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A new species of *Sinningia* (Gesneriaceae) and additional floristic data from Serra dos Carajás, Pará, Brazil

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Abstract

The new species *Sinningia minima* (Gesneriaceae) from Serra dos Carajás (Pará, Brazil) is described and illustrated. It is readily distinguished from its congeners by its minute size, being smaller in all vegetative and fertile organs than any other *Sinningia* species. It is also the first member of this genus registered for the Pará State. New floristic data and an identification key to the Gesneriaceae from the Serra do Carajás are also provided.

Key words: canga flora, miniature Ligeriinae, taxonomy

Introduction

In the course of taxonomic studies on Brazilian Gesneriaceae, a new species was recognized during a field excursion in the Serra do Carajás. At first sight, it was assigned to genus *Sphaerorrhiza* Roalson & Boggan (2005: 236), but closer morphological examination and preliminary phylogenetic analysis clearly placed it whitin the genus *Sinningia* Nees (1825: 297).

Sinningia (tribe Gesnerieae, subtribe Ligeriinae) is a genus of over 70 species distributed from southern Mexico to northern Argentina, with the greatest species richness in southeastern Brazil (Chautems *et al.* 2010, Perret *et al.* 2003, 2006, Weber *et al.* 2013). The genus is found in almost all Brazilian Phytogeographic Domains and almost all States of Brazil, but phylogenetic data have shown that the subtribe originated in the Atlantic Rainforest where the vast majority of species still occurs (Araujo *et al.* 2015, Perret *et al.* 2006, 2013). Plant size in this genus varies from a few cm, for some miniature species, to over 200 cm for the largest, though most species measure between 8 and 50 cm.

The region of the Serra dos Carajás, in the southeast of the State of Pará (Brazil), is part of the hydrographic system of the Araguaia-Tocantins. The longest axis of the Serra extends 160 km (east-west) and the minor axis stretches 60 km, with elevation from 150 m to 897 m (Serra Sul) above sea level (IBAMA 2004). The Serra dos Carajás harbors mostly tropical rainforest (about 95% of the area) that varies from dense to open forest occupying different elevations. The remaining area is restricted to the top of the hills and is formed of ironstone outcrops locally called "canga" (or "metalophilous savanna" or "campo rupestre" or "canga hematítica") covered by low and open vegetation growing directly on the mineral deposits of iron (Ab´Saber 1986, IBAMA 2004, Secco & Mesquita 1983, Silva *et al.* 1986). The "canga" areas are intensely mined for extraction of iron (it is currently the largest site of iron-ore extraction in the world), gold and others metals. This activity leads to irreversible habitat degradation due to massive excavations (Carmo & Jacobi 2012, Carmo *et al.* 2012). Less than 1% of the areas of "canga" in Brazil are included in conservation units insuring integral protection. Floristic studies are needed in order to inventory the plant communities that are only found in this environment. These data are essential for understanding the biological importance of these communities and for taking the necessary measures towards their preservation (Jacobi & Carmo 2008, Jacobi *et al.* 2011, Carmo *et al.* 2012, Carmo & Jacobi 2013).

Data discussed in this paper were obtained through field work undertaken by the first author, as well as examination of the many Gesneriaceae specimens collected in the Serra dos Carajás by the Universidade Federal de Minas Gerais research group and housed at the BHCB herbarium, analysis of virtual herbaria specimens and observation of cultivated material.

Taxonomy

Sinningia minima A.O.Araujo & Chautems, *sp. nov.* (Figs. 1–3)

Sinningia minima is similar to S. muscicola Chautems, differing from the latter by its very small overall size not exceeding 25 mm (vs. 40–80 mm); leaves with serrate margin (vs. deeply crenate); ventricose corolla (vs. narrowly funnel shaped), with vinaceous dots inside the tube. It is readily distinguished from all other species of Sinningia by its androecium reduced to two fertile stamens (vs. four).

Type:—BRAZIL. Pará: Parauapebas, Serra dos Carajás, Serra N1, cerca de 1 km da estrada, na corredeira do riacho, próximo à cachoeira, 06°02'22.97"S, 50°17'25.94"W, 668 m, 09 February 2014, *Araujo & Almeida 1146* (holotype HUFABC!, isotypes G!, BHCB!, MG!, RB!).

