 0.2–1 cm, bracts 1 × 0.6 mm, lanceolate, apex acuminate, ciliate, with a pair of small yellowish spots at the base, bracts caducous post-anthesis and during capsule development, 2 times longer than bracteoles; bracteoles 0.6 × 0.4 mm, ovate, ciliate; pedicel 0.8–1 mm, puberulous. **Flowers** white, 3.5–4 mm long (counting the pedicel); outer sepals ciliate; lower outer sepal ca. 1.1 × 0.8 mm, ovate, apex slightly acuminate, with two pairs of yellow spots at the base; upper outer sepals ca. 0.9 × 0.7 mm, ovate, apex acute, free almost to the base, with 2 pairs of small yellow spots at the base; inner sepals (wings) ca. 2.7 × 1.1 mm, elliptic, apex acuminate, margins not ciliate, longer than mature fruits; lateral petals 2.1 × 1 mm, apex acute, elliptic; keel ca. 2.3 mm long, cristate, with yellow spots around the dorsal central vein, persistent on mature fruits; crest 6-lobed, central lobes deeply separated, lateral lobes united 3/4 of the length, style erect, terminated by an oblique cymbiform pre-stigmatic cavity, posterior extremity with a conspicuously crested appendage with abundant trichomes, stigma anterior, globose. **Capsules** 1.5 × 1.2 mm, ovate, nearly symmetric, with yellow spots along the central vein, style caducous in fruit; seeds 1.3 × 0.7 mm, ovate, pubescent; appendages oblong, 1/2 of the length of the seed, 0.6 × 0.2 mm. Figure 2.

Distribution—*Polygala multiceps* seems to be endemic to the region of Serra da Canastra in the west of Minas Gerais state. The species is often collected in areas prone to flooding along sand banks of the river margins (Fig. 3).

Notes—Although *P. multiceps* was treated by Bernardi (2000) as a synonym of *P. obovata*, the two species may be easily recognized by the differences in the shape of the apex of the lateral petals (acute in *P. obovata* vs. rounded in *P. multiceps*), the length of the keel (three times longer in *P. obovata* than in *P. multiceps*), and the length of the crest (same length or longer than the hood in *P. obovata* vs. noticeably shorter than the hood in *P. multiceps* (Fig. 4).

Additional Specimens Examined—**Brazil.** —MINAS GERAIS: Delfinópolis, Estrada para Guarita, beira do Rio Santo Antônio, 20°16′52″S, 46°52′16″W [-20.281, -46.871], 21 Oct 2003, *J. Nakajima et al. 3520* (CEN, HUFU); Ibiá, former 'São Pedro de Alcântara', 8 Sep 1818, *J.B.E. Pohl 598* (BR, W); Nova Ponte, Fazenda Santana, Margens do Rio Araguari, 27 Nov 1986, *J.R. Stehmann et al. s.n.* (BHCB); Nova Ponte, Margem do Rio das Velhas, 11 Jun 1940, *Mendes Magalhães 239* (BHCB, HUEFS); Nova Ponte, Rio Araguari, Área de inundação da UHE Nova Ponte, 20 Jul 1993, *E. Tameirão Neto 930* (BHCB, RB); Serra da Babilônia, MG-438 entre Ibiraci e Delfinópolis, entre a pousada Boa Esperança e a Serra Branca, 10 Feb 2012, *J.F.B. Pastore et al. 3988* (HUEFS). —SÃO PAULO: Itu, 20 Oct 1897, *A. Russell 50* (NYBG); São Paulo, Mandaqui, May 1913, *Toledo 640* (RB); São Paulo, Serra da Cantareira, 26 May 1896, *G. Edwall CGG3321* (SP).

POLYGALA OBOVATA A.St.-Hil. & Moq., Ann. Soc. Roy. Sci. Orléans 9: 52 1828. "Crescit inter rupes prope urbem S.Pauli, necnon in pascuis prope praedium Rincaó de Sanelons ad fines provinciæ Rio Grande de Sul et provinciæ Missionum" TYPE: BRAZIL. Rio Grande do Sul: Uruguaiana, 7–9 February 1821, *A.Saint-Hilaire C2 2609* (lectotype, designated by Pastore 2014: 212, P [000733518]!; isolectotype: MPU [9937]!).

Polygala albicoma Arechav., Anales Mus. Nac. Montevideo 3: 69. 1898. or Fl. Uruguay, 1: 69. 1898 [Arech.]. "Vive en colinas pedregosas de las cercanias del Salto. Flores en Septiembre y Novembre." TYPE: URUGUAY. Salto: Salto 'Terrenos Pedregosos,' Nov 1897, *J. Arechavaleta 52* (holotype: SI[3305]!).

Decumbent herbs to 15 cm tall. **Roots** fleshy, lignified. **Stems** slender, with a few to many sub-angulose stems arising from the base, green, without yellowish glands forming spots, densely puberulous, trichomes short-clavate. **Leaves** subopposite or alternate, petiole ca. 0.5–1 mm long, chartaceous, laminas (0.45–)0.8–1.3 × (0.2–)0.35–0.5(–0.6) cm, wide elliptical to obovate, apex apiculate, margins slightly thicker, base acute, densely covered by small glandular trichomes. **Racemes** spiciform, 0.6–1.2 × 1.1 cm, reaching 1.5 cm after fruits fallen, flowers congested; peduncles short, 0.2 cm, bracts 1.1 × 0.4 mm, lanceolate, apex acuminate, ciliate, with a pair of small yellowish spots at the base, bracts caducous post-anthesis and during capsule development, 3 times longer than bracteoles; bracteoles 0.4–0.6 × 0.4 mm, deltate, ciliate; pedicel 1.8–2.2 mm, glabrous. **Flowers** white colored, 6.6–7 mm long (counting the pedicel); outer sepals with ciliate margins; lower outer sepal ca. 1.4–1.5 × 1–1.1 mm, ovate, with a slightly acuminate apex and two pairs of yellow spots at the base; upper outer sepals ca. 1.6 ×

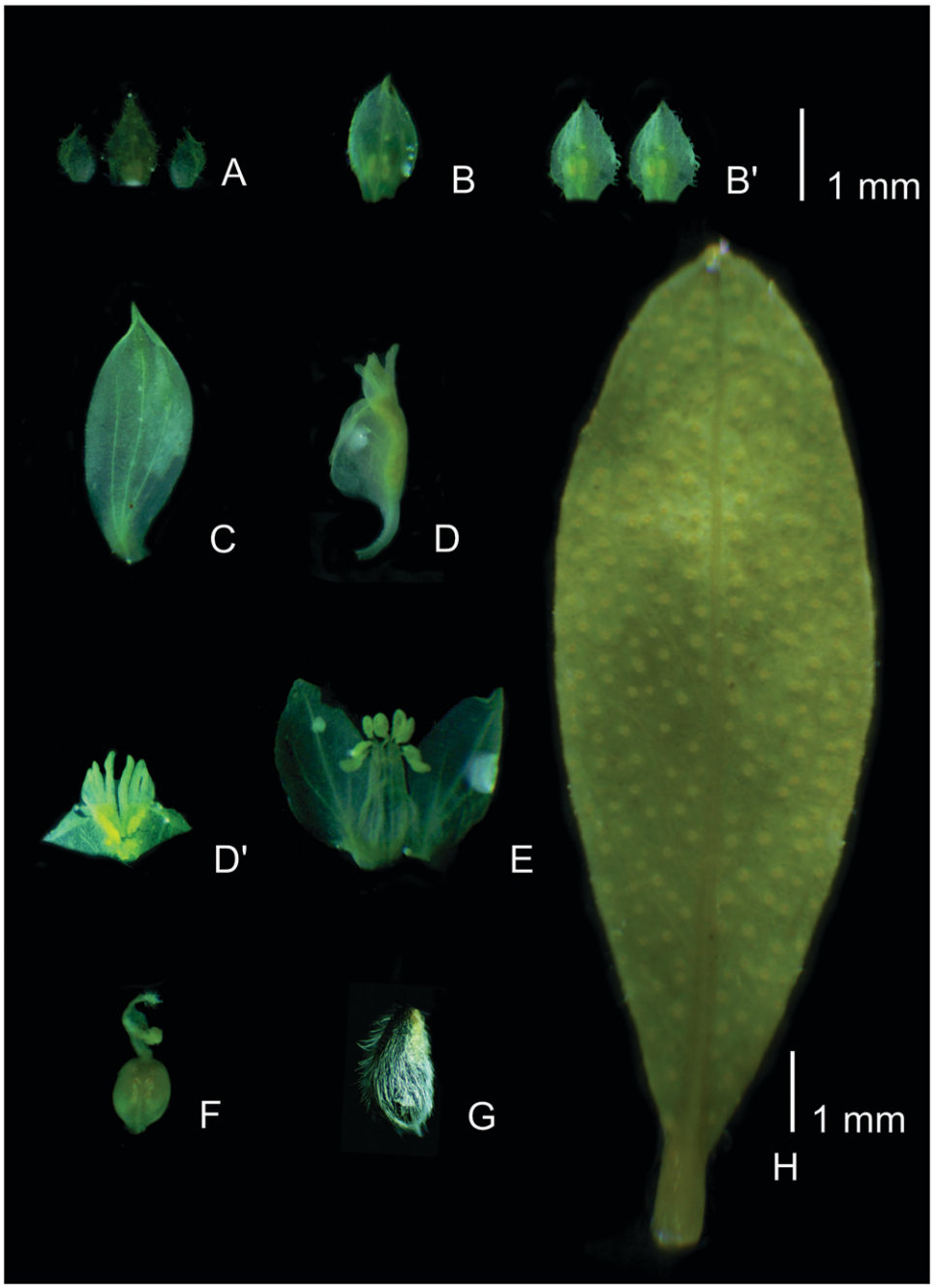

FIG. 2. *Polygala multiceps* Mart. ex A.W.Benn. A. Bract and bracteoles. B. Inferior outer sepal. B'. Two superior outer sepals. C. One of the two inner sepals (wings). D. Keel. D'. Keel crest, opened. E. Androecium and lateral petals. F. Gynoecium. G. Seed. H. Leaf. Scale bar = 1 mm. Photos by J. F. B. Pastore. (A–H. *J.N. Nakajima 3520* (CEN)).

