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## A new species of *Pleroma* (Melastomataceae) from high-altitude grasslands of the state of São Paulo, Brazil

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### Abstract

A new species of *Pleroma*, endemic to the high-altitude grasslands of the state of São Paulo, is described. *Pleroma curucutuense* is morphologically similar to *Pleroma caissara*, but differs by the shrubby plants, 0.4–2 m tall (vs. arboreal plants, 2–7 m tall in *P. caissara*), smaller leaves, 2.4–5.6 × 1.2–2 cm (vs. 2.4–8.5 × 1.2–3.4 cm), with only 3 veins (vs. 5 veins), the smaller hypanthium, 5.5–6 × 4.5–5.5 mm (vs. 6.7–8.8 × 5.2–7.7 mm) and smaller sepals, 3.3–4.5 × 2.3–3.3 mm (vs. 6.7–10.2 × 2.7–4.6 mm). These species also occur in different habitats: *P. curucutuense* occurs above 750 m in high-altitude grasslands, while *P. caissara* occurs between 10–400 m elevation, in Restinga and Lowland and Submontane Atlantic Forest. According to our assessments based on IUCN criteria, *P. curucutuense* is preliminarily included in the Deficient Data category, because there is little information about its extent of occurrence and area of occupancy. Here we present its taxonomic description, comparisons with related species, illustrations made with photos of live and dehydrated specimens, and a distribution map. To facilitate its recognition, we present an identification key for the species of *Pleroma* that occur on high-altitude grasslands of the Parque Estadual da Serra do Mar, at the Núcleo Curucutu, where *P. curucutuense* has been collected.

**Key words:** Melastomataceae, Taxonomy, *Tibouchina s.l.*

### Introduction

The high-altitude grasslands are distributed in Brazil along the highest points of mountains that rose during the Tertiary (Serra do Mar and Serra da Mantiqueira), mainly associated with soils from igneous or metamorphic rocks, such as granites, and gneisses (Vasconcelos 2011, Longhi-Wagner *et al.* 2012). This vegetation type usually occurs above 1,500 m elevation (Vasconcelos 2011), but there is an exception in the state of São Paulo, more precisely in the Parque Estadual da Serra do Mar, Núcleo Curucutu, where the high-altitude grasslands occur at lower elevations, between 750–850 m (Garcia 2003, Garcia & Pirani 2005a, Vasconcelos 2011). Some of the restrictive environmental conditions in these habitats are low temperatures, nutrient deficiency, shallow soils with low water-holding capacity, strong and constant winds, and high solar radiation (Conceição *et al.* 2017). Despite this, 2,682 species of plants from 660 genera have been listed for the high-altitude grasslands of Brazil, of which 1,412 species are endemic (Flora e Funga do Brasil 2023). Global warming can also threaten endemic species that grow in highland grasslands, as the environments where they occur tend to disappear (Assis & Mattos 2016, Cordeiro & Neri 2019).

The Parque Estadual da Serra do Mar, Núcleo Curucutu, has a quite rich vegetation, considering that it lays inside the municipality of São Paulo, which in turn has the heaviest populated city in Brazil and South America, and probably the fourth biggest in the world (Wikipedia contributors 2023). The park has at least 512 native species, including angiosperms, pteridophytes, and gymnosperms, already inventoried in its high-altitude grasslands (Garcia & Pirani 2005a). This Conservation Unit has been the target of some floristic/taxonomic studies (Pscheidt & Affonso 2008, Takeuchi *et al.* 2008, Rosa & Affonso 2009, Takeuchi & Affonso 2009, Rodrigues-Lima & Affonso 2010, Affonso & Takeuchi 2014, Mellado & Garcia 2014, Rodrigues-Lima & Affonso 2016, Souza & Affonso 2017, Bianchi & Affonso 2020, Hora & Affonso 2021, Santos & Affonso 2022), including one study for the genus *Pleroma* D. Don (1823: 283),

in which five species have been listed (Silva & Affonso 2005). Despite this study, we recently found an undescribed species of *Pleroma* from the same locality, collected in an expedition in February 2012. Part of the samples of the new species has been identified as *Pleroma trichopodum* De Candolle (1828: 151) or *Pleroma sellowianum* (Chamisso 1835: 440) Guimarães & Michelangeli (in Guimarães *et al.* 2019: 989); both taxa are morphologically close to the new species.

The species of *Pleroma* are shrubs or trees with showy, large (up to 8.5 cm diameter) flowers with white, pink, lilac, purple or with mutable coloration, white in anthesis, and pink in senescence petals. The stamens have prolonged pedoconnectives (seldom inconspicuous), these white, lilac, pink, cream, or purple, and glabrous or glandulose, usually with ventral bilobed appendages (rarely biauriculate), these also glabrous or glandulose, and with the same color as the pedoconnective. Most species have anthers attenuate at the apex (rarely truncate), with white, lilac, pink, cream, or purple thecae, but can be seldom yellow in only one of the two cycles; the filaments and style are covered with trichomes or less frequently glabrous. The ovary is superior and covered with trichomes on its apical portion. The fruits are capsular, velatidium-type, and lacking sepals, which are caducous in mature fruits for most species. The seeds are minute, cochleate, with a tuberculate testa (Michelangeli *et al.* 2013, Meyer & Goldenberg 2014, Meyer *et al.* 2016, Meyer *et al.* 2018, Guimarães *et al.* 2019, Goldenberg *et al.* 2022, Meyer *et al.* 2022a, Meyer *et al.* 2022b).

In order to facilitate the recognition of the new species we provide a taxonomic description, comparisons with possibly closely related species, a distribution map, illustrations made with photos of dehydrated specimens, photos of live specimens, and an identification keys for the native species of *Pleroma* occurring on the high-altitude grasslands of the Núcleo Curucutu.

## Material and Methods

This study was based on the analysis of protologues and identification keys in *Flora Brasiliensis* (Cogniaux 1885) and *Monographiae Phanerogamarum* (Cogniaux 1891). Regional floras for the states of Paraná (Meyer *et al.* 2010, Meyer & Goldenberg 2014), and São Paulo (Guimarães & Oliveira 2009) were also consulted, in addition to an unpublished review of *Tibouchina* Aublet (1775: 177) section *Pleroma* Cogniaux (1885: 330) (Guimarães 1997). The species listed in the new taxonomic classification of *Tibouchina* and allies (Guimarães *et al.* 2019) were also consulted along with some taxa relegated there to synonyms.

One field expedition was carried out in the municipality of São Paulo, in the Parque Estadual da Serra do Mar—Núcleo Curucutu, in February 2012. The samples of the new species were collected and dried according to the usual methodology (see Fidalgo & Bononi 1989), and incorporated into UPCB herbarium, with duplicates sent to MBM, RB, SP, and UEC (acronyms following Thiers 2023).

The terminology used to describe vegetative and floral structures, as well as the indumentum type, is based on Stearn (1985) and Hickey & King (2000). The samples were analyzed under stereoscopic microscope, and the vegetative and floral structures were measured with a caliper or through images with scales through the software Image J (Schneider *et al.* 2012). The states and measurements of the morphological characters of the closest species were obtained through the analysis of specimens deposited in herbaria or from protologues (De Candolle 1828, Chamisso 1835, Cogniaux 1885, Meyer & Goldenberg 2014) and other taxonomic studies (Guimarães & Oliveira 2009, Meyer *et al.* 2010).

The distribution map was made in QGIS 3.30.0 (QGIS Development Team 2023) based on distribution points from the herbarium specimens. Conservation assessments followed IUCN criteria (IUCN 2022). The extent of occurrence (EOO) and the area of occupancy (AOO) were estimated using GeoCAT software (Bachman *et al.* 2011). The AOO was based on 2 km<sup>2</sup> cells, according to IUCN standards (IUCN 2022).

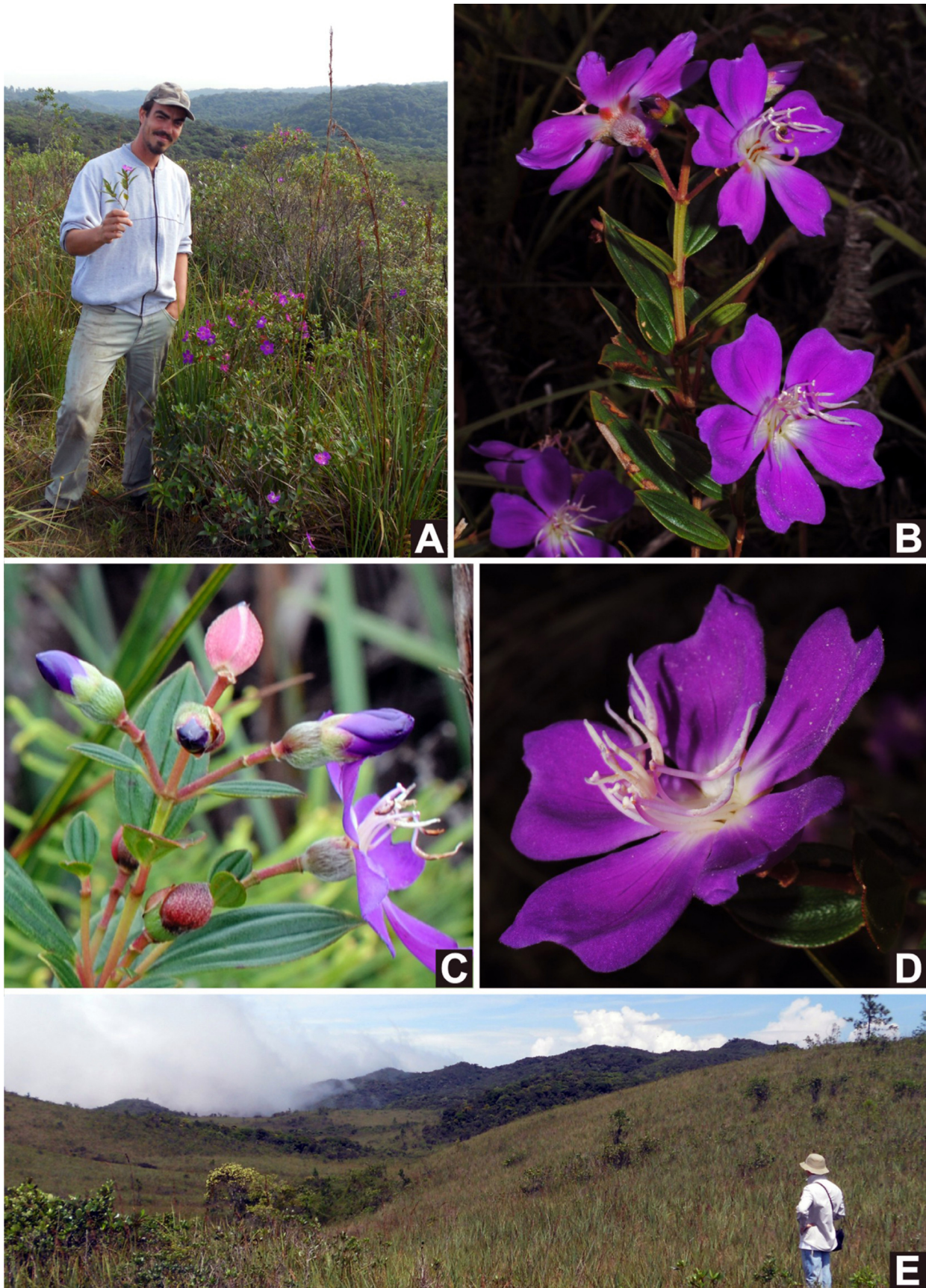
## Taxonomy

*Pleroma curucutuense* F.S.Mey. & R.Goldenb. *sp. nov.* (Figures 1–2).

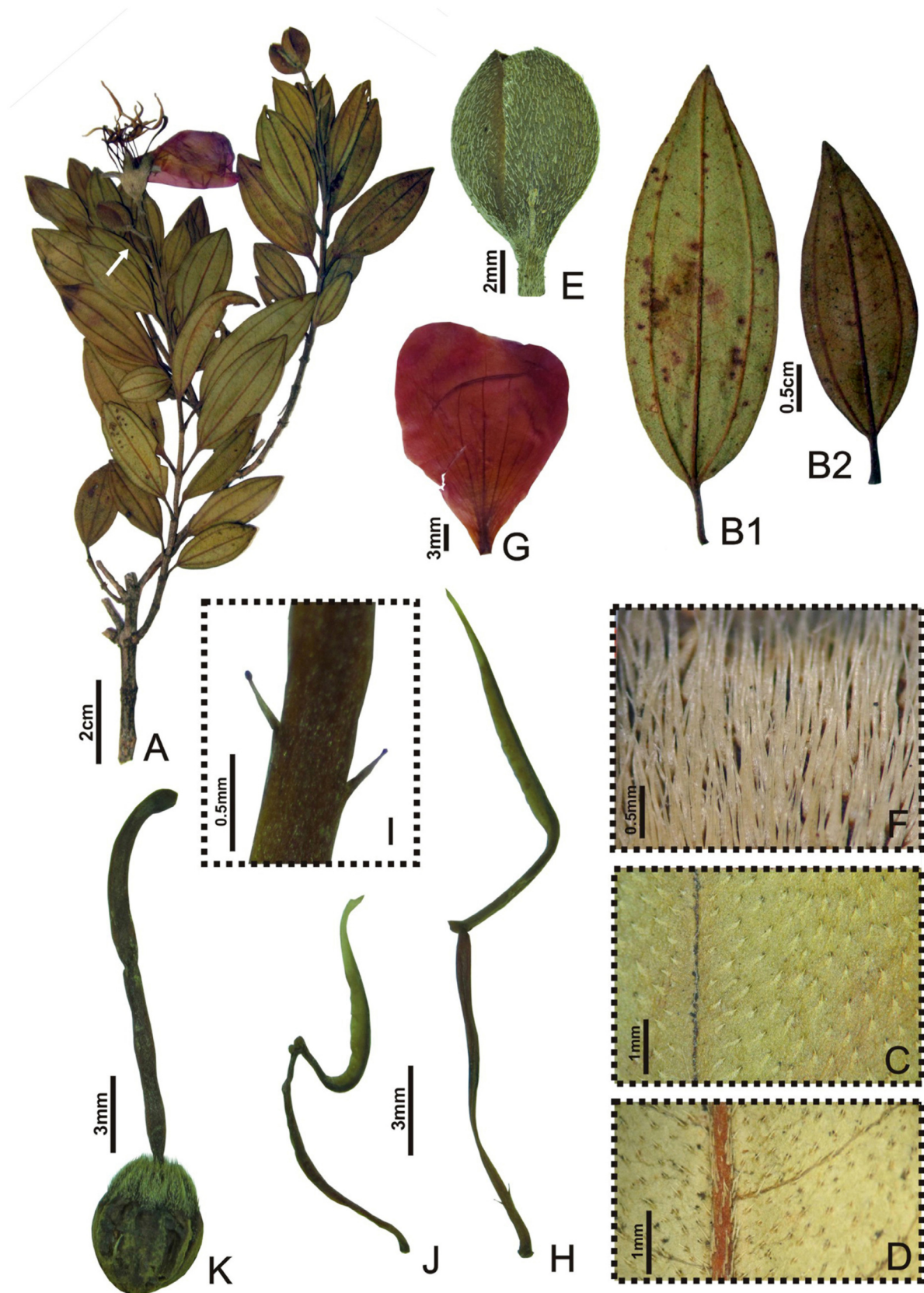
Type:—BRAZIL. State of São Paulo, Municipality of São Paulo, Parque Estadual da Serra do Mar—Núcleo Curucutu, -23.97929, -46.73450, 14 February 2012, *F.S. Meyer, M. Reginato, R. Goldenberg & R.J.F. Garcia 1107* (holotype: UPCB!; isotypes: RB!, SP!, UEC!).

**Diagnosis:**—*Pleroma curucutuense* differs from *Pleroma caissara* Meyer (in Meyer & Goldenberg 2012: 9527) by the smaller leaves, 2.4–5.6 × 1.2–2 cm (*vs.* 2.4–8.5 × 1.2–3.4 cm in *P. caissara*), the smaller hypanthium, 5.5–6 × 4.5–5.5 mm (*vs.* 6.7–8.8 × 5.2–7.7 mm) and smaller sepals, 3.3–4.5 × 2.3–3.3 mm (*vs.* 6.7–10.2 × 2.7–4.6 mm). In addition, *P. curucutuense* has antesealous stamens with a smaller pedoconnective, 2.8–3.8 mm long (*vs.* 4–5 mm long), smaller anthers, 7.8–9.5 mm long (*vs.* 11.5–14.4 mm long), and smaller style, 13.5–18 mm long (*vs.* 19.7–23.4 mm long).

**Description:**—Shrubs with sympodial growth, moderately branched, 0.4–2 m tall. Younger branches moderately strigose, trichomes 0.4–0.9 mm long, eglandular, appressed, the base linear, not immersed, not forked; the older branches with the same indumentum as the younger branches, but sparser, frequently decorticating; nodes slender. Leaves opposite; petioles 4–8 mm long; blades 2.4–5.6 × 1.2–2 cm, chartaceous slightly discoloured, elliptical, base obtuse, apex acute to obtuse, margins entire, slightly crenulate at the apex, 3 acrodromous veins, basal, domatia absent, reticulation inconspicuous on the abaxial surface; adaxial surface flat, brown to dark green in dry specimens, green in fresh material, moderately strigose, trichomes 0.3–0.6 mm long, eglandular, appressed, the base linear, immersed, not forked, followed by a sequence of white dots, abaxial surface flat, yellowish-green or brown in dry specimens, pale-green in fresh material, moderately strigose on the actual surface, trichomes 0.1–0.5 mm long, eglandular, appressed, the base linear, not immersed, not forked, moderately strigose on the primary and secondary veins, trichomes 0.3–1 mm long, eglandular, appressed, the base linear, not immersed, not forked. Dichasial cymes 1.5–2.5 × 1.5–3 cm, terminal, 3–7(–9) flowers, axis quadrangular, with the same indumentum as the branches; bracts in pairs, the color similar to that of the leaves, late deciduous, leafy, petioles 1–3 mm long, blade 2–13 × 1–8 mm, elliptical, base obtuse, apex acute to obtuse, flat, indumentum the same as that on the leaves; bracteoles 2, cream, reddish or cream-reddish in fresh material, brown in dry specimens, early deciduous, 9–11.2 × 8–9.2 mm, cucullate, base obtuse, apex obtuse [and covering the apex of the flower bud], concave, adaxial surface glabrous, abaxial surface moderately strigose, with indumentum arranged along the entire abaxial surface, sparser near the margins and the apex, trichomes 0.3–0.9 mm long, eglandular, appressed, the base linear, not immersed, not forked. Flowers 5-merous, on pedicels 0.7–1.2 mm long; hypanthium, 5.5–6 × 4.5–5.5 mm, not costate, the epidermis green to reddish-green in fresh material, brown in dry specimens (adaxial surface), the apex not constricted, densely sericeous, trichomes 1.1–2.2 mm long, eglandular, appressed, the base slightly broadened, not immersed, not forked; sepals early deciduous, 3.3–4.5 × 2.3–3.3 mm, obovate, the epidermis green to reddish-green in fresh material, brown in dry specimens, margins ciliolate, apex obtuse, adaxial surface glabrous, abaxial surface with the same indumentum as the hypanthium, trichomes concentrated on the central portion of each sepal; petals 21.5–25 × 15.5–19 mm, obovate, apex retuse, emarginate or mucronate, purple with a white base (during anthesis) or purple with a red base (in senescent flowers), glabrous in both surfaces, margin ciliate, moderately pilose, trichomes 0.1–0.3 mm long, eglandular or glandular (often mixed), erect, the base linear, not immersed, not forked; stamens 10, strongly dimorphic, the antesealous with the filaments white in the basal portion, and purple (during anthesis) to reddish (in senescent flowers) in its apical portion, 10.2–11 mm long, glabrous or sparsely pilose on its basal portion, trichomes 0.3–0.5 mm long, glandular, curved, the base linear to slightly broadened, pedoconnective light purple (during anthesis) to reddish (in senescent flowers), 2.8–3.8 mm, glabrous, ventral appendages bilobed, light purple (during anthesis) to purple (in senescent flowers), patent, apex obtuse, ca. 0.6 mm long, glabrous, thecae white in the basal portion, and purple in its apical portion (during anthesis) to whitish (in senescent flowers), 7.8–9.5 mm long, falcate, the antepetalous with filaments white (during anthesis) to reddish (in senescent flowers), 8–9.5 mm long, glabrous, pedoconnective white to light purple (during anthesis) to reddish (in senescent flowers), 1.1–1.5 mm long, glabrous, ventral appendages bilobed, white (during anthesis) to light purple (in senescent flowers), patent, apex obtuse, ca. 0.6 mm long, glabrous, thecae white (during anthesis) to whitish (in senescent flowers), 7.8–8.2 mm long, falcate; ovary ca. 5–6 × 4–4.5 mm, 5-locular, apex densely strigose, trichomes 0.2–0.6 mm long, eglandular, appressed, the base linear, not immersed, not forked; style whitish to light purple (during anthesis) to lilac (in senescent flowers), 13.5–18 mm long, apex curved, glabrous. Immature capsular fruits 6.2–7.5 × 7–8 mm, sepals early deciduous, epicarp undivided when mature, ecostate. Seeds not seen.



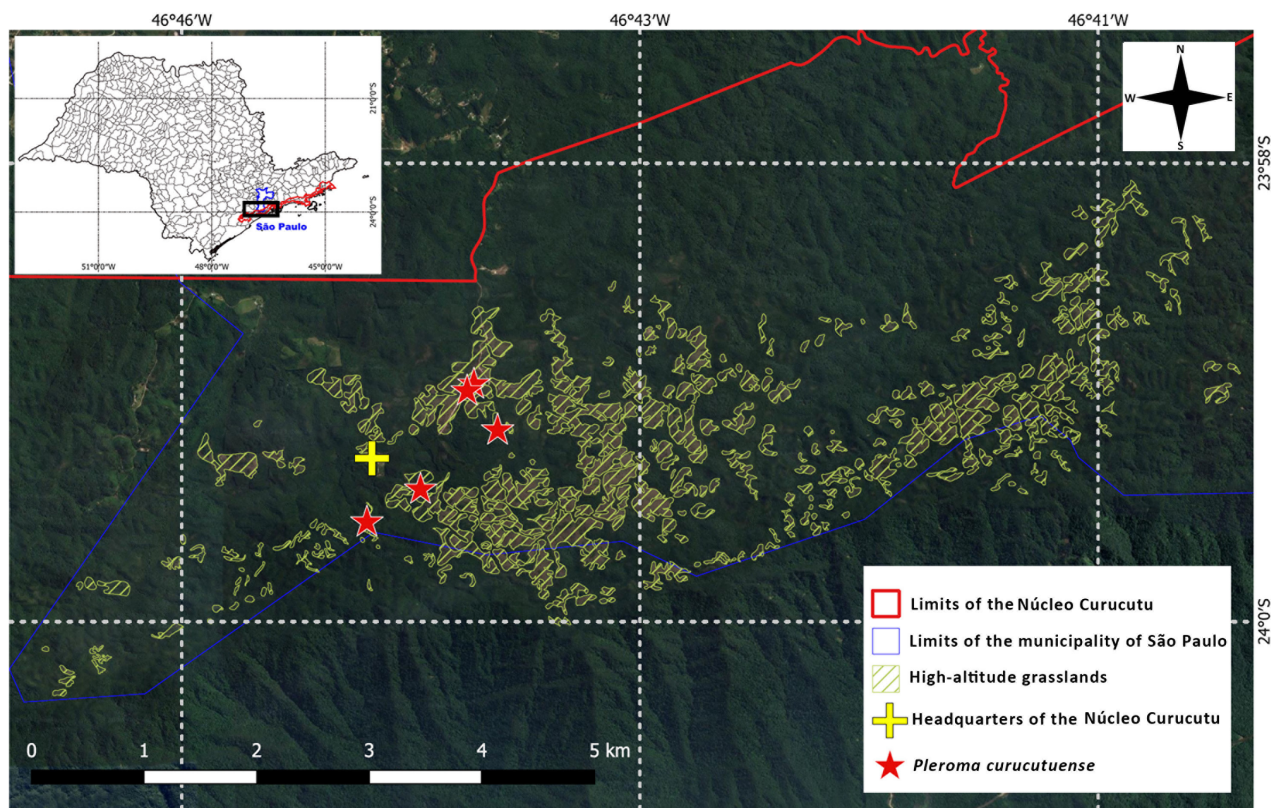
**FIGURE 1.** Photos of living specimens of *Pleroma curucutuense*. A. Habit. B. Flowering branch. C. Apex of the flowering branch showing the inflorescence, the flower buds free or enclosed by the bracteoles, and a mature flower. D. Flower in anthesis (lateral view). E. High-altitude grasslands of the Parque Estadual da Serra do Mar, Núcleo Curucutu [Photos A–B and D by Renato Goldenberg, Photos C and E by Fabrício Schmitz Meyer].



**FIGURE 2.** Illustration made with photos from herbarium specimens of *Pleroma curucutuense*, based on the holotype and isotypes. A. Branch; the white arrow indicating the base of the inflorescence. B1–B2. Leaves (abaxial surface), variation in size. C. Detail of the indumentum on the adaxial surface of the leaf. D. Detail of the indumentum on the abaxial surface of the leaf. E. Bracteoles covering the floral bud. F. Detail of the indumentum on the abaxial surface of the hypanthium. G. Petal (adaxial surface). H. Antesepalous stamen. I. Glandular trichomes on the base of the filament of the antesepalous stamen. J. Antepetalous stamen. K. Gynoecium.

**Paratypes:**—BRAZIL. São Paulo, Municipality of São Paulo, Parque Estadual da Serra do Mar, Núcleo Curucutu, 23°59'28"S 46°44'36"W, 28 March 1996, *G.M.P. Ferreira et al.* 71 (PMSP image online!, UEC!); *ibidem*, 23°59'16"S, 46°44'1"W, 13 February 1997, *R.J.F. Garcia et al.* 1034 (PMSP image online!), *ibidem*, 14 May 1997, *N.S. Chukr et al.* 567 (PMSP image online!), *ibidem*, 22 August 1997, *P. Affonso et al.* 92 (PMSP image online!), *ibidem*, 23°59'S, 46°44'W, 11 April 2001, *F.T. Farah et al.* 2127 (ESA!), *ibidem*, *F.T. Farah et al.* 2131 (ESA!), *ibidem*, -23.97988, -46.73509, 14 February 2012, *F.S. Meyer et al.* 1108 (MBM!, RB!, UPCB!), *ibidem*, -23.98846, -46.73916, 14 February 2012, *F.S. Meyer et al.* 1109 (MBM!, RB!, UPCB!); Reserva Estadual do Curucutu, 23°59'28"S 46°44'36"W, 16 August 1995, *S.A.P. Godoy et al.* 768 (SP!, UEC!).”

**Distribution and habitat:**—*Pleroma curucutuense* occurs in the state of São Paulo, only at the Parque Estadual da Serra do Mar, in the Núcleo Curucutu, which is located inside the municipality of São Paulo, and only about 70 km to the south of the city of São Paulo (Garcia 2003, Garcia & Pirani 2005a, Silva & Affonso 2005). The vegetation is mostly represented by Atlantic Forest on the slopes, but with high-altitude grasslands on higher ground (“Refúgio Vegetacional Altomontano”, according to the classification by IBGE 2012; see Figure 3), where *P. curucutuense* has been found. Apart from *P. curucutuense*, other six species in the same genus can be found nearby (see identification key, below).



**FIGURE 3.** Distribution map of *Pleroma curucutuense*.

**Phenology:**—Flowering between February to April, and fruiting starting in April. There is only one sample with flowers collected in August, but that is probably not the most intense flowering period. We did not find samples with mature fruits.

**Conservation status:**—The species is currently known from a very small population, with restricted distribution. Its extent of occurrence (EOO) is 530 km<sup>2</sup> and its area of occupancy (AOO) is about 4.0 km<sup>2</sup>, but this can be underestimated. *Pleroma curucutuense* has been only collected in high-altitude grasslands close to the headquarters of the Núcleo Curucutu, but the same vegetation extends further east and south on the highest ridges of this portion of the Serra do Mar (Figure 3). It is very likely that *P. curucutuense* may be also distributed in these places, and for this reason, we consider that the species should be preliminarily considered within the Data Deficient Category (IUCN 2022).

**Etymology:**—The epithet “*curucutuense*” refers to the Núcleo Curucutu, a subunit of the Parque Estadual da Serra do Mar and the only place of occurrence for the species until now. The toponym “Curucutu” is of onomatopoeia origin, in reference to the hoot of an owl (CEO 2002, Garcia & Pirani 2005b).

**Affinities:**—*Pleroma curucutuense* is morphologically close to *P. caissara* due to the elliptical leaves with conspicuous petioles (3–15 mm long in *P. caissara* and 4–8 mm long in *P. curucutuense*), strigose blades on both surfaces, moderately strigose branches, inflorescences in short cymes, with 3–7(–9) flowers, and cucullate bracteoles. Both species also share the 5-merous flowers, sericeous hypanthium, and purple petals with a white base at anthesis, becoming reddish during senescence. *Pleroma curucutuense* differs from *P. caissara* by the characters pointed out in the diagnosis, and by the shrubby habit, 0.4–2 m tall plants (vs. arboreal habit, 2–7 m tall in *P. caissara*), leaves with only 3 veins (vs. 5 veins), and smaller petals 21.5–25 × 15.5–19 mm (vs. 35.5–45 × 29.5–36 mm in *P. caissara*). One of the samples of the new species (Godoy *et al.* 768) had been indicated as a paratype of *P. caissara* (Meyer & Goldenberg 2014), which can be explained by the great similarity between the two species. These species also occur in different habitats: *P. curucutuense* occurs above 750 m in high-altitude grasslands, while *P. caissara* occurs between 10–400 m elevation, in Restinga and Lowland and Submontane Atlantic Forest.

*Pleroma curucutuense* is also morphologically related to *Pleroma andersregnellii* Guimarães & Michelangeli (in Guimarães *et al.* 2019: 974) due to the inflorescences in short cymes, with 3–7(–9) flowers, and cucullate bracteoles. Both also share the 5-merous flowers, sericeous hypanthium, and purple petals. *Pleroma curucutuense* differs from *P. andersregnellii* by the smaller elliptical leaves, 2.4–5.6 × 1.2–2 cm (vs. larger ovate leaves, 8–11 × 3–4 cm in *P. andersregnellii*), with only 3 veins (vs. 5 veins), smaller petioles 4–8 mm (vs. 10–15 mm long), and smaller petals 21.5–25 × 15.5–19 mm (vs. 30–35 × 25–30 mm; see Cogniaux 1885). In addition to the indicated morphological characters, these species occur in different vegetation types; *P. curucutuense* is exclusive to high-altitude grasslands in the state of São Paulo, and *P. andersregnellii* occurs in Cerrado in the state of Minas Gerais, being known from a single collection from Serra de Caldas (Cogniaux 1885).

*Pleroma curucutuense* also seems to be related to *P. trichopodum* due to the elliptical leaves with conspicuous petioles (4–14 mm long in *P. trichopodum*), flowers gathered in inflorescences, the 5-merous flowers, and the purple petals, with a white base in young flowers and becoming reddish in mature flowers (Meyer *et al.* 2010). *Pleroma curucutuense* differs from *P. trichopodum* by the smaller habit, i.e., the first is a small shrub and the second is a shrub or treelet, larger cucullate bracteoles, 9–11.2 × 8–9.2 mm (vs. smaller ovate to orbicular bracteoles, 3.9–7.2 × 3.2–6 mm in *P. trichopodum*), and its densely sericeous hypanthium (vs. moderately setulose). Whereas *Pleroma curucutuense* is exclusive to high-altitude grasslands in São Paulo, *P. trichopodum* occurs in Restinga, Lowland and Submontane Atlantic Forest in the states of Espírito Santo, Minas Gerais, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul (Guimarães 2023). *Pleroma trichopodum* was also collected in high-altitude grasslands of the Núcleo Curucutu, and occurs in sympatry with *P. curucutuense*, but its occurrence at higher altitudes was unknown until now.

Finally, *P. curucutuense* shares some morphological features with *P. sellowianum*—the elliptical leaves with conspicuous petioles (3–15 mm long in *P. sellowianum*), the blades with 3 veins, and strigose on both surfaces, the 5-merous flowers, and the sericeous hypanthium. *Pleroma curucutuense* differs from *P. sellowianum* by the flowers gathered in inflorescences (vs. solitary in *P. sellowianum*), floral buds surrounded by 2 bracteoles (vs. 6 bracteoles), and purple petals with a whitish base at anthesis (vs. white petals at anthesis, turning lilac during senescence). Although both species occur in sympatry, so far *P. curucutuense* is only known from the high-altitude grasslands at the Parque Estadual da Serra do Mar, Núcleo Curucutu, while *P. sellowianum* occurs in Araucaria Forest and high-altitude grasslands in Minas Gerais, Rio de Janeiro, São Paulo, Paraná, Santa Catarina, and Rio Grande do Sul (Guimarães 2023).

### Identification key for the native species of *Pleroma* in the high-altitude grasslands of the Parque Estadual da Serra do Mar, Núcleo Curucutu

1. Leaves discolorous; hypanthium oblong to oblong-campanulate, conspicuously constricted at the apex .....*P. scaberrimum*
- Leaves concolorous; hypanthium campanulate, not constricted at the apex .....2
2. Flowers solitary .....*P. sellowianum*
- Flowers arranged in inflorescences, from cymes with few flowers (3–9) flowers) to thyrsoids with more than 15 flowers .....3
3. Pedoconnective appendages glandulose-pilose ..... *P. fothersgillae*
- Pedoconnective appendages glabrous .....4
4. Bracteoles ovate to orbicular, 3.9–7.2 × 3.2–6 mm; hypanthium setulose..... *P. trichopodum*
- Bracteoles cucullate, 9–11.2 × 8–9.2 mm; hypanthium sericeous ..... *P. curucutuense*

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