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The identity of *Stemodia lanceolata* (Plantaginaceae) and its occurrence in Brazil

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Abstract

In this contribution, we reassess the identity of *Stemodia lanceolata* (Plantaginaceae) and confirm its occurrence in Brazilian territory. We present a detailed and updated description, a fine illustration, and photographs of this species, along with comments on its distribution, habitat and phenology, and notes on taxonomic affinities. *Stemodia lanceolata* is characterized by its stiffy erect terminal inflorescence with filamentous aspect due to the long, linear-triangular, frequently out-curved floral bracts. Finally, we propose second-step lectotypifications for three names subordinated to *S. lanceolata*.

Keywords: Chaco, Gratioleae, Pantanal

Resumo

Neste trabalho, investigamos a identidade de *Stemodia lanceolata* (Plantaginaceae) e confirmamos sua ocorrência no território brasileiro. Apresentamos uma descrição atualizada e detalhada, uma ilustração e fotos desta espécie, além de comentários sobre sua distribuião, seu habitat e sua fenologia, e notas sobre suas afinidades taxonômicas. *Stemodia lanceolata* é caracterizada pela inflorescência terminal ereta, com aspecto filamentoso por conta das brácteas florais longas, linear-triangulares, frequentemente curvadas para fora. Por fim, propomos lectotipificações de segundo passo para três nomes subordinados a *S. lanceolata*.

Palavraschave: Chaco, Gratioleae, Pantanal

Introduction

Brazil is a South American country known for its great plant diversity, with over 46,000 species (Flora do Brasil 2020, in construction). A recent published compilation of the seed plant diversity in Brazil estimated ca. 33,000 species, included in 2,746 genera and 229 families (BFG 2015). The Flora do Brasil 2020 project aims to deliver online monographs with nomenclatural information, descriptions and geographic distribution along with identification keys and images of all known species of plants, algae and fungi in the country. As part of our contribution to the knowledge on the genus *Stemodia* Linnaeus (1759: 1118) (Plantaginaceae), under the scope of this project, we have been conducting field trips and consulting herbarium collections in Brazil.

Stemodia, with over 50 species and pantropical distribution, is one of the largest genera of the tribe Gratioleae (Turner & Cowan 1993a, Albach *et al.* 2005). The genus presents a great morphological heterogeneity, being usually characterized by herbs, calyx with equal to sub-equal sepals, and androecium composed of 4 fertile stamens with short-stalked, glabrous thecae (Turner & Cowan 1993a, Souza & Giulietti 2009, Sosa *et al.* 2012). In Brazil, 16 species were

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recognized until recently (BFG 2015), but the recent discovery of two new species brought it to 18 (Scatigna *et al.* 2017, 2018). During a field trip to Mato Grosso do Sul, Brazil, we found representatives of a species whose identity and occurrence in this country was still controversial. *Stemodia lanceolata* Bentham (1846: 384) was first described based on specimens collected in Argentina. Turner & Cowan (1993b) expanded its occurrence to Bolivia, Brazil, Paraguay and Uruguay, without citing a voucher for the second country. More recently, Souza & Giulietti (2009) kept this species out of their account of the Scrophulariaceae *s.l.* of Brazil; in addition, the authors questioned the identity of *S. lanceolata*, suggesting that it could be synonymous with *Stemodia stricta* Chamisso & Schlechtendal (1828: 10), which in turn could be subordinated to *Stemodia durantifolia* (Linnaeus 1759: 1116) Swartz (1791: 240), but did not propose any formal synonymization, arguing that they had not seen sufficient material. Sosa & Dematteis (2013) presented a taxonomic treatment of *Stemodia lanceolata*, distinguishing it from *S. stricta* and *S. scoparioides* Hassl. ex Minod (1918: 208) but did not include Brazilian specimens. The last Brazilian Flora list (BFG 2015) and the recently published Checklist of Angiosperms from the Chaco of Mato Grosso do Sul (Sartori *et al.* 2018) also excluded *S. lanceolata* from the account.