1 mm, ovate, apex acute, free almost to the base, with 2 pairs of small yellow spots on the base; inner sepals (wings) ca. 3.5–5 × 1.3–2.6 mm, elliptic, apex acuminate, margins not ciliate, longer than the mature fruits; lateral petals 3.4 × 1.5–1.6 mm, apex acute, elliptic; keel ca. 4.2–4.5 mm long, cristate, with yellow spots along the dorsal central vein, persistent on mature fruits; crest 6–8-lobed, lateral and central lobes deeply separated, style erect, terminated by an oblique cymbiform pre-stigmatic cavity, posterior extremity with a conspicuously crested appendage with abundant trichomes and an anterior globose stigma. **Capsules** 2.6 × 1.5 mm, ovate, asymmetric, with dark yellow spots along the central nerve, style caducous in fruit; seeds 2 × 0.6 mm, ovate, pubescent; appendages oblong, 1/4 to 1/2 of the length of the seed, 0.6–0.7 × 0.2 mm. Figure 5.

Distribution—*Polygala obovata* occurs at low altitudes of 50–100(–350) m in open fields along the Paraná river basin, from southern Paraguay to the west of Rio Grande do Sul state, Brazil, eastern Argentina, and western Uruguay (Fig. 3).

Notes—Fertile structures of specimens of *Polygala obovata* examined for this study show noticeable variations (Fig. 6). However, they are not here considered to be taxonomically relevant.

P. obovata was described by Saint-Hilaire and Moquin-Tandon (1828a, 1828b) on the basis of two specimens belonging

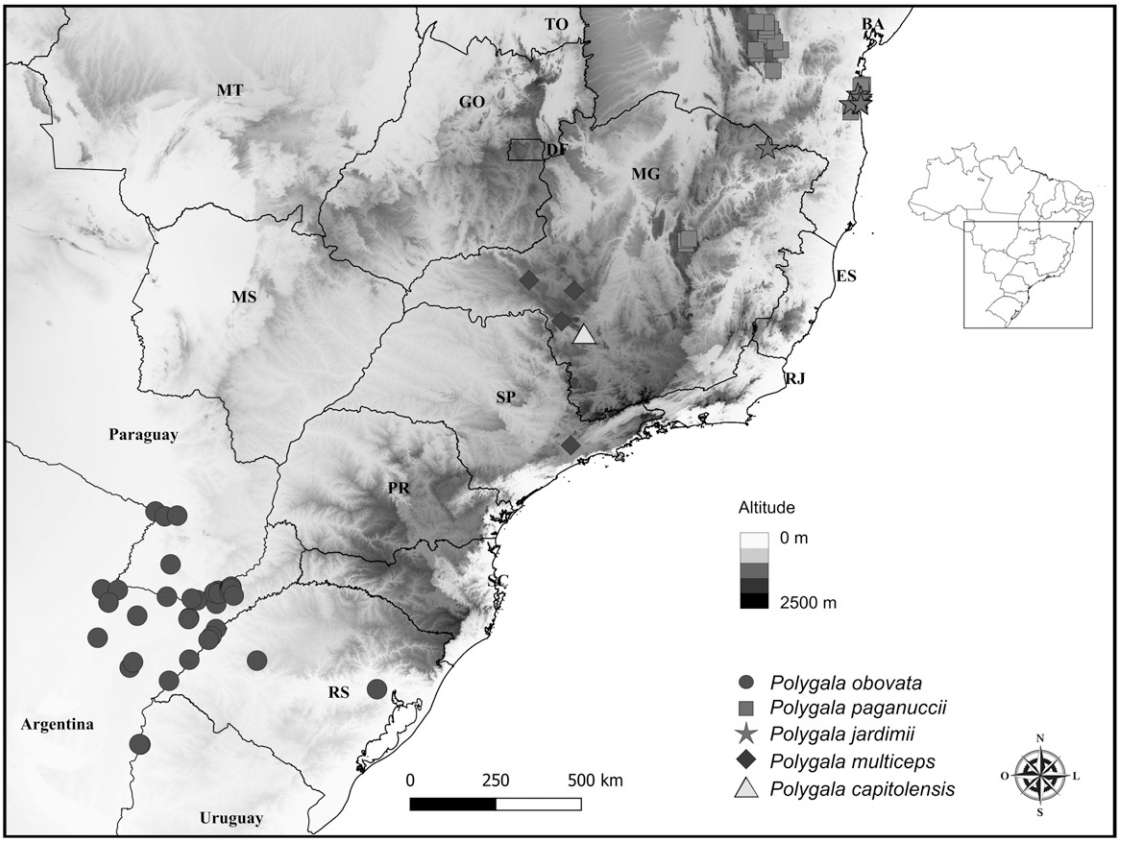

FIG. 3. Distribution map for *Polygala capitolensis* J.F.B.Pastore, *P. jardimii* J.F.B.Pastore, *P. paganuccii* J.F.B.Pastore, *P. obovata* A.St.-Hil. & Moq., and *P. multiceps* Mart. ex A.W.Benn.

to two different species: one specimen (*Saint-Hilaire, C2 1254* bis), from São Paulo state, is conspecific with *P. multiceps*, while the other (*Saint-Hilaire C2 2609*, P[00733518]), from Rio Grande do Sul state, and likely from the municipality of Uruguaiana, was chosen by Pastore (2014) as a lectotype.

***Additional Specimens Examined*—Argentina.** —CORRIENTES: Bella Vista 10 km S de Bella Vista, cauce seco del arroyo Toropi, 13 Sep 1972, *A. Schinini 5244* (CTES); Berón de Astrada 46 km W de Itá Ibaté, Valencia, 15 Jan 1977, *A. Schinini 14052* (SI); Berón de Astrada Ruta Nacional 12 y arroyo Santa María, 31 Mar 1974, *A. Krapovickas 24817* (CTES); Concepción Ea. Buena Vista, 25 Sep 1971, *T.M. Pedersen 9857* (CTES); Empedrado Estación Experimental INTA, 7 Dec 1978, *A. Schinini 16197* (CTES); General Paz 15 km E de Itá Ibaté, arroyo Santa Lucía, 9 Apr 1972, *L.A. Mroginski 573* (CTES); Ituzaingó Ruta 34, 7 km NW de San Carlos. Campo em beira de estrada, 18 Jan 2007, *J. Paula-Souza et al. 7442B* (SI); Ituzaingó Ea. Puerto Valle, 10 Nov 1962, *W. Partridge s.n.* (BA 59595); Ituzaingó 10 km NNE de Ituzaingó, camino a Guardia Cué., 13 Dec 1973, *C.L. Quarín 1857* (CTES); Mburucuyá Estancia "Santa María", 9 Aug 1952, *T.M. Petersen 1787* (LP); Mercedes Ruta 119, 7 km S del acceso a Mercedes., 20 Feb 1984, *S.G. Tressens 2244* (CTES); Mercedes Justino Solari, cercanías, 10 Mar 1945, *T.S. Ibarrola s.n.* (LP 290390); Mercedes Arroyo Ypané, a 8 km N de la ruta 14, 3 Sep 1997, *M.S. Ferrucci 1223* (CTES); Monte Caseros La Potota, orilla de laguna, 10 Feb 1957, *E.G. Nicora 5701* (SI); Monte Caseros Campo General Ávalos, Arroyo Curupí Chico, 11 Sep 1979, *A. Schinini 18791* (CTES); Monte Caseros Monte Caseros, La Potota, orilla de laguna, 22 Nov 1949, *E.G. Nicora 5109* (SI 093177); Paso de los Libres Estancia "La Siña," Ao Tapebicu y río Uruguay, 7 Aug 1974, *R. Carnevali 3466* (CTES); Paso de Los Libres Ruta 117, acceso a Paso de Los Libres, 14 Dec 1991, *N.M. Bacigalupo & E. R. Guaglianone 1491* (SI); San Cosme Paso de la Patria, 30 Oct 1936, *T. Meyer 2171* (SI); San Martín La Cruz, vías, 7 Nov 1936, *A. Burkart 7934* (SI); Santo Tomé cerca de Santo Tomé, 10 Oct 1977, *A.L. Cabrera et al. 28408* (SI); Santo Tomé Camino de Santo Tomé a Arroyo Cuay Grande, 22 Oct 1975, *E.M. Zardini et al. 1082* (LP); Santo Tomé a. San Lorenzo, 4 km N de Galarza, ruta 41, 14 Nov 1994, *M.M. Arbo 6180* (CTES); Santo Tomé Galarza, 6 Dec 1974, *C.L. Quarín 2473* (CTES); Santo Tomé RP 94 entre Santo Tomé y Cnia. Garabí, 6 Dec 2017, *L. Aagesen & M. J. Bena 35* (SI); Paso Iberá, 7 Oct 1886, *G. Niederlein 2234* (1009) (BA). —MISIONES: Candelaria Santa Ana, 3 Feb 1913, *F.M. Rodríguez 12545* (LIL); Candelaria Loreto, 4 Jun 1957, *J.E. Montes 27265* (BAA); Candelaria Loreto, 27 Sep 1919, *A.A. Muniez 21* (BA 44492, BAF); Candelaria Estancia Sol de Mayo, Sep 1947, *E.M. Grondona 1430* (BAB); Capital alrededores del pueblo, 1 Jan 1922, *L.R. Parodi 4595* (BAA); Capital cerca de Lanús, Sep 1947, *E.M. Grondona 1276* (BAB); Posadas, Oct 1911, *A.A. Muniez 24* (BAF); Capital Itaembé, 8 Oct 1934, *F.M. Rodríguez 364* (BA 16206); Montecarlo Completar datos, 15 Mar 1958, *J.E. Montes 27727* (NY); San Ignacio Teyucuaré, 13 Feb 1945, *A. Burkart 15381* (SI); San Ignacio San Ignacio, 17 Feb 1978, *A.L. Cabrera & A. A. Saenz 29251* (SI); San Ignacio San ignacio, campo alto, arenoso, 7 Feb 1914, *H. Quiroga 316* (BAF 6987); San Ignacio Camino al Parque Provincial Teyú Cuaré, campos antes del cruce a Payal., 3 Apr 1998, *F. Biganzoli 25* (SI); San Ignacio campo antes de la entrada al Parque Provincial Teyucuaré, 21 Apr 1996, *F.O. Zuloaga 5751* (SI); San Ignacio San Ignacio, camino a Teyucuaré, 29 Jul 1992, *A. Krapovickas 44139* (CTES); San Ignacio San ignacio, 31 Jul 1913, *H. Quiroga s.n.* (BAF, BA); San Ignacio San Ignacio, 25 Aug 1978, *A.L. Cabrera et al. 29351* (SI); San Ignacio Teyucuaré. Campos, 19 Sep 2000, *M.E. Múlgura 2068* (SI); San Ignacio San Ignacio, 4 Oct 1913, *H. Quiroga s.n.* (BAF, BA); San Ignacio 5 km de San Ignacio camino al Teyu-cuaré, 12 Nov 1976, *C.L. Quarín 3482* (SI); San Ignacio camino al Parque Prov. Teyú Cuaré, campos, 23 Nov 1995, *E.R. Guaglianone et al. 3032* (SI); San Ignacio Campo saliendo de la casa de Horacio Quiroga, 15 Nov 2011, *F.O. Zuloaga et al. 13291* (SI); San Ignacio San Ignacio, campos, 22 Nov 1896, *N. Alboff s.n.* (LP 042188); San Ignacio Campo con afloramiento rocoso en la entrada del acceso a Teyu Cuaré, 8 Dec 2017, *L. Aagesen & M. J. Bena 44* (SI). **Brazil.** —RIO GRANDE DO SUL: Santiago, 04 Sept. 2006, *R. Schmidt, 1519* (ICN); Triunfo, 13 Sept 1974, *K. Hagelund 8221* (ICN). **Paraguay.** —CENTRAL: Cordillera Barrero Grande, Jun 1968, *A. Schinini 1942* (SI); Trinidad-Luque, Campo de aviación, Dec 1945, *T. Rojas 13054* (SI); Ypacarai, 15 Oct 1944, *T. Rojas 12441a* (BAF); Ytororó, Jan 1918, *T. Rojas 3152* (SI). —GUAIRÁ. San Salvador, Alto Paraguay, Feb 1917, *T. Rojas 2488* (SI); MISIONES: San Juan Bautista, Oct 1931, *T. Rojas 5721* (SI). **Uruguay.** —SALTO: Salto, 1897, *J. Arechavaleta 51* (SI); Cercanías de Salto, Nov 1897, *J. Arechavaleta s.n.* (SI 3312).