Herb, 9.5–25.0 mm in height, arising from perennial globose tuber, ca. 5.6 × 2.9 mm in diam., saxicolous. Stems 1.0–9.9 mm tall, unbranched, internodes 0.3–2.6 mm, with 2 or 3 leaf pairs. Leaves opposite, petiole 0.8–4.2 mm, green or violet; blade ovate to ovate-elliptic, 1.3–11.3 × 1.2–7.9 mm, apex obtuse, base cordate rarely rounded, above densely sericeous, green, sometimes with broad vinaceous streaks, beneath sparsely sericeous, green, margin serrate, 2–3 pairs of veins. Inflorescence reduced to solitary flower, axillary, lacking peduncle. Flowers obliquely borne on pedicels, 6.4–12.8 mm, vinaceous, sparsely pubescent with glandular and eglandular trichomes. Calyx dialysepalous, sepals 1.3–3 × 0.4–0.7 mm, lanceolate, margin entire, vinaceous to green, densely pubescent with eglandular trichomes. Corolla ventricose, 1.1–1.4 mm in diam. at base, with a little swelling on the dorsal side, tube 1.7–5.7 mm long, lilac outside, white with vinaceous dots inside, mouth 2.6–4.9 mm in diam., white, lobes lilac towards the margin and white towards the mouth, unequal, upper two 0.8–1.8 × 1.2–1.7 mm; 2 lateral 1.4–2.2 × 1.3–2.2 mm, lower one 1.7–2.9 × 1.6–2.1 mm. Stamens 2, included, filaments 3.5–4.8 mm long, white, anthers coherent, staminodes 2, ca. 1 mm long; nectary of 5 glands (2 near each other in dorsal position, 1 ventral of the same size as the dorsal ones and 2 lateral smaller); ovary densely pubescent, stigma bilobed. Fruit a dry capsule, 3.5–5.2 × 1.0–1.7 mm, apex turned upward; seeds ellipsoid, 0.15–0.19 × 0.28–0.33 mm.

Distribution and ecology:—The species is so far only known from the Serra dos Carajás (Pará, Brazil) where it is locally common (about 8 localities known so far; Fig. 3). The plants were observed growing together with mosses, liverworts and *Goyazia rupicola* Taubert (1896: 451) (Fig. 1) on wet rocks along streams, in shade, at elevation between 500 and 750 m. These rocks have a high concentration of iron and other heavy metals. Porto & Silva (1989) showed that plants in this area can absorb high values of these metals and speculate that this factor led to the establishment of a specific metalophilous vegetation. These growing conditions likely contributed to the restricted distribution of this species. Additionally, this is the only species of *Sinningia* recorded so far in Pará (Brazil) (Araujo *et al.* 2015).

Phenology:—Collected in bloom and fruit in January–March.

Conservation status:—Endangered (EN) B1b(i,iii,iv)c(iii), according to the IUCN criteria, based on the extent of occurrence not exceeding 5,000 km^2, projected decline of extent, quality of habitat and number of locations or subpopulations (IUCN 2012). This species occurs in an area that is intensely mined by Vale S.A. Company for extraction of iron, gold and others metals.

TABLE 1. Morphological comparisons of *Sinningia minima* with other miniature *Sinningia* species.

	S. minima	*S. concinna*	*S. muscicola*	*S. pusilla*
plant height [cm]	0.95–2.5	6–10	4–8	3–5
petiole length [mm]	0.08–0.42	5–10	3–6	2.5–8
petiole /blade ratio	shorter than the blade	often longer than the blade	shorter than the blade	shorter than the blade
blade size [mm]	0.13–1.13 × 0.12–0.79	8–15 × 9–15	7– 44 × 3–19	3–13 × 2.1–8
blade shape	ovate to ovate-elliptic	suborbicular	ovate	ovate to elliptic

...Continued on next page

TABLE 1. (Continued)

	S. minima	*S. concinna*	*S. muscicola*	*S. pusilla*
blade margin	serrate	moderately crenate	deeply crenate	moderately crenate
adaxial blade midrib and veins	green	reddish	dark violet	tinged reddish
adaxial blade coloration	green	dark green	dark violet or blackish around the veins, dark green towards the margin	dark green
abaxial blade coloration	green	reddish	reddish	pale green
pedicel length [mm]	6.4–12.8	25–30	15–35	25–35
pedicel indument	glandular and eglandular trichomes	glabrous (fine hairs visible only under binocular microscope)	glandular trichomes	glandular trichomes
calyx lobes shape	lanceolate	narrowly lanceolate	linear lanceolate	narrowly lanceolate
calyx lobes size [mm]	1.3–3 × 0.4–0.7	2–2.5 × 1.3–1.6	2.8–3.3 × 0.7–0.9	2.2–2.8 × 1.2, dorsal lobe 1.8–2 x 1.0
corolla tube shape	ventricose	narrowly funnel-shaped	narrowly funnel-shaped	narrowly funnel–shaped
corolla tube length [mm]	1.7–5.7	12–15	10–12	11–13
corolla tube color	lilac	white with purple band on dorsal side	white flushed with lilac on dorsal side	white flushed with lilac on dorsal side
corolla base	not spurred	not spurred	not spurred	spurred, spur 2–2.5 mm long
throat in ventral part	not sulcate	distinctly 2-sulcate	inconspicuously 3-sulcate	inconspicuously 3-sulcate
throat pigmentation	white with some large vinaceous dots	cream-colored with many small purple dots	Cream-colored, not dotted	Cream-colored and purple, not dotted
corolla mouth diameter [mm]	2.6–4.9	3–4	1.8–2.2	1.8–2
corolla lobes shape	oblate or orbiculate	obovate-orbicular	obovate	obovate-oblong
corolla lobes color	uniformly lilac towards the margin and white in the middle and towards the mouth	2 dorsal lobes purple, the other 3 pale lilac at the margin and white towards the mouth	uniformly lilac but white at their junction into the mouth	uniformly lilac, slightly darker in the middle
corolla lobes size (2 upper, 2 lateral and 1 lower)[mm]	upper 0.8–1.8 × 1.2–1.7, lateral 1.4–2.2 × 1.3–2.2, lower 1.7–2.9 × 1.6–2.1	upper 3–4 × 3.5–4.5, lateral 5.6–6.8 × 6.2–6.4, lower 5–5.2 × 6.2–6.4	upper 3–3.5 × 3–3.5, lateral 4.5–5 × 3.5–3.8, lower 5–5.5 × 4.2–4.5	upper 4.5–5 × 2.8–3, lateral 4.5–5 × 3, lower 5–5.5 × 3.5–4
fertile stamens	two	four	four	four
nectary glands	2 dorsal, separate, 1 ventral of same size, 2 smaller lateral	2 dorsal, separate, 3 other ones smaller	2 dorsal, separate	2 dorsal separate, 3 other ones vestigial
stigma	bilobed	stomato-morphic	bilobed	bilobed

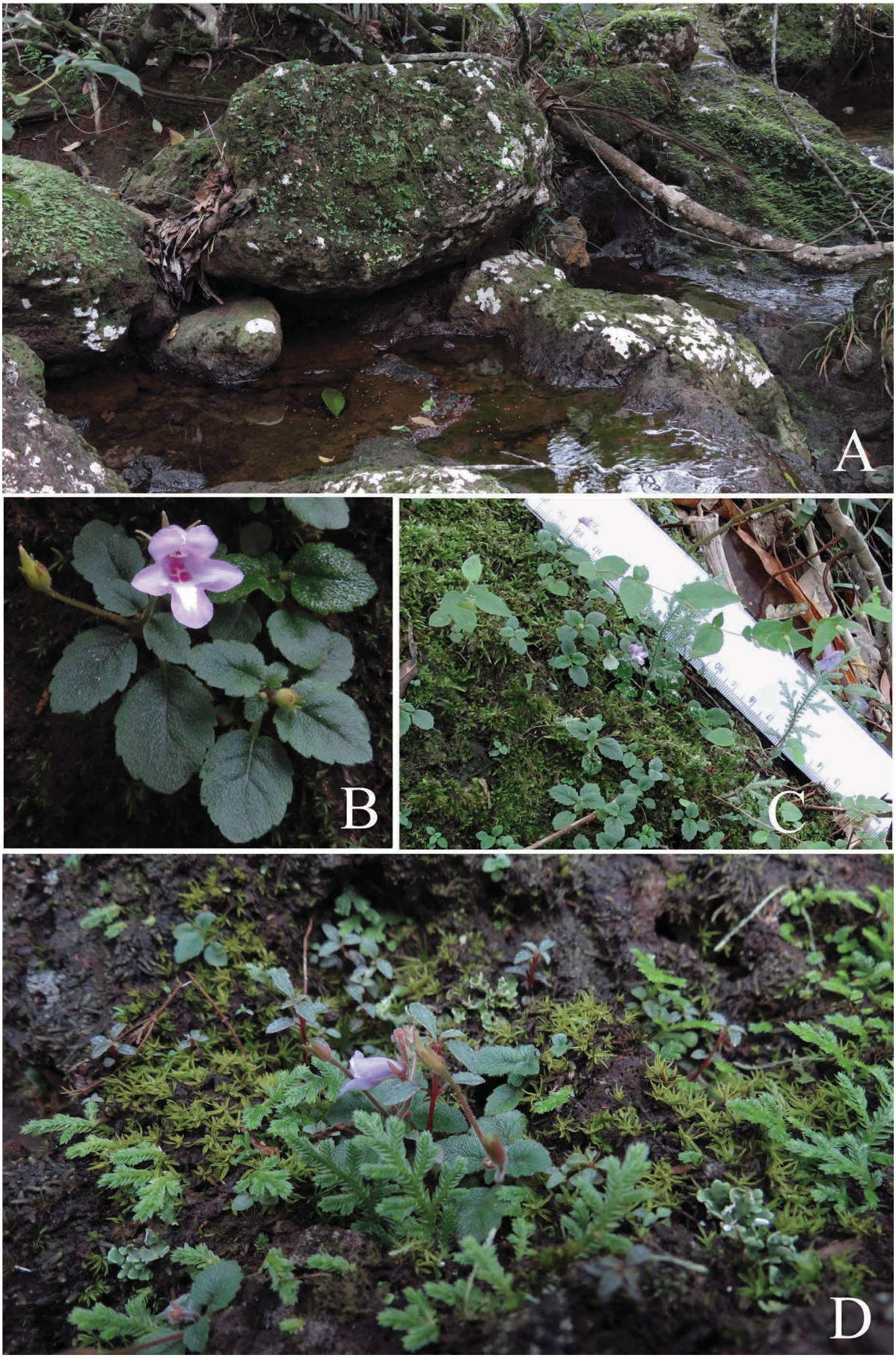

FIGURE 1. *Sinningia minima*. A. Wet rocks along streams, showing its saxicolous habitat. B. Habit with bud, flower and fruit. C. Individuals growing together with *Goyazia rupicola*. D. Individuals growing among mosses. (A–D: A.O.Araujo & Almeida 1146).

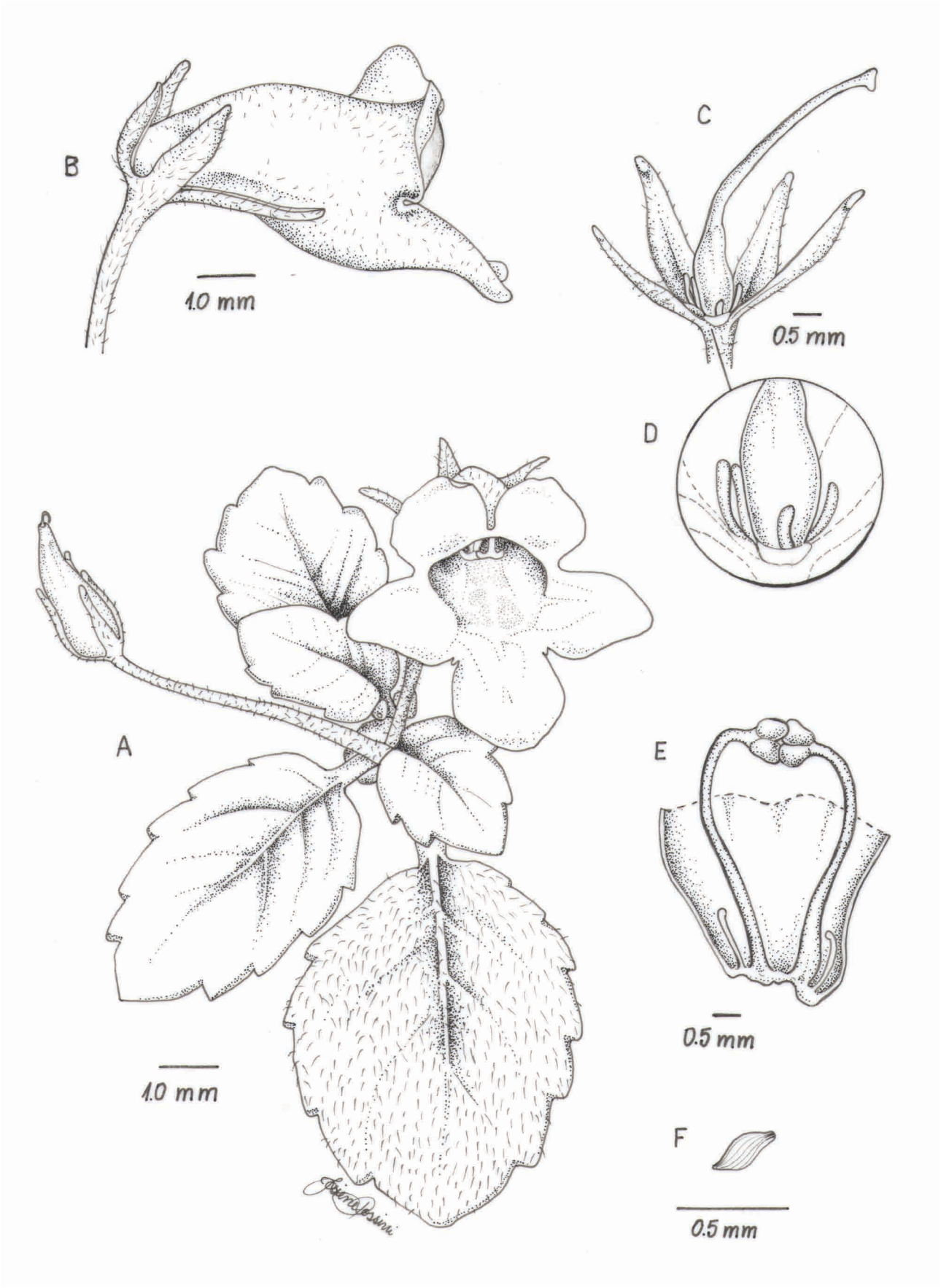

FIGURE 2. *Sinningia minima*. A. Habit. B. Flower, side view. C. Gynoecium, nectary and calyx. D. Nectary in detail. E. Androecium. F. Seed.

Taxonomic relationships:—Preliminary phylogenetic data place this species in clade *Corytholoma* along with three other micro-miniature species: *Sinningia concinna* (Hooker 1861: t. 5253) Nicholson (1887: 436), *S. muscicola* Chautems, Lopes & Peixoto (2010: 258) and *S. pusilla* (Martius 1829: 61) Baillon (1888: 772) (M. Perret, *pers. comm.*). Table 1 summarizes the characters that allow distinguishing these four species. S. *minima* is the smallest known species of *Sinningia*, thus far (Fig.1).

Etymology:—The epithet "*minima*" refers to the minute size of this plant, it is likely the tiniest known Gesneriaceae.

Additional specimens examined (paratypes):—BRAZIL**.** Pará: Canaã dos Carajás, S11C, mata baixa sobre canga, 750 m, 6°22'58"S, 50°23'6"W; 20 March 2012, *Arruda et al. 723* (BHCB). Canaã dos Carajás, S11D, Transição entre mata baixa sobre canga e floresta ombrófila densa, 635 m, 6°24'8"S, 50°18'7"W, 22 January 2013, *Arruda et al. 1333* (BHCB). Canaã dos Carajás, S11D, Floresta ombrófila densa, 610 m, 6°23'30"S, 50°19'6"W, 24 January 2013, *Arruda et al. 1343* (BHCB). Canaã dos Carajás, S11B, Interior de floresta, próximo de drenagem, 690 m, 6°20'40"S, 50°24'32"W, 24 January 2012, *Paula et al. 431* (BHCB). Canaã dos Carajás, S11C, floresta ombrófila, 650 m, 6°20'54"S, 50°25'47"W, 13 February 2010, *Silva et al. 752* (BHCB). Canaã dos Carajás, S11A, floresta ombrófila, 600 m, 6°19'27,5"S, 50°27'8"W, 16 February 2010, *Silva et al. 770* (BHCB). Canaã dos Carajás, S11A, floresta, 613 m, 6°20'24"S, 50°26'2"W, 08 February 2012, *Silva et al. 1202* (BHCB). Canaã dos Carajás, S11-C, floresta ombrófila, erva, 743 m, 6°24'1"S, 50°23'18"W, 18 March 2009, *Viana et al. 4147* (BHCB, G). Marabá, Serra dos Carajás, mina de ferro N-1; 28 April 1985, *Rosa & Silva 4725* (MG, RB 238023). Marabá, Serra Norte (carajás), N1, corredeira de água sobre pedras, no centro da vegetação de canga aberta, 19 March 1985, *Secco et al. 510* (MG). Parauapebas, Serra dos Carajás, Serra Sul, Corpo C, floresta de galeria, nas rochas do leito do córrego, 707 m, 06°23'47.85"S, 50°23'0.17"W, 10 February 2014, *Araujo & Almeida 1151* (HUFABC). Parauapebas, N1, floresta ombrófila densa associada a encosta, 550 m, 6°2'S, 50°16'1"W, 14 February 2012, *Arruda et al. 624* (BHCB). Parauapebas, N8, floresta ombrófila densa, 700 m, 6°11'11"S, 50°7'51"W, 17 May 2012, *Arruda et al. 1130* (BHCB). Parauapebas, N4SW, mata ombrófila densa, sobre afloramento rochoso, 505 m, 6°4'22"S, 50°11'42"W, 24 March 2012, *Mayer et al. 1200* (BHCB).

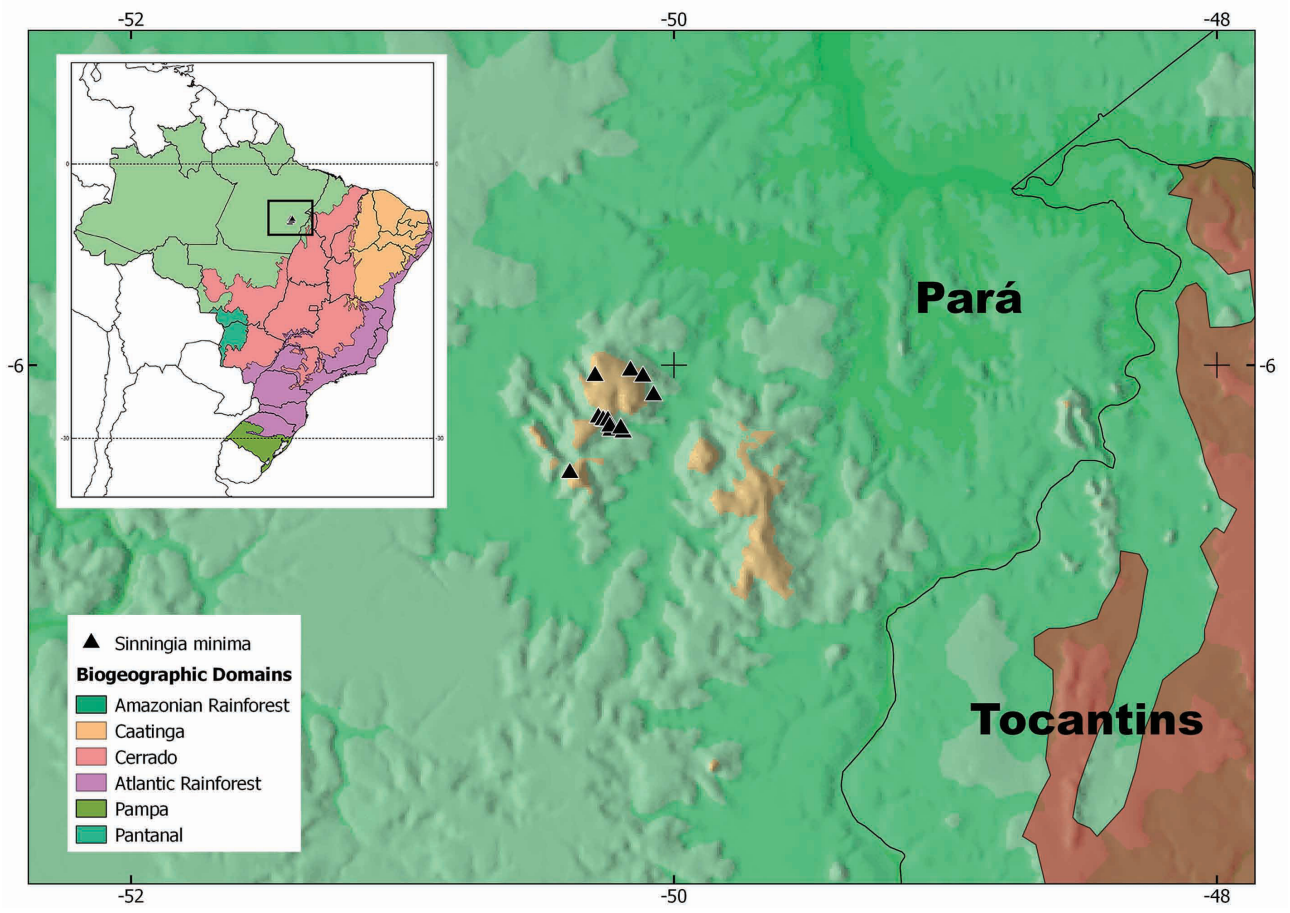

FIGURE 3. Distribution map of *Sinningia minima* in the Serra dos Carajás.

Floristic data:—In addition to *Sinningia minima*, described here, we identified in the studied area three other taxa which probably are new Gesneriaceae species, but more studies are needed to confirm their identities. So far, a total of twelve Gesneriaceae species have been registered in Carajás, distributed in four subtribes: 1) G. subtrib. Columneinae: *Codonanthopsis crassifolia* (Focke 1852: 199) Chautems & Perret (2013: 152), *Drymonia serrulata* (Jacquin 1798: 290) Martius (1832: 192), *Episcia fimbriata* Fritsch (1906: 484), *Nautilocalyx cf. kohlerioides* (Leeuwenberg 1964: 61) Wiehler (1978: 34), *Nautilocalyx cf. fasciculatus* Skog & Steyermark (1991: 219), *Nautilocalyx* sp.; 2) G. subtrib. Gloxiniinae: *Goyazia rupicola* Taub., *Mandirola rupestris* (Gardner 1842: t. 480) Roalson & Boggan (2005: 230), *Phinaea albolineata* (Hooker 1847: t. 4282) Bentham ex Hemsley (1882: 472) and *Phinaea sp.*; 3) G. subtrib. Ligeriinae: *Sinningia minima* A.O.Araujo & Chautems; and 4) G. subtrib. Besleriinae: *Besleria cf. flavo-virens* Nees & Martius (1823: 49).

Key to the Gesneriaceae species from Serra dos Carajás

1. Plants with rhizome or tuber; nectary composed of more than 2 glands, or ring-shaped (then flowers longer than petioles), or missing 2
- Plants without rhizome or tuber; nectary composed of a bilobed or a single gland in dorsal position, if nectary ring-shaped, flowers (with pedicels) shorter than the petioles 6
2. Plant up to 25 mm high, with tuber; androecium reduced to two fertile stamens ..... *Sinningia minima*
- Plant greater than 25 mm in height, with rhizome; four fertile stamens 3
3. Corolla entirely white or cream with dark spots inside 4
- Corolla lilac 5
4. Corolla entirely white, campanulate ..... *Phinaea albolineata*
- Corolla cream with dark spots inside, funnel-shaped ..... *Phinaea* sp.
5. Leaf margins 2–3 toothed; corolla tube up to 6 mm in length ..... *Goyazia rupicola*
- Leaf margins with more than 5 teeth; corolla tube larger than 7 mm in length ..... *Mandirola rupestris*
6. Plants growing in ant-gardens; leaf blade up to 3 cm long ..... *Codonanthopsis crassifolia*
- Plants growing as epiphytes or terrestrial; leaf blade more than 4.5 cm long 7
7. Corolla red 8
- Corolla white 9
8. Leaf blade up to 14 cm long; corolla lobes light red with red dots and lines mixed with some white patches; sepals with brownish trichomes ..... *Nautilocalyx cf. kohlerioides*
- Leaf blade more than 14.5 cm long; corolla lobes without red dots; sepals with reddish trichomes ..... *Nautilocalyx cf. fasciculatus*
9. Flowers (with pedicels) shorter than the petioles, corolla up to 1 cm long ..... *Besleria cf. flavo-virens*
- Flowers (with pedicels) longer than the petioles, corolla more than 2 cm long 10
10. Corolla lobes entire ..... *Nautilocalyx* sp.
- Corolla lobes fimbriate 12
11. Terrestrial herb creeping on the ground, leaf blade bullate, margin crenate, base rounded or cordate, sepals 0.8–1 × 0.3–0.4 cm ..... *Episcia fimbriata*
- Terrestrial shrub or liana, leaf blade with flat surface, margin serrate, base acute or attenuate, sepals 2–3 × 0.5–2 cm ..... *Drymonia serrulata*

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