After the analysis of several specimens from Argentina, Brazil and Paraguay, on field and in herbaria, the identity of *Stemodia lanceolata* and its occurrence in Brazilian territory were confirmed. Here, we present a detailed and updated description, a fine illustration, and photographs of *Stemodia lanceolata*, along with comments on its distribution, habitat and phenology, and notes on taxonomic affinities and nomenclature.

Material and Methods

Our description and morphological comparison were based on field observations and on analysis of herbarium specimens, and complemented with literature information (Turner & Cowan 1993b, Souza & Giulietti 2009, Sosa & Dematteis 2013). We searched for additional records in the ALCB, BHCB, BHZB, CEN, CEPEC, CGMS, COR, CPAP, CTES, CVRD, DIAM, EAC, ESA, HCJS, HRB, HRCB, HUEFS, IAC, IAN, ICN, MBM, MBML, MG, OUPR, PACA, R, RB, SP, SPF, UB, UEC, UFG and UPCB collections and in the digital databases of K, MO, NY and P. The map was prepared by João A. M. do Carmo and was generated with ArcGIS, a product of the Environmental Systems Research Institute (ESRI; Redlands, California), under license for UNICAMP.

Taxonomic treatment

Stemodia lanceolata Bentham (1846: 384). *Stemodiacra lanceolata* (Benth.) Kuntze (1891: 466). Lectotype (designated by Turner & Cowan 1993b):—ARGENTINA. "In Andibus Mendozae", *Gillies s.n.* (K barcode K000529091!; isolectotype OXF not seen). Residual syntype:—ARGENTINA. "In Banda orientali et prov. La Plata", *Tweedie s.n.* (K barcode K000529092!). (Figs. 1 & 2).

Stemodia lanceolata f. *angustifolia* Chodat & Hassler (1904: 287). *S. lanceolata* var. *angustifolia* (Chodat & Hassl.) Minod (1918: 210). Lectotype (first-step designated by Turner & Cowan 1993b, second-step designated here):—PARAGUAY, "ad ripam lacus Ypacaray", 1898–1899, *Hassler 3035* (G barcode G00306654!, isolectotypes: BM barcode BM000953299!, G barcodes G00306680! & G00306679!, GH barcode 00091756 [digital image]!, K barcode K000528925 [digital image]!, UC barcode UC 944821 [digital image]!).

Stemodia lanceolata f. *latifolia* Chodat & Hassler (1904: 287). *Stemodia lanceolata* var. *latifolia* (Chodat & Hassl.) Minod (1918: 211). Lectotype (first-step designated by Turner & Cowan 1993b, second-step designated here). Paraguay. "in stagnis pr. Concepción", IX 1901–1902, *E. Hassler 7473* (G barcode G00306648!; isolectotypes: BM barcode BM000953300!, G barcodes G00306649!, G00306652 [two sheets]! & G00306650 [two sheets]!, GH barcode 00091757 [digital image]!, K barcode K000528929 [digital image]!, MICH barcode 1108070 [digital image]!, MO stamp no. 1573387 [digital image]! MPU barcode MPU020206 [digital image]!, NY barcodes 00130682 [digital image]! & 00130681 [digital image]!, PH barcode 00022857 [digital image]!, S Herb. No. S 10-20768 [digital image]!, UC barcode UC 935131 [digital image]!).

Stemodia lanceolata f. *laxiflora* Chodat & Hassler (1904: 287). Lectotype (first-step designated by Turner & Cowan 1993b, second-step designated here). Paraguay: "in palude pr. Tobaty", IX 1900, *Hassler 6385* (G barcode G00306645; isolectotypes: BM barcode BM000098448!, G barcode G00306647!, S Herb.No. S 10-20769 [digital image]!, UC barcode UC 944820 [digital image]!). Specimen excluded: G barcode G00306646!.

FIGURE 1. *Stemodia lanceolata*. A. Flowering branch. B. Leaf base clasping the stem; C. Inflorescence apex; D. Flower; E. Immature fruit with persistent calyx subtended by two bracteoles. F. Detail of sepal surface showing glandular trichomes. G. Dissected corolla showing androecium. H–I. Stamens. [Drawn by Mirtha L. Gómez after *Hatschbach 29564*(CTES)].