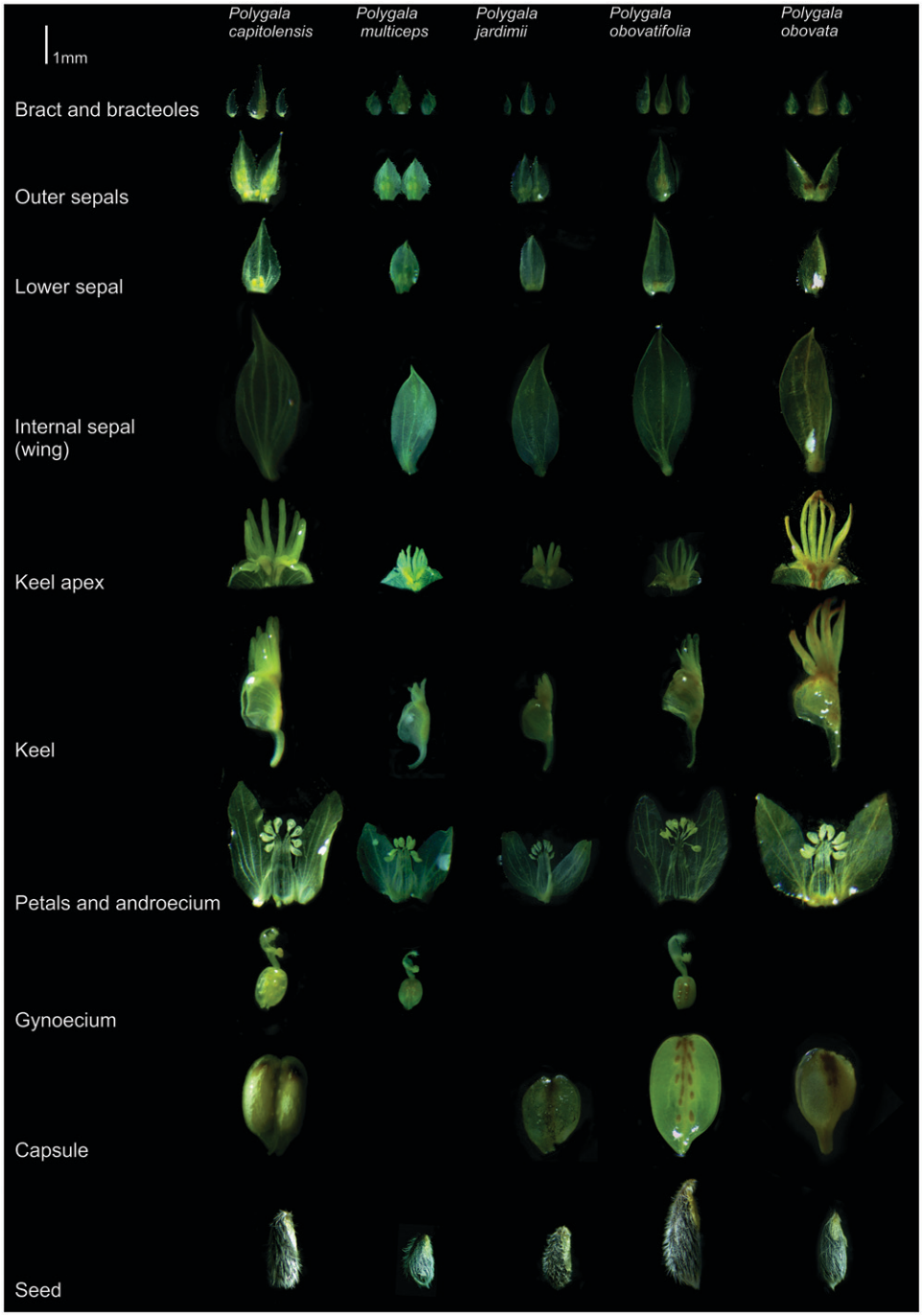

FIG. 4. Comparison of floral morphology of *Polygala capitolensis* J.F.B.Pastore (*L.S. Kinoshita 08–198* (UEC)), *P. multiceps* Mart. ex A.W.Benn (*J.N. Nakajima 3520* (CTBS)), *P. jardimii* J.F.B.Pastore (*J.F.B. Pastore & Suganuma 2138* (CTBS)), *P. paganuccii* Mart. ex A.W.Benn. (*G. Hatschbach 56835* (CTBS)), *P. obovata* A.St.-Hil. & Moq. (*R. Schmidt 1519* (ICN)). Scale bar = 1 mm. Photos by J. F. B. Pastore.

Polygala capitolensis J.F.B.Pastore, sp. nov. TYPE: BRAZIL. Minas Gerais: Capitólio, 20°35′38″S, 46°17′33″W [-20.593, -46.292], 5 Nov 2008, *L.S. Kinoshita et al. 08–198* (holotype: UEC [149151!]; isotype: HUFU).

Decumbent herbs, to 15 cm tall. **Roots** slightly lignified. **Stems** slender, with a few to many arising from the base, cylindrical, green, without yellowish glands forming spots, puberulous, trichomes short-clavate. **Leaves** alternate to sub-opposite, petiole ca. 0.5 mm long, chartaceous, slightly decurrent, laminas (0.3–)0.6–0.9(–1.1) × 0.3–0.4 cm, elliptical, apex acute, margin slightly revolute, base acute, with a pair of yellow glands in it, covered by small glandular trichomes. **Racemes** spiciform, 0.6–0.8 × 0.8–0.9 cm, reaching 1 cm after fruits fallen, flowers congested; peduncles short, to 2 mm, bracts 1–1.3 × 0.4–0.5 mm, lanceolate, apex acute to acuminate, ciliate, with two pairs of small yellow glands at the base, persistent on mature capsules, ca. twice the length of the bracteoles; bracteoles 0.7–0.8 × 0.2 mm, lanceolate, ciliate; pedicel ca. 1.1–1.2 mm, glabrous or distally sparsely puberulous. **Flowers** white, 4.8–5.2 mm long; outer sepals ciliate; lower

