

Maracujá on the rocks: a new *Passiflora* species (Passifloraceae sensu stricto) from the rupicolous ecosystems of the Brazilian Atlantic rainforest

Authors: Mezzonato-Pires, Ana Carolina, da Silva Ribeiro, Ricardo, and Gonella, Paulo Minatel

Source: *Willdenowia*, 51(3) : 371-381

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: <https://doi.org/10.3372/wi.51.51305>

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Maracujá on the rocks: a new *Passiflora* species (*Passifloraceae* sensu stricto) from the rupicolous ecosystems of the Brazilian Atlantic rainforest

Ana Carolina Mezzonato-Pires¹, Ricardo da Silva Ribeiro² & Paulo Minatel Gonella³

Version of record first published online on 14 December 2021 ahead of inclusion in December 2021 issue.

Abstract: Here we describe a new species of *Passiflora* subg. *Passiflora* (*Passifloraceae* sensu stricto) found in the Brazilian Atlantic rainforest in areas of campos rupestres of the João Pinto formation in Minas Gerais and on granitic inselbergs of Espírito Santo. The new species, named *Passiflora ita*, is described, illustrated, compared to similar species and its conservation status is preliminarily assessed as Endangered (EN) following IUCN Red List categories and criteria, reinforcing the importance of the areas where it occurs (which are not national or state-level parks) as priorities for conservation.

Keywords: Atlantic rainforest, Brazil, campos rupestres, inselbergs, new species, *Passiflora*, *Passifloraceae*, threatened species

Article history: Received 9 July 2021; peer-review completed 22 November 2021; received in revised form 26 November 2021; accepted for publication 27 November 2021.

Citation: Mezzonato-Pires A. C., Ribeiro R. da S. & Gonella P. M. 2021: Maracujá on the rocks: a new *Passiflora* species (*Passifloraceae* sensu stricto) from the rupicolous ecosystems of the Brazilian Atlantic rainforest. – *Willdenowia* 51: 371–381. <https://doi.org/10.3372/wi.51.51305>

Introduction

The Atlantic rainforest is a complex mosaic of vegetation types that extends along the entire E coast of Brazil, also occurring in smaller areas of Argentina and Paraguay (Joly 1999; IBGE 2019), and is recognized as a biodiversity hotspot due to its high endemism rate combined with severe habitat destruction level (Myers & al. 2000). Despite being well known for its exuberant ombrophilous and seasonal forests, this phytogeographical domain contains several other vegetation types as a result of the climatic, edaphic and altitudinal diversity of the Brazilian coast. Among these vegetation types, the rupicolous ecosystems stand out in areas where rocks of different geologies outcrop and are inhabited by communities of species adapted to the conditions of water stress, such as intense sunlight and winds, shallow soils and high thermal amplitude (Porembski & al. 1998; Martinelli 2007). These ecosystems can be divided into campos rupestres (over quartzite and iron ore; Vasconcelos 2011; Silveira & al. 2016), campos de altitude (the “Brazilian Paramos”; mainly on granite and above 1500 m; Safford 1999, Vasconcelos 2011) and lowland inselbergs (“sugar-loaves”, on granite/gneiss at lower elevations; Porembski & al. 1998; Paula & al. 2020).

Passiflora L. (*Passifloraceae* sensu stricto, popularly maracujás in Portuguese or passionflower/passionfruit in English) is a genus of mainly climbing plants or lianas with over 560 species (Krosnick & al. 2013), of which 157 occur in Brazil (Bernacci & al. 2020). Although the Atlantic rainforest is the main centre of species diversity in the country (84 species), the majority of these species are found in ombrophilous forests (55 species), while only 10 species are reported from the aforementioned rupicolous ecosystems.

Passiflora is considered the largest genus of climbing flowering plants of the neotropical region (Acevedo-Rodríguez & al. 2015+) and can be easily recognized by the presence of tendrils, petiole usually with the presence of extrafloral nectaries, flower with androgynophore, a well-developed corona and a tricarpellate and unilocular ovary. The genus has a complex history of infrageneric classification, starting in the 19th century with Candolle (1822), who subdivided the genus into seven sections. Since then, some modifications were published, with emphasis on the important work of Killip (1938), who subdivided *Passiflora* into 22 subgenera. By the end of the 20th century, Escobar (1989) modified part of Killip’s (1938) classification and described a new subgenus, *P. subg. Porphyropathanthus* L. Escobar. This classification remained until the proposal of Feuillet &

1 Universidade Federal de Juiz de Fora, R. José Lourenço Kelmer s.n., São Pedro, Juiz de Fora, Minas Gerais, 36033-900, Brazil.

2 Instituto Nacional da Mata Atlântica, Av. José Ruschi, 4, Santa Teresa, Espírito Santo, 29650-000, Brazil.

3 Universidade Federal de São João del-Rei, Campus Sete Lagoas, Rodovia MG 424, km 47, Sete Lagoas, Minas Gerais, 35701-970, Brazil.