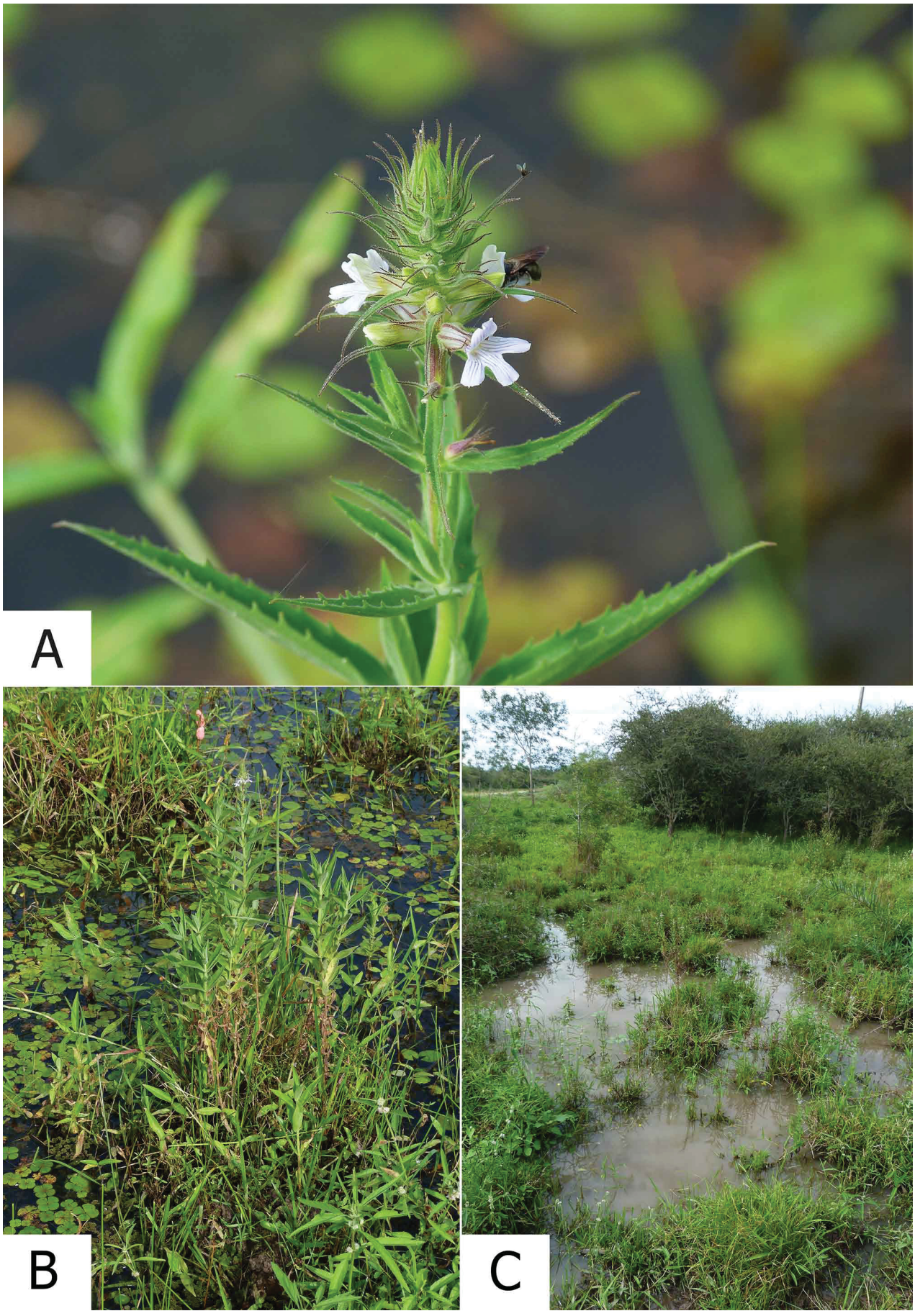

FIGURE 2. *Stemodia lanceolata*. A. Inflorescence with linear, out-curved bract apices and white flowers. B. Habit in flooded habitat; C. Habit: flooded chaco. Photos: A.V. Scatigna.