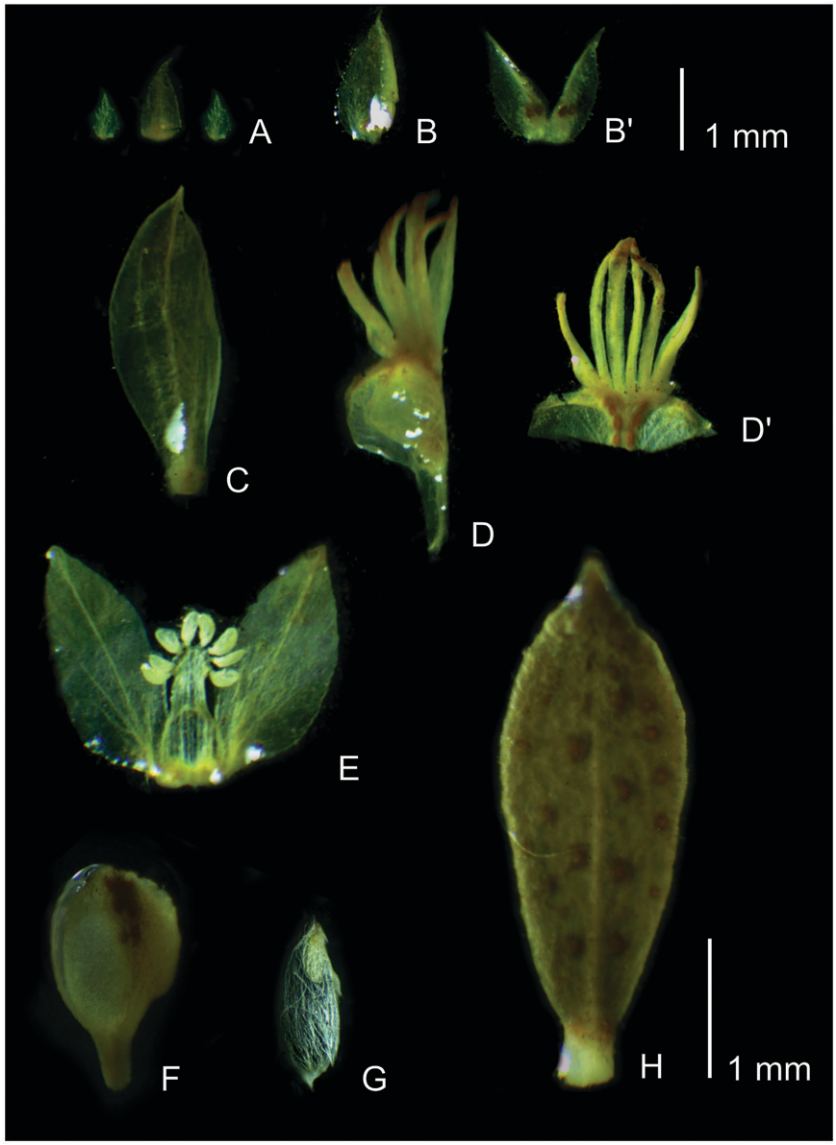

FIG. 5. *Polygala obovata* A.St.-Hil. & Moq. A. Bract and bracteoles. B. Inferior outer sepal. B'. Two superior outer sepals. C. One of the two inner sepals (wings). D. Keel. D'. Keel crest, opened. E. Androecium and lateral petals. F. Capsule. G. Seed. H. Leaf. Scale bar = 1 mm. Photos by J. F. B. Pastore. (A–H. *K. Hagelund 8221* (CTBS)).

outer sepal 1.6–1.8 × 1 mm, ovate, with two or three small yellow glands at the base, apex slightly acuminate; upper outer sepals 1.3–1.6 × 0.7–0.8 mm, lanceolate, apex acute to acuminate, free almost to the base, with a number of small yellow glands; inner sepals (wings) 3.8–4 × 1.6 mm, elliptic, apex acuminate, margins not ciliate, longer than the mature fruits, occasionally with one or two yellow glands at the base; lateral petals 2.7–2.8 × 1.1–1.3 mm; keel 3.7–3.9 mm long, cristate, with yellow glands along the dorsal central vein, persistent on the mature fruits; crest 6-lobed; style erect, terminated by an oblique cymbiform pre-stigmatic cavity, posterior extremity with a conspicuously crested appendage with abundant trichomes and an anterior globose stigma. **Capsules** 2.4–2.7 × 1.6–1.8 mm, elliptical, not or slightly stipitate, asymmetric, with yellow glands along the central vein, occasionally only distally, style caducous in fruit; seeds ca. 1.9–2 × 0.8–0.9 mm, oblong-elliptical, pubescent, appendages obovate, 1/3–1/2 of the length of the seed, 1–1.1 × 0.2 mm. Figure 7.

Distribution*—Polygala capitolensis* is narrowly endemic to the municipality of Capitólio, in Minas Gerais state, Brazil. The species occurs in rocky fields at elevations above 1200 m (Fig. 3).

***Etymology*—**The epithet refers to the municipality of Capitólio, Minas Gerais state, Brazil.

Notes*—Polygala capitolensis* is more related morphologically with *P. paganuccii*, whereas it is easily recognized by the floral structures, capsule, and seed differences (see the comparative plate, Fig. 4). Also, the leaves in *P. capitolensis* are elliptic with an acute apex (vs. narrow obovate to oblong obovate with apex apiculate in *P. paganuccii*). The bracts in *P. capitolensis* are persistent with the mature capsule (vs. bracts caducous after the flowers open and during the capsule development). The apex of the lateral petal in *P. capitolensis* is acute but truncate in the top (vs. rounded apex in *P. paganuccii*), whereas the venation pattern in the lateral petals of *P. capitolensis* is formed by 3–4 veins arising from the base but not, or just a few, branched distally (vs. single vein from the base of the lateral

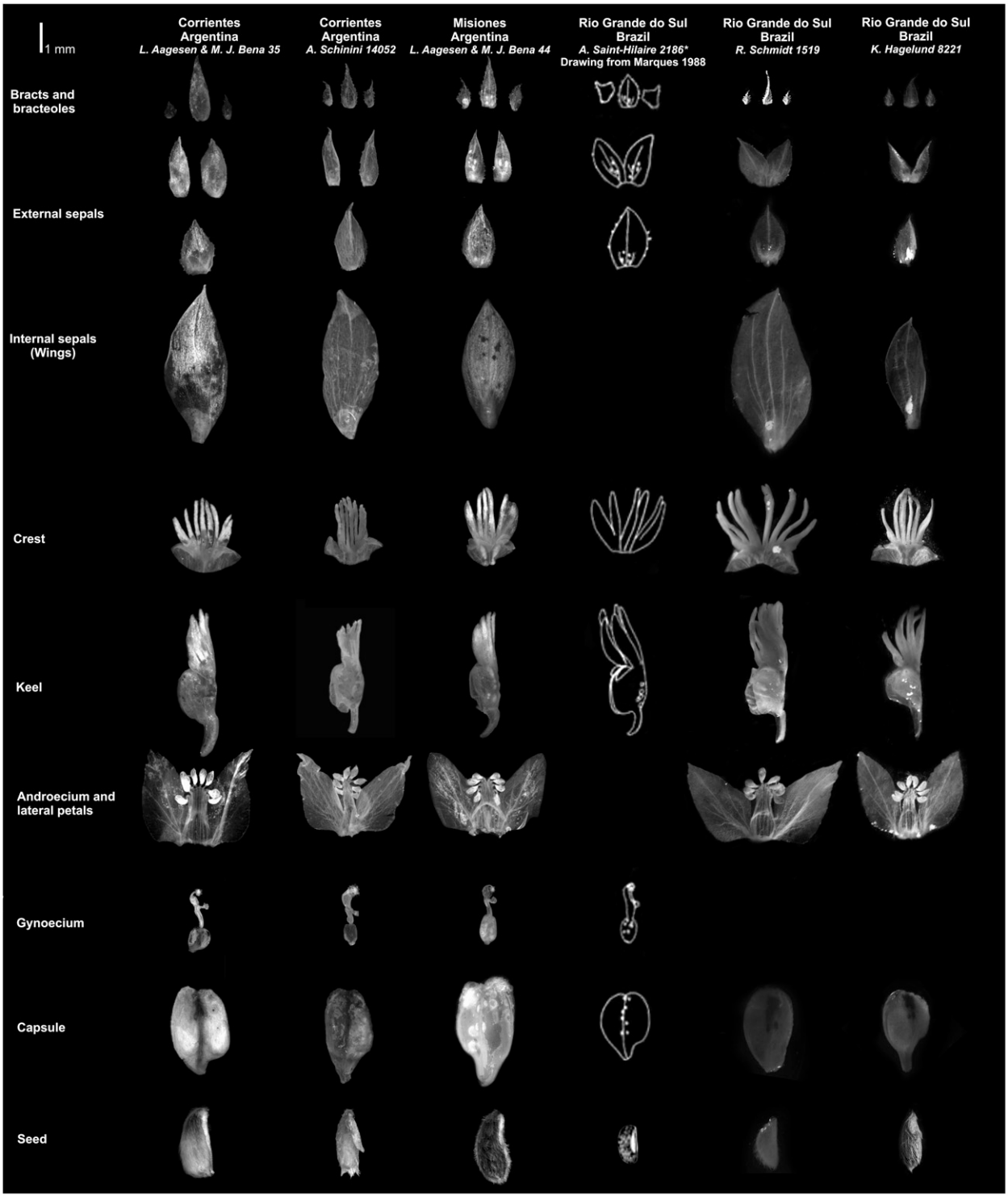

FIG. 6. Infraspecific morphological variation in *Polygala obovata* A.St.-Hil. & Moq.

petal branched distally). Furthermore, *Polygala capitolensis* has maculated leaves with yellow glands, which also appears in all other related species, but in *P. capitolensis* the glands are bigger and more visible (see Fig. 2).

***Additional Specimens Examined*—Brazil.** —MINAS GERAIS: Capitólio, Represa de Furnas, estrada para mineradora Gabi Extrações, 20°35′32″S, 46°17′20″W [-20.592, -46.288], 26 May 2006, *J. N. Nakajima et al. 4378* (CTBS, HUFU).