Author for correspondence: Ana Carolina Mezzonato-Pires, carolina.mezzonato@gmail.com

MacDougal (2003), who drastically reduced the number of subgenera to four, namely: *P.* subg. *Astrophea* (DC) Mast., *P.* subg. *Deidamioides* (Harms) Killip, *P.* subg. *Decaloba* (DC.) Rchb. and *P.* subg. *Passiflora*. Currently, two other subgenera are also recognized: *P.* subg. *Tetrapathea* (DC.) P. S. Green (Krosnick & al. 2009) and *P.* subg. *Tryphostemmatoides* (Harms) Killip (Restrepo & al. 2019). Only the four subgenera recognized by Feuillet & MacDougal (2003) are found in Brazil.

Passiflora subg. *Passiflora* is the largest among the subgenera, characterized by: species with herbaceous habit; bracts large and usually whorled; flowers generally large (>3 cm in diameter) and coloured (petals, sepals and filaments of the corona); corona with filaments varying in the number of series, usually three series or more, except for some species which can have one or two series; corona filaments frequently with different sizes and banded with distinct colours; nectar ring and limen can be present; and fruit frequently >3 cm long (Cervi 1997). Currently, the subgenus is divided into six supersections, 20 sections and 11 series (Feuillet & MacDougal 2003). The largest supersection is *P.* supersect. *Stipulata* MacDougal & J. M. Feuillet described as having foliaceous stipules with clearly asymmetric base and bracts also foliaceous. The richest section is *P.* sect. *Granadillastrum* (Triana & Planch.) Feuillet & J. M. MacDougal, with 66 species (Ulmer & MacDougal 2004), comprising species with conspicuous stipules, mainly subreniform or oblong-ovate, bracts free, leaves usually trilobed or entire and flowers with a conspicuous corona (Ulmer & MacDougal 2004).

During fieldwork for the floristic inventory of the campos rupestres areas of E Minas Gerais, a species of *Passiflora* was found that did not fit any named species. Further herbarium investigations uncovered other collections of such species from granitic inselbergs from Espírito Santo state. In this work, we describe and illustrate this new species, map its distribution, discuss the morphological relationships with the putative closest species and preliminarily assess its conservation status following the IUCN (International Union for Conservation of Nature) Red List categories and criteria (IUCN 2012).

Material and methods

The field expeditions were carried from June 2020 and are ongoing. The collected material was deposited in the herbaria CESJ and MBML (herbarium codes according to Thiers 2021+). Other herbaria were consulted via the online databases of Re flora (2021) and SpeciesLink (2021), as well as digitized specimens at the virtual herbaria of F, MEXU, MO, NY and US. One specimen with similarities with the new species was located at RB but was not seen *in loco*, therefore it is not included in the paratypes list. The terminology for floral and vegeta-

tive characters follows Cervi (1997) and Radford & al. (1974). Data for the preparation of Table 1 were extracted from Cervi (1997).

The distribution map was prepared with the Geographic Information System (GIS) software QGIS 3.4 (QGIS Development Team 2021). The layers of biomes, geopolitical areas, phytogeography and protected areas used in this study were extracted from Instituto Brasileiro de Geografia e Estatística (IBGE 2019, 2020), Banco de Dados Geomorfológicos do Brasil – TOPODATA (<http://www.dsr.inpe.br/topodata/>), Instituto Estadual de Florestas – IEF (<http://www.ief.mg.gov.br/>) and Fraga & al. (2019). For the conservation status assessment, a Darwin Core (DwC) dataset was assembled with the georeferenced occurrence deposited in collections. The methods of the IUCN Red List categories and criteria version 3.1 (IUCN 2012) were employed and the values of Extent of Occurrence (EOO) and Area of Occupancy (AOO) were calculated using the conservation assessment tool GEOCAT (<http://geocat.kew.org/>) using the standard IUCN grid of 2 × 2 km (Bachman & al. 2011).

Taxonomic treatment

Passiflora ita Mezzonato, R. S. Ribeiro & Gonella, **sp. nov.** – Fig. 1–3.

Holotype: Brazil, Minas Gerais, Conselheiro Pena, Serra do Padre Ângelo, Pico do Padre Ângelo, platô do topo do pico, 19°19'05.04"S, 41°34'42.26"W, 1480 m, 21 Aug 2020, *P. M. Gonella & al.* 1565 (CESJ; isotype: MBML).

Diagnosis — *Passiflora ita* differs from the other species of *P.* supersect. *Granadillastrum* by having stipules foliaceous, asymmetric ovate, apex mucronate; petiole with 2–4 sessile, elliptic to circular glands; lamina entire; bracts ovate, 10.3–21.5 × 7–9 mm; sepals oblong-lanceolate, cucullate, carinate, apex with arista 1.7–1.8 mm long; corona filaments in 3 well-defined series and 1 undefined series; third series of corona filaments erect-inclined toward androgynophore, filiform, united at base.