Herbs, rhizomatous, stiffly erect, sticky and aromatic, 0.3–1.5 m tall. *Stems* sub-quadrangular, single or sparsely branched at base, glandular-pubescent, denser towards apex. *Leaves* opposite to 3–4-whorled, sessile; blades lanceolate, narrow-elliptic, or oblanceolate, 2.5–9 cm × 0.5–2 cm, apex acute to acuminate, base truncate to slightly auriculate, clasping, margins sub-entire, dentate, serrate to argute-serrate, especially on distal half, abaxial surface sparsely glandular-pubescent, with short capitate trichomes concentrated on veins, adaxial surface glandular-pubescent, with short capitate trichomes scattered over surface. *Flowers* axillary, single or geminate, bi-bracteolate, sessile to short-pedicelate, concentrated on apex of branches, forming well defined spiciform inflorescence; bracts leaf-like, lanceolate to linear-triangular, 1–9 cm × 0.5–1 cm, usually as long as to over to times as long as flowers, apex acute to long-acuminate, frequently curved outwards, giving a filamentous aspect to the inflorescence, base acute to slightly auriculate, clasping, margins entire or dentate, serrate to argute-serrate, indument same as leaves; pedicel up to 2 mm long, sometimes twice longer in fruits, glandular-pubescent; bracteoles 2, opposite, appressed to calyx, linear 7–9 × 0.5–0.6 mm, frequently longer than sepals, glandular-pubescent on both faces; sepals equal to sub-equal, linear-triangular 4–7 × 0.8–1 mm, abaxial surface glandular-pubescent, adaxial glabrous; corolla bilabiate, white to lilac, yellowish on throat, with purplish veins, tube 7–10 mm long, externally glandular pubescent on veins, internally sparsely glandular-pubescent, upper lip obscurely 2-lobed, ca. 5–5.1 × 4.5–4.6 mm, apex truncate to slightly emarginated, externally glandular-pubescent, internally glabrous, lower lip clearly 3-lobed, lobes 3.9–4.2 × 2–2.1 mm, externally glandular-pubescent, internally sparsely villous on central lobe up to filaments insertion, glabrous in lateral lobes, apices truncate to mucronulate. *Stamens* 4, didynamous, reaching throat, filaments filiform, inserted at half of corolla tube, apex capitate, anterior pair 4–4.5 mm long, posterior 1.8–2.1 mm long, glabrous; anthers with 2 fertile thecae, separated by the connective, 0.5–1.1 mm long, glabrous; staminode 1, much reduced. *Ovary* superior, syncarpous, 2-carpelar, 2-locular, ovoid, ca. 2–3 × 1–1.5 mm, with two opposite longitudinal grooves, glabrous; placentation axillary, ovules numerous; style terminal, filiform, 5–5.5 mm long, glabrous, persistent; stigma slightly bi-globular, 0.5–0.6 mm long, down-curved, glabrous. *Capsule* ovoid, 4–5.2 × 3–3.5 mm, dehiscence both loculicidal and septicidal on apical portion, glabrous. *Seeds* cylindrical, 0.28–0.5 × 0.1–0.2 mm, base acuminate, reticulate, longitudinally ribbed.