Polygala jardimii J.F.B.Pastore, sp. nov. TYPE: BRAZIL. Bahia: Uruçuca, rodovia BA-001, mirante da praia, rodovia, 14°28′36″S, 39°1′51″W [-14.476, -39.030], 22 Jun 2007, *J.F.B. Pastore & Suganuma 2138* (holotype: HUEFS[127600!]; isotype: CEN[69433!]

Decumbent herbs, to 25 cm tall. **Roots** slightly lignified. **Stems** slender, with a single to few arising from the base, cylindrical, green, without yellowish glands forming spots, densely puberulous, trichomes short-clavate. **Leaves** opposite, subopposite, or alternate, petiole ca. 1 mm long, chartaceous, lamina (0.5–)0.8–1.2 × (0.3–)0.4–0.5 cm, broad- obovate, rarely

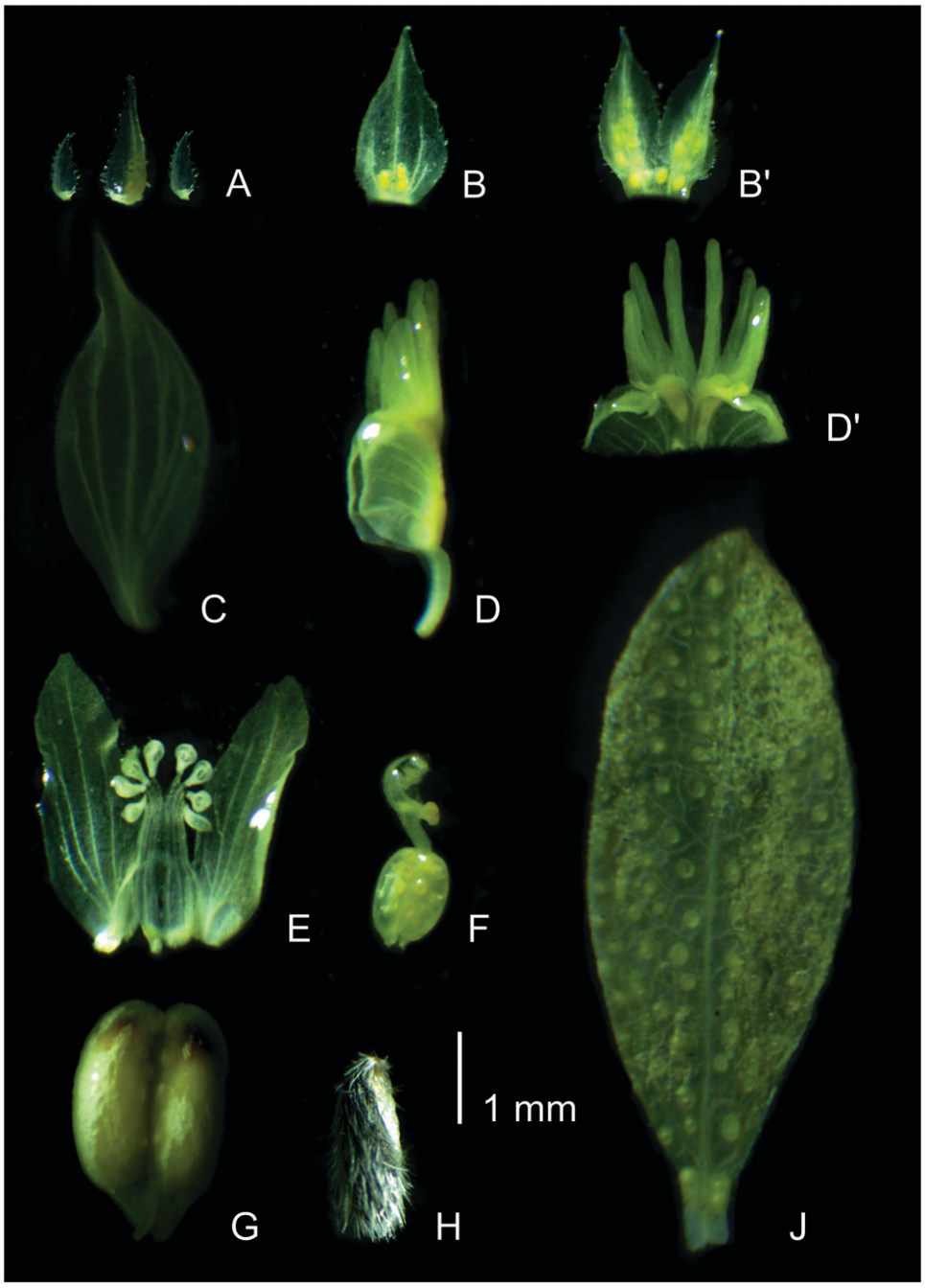

FIG. 7. *Polygala capitolensis* J.F.B.Pastore. A. Bract and bracteoles. B. Inferior outer sepal. B'. Two superior outer sepals. C. One of the two inner sepals (wings). D. Keel. D'. Keel crest, opened. E. Androecium and lateral petals. F. Gynoecium. G. Capsule. H. Seed. J. Leaf. Scale bar = 1 mm. Photos by J. F. B. Pastore. (A–J. *L.S. Kinoshita 08–198* (CTBS)).

narrow-obovate, apex apiculate, margin slightly thickened, base obtuse, covered by small glandular trichomes. **Racemes** spiciform, 0.4–0.7 × 0.6–0.8 cm, reaching 1.2 cm after fruits fallen, flowers congested; peduncle short, to 2 mm; bracts 0.8–1 × 0.4 mm, lanceolate, apex acute, ciliate, with two small yellowish spots at the base, occasionally persistent at anthesis, twice the length of bracteoles; bracteoles 0.5–0.6 × 0.2 mm, lanceolate, ciliate; pedicel 1–1.1 mm, glabrous. **Flowers** white, 3.6–3.8 mm long; outer sepals ciliate, with two small yellow spots at the base; lower outer sepal 1.3–1.4 × 0.7–0.9 mm, ovate, apex slightly acuminate; upper outer sepals 1–1.3 × 0.5 mm, free to almost the base, lanceolate, apex acuminate; inner sepals (wings) 3–3.2 × 1.1–1.2 mm, elliptic, apex acuminate, margins not ciliate, longer than the mature fruits; lateral petals 1.7–1.9 × 0.7–0.8 mm; keel 2.1–2.4 mm long, cristate, with yellow spots along the dorsal central vein, persistent on mature fruits; crest 4–6-lobed; style erect, terminated by an oblique cymbiform pre-stigmatic cavity, posterior extremity with a conspicuously crested appendage with abundant trichomes and an anterior globose stigma. **Capsules** 2–2.2 × 1.3–1.4 mm, elliptical, stipitate, asymmetric, with yellow spots along the central vein, style caducous in fruit; seeds ca. 1.5–1.7× 0.6–0.7 mm, oblong-elliptical, puberulous, appendages obovate, 2/3 of the length of the seed, 1–1.1 × 0.2–0.4 mm. Figure 8.