Description — Herbaceous vine with tendrils, entirely glabrous; *stems* reddish green at apex, turning brown to yellowish brown with age, cylindrical, 0.8–2 mm in diam., striate. *Stipules* basifixed, foliaceous, caducous, yellowish green with reddish nerves, asymmetric ovate, 11.4–23.9 × 7.4–14.5 mm, glabrous, base asymmetric rounded, margin entire or slightly serrate glandular, apex acute, mucronate, mucro 0.3–0.6 mm long. *Petiole* reddish, 5.2–13.7 × 0.4–0.8 mm, glabrous; glands 2–4, paired or alternate, located in upper portion or also in lower portion of petiole, 2.1–5.6 mm from apex of petiole, sessile, vinaceous, elliptic to circular, 0.5–0.9 × 0.5–0.8 mm. *Lamina* peltate, green with reddish nerves and margin, entire, ovate to ovate-lanceolate, 22.4–86 × 17.5–50 mm, chartaceous, both surfaces glabrous,

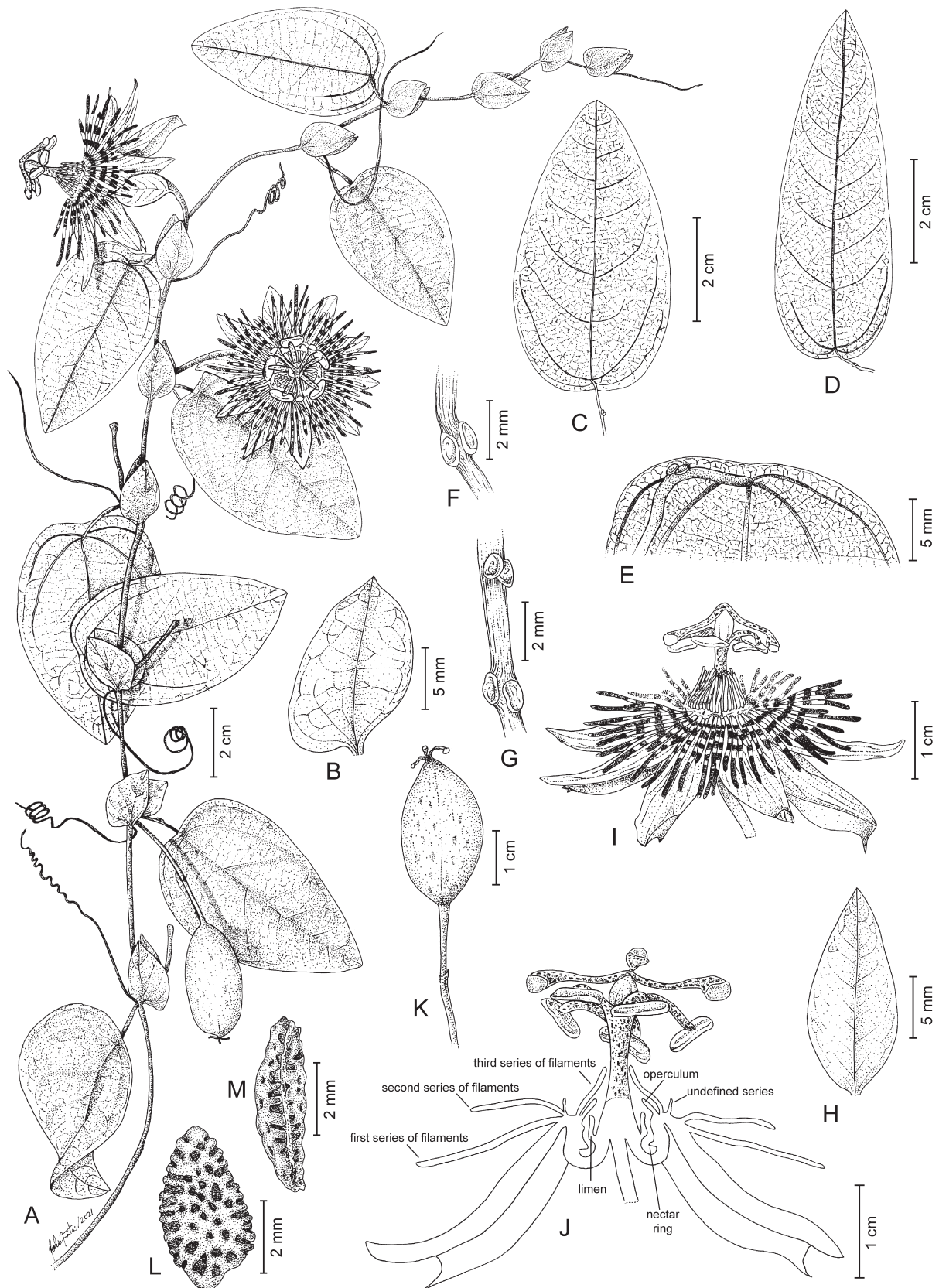


Fig. 1. *Passiflora ita* – A: habit; B: stipule; C, D: leaf adaxial surface, showing variation in shape; E: leaf abaxial surface, showing detail of insertion of petiole in lamina; F, G: glands on petiole, showing variation in arrangement and number; H: bract; I: flower, lateral view; J: schematic sagittal section of flower, series of corona filaments and other internal components of flower identified; K: fruit; L, M: seed. – A–C, E–M based on *P. M. Gonella & al. 2325* (MBML); D based on *P. M. Gonella & al. 2395* (MBML). – Illustration by Joelcio Freitas.



Fig. 2. *Passiflora ita* – A: habit; B: stipule; C: peltate leaf lamina and detail of glands on petiole; D: flower bud; E: detail of bracts; F: flower, lateral view, showing three well-defined series of corona filaments; G: general view of flower; H: sagittal section of flower; I: fruit. – Photographs: A–C, E–I by Paulo Minatel Gonella; D by Ricardo da Silva Ribeiro.



Fig. 3. A: Campos rupestres at the top of Pico do Padre Ângelo, Conselheiro Pena, Minas Gerais, Brazil; B: habitat of *Passiflora ita*; C: detail of *P. ita* growing among rocks. – Photographs by Paulo Minatel Gonella.

base cordate, rounded to truncate, margin entire, apex emarginate to obtuse. *Inflorescence* 1-flowered. *Peduncle* green to reddish, 17–32 mm long. *Bracts* whorled, green to pinkish, ovate to narrowly ovate, 10.3–21.5 × 7–9 mm, glabrous. *Pedice* green to reddish, 4.4–6.4 mm long. *Flowers* 30.1–54.5 mm in diam.; *hypanthium* cam-

panulate, 2.5–3.8 × 5.8–8.1 mm, glabrous; *sepals* abaxially green, brownish green, purple to pinkish, adaxially purple, oblong-lanceolate, cucullate, carinate, 14–25.3 × 6.9–7.9 mm, glabrous, apex acute to obtuse, with arista 1.7–1.8 mm long; *petals* purple on both surfaces, oblong-lanceolate, 18.6–21.9 × 8.1–8.6 mm, glabrous, apex

obtuse; *corona* with 3 well-defined series of filaments and 1 undefined series of sparse filaments; *first series* of filaments radial, banded with bluish purple and white along entire length, filiform, 12.5–14 × 0.3–0.8 mm; *second series* of filaments radial, banded with bluish purple and white along entire length, filiform, 3.4–9.2 × 0.3–0.5 mm; *third series* of filaments erect-inclined toward androgynophore, dark purple, banded with white toward apex, filiform, 3.1–5.8 × 0.4–0.6 mm, bases united for 0.8–1.1 mm; *undefined series* located between second and third well-defined series, with scattered filaments not forming a proper series, dark purple, filiform, 1.9–2.4 × 0.1–0.2 mm; *operculum* adnate to united base of third series of filaments, 1.2–2.1 mm long, membranous, apical portion free for 0.2–0.7 mm, apex plicate; *nectar ring* present; *limen* cupuliform, 1.4–1.6 mm long; *androgynophore* green with vinaceous spots, 8.6–9.2 mm long; *stamen filaments* with vinaceous spots, 5–5.6 × 0.6–1 mm, glabrous; *anthers* 5.3–7 × 2.2–2.4 mm; *ovary* green, oblong, 2.9–4.5 × 1.6–2 mm, glabrous; *style* with purple spots, 5.7–6.1 × 0.2–0.5 mm. *Fruit* green, oblong to ellipsoid, 22–31 × 11–16 mm. *Seed* ovate or obovate to ellipsoid, 4.5–4.9 × 2.5–3 mm, testa reticulate-foveolate.

Phenology — Collected with flowers in January, February, March, May, June, August, September and November, and with fruits in February, March and June, therefore suggesting a continuous reproductive period year-round.

Distribution and habitat — *Passiflora ita* occurs in the Atlantic rainforest domain in the states of Minas Gerais and Espírito Santo, SE Brazil (Fig. 4). In Minas Gerais, the species was found in areas of quartzitic campos rupestres of the João Pinto formation, in the municipalities of Alvarenga and Conselheiro Pena in the E region of the state. These areas include the Serra do Padre Ângelo, where the species was recorded in the sectors of Pico do Padre Ângelo (Fig. 4C), Serra do Pinhão and the Serra da Palha Branca; it was also recorded in a quartzitic outcrop near the district of Vista Alegre (Alvarenga) and at the Pico da Aliança. In these areas, the species occurs in open areas under direct sunlight, among and on rock outcrops with herbaceous-shrubby vegetation at elevations of 920–1550 m. The species was also recorded from granitic inselbergs in the state of Espírito Santo, in the municipalities of Santa Leopoldina (Pedra Preta), São Roque do Canaã (Alto Misterioso; Fig. 4D) and Serra (APA Mestre Álvaro; Fig. 4E), where it also occurs as a rupicolous element exposed to direct sunlight, at elevations of 600–1078 m. A specimen collected in the municipality of Santa Teresa, Espírito Santo [Perdiz & al. 825 (RB 563073 – image!)], may be an additional occurrence of *P. ita*. The specimen lies within the reported range of *P. ita* and shares similarities in the shape of petiole glands, stipules and bracts. The specimen, however, lacks a ma-

ture flower, making it impossible to ascertain its identity. Future field observations at this location should provide a better understanding of this specimen.

Preliminary conservation status — Endangered: EN B1ab(iii)+2ab(iii). *Passiflora ita* has a naturally fragmented distribution (Fig. 4), occurring in isolated populations on hilltops that are subject to various threat situations. The species has an estimated EOO of 3362 km² and an estimated AOO of 44 km² (Fig. 4B). The Atlantic rainforest in the states of Minas Gerais and Espírito Santo has been severely altered, with most of its original area converted into pastures and other agricultural activities (Fig. 4C–E), resulting in small and isolated fragments of natural vegetation remaining. In the areas of campos rupestres where *P. ita* was found, it is threatened by the invasion of exotic grasses such as *Melinis minutiflora* P. Beauv. (“molasses-grass”) and species of *Urochloa* P. Beauv. (“brachiaria”), which were introduced in the surrounding pasturelands. The fern *Pteridium aquilinum* (L.) Kuhn (*Dennstaedtiaceae*) also poses a threat, invading the natural areas of the region (Gonella & al. 2015). The proximity of these areas of campos rupestres to pastures and human settlements makes them vulnerable to anthropogenic fires, given that the use of fire for pasture renovation and clearance of deforested areas is a common practice in the region. The populations of *P. ita* and other endangered species at Serra do Padre Ângelo were affected by such an anthropogenic fire in late 2020 (Andrino & Gonella 2021; Antar & al. 2021b; Kollmann & Gonella 2021), which can potentiate the invasion by the aforementioned alien species. In some of the areas, the presence of cattle was also observed directly on the campos rupestres. In the inselberg habitats, *P. ita* is similarly vulnerable to biological invasions, fire, grazing and mining (Porembski & al. 2016). In all studied areas, *P. ita* was observed forming small populations with low density and frequency of individuals. None of the known populations is found inside national and state-level parks, and the EOO polygon does not include any such type of protected area. Other areas of similar habitats can be found in the region and have the potential for the occurrence of the species, hence floristic inventories in protected areas such as the Sete Salões State Park (campos rupestres) and the Natural Monument of Pontões Capixabas (inselbergs) could result in the discovery of new populations. The species is currently recorded only for the Environmental Protection Area Mestre Álvaro (category of sustainable use). Given this scenario, we recommend that *P. ita* should be assessed as Endangered (EN) based on the aforementioned criteria of the IUCN (2012).

Etymology — The epithet chosen for the species is a noun in apposition, originating in the noun itá of the Tupi-Guarani language, meaning “rock” (Carvalho 1987). The epithet alludes to the rupicolous habit of the species, growing among and over rocks.

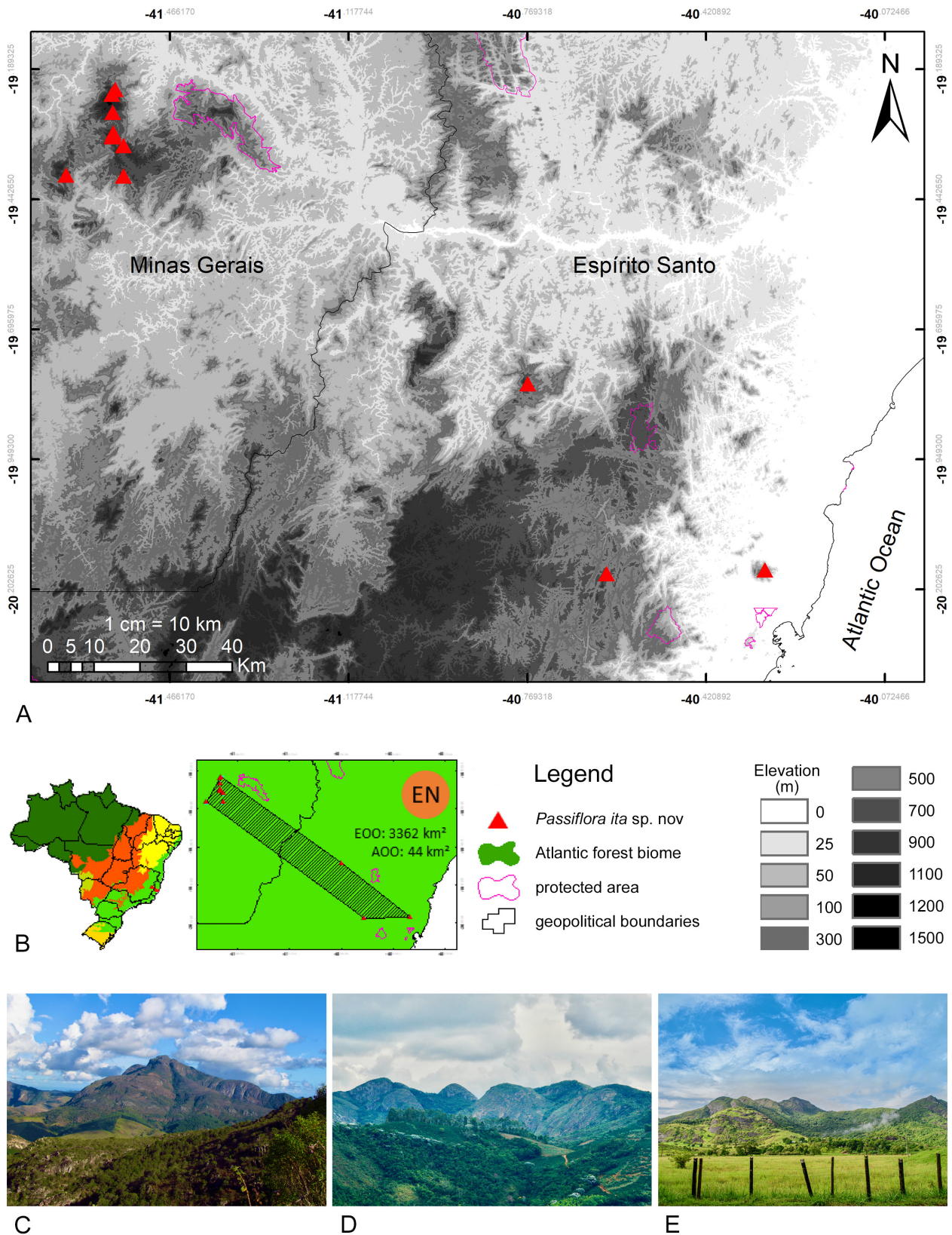


Fig. 4. Distribution map and habitats of *Passiflora ita* – A: distribution of *P. ita* in E Minas Gerais and C Espírito Santo, SE Brazil; B: distribution parameters of *P. ita*, including values for EOO, AOO and preliminary conservation status; C–E: panoramic views of the areas inhabited by *P. ita*; C: Serra do Padre Ângelo, Conselheiro Pena, Minas Gerais; D: Alto Misterioso, São Roque do Canaã, Espírito Santo; E: Serra do Mestre Álvaro, Serra, Espírito Santo. – Photographs: C by Paulo Minatel Gonella; D by Cláudio N. Fraga; E by Junior Nass.

Additional specimens examined — BRAZIL: ESPÍRITO SANTO: Santa Leopoldina, Luxemburgo, Pedra Preta, 15 Mar 2005, *L. Kollmann & al.* 7422 (MBML); São Roque do Canaã, Alto Misterioso, pedra 7, 19°48'07.6"S, 40°46'07.9"W, 1078 m, 27 Aug 2006, *C. Esgario & al.* 90 (MBML); Serra, Mestre Álvaro, 20°09'51"S, 40°18'24"W, 600 m, 1 Mar 2011, *L. Kollmann & R. Cribari* 12211 (MBML). — MINAS GERAIS: Alvarenga, Pico da Aliança, no topo do pico, 19°23'43.8"S, 41°40'08.8"W, 1440 m, 9 May 2021, *P. M. Gonella & al.* 2930 (MBML); Conselheiro Pena, Chapada do João Pinto, 19°20'17"S, 41°33'26"W, 18 Apr 2018, *L. Kollmann & R. Cipriano* 13508 (MBML); Conselheiro Pena, Serra do Padre Ângelo, Pico do Padre Ângelo, platô do topo do pico, 1500 m, Jun 2020, *R. S. Ribeiro & al.* 649 (MBML); *ibid.*, 19°19'12.78"S, 41°34'42.02"W, 1515 m, 30 Nov 2020, *P. M. Gonella & D. P. Cordeiro* 1823 (MBML); *ibid.*, próximo ao cruzzeiro, 19°19'13.89"S, 41°34'44.18"W, 1550 m, 15 Mar 2021, *P. M. Gonella & D. P. Cordeiro* 2325 (MBML); *ibid.*, primeiro platô da subida do pico, vale da mata nebulosa na vertente leste, 19°18'47.14"S, 41°34'36.53"W, 1265 m, 13 Sep 2020, *P. M. Gonella & al.* 1697 (CESJ, MBML); Serra da Palha Branca, afloramento ao lado do mirante da Bela Adormecida, 19°20'15.5"S, 41°33'26.4"W, 1060 m, 30 Jan 2021, *P. M. Gonella & al.* 1903 (MBML); Serra do Pinhão, área de afloramentos acima da Cachoeira do Diabo, na margem direita do córrego do Pinhão, 19°16'24.24"S, 41°34'41.49"W, 975 m, 31 Jan 2021, *P. M. Gonella & al.* 1985 (MBML); *ibid.*, subida para o Pico do Sossego, 19°13'43.27"S, 41°34'22.57"W, 1070 m, 1 May 2021, *P. M. Gonella & al.* 2415 (MBML); *ibid.*, base do Pico do Sossego, 19°14'16.9"S, 41°34'48.7"W, 1260 m, 2 May 2021, *P. M. Gonella & al.* 2527 (MBML); Afloramento quartzítico próximo a Vista Alegre (distrito de Alvarenga), 19°23'49.6"S, 41°33'26.4"W, 920 m, 1 Feb 2021, *P. M. Gonella & al.* 2061 (MBML); *ibid.*, 18 Mar 2021, *P. M. Gonella* 2395 (MBML).

Discussion

Based on the presence of conspicuous and ovate stipules, free bracts, entire leaves, and flowers with conspicuous corona, *Passiflora ita* is best placed in *P.* [subg. *Passiflora* supersect. *Stipulata*] sect. *Granadillastrum*. The new species shows morphological affinity with *P. miersii* Mast. of *P.* sect. *Kermesinae* (Cervi) Feuillet & J. M. MacDougal and *P. castellanosii* Sacco of *P.* sect. *Granadillastrum* (Table 1).

The similarity observed between the new species and *Passiflora miersii* has led to specimens of *P. ita* being considered under the misapplied name *P. miersii* by Borges & al. (2020) in the floristic treatment of the family for Espírito Santo. Other floristic studies dealing with the states where *P. ita* occurs did not mention speci-

mens of the species (Vitta & Pirani 2015; Imig & al. 2018; Moraes & al. 2018).

Passiflora ita can be easily distinguished from *P. castellanosii* and *P. miersii* by vegetative characters. Although the three species are glabrous, *P. ita* possesses 2–4 glands on the petiole that are sessile, elliptic to circular and not stipitate as in the other two species. Furthermore, the bracts of *P. ita* (10.3–21.5 × 7–9 mm) are intermediate in size between *P. castellanosii*, with larger bracts (25–40 × 15–25 mm) and *P. miersii*, with smaller ones (6–8 × c. 2 mm). The number of filament series of the corona also varies between these species, *P. ita* having three well-defined series and one undefined series (vs three well-defined series in *P. castellanosii* and four well-defined series in *P. miersii*).

The filament series here referred to as “undefined” in *Passiflora ita* is a set of filiform filaments that do not form a series *per se*, because the scarce filaments are scattered between the second and third well-defined series (Fig. 1J). These characters are not found in the other two species.

Passiflora ita is the eleventh species of the genus found in the rupicolous ecosystems of the Atlantic rainforest. Before *P. ita*, the latest species described was *P. rupestris* Bernacci & al., from the campos rupestres of Serra Negra, part of Serra da Mantiqueira, in SE Minas Gerais (Bernacci & al. 2014).

Similar to that reported for species of *Asteraceae* by Antar & al. (2021b), *Passiflora ita* occurs both on areas of quartzitic campos rupestres and granitic inselbergs, therefore showing tolerance to distinct edaphic conditions. *Passiflora ita* adds to the growing list of species recently described from the campos rupestres and associated vegetation of the João Pinto formation (e.g. Gonella & al. 2015; Andrino & Gonella 2021; Antar & al. 2021a, 2021b; Kollmann & Gonella 2021), demonstrating the relevance of this area as a refuge of biodiversity and a priority for conservation. The same holds for the inselbergs where the species was found, which harbour unique biodiversity and have revealed many new, threatened species (e.g. Fraga & Feres 2007; Esgario & al. 2009; Monge & al. 2018).

Author contributions

ACMP wrote the first draft of the manuscript and led the investigation. ACMP and RSR prepared the figures and map. PMG and RSR performed field observations and collections. PMG performed the conservation status assessment. ACMP, RSR and PMG revised and edited the manuscript.

Acknowledgements

The authors are grateful to Ednilson Caetano Ribeiro, Lucian Medeiros and Júlio César Ribeiro for company

Table 1. Distribution (according to Bernacci & al. 2020) and morphological traits in *Passiflora ita* and closely related taxa (according to Cervi 1997). Brazilian states: BA = Bahia; CE = Ceará; DF = Distrito Federal; ES = Espírito Santo; MG = Minas Gerais; MS = Mato Grosso do Sul; MT = Mato Grosso; PA = Pará; RJ = Rio de Janeiro; SE = Sergipe; SP = São Paulo. *size of horn not given in description of *P. miersii*.

	<i>P. ita</i>	<i>P. castellanosii</i>	<i>P. miersii</i>
Distribution	ES, MG	CE, MT	BA, DF, ES, MG, MS, PA, RJ, SE, SP
Stipule shape	asymmetric ovate	oblong to oblong-ovate	semi-ovate
Stipule size	11.4–23.9 × 7.4–14.5 mm	20–30 × 10–17 mm	10–25 × 5–12 mm
Petiole glands number	2–4	4	2
Petiole glands position	paired or alternate, in upper portion or also in lower portion of petiole	alternate, scattered along petiole	paired, upper third of petiole
Petiole glands shape	sessile, elliptic to circular	stipitate	stipitate
Lamina	entire	entire to 3-lobed	entire
Bracts shape and phyllotaxis	whorled, ovate	whorled, ovate	alternate, narrowly ovate, oblanceolate to linear-setaceous
Bracts size	10.3–21.5 × 7–9 mm	25–40 × 15–25 mm	6–8 × c. 2 mm
Sepals	oblong-lanceolate, cucullate, carinate, with arista 1.7–1.8 mm long	linear-oblong, carinate, with arista 2–6 mm long	oblong, with horn* near apex
Corona colour	externally entirely banded with bluish purple and white; internally dark purple, banded with white toward apex	externally with vinaceous base, banded with white and purple; internally purple	externally banded with white and purple; internally violet or banded with violet and purple
Corona filaments series	3 well defined and 1 undefined	3 well defined	4 well defined
Corona first and second series filaments shape	filiform	subulate	filiform
Corona first and second series filaments size	12.5–14 mm long	3–5 mm long	10–15 mm long
Operculum	included in corona	included in corona	exserted from corona

and guidance in the field work; Luiz França for logistic support in the field expeditions; Danilo Cordeiro, Gabriele Silva, Thais Condez, Eliana Ramos, Pedro Bartholomay and Alan Araújo for company in fieldwork; Caroline Andrino for suggestions to the improvement of the manuscript; Weverson Cardoso for sending photos of the species from the inselbergs of Espírito Santo; Cláudio Nicoletti de Fraga and Junior Nass for photographs used in this manuscript; Joelcio Freitas for the line drawing; Beethoven Belém for editing some images; and two anonymous reviewers for their comments on an earlier version of this paper. License for fieldwork was granted by the Authorization and Information System in Biodiversity (SISBIO), from the Chico Mendes Institute for Biodiversity Conservation (ICMbio). RSR thanks a fellowship grant by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) (Projeto:403440/2020-3; Processo: 301395/2021-7). This work was undertaken with the support of The Mohamed bin Zayed Species Conservation Fund, project no.192522325. PMG also thanks IDEA WILD for research equipment.

References

- Acevedo-Rodríguez P. & al. 2015+: Lianas and climbing plants of the Neotropics. – Published at <https://naturalhistory.si.edu/research/botany/research/lianas-and-climbing-plants-neotropics> [accessed 9 Mar 2021].
- Andrino C. O. & Gonella P. M. 2021: An escape from the Espinhaço range: a new species of *Paepalanthus* subg. *Xeractis* (*Eriocaulaceae*) from the campos rupestres of Serra do Padre Ângelo, Minas Gerais, Brazil. – *Pl. Ecol. Evol.* **154**: 137–149. Crossref.
- Antar G. M., Harley R. M., Pastore J. F. B., Gonella P. M. & Sano P. T. 2021a: *Hyptidendron pulcherrimum* Antar & Harley, sp. nov. (*Hyptidinae*, *Lamiaceae*), a new narrowly endemic species from Minas Gerais, Brazil. – *Adansonia*, sér. 3, **43**: 1–8. Crossref.
- Antar G. M., Siniscalchi C. M., Gonella P. M., Monge M. & Loeuille B. 2021b: Novelties in *Lepidaploinae* (*Asteraceae*, *Vernonieae*) from the easternmost campos rupestres of Minas Gerais, Brazil: two new species and a range expansion. – *Pl. Ecol. Evol.* **154**: 121–136. Crossref.

- Bachman S., Moat J., Hill A., Torre J. de la & Scott B. 2011: Supporting Red List threat assessments with GeoCAT: geospatial conservation assessment tool. – *ZooKeys* **150**: 117–126. Crossref.
- Bernacci L. C., Mezzonato A. C. & Salimena F. R. G. 2014: A new and threatened species of *Passiflora* section *Decaloba* (*Passifloraceae*) from Minas Gerais State, Brazil. – *Syst. Bot.* **39**: 517–522. Crossref.
- Bernacci L. C., Nunes T. S., Mezzonato A. C., Milward-de-Azevedo M. A., Imig D. C. & Cervi A. C. (in memoriam) 2020: *Passifloraceae* in Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. – Published at <http://floradobrasil.jbrj.gov.br/reflora/floradobrasil/FB182> [accessed 15 Mar 2021].
- Borges K. F., Lorenzoni R. M., Fontes M. M. P. & Milward-de-Azevedo M. A. 2020: A família *Passifloraceae* sensu stricto do Espírito Santo, Brasil. – *Rodriguésia* **71**: e03212018. Crossref.
- Candolle A. P. de 1822: *Passiflora ligularis*. – Pp. 434–436 in: Rapport sur les plantes rares ou nouvelles qui ont fleuri dans le Jardin de Botanique de Genève pendant les années 1819, 1820 et 1821. – *Mem. Soc. Phys. Genève* **1**: 431–463.
- Carvalho M. R. de 1987: Dicionário Tupi (antigo)-Português. – Salvador: Empresa Gráfica da Bahia.
- Cervi A. C. 1997: *Passifloraceae* do Brasil: estudo do gênero *Passiflora* L. subgênero *Passiflora*. – *Fontqueria* **45**: 1–92.
- Escobar L. K. 1989: A new subgenus and five new species in *Passiflora* (*Passifloraceae*) from South America. – *Ann. Missouri Bot. Gard.* **76**: 877–885. Crossref.
- Esgario C. P., Fontana A. P. & Silva A. G. 2009: A flora vascular sobre rocha no Alto Misterioso, uma área prioritária para a conservação da Mata Atlântica