Specimens examined:—BRAZIL. Mato Grosso do Sul: Corumbá, invernada Barreiro, a 50 m da invernada Braque, Fazenda Acurizal, Nabileque, Pantanal, 19º44'S, 57º06'W, 24 June 1987, fl., *Pott et al. 3033* (CPAP!, UEC!); Fazenda Acurizal, Nabileque, Pantanal, 19º52'S, 57º08'W, 7 December 1987, *Pott et al. 4079* (CPAP!) Miranda, Rodovia BR 262, Passo do Lontra, 16 April 1972, fl., fr., *Hatschbach 29564* (CTES!, MBM!, NY[digital image]!); Porto Murtinho, Ingazeira, Fazenda Ovo de Ema, depressão úmida, 16 November 2006, fl., fr., *Barbosa & Silva 1922* (ESA!, MBM!); Estrada para o Norte, Fazenda Tarumã, orla do brejo, 20 October 2003, fl., fr., *Hatschbach et al. 76566* (ESA!, MBM!); Fazenda Panorama, área alagada na margem do corredor próximo à sede, 21º36'27"S, 57º38'17"W, 5 June 2017, fl., *Scatigna et al. 1210* (UEC!); Fazenda Retiro Conceição, área alagada ao lado de corredor, 21º42'15"S, 57º45'48"W, 5 June 2017, fl., fr., *Scatigna et al. 1212* (UEC!); Rio Grande do Sul: São Gabriel, Fazenda Sta. Cecilia, "in dumetosis subpaludosis", January 1944, fl., fr., *Rambo s.n.* (PACA 25832!).

Distribution and habitat:—*Stemodia lanceolata* is restricted to South America, being previously recorded in Argentina, Bolivia and Paraguay (Sosa & Dematteis 2013). In Brazil, this species was collected in the states of Rio Grande do Sul and Mato Grosso do Sul (Fig. 3). Specimens grow in moist soil, in open, often disturbed, areas of flooded grasslands and Chaco (Fig. 2C).

Phenology:—*Stemodia lanceolata* was collected with flowers and fruits in January, February, April, June, September, October and November. It is likely to produce flowers and fruits whenever there is water available. Plants exhibit vegetative propagation by aerial rhizomes.

Typifications:—Turner & Cowan (1993b) effectively lectotypified the names treated here, and apparently annotated the specimens properly; nevertheless, we believe that it might be narrowed according to Art. 9.17 of the ICN (Turland *et al.* 2018), in order to simplify and avoid confusion in further citation of the original materials. For *Stemodia lanceolata* f. *angustifolia*, the authors selected the specimen *Hassler 3035* housed at G as the lectotype and a duplicate at G-DEL as an isolectotype; however, the collection of G-DEL has been incorporated in the general collection of G, in which we found three duplicates of the same gathering. We selected the specimen annotated as lectotype by B. Turner, bearing the label of Hassler's herbarium, as second-step lectotype (barcode G00306654), while the remaining specimens, both annotated as isolectotype by Turner, are here considered isolectotypes. For *S. lanceolata* f. *latifolia*, the authors selected a specimen at G-DEL of *Hassler 7473* as the lectotype and a duplicate at G as one of the isolectotypes, but we found, in the general collection, four duplicates of the same gathering, two of them mounted in two sheets each. We selected the specimen bearing the label from Delessert's herbarium and annotated as lectotype by B. Turner as the second-step lectotype (barcode G00306648), and considered the remaining specimens, all of them annotated as isolectotype by Turner, as isolectotypes. Finally, for *S. lanceolata* f. *laxiflora*, Turner & Cowan

(1993b) selected a specimen of *Hassler 6385* at G as the lectotype and a duplicate at G-BOIS (also incorporated in G) as isolectotype, but we found three duplicates of this gathering in the general collection; we selected the specimen bearing a label from Chodat's herbarium and annotated as lectotype by Turner as the second-step lectotype (barcode G00306645), and considered the specimen bearing a label from Hassler's herbarium and annotated as isolectotype by Turner as an isolectotype (barcode G00306647). The third duplicate of *Hassler 6385* (barcode G00306646) bears a label from Boissier's herbarium and the location of "Cerros de Tobaty", presumably a different location from that cited in the protologue; therefore, we considered it as belonging to a different gathering, although it has been annotated as isolectotype by Turner.