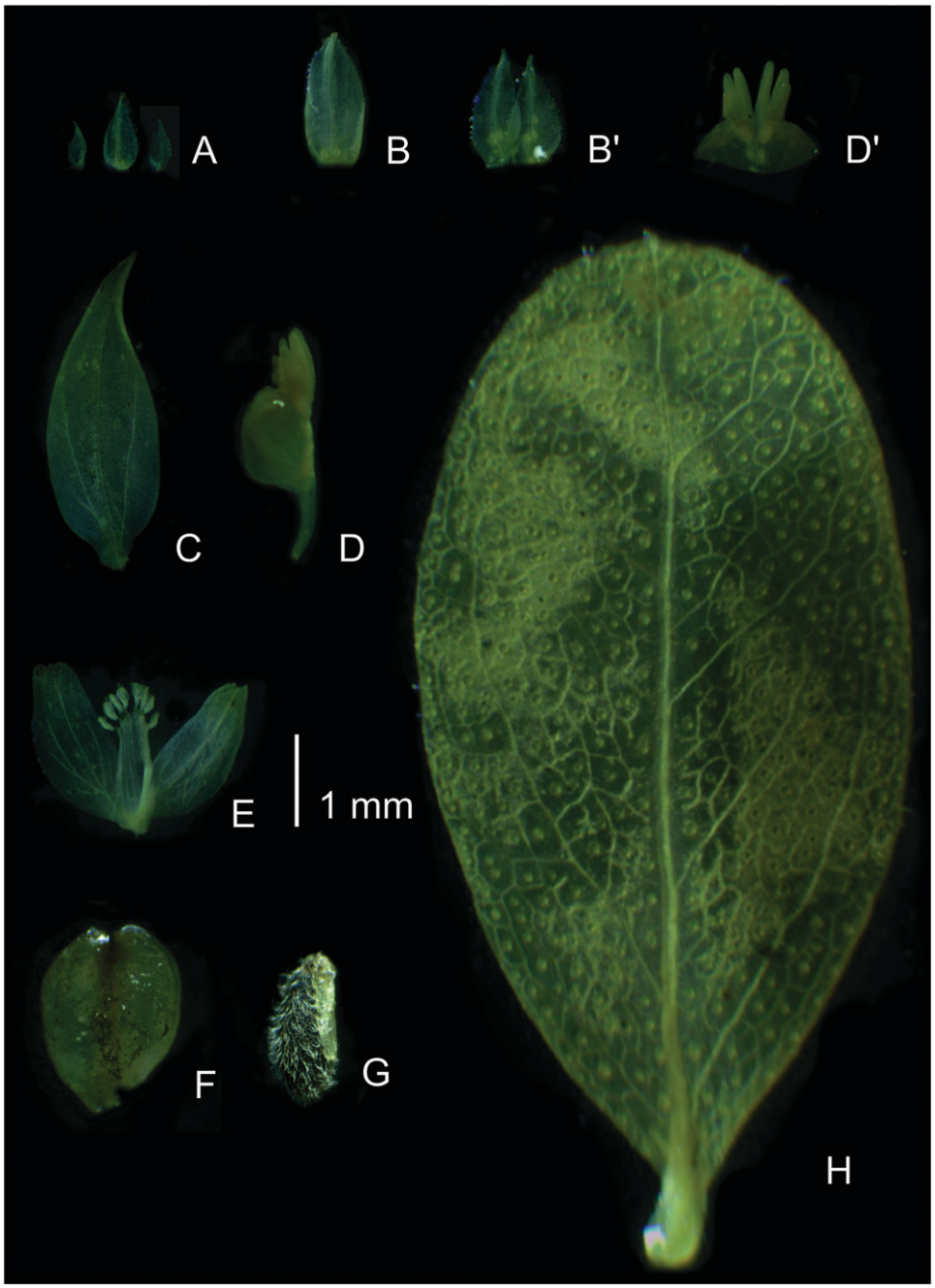

FIG. 8. *Polygala jardimii* J.F.B.Pastore. A. Bract and bracteoles. B. Inferior outer sepal. B'. Two superior outer sepals. C. One of the two inner sepals (wings). D. Keel. D'. Keel crest, opened. E. Androecium and lateral petals. F. Capsule. G. Seed. H. Leaf. Scale bar = 1 mm. Photos by J. F. B. Pastore. (A–H. *J.F.B. Pastore & Suganuma 2138* (CTBS)).

Distribution—*Polygala jardimii* occurs in the municipalities of Itacaré, Uruçuca, and Ilhéus, southern coastal areas of Bahia state, Brazil (Fig. 3). The species was frequently collected in open roadside areas on red-clay soils in the Atlantic Forest biome.

Etymology—The species is named after Dr. Jomar G. Jardim for his important contributions to the study of the Brazilian flora, especially that of the southern coastal areas of Bahia state.

Notes—There was little variation in the fertile structures among the examined specimens of this species (Fig. 9).

By the floral morphology and seed size, *Polygala jardimii* is closely related to *P. multiceps* (Fig. 4). However, it may be easily distinguished by the leaf shape (wide obovate in *P. jardimii* vs. elliptic in *P. multiceps*), the apex of the lateral petals (rounded in *P. jardimii* vs. acute in *P. multiceps*), and the number of lobes in the crest (four in *P. jardimii* vs. six in *P. multiceps*). Whereas *Polygala jardimii* occurs in open areas of the Atlantic Forest in the coastal areas in the south of Bahia state, *Polygala multiceps* is frequently found on rocky fields of the campos rupestres vegetation of the Serra do Espinhaço in Minas Gerais state.

Polyaga jardimii resembles *P. obovata* by the asymmetrical fruits, elliptical seeds, and elliptical to obovate leaves. However, it may be easily recognized from this and all other related species by its smaller flowers and fruits (Fig. 4), and

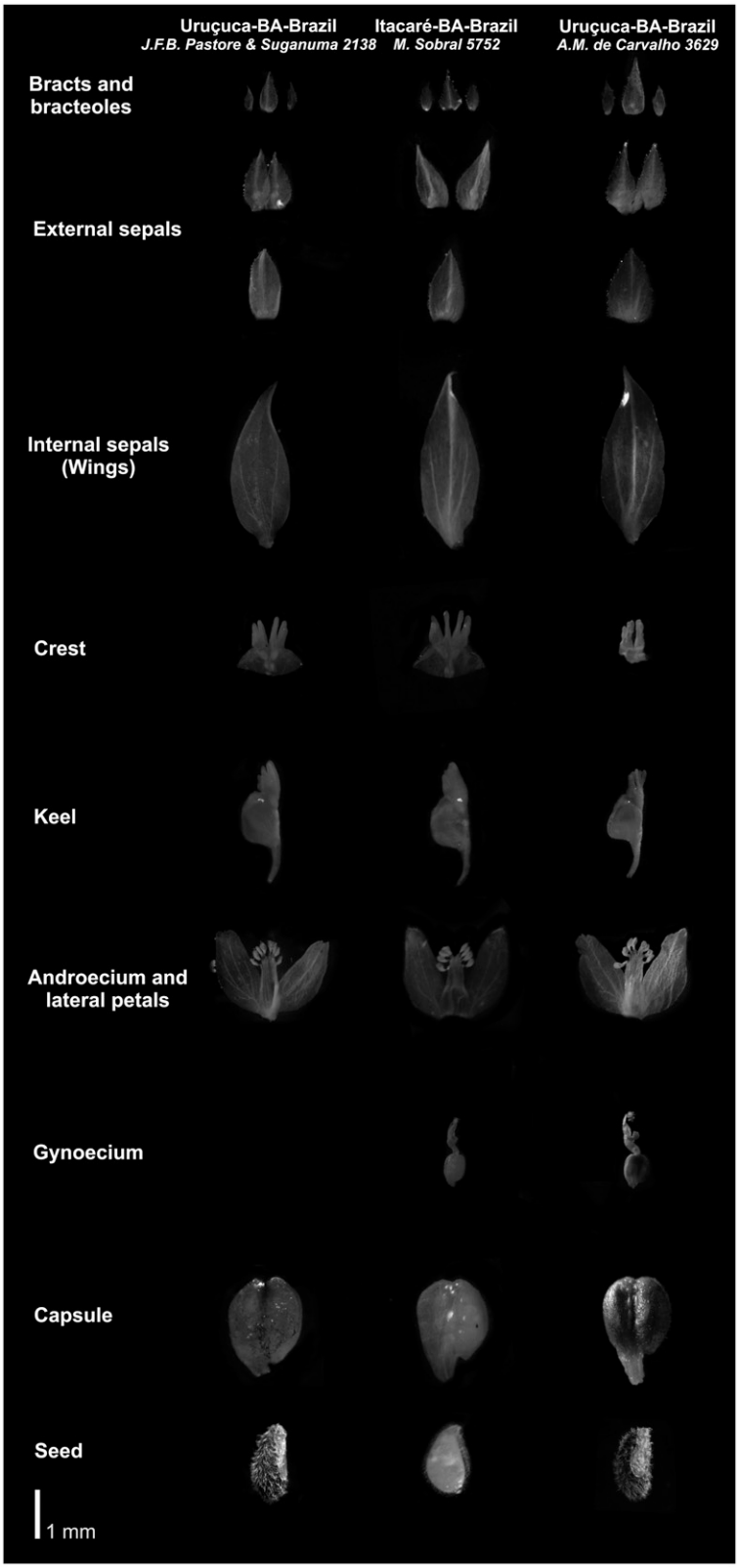

FIG. 9. Infraspecific morphological variation in *Polygala jardimii* J.F.B.Pastore.

by the bracts, bracteoles, and external sepals (ciliate in *P. jardimii* vs. sparsely ciliate or glabrous in other species).

***Additional Specimens Examined*—Brazil.** —BAHIA: Ilhéus, estrada de Ilhéus para Itacaré, entrada à esquerda, 14°33′56″S, 39°03′23″W [-14.565, -39.056], 28 Dec 2005, *S.F. Conceição et al. 479* (HUEFS); Itacaré, ca. 6 km SW of Itacaré, on side road south from the main Itacaré-Ubaitaba road, south of the mouth of the Rio de Contas, 29 Jan 1977, *R.M. Harley et al. 18378* (L, NY); Itacaré, Fazenda Capitão, 7.9 km W of junction BA 001 on road from Itacaré to Itacaré, 5 Jan 1967, *R.P. Belém and R.S. Pinheiro 2984* (UB, US); Itacaré, Junto a estrada Taboquinhas/Itacaré, 01 Jan 1988, *M. Sobral 5752* (CEPEC); Ubaitaba, 14°20′6.59″S, 39°05′30.4″W [-14.335,

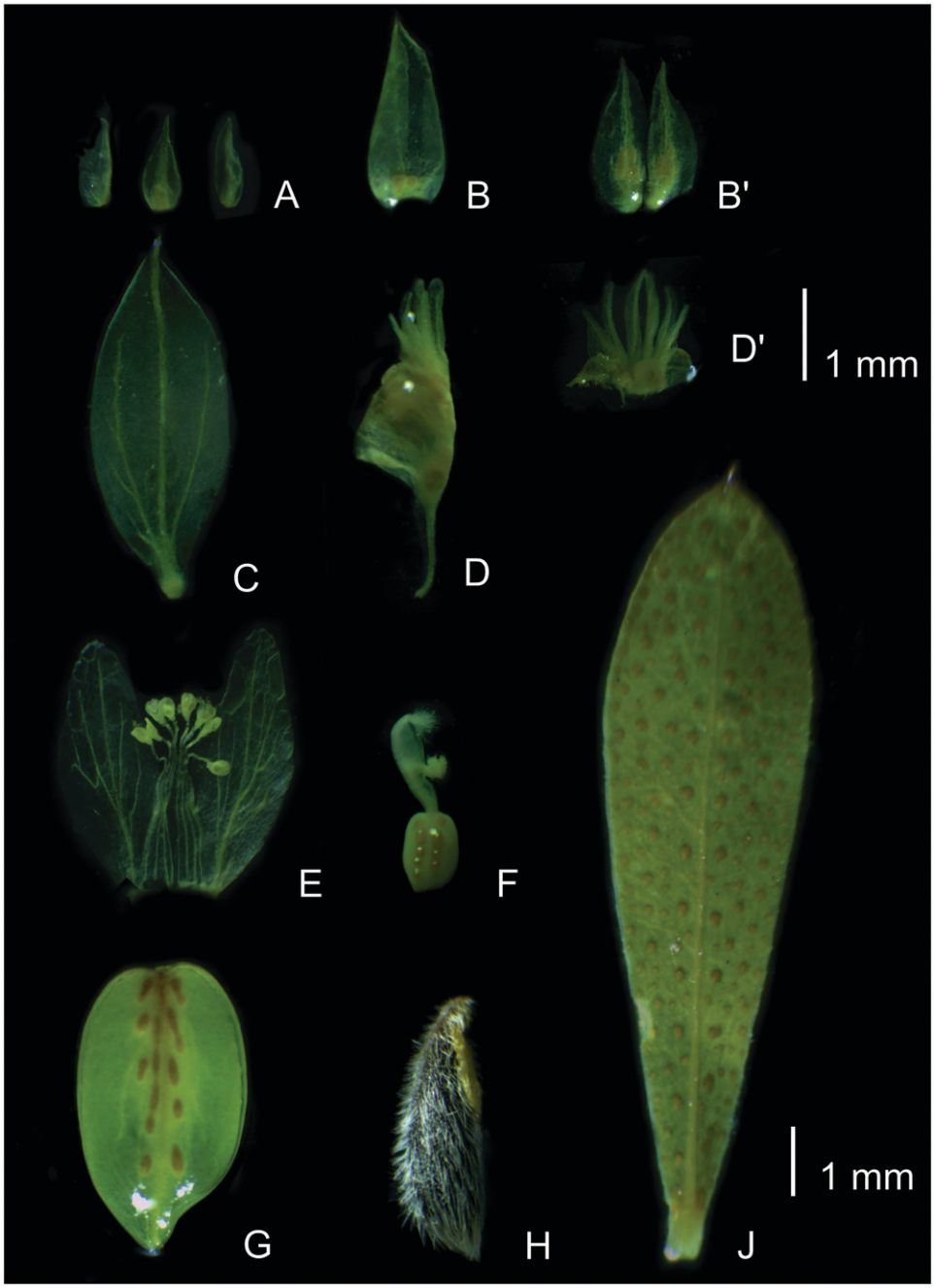

FIG. 10. *Polygala paganuccii* J.F.B.Pastore. A. Bract and bracteoles. B. Inferior outer sepal. B'. Two superior outer sepals. C. One of the two inner sepals (wings). D. Keel. D'. Keel crest, opened. E. Androecium and lateral petals. F. Gynoecium. G. Capsule. H. Seed. J. Leaf. Scale bar = 1 mm. Photos by J. F. B. Pastore. (A–E, G–J. *G. Hatschbach 56835* (CTBS); F. *R.T. Queiroz 11602* (CTBS)).

-39.091], 40–100 m, 04 Nov 2001, *W.W. Thomas et al. 12773* (HUEFS); Uruçuca, Distrito de Serra Grande. 7.3 km na estrada Serra Grande/Itacaré, Fazenda Lagoa do Conjunto Fazenda Santa Cruz, 14°25′S, 39°01′W [-14.416, -39.016], 7 Sep 1991, *A.M. de Carvalho 3629* (HUEFS, NY); Uruçuca, Serra Grande, 14°35′S, 39°17′W [-14.583, -39.283], 29 Jun 2017, *M.L. Guedes et al. 25816* (ALCB); Uruçuca, Serra Grande, forest inventory study site, 7.3 km N of Serra Grande on road to Itacaré, Fazenda Lagoa do Conjunto Fazenda Santa Cruz, 02 Feb 1992, 39°01′S, 14°35′W [-14.583, -39.016], *W.W. Thomas et al. 9028* (NY); Uruçuca, Serra Grande, 7.3 km na estrada Serra Grande/Itacaré, Conjunto Fazenda Santa Cruz, 39°01′S, 14°35′W [-14.583, -39.016], 25 Aug 1992, *A.M. Amorim et al. 650* (NY, US, USP).

Polygala paganuccii J.F.B.Pastore, sp. nov. TYPE: BRAZIL. Bahia: Palmeiras, Subida para a cachoeira da Fumaça, 08 Aug 2006, *J.F.B. Pastore* & *E. Suganuma 1534* (holotype: CEN [00065007]!; isotype: HUEFS[0176228]!).

Decumbent herbs, to 20 cm tall. **Roots** lignified. **Stems** slender, with a few to many arising from the base, cylindrical, green, without yellowish glands forming spots, densely puberulous, trichomes short-clavate. **Leaves** alternate, rarely sub-opposite, subsessile, petiole 1 mm long, chartaceous, lamina (0.3–)0.7–1.5 × (0.2–)0.3–0.4 cm, narrow-obovate to oblong-obovate, apex apiculate, margin slightly thicker, base acute, densely covered by small glandular trichomes. **Racemes** spiciform, 0.6–1.2 × 0.8–1.1 cm, reaching 1.5 cm after fruits fallen, flowers congested; peduncle short 0.2–1 cm, bracts 1–1.2 × 0.4–0.6 mm, lanceolate, apex acuminate, glabrous to sparsely ciliate, with a pair of small yellowish spots at the base; bracts caducous post-anthesis and during capsule

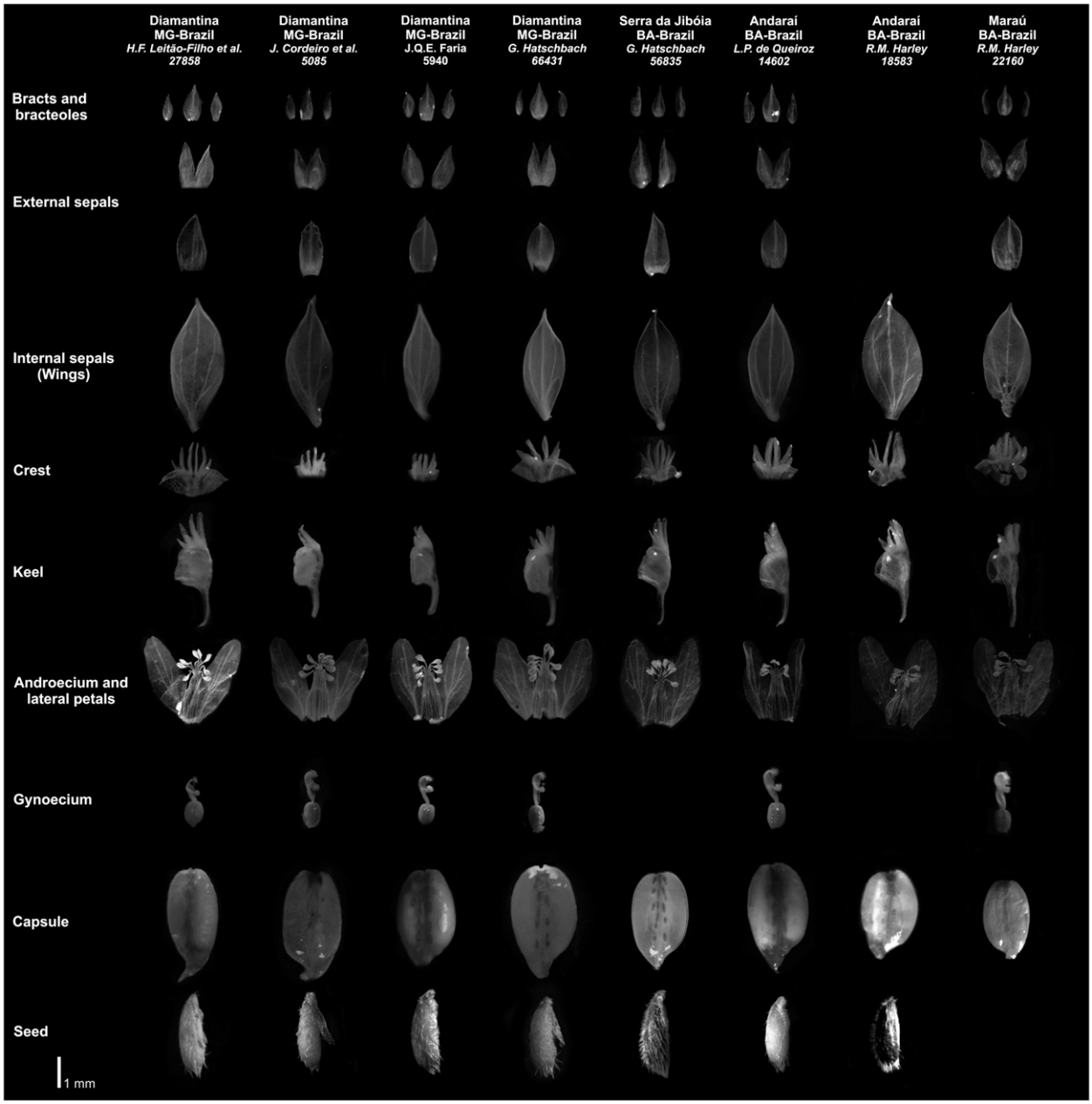

FIG. 11. Infraspecific morphological variation in *Polygala paganuccii* J.F.B.Pastore.

development, equal in length to bracteoles to 1.5 times longer; bracteoles 0.8–1 × 0.3–0.4 mm, lanceolate, glabrous or more rarely sparsely ciliate; pedicel 0.8–1.5 mm, glabrous. **Flowers** white, 4.5–5.5 mm long (including the pedicel); outer sepals glabrous to sparsely ciliated; the lower outer sepal 1.5–2.1 × 0.9–1.1 mm, ovate, apex slightly acuminate, with two small yellow spots at the base; upper outer sepals 1.2–1.7 × 0.5–0.7 mm, lanceolate, apex acute to acuminate, free almost to the base, with 2–4 pairs of small yellow spots from the base to the middle of the sepal; inner sepals (wings) 3.4–4.1 × 1.1–1.6 mm, elliptic, apex acuminate, margins not ciliate, longer than the mature fruits; lateral petals 2.5–2.7 × 0.9–1 mm, oblong-elliptic, apex rounded; keel 2.8–3.5 mm long, cristate, with yellow spots along the dorsal central vein, persistent on mature fruits; crest 4–6-lobed; style erect, terminated by an oblique cymbiform pre-stigmatic cavity, posterior extremity with a conspicuously crested appendage with abundant trichomes and an anterior globose stigma. **Capsules** 3–3.6 × 1.6–2 mm, oblong-elliptic, stipitate, slightly asymmetric, with yellow spots along the central vein, style caducous in fruit; seeds 2.1–2.6 × 0.7–0.9 mm, oblong-elliptic, rarely slightly ovate, pubescent, appendages oblong, 1/3–2/3 of the length of the seed, 1.2–1.6 × 0.2 mm. Figure 10.

Distribution—*Polygala paganuccii* occurs in rocky fields, often associated with elevations above 1000 m, of the Serra do Espinhaço mountain range, with an apparent disjunction between the municipality of Diamantina in Minas Gerais state and Chapada Diamantina in Bahia state. Nonetheless, one population was found at elevations close to sea level in the coastal zone of the municipalities of Maraú and northern Itacaré in Bahia state, where *P. paganucci* occurred sympatrically with *P. jardimii* (Fig. 3).

Etymology—This species is named after Dr. Luciano Paganucci de Queiroz, a major figure among the Brazilian botanists of today.

Notes—We found little variation in the fertile structures of the specimens examined for this study (Fig. 11). The species was often misidentified as *Polygala multiceps* in the visited herbariums. However, the two species differ in their distribution: *P. paganuccii* occurs in rocky fields of the campos rupestres of the Serra do Espinhaço mountain range from Bahia to Minas Gerais, whereas *P. multiceps* occurs on sandy soils near river streams and is endemic to southwestern areas of Minas Gerais state, including its Serra da Canastra.

Additional Specimens Examined—**Brazil.** —Bahia: Abaíra, Chapada Diamantina, Mata do Criminoso, Estrada entre Catolés e Abaíra, 22 Feb 1992, *B. Stannard et al. 51619* (HUEFS, K, MBM); Abaíra, estrada Abaíra-Piatã, km 12, 13°15′38″S, 41°43′46″W [-13.260, -41.729], 1000 m, 26 May 2004, *G. Pereira-Silva et al. 9132* (CEN); Andaraí, 06 Dec 2007, *M.L. Guedes et al. 14185* (ALCB); 5 km South of Andaraí on road to Mucugê, by bridge over the Rio Paraguaçu, 12 Feb 1977, *R.M. Harley 18583 et al.* (IPA, NYBG, UEC, US); Andaraí, estrada entre Andaraí e Mucugê, 17 Dec 2009, *M.L. Guedes 16858* (ALCB); Andaraí, margem do rio Paraguaçu, 4 May 2009, *L.P. de Queiroz 14602* (CTBS, HUEFS); Barra da Estiva, Torre da Telebahia, alt. 1130 m, 13°41′27″S, 41°19′00″W [-13.690, -41.316], 16 Feb 1997, *B. Stannard et al. 5747* (HUEFS); Igatu, 750 m, 19 Feb 2011, *A.A.C. Miranda 19* (HUEFS); Itaetê, Paraguaçu, Assentamento Baixão, área de lote, 13°09′S, 41°07′W [-13.150, -41.116], 13 Apr 2011, *L.J. Alves 70* (ALCB); Jussiape, Serra da Jibóia, 08 Apr 1992, *G. Hatschbach et al. 56835* (CTBS, MBM); Lençóis, 3 Apr 1980, *L.R. Noblick 1772* (HUEFS); Lençois, Área de garimpo às margens do Rio São José, 12°36′26″S 41°22′36″W [-12.607, -41.376], 350 m, 10 Apr 2011, *A.E. Silva 11* (HUEFS); Maraú, About 5 km North from turning to Maraú, Campinho road, 38°58′W 14°04′S [-14.066, -38.966], 17 May 1980, *R.M. Harley 22160* (NY); Morro do Chapéu, estrada para a fazenda Matão, 11°37′02″S, 41°00′25″W [-11.617, -41.006], 921 m, 20 Apr 2018, *E. Melo & B.M. Silva 13739* (HUEFS); Mucugê, ca. 30 km na estrada de Andaraí para Mucugê, 19 Mar 1990, *A.M. De Carvalho, & J. Saunders 2928* (HUEFS); Mucugê, Chapada Diamantina, 12°56′42″S, 41°16′28″W [-12.945, -41.274], 862 m, *M.L. Guedes et al. 16931* (ALCB); Mucugê, Fazenda Hayashi, Guiné, 12°47′S 41°31′W [-12.783, -41.516], Apr 2006, *C.F. de Azevêdo-Gonçalves s.n.* (HUEFS); Palmeiras, Caeté Açu, Trilha para Águas Claras, 16 Feb 2010, 12°32′57″S 41°29′13″W [-12.549, -41.486], 960 m, *F.S. Gomes et al. 557* (ALCB); Palmeiras, Capão, caminho para o Rio Capão, 12°38′48″S 41°29′34″W [-12.646, -41.492], 885 m, 02 May 2014, *M.L. Guedes et al. 21644* (ALCB); Palmeiras, leito seco do Rio São João, 12°26′10″S 41°29′34″W [-12.436, -41.492], 392 m, 02 Nov 2007, *E. Melo et al. 5333* (HUEFS); Palmeiras, subida para a cachoeira da Fumaça, 08 Aug 2006, *J.F.B. Pastore & E. Suganuma 1534* (CEN, HUEFS); Piatã, Chapada Diamantina, córrego na saída de Piatã, 20 Apr 2015, *J.E.Q. Faria & A.R.O. Ribeiro 4406* (CTBS, HUEFS, UB, RB); Seabra, Queimada Nova, 19 Jan 1977, *G. Hatschbach 39540* (MBM). —Minas Gerais: 65 km NE of Itabuna, at the mouth of the Rio de Contas on the N. Bank, opposite Itacaré, 30 Jan 1977, *R.M. Harley et al. 18389* (NY); Diamantina, 8 Sep 1971, *G. Hatschbach 27499* (MBM, US, USP); Diamantina, 28 Jan 1976, *L. Krieger 14067* (HUEFS); Diamantina, 20 Jul 1980, *N.L. Menezes 201* (USP); Diamantina, Rodovia Bocaiúva-Diamantina, próximo à Senador Mourão, 18 Mar 1997, *G. Hatschbach et al. 66431* (CTBS, US); Diamantina, 15 km N da cidade, 29 Apr 2003, *H.F. Leitão-Filho et al. 21827* (UEC); Diamantina, Rodovia BR-367, 29 Apr 2013, *J. Cordeiro et al. 5085* (CTBS, IAN, MBM); Diamantina, Margem da estrada para formação, 04 Jun 2016, *J.Q.E. Faria 5940* (CTBS, HDJF, UB); Diamantina, Parque Estadual do Biribi, ca. 2 km da Vila, 18°09′25″S 43°36′57″W [-18.156, -43.615], 25 Mar 2009, *J.F.B. Pastore et al. 2643* (CESJ, HUEFS); Diamantina, Rodovia Diamantina–Mendanha, 10 Dec 1992, *H.F. Leitão-Filho et al. 27648* (UEC); Diamantina, Rodovia Diamantina–Mendanha, 10 Dec 1992, *H.F. Leitão-Filho et al. 27858* (UEC); Diamantina, Rodovia Diamantina–Mendanha, km 578, 1° parada, 06 Jun 1985, *H.F. Leitão-Filho et al. 17521* (UEC); Diamantina, Serra do Espinhaço, ca. 17 km NE of Diamantina, road to Mendanha, 29 Jan 1969, *H.S. Irwin et al. 22876* (MO, NY, USP); estrada saindo de Maraú para Ubaitaba, 29 Dec 2005, *P.D. Carvalho 273* (RB); Itacaré, Caminho para Piracanga, após a travessia da balsa, 17 Mar 2006, *J.G. de Carvalho-Sobrinho 767* (HUEFS); Maraú, km 14, da estrada Maraú-Ubaituba, 18 May 1985, *G. Martinelli 11052* (RB); Serra do Espinhaço, 15 Apr 1973, *Anderson, W.R. 9003* (NY, SPF, UB); Serra do Espinhaço, 25 km by road NE of Diamantina, 2 km W of Rio Jequití, 09 Apr 1973, *W.R. Anderson 8359* (MO, NY, UB).

Key to the Three New Species of Polygala and Their Allies

1. Lateral petal lanceolate, crest longer than the hood (Brazil: Rio Grande do Sul, Paraguay, Uruguay, Argentina) ..... *P. obovata*
1. Lateral petal elliptic, crest shorter (or slightly shorter) than the hood (Brazil: São Paulo, Minas Gerais, Bahia) 2
   2. Flowers 4.5–5.5 mm, keel 2.9–3.9 mm 3
      3. Leaf blades elliptic, all stems decumbent ..... *P. capitolensis*
      3. Leaf blades oblanceolate, central stems erect, lateral partially prostate ..... *P. paganuccii*
   2. Flowers 3.6–4.0 mm, keel 2.1–2.4 mm 4
      4. Leaf blades oval, lateral petal ovate, veins branched until secondaries, apex acute ..... *P. multiceps*
      4. Leaf blades elliptic, lateral petal sub-oblong, veins branched until tertiaries, apex rounded ..... *P. jardimii*

Acknowledgments

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Author Contributions

JFBP conducted field work; JFBP, MM, AM, and EA wrote the manuscript; JFBP, MM, and AM prepared the figures; MM and JFP prepared the maps.

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