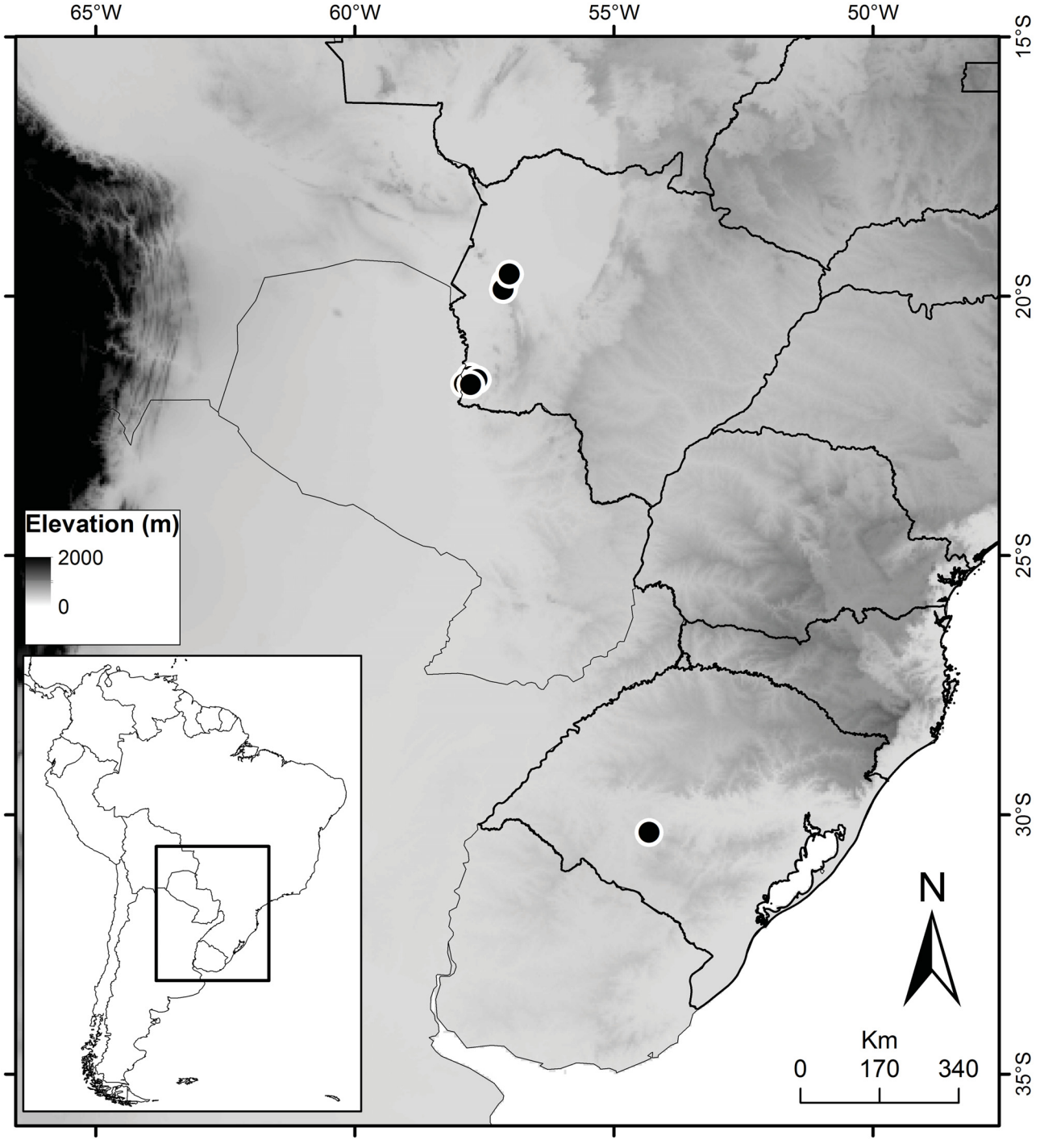

FIGURE 3. Distribution map of *Stemodia lanceolata* in Brazil. Black circles are cited records.

Discussion:—*Stemodia lanceolata* presents erect habit (Fig. 2B), sessile leaves with clasping base (Fig. 1B), and sessile or short-pedicelate flowers (Fig. 1C), each one subtended by a pair of bracteoles right below the calyx (Fig. 1D), concentrated at the apex of branches (Figs. 1A, 1C, 2A), a set of traits that, according to Souza & Giulietti (2009) and Scatigna *et al.* (2018) approximate it to *S. durantifolia*, *S. hyptoides* Chamisso & Schlechtendal (1828: 8), *S. maritima* Linnaeus (1759: 1118), *S. palustris* Saint-Hilaire (1824–1826: 216), *S. perfoliata* Scatigna & V.C.Souza in Scatigna *et al.* (2018: 253) and *S. stricta*. Some of these taxa are of difficult identification, which has led to conflicting circumscriptions (Dawson 1979, Turner & Cowan 1993b, Souza & Giulietti 2009, Sosa & Dematteis 2013). In addition, records of intermediate specimens suggest that hybridization may occur among some species, contributing to the taxonomic confusion in the called *Stemodia stricta* complex (Sosa *et al.* 2012). In Brazilian herbaria, the few specimens belonging to *S. lanceolata* have been identified either as *S. stricta* or *S. durantifolia*, especially due to the presence of short, capitate trichomes on sepals, a feature used by Souza & Giulietti (2009) to differentiate these species from *S. hyptoides*; however, there are some morphotypes of *S. hyptoides* that exhibit this type of trichomes on sepals, proving the fragility of this character as diagnostic (Sosa *et al.* 2012). The size of flowers has long been used to characterize *S. lanceolata* (Minod 1918, Turner & Cowan 1993a, 1993b), but this feature currently presents intra- and interspecific variation and overlap (Sosa *et al.* 2012, Sosa & Dematteis 2013).

Stemodia lanceolata is characterized by the long, lanceolate leaves that frequently turn blackish after herborization, and by the long linear-triangular bracts, with a linear, out-curved apex that give a filamentous aspect to the terminal inflorescences (Figs. 1C, 2A). This species differs from *S. stricta* in the more robust and taller habit, in the larger leaves distributed throughout the stem (*vs*. concentrated at base), in the erect inflorescence (*vs*. frequently flexuous), in the bracts longer than flowers (*vs*. shorter), and in the sepals longer than half of the corolla tube (*vs*. shorter). It differs from *S. durantifolia* in the taller habit, in the bracts as long as to over two times as long as the flowers (*vs*. usually as long as or slightly longer than the flowers) with the apices linear and curved outwards (*vs*. acute, patent or incurved). *Stemodia lanceolata* differs from *S. hyptoides* in the terminal inflorescence (*vs*. axillary), in the bracts longer than flower (*vs*. shorter), and in the sepals longer than half of the corolla tube (*vs*. shorter). A comparison between *S. lanceolata*, *S. stricta* and *S. scoparioides* was provided by Sosa & Dematteis (2012) using some characters, such as corolla length and leaf shape, that may overlap with our updated description. We summarized additional characters that are helpful in diagnosis in Table 1.

TABLE 1. Comparison between *Stemodia lanceolata* and similar species.

Character/Species	***S. lanceolata***	***S. stricta***	***S. durantifolia***	***S. hyptoides***
Height (m)	0.3–1.5	0.1–0.4	0.2–0.3	0.25–1
Branching	basal	basal	basal and axillary	basal and axillary
Inflorescence position	terminal	terminal	terminal	axillary
Inflorescence orientation	erect	frequently flexuous	ascending	erect
Bracts length (relatively to flowers)	equal to over 2 times as long	shorter	equal or slightly longer	shorter
Sepals length (relatively to half of corolla tube)	longer	shorter	equal or longer	equal or shorter

Stemodia ericifolia (Kuntze 1898: 239) Schumann (1900: 395) and *S. hassleriana* Chodat in Chodat & Hassler (1904: 287), both species previously known to occur in Argentina and/or Paraguay, near Brazilian borders, were also kept out from the account by Souza & Giulietti (2009), but their occurrence in Brazil is clearly documented (Pott & Pott 2000, Sosa 2010, BFG 2015). At this point, Brazil counts with 19 species of *Stemodia*, but it is possible that other species from neighbor countries, such as *S. diplohyptoides* Sosa & Dematteis (2014: 272), from Argentina, and *S. scoparioides,* from Paraguay, may be found in Brazilian territory if further collection efforts are concentrated at border regions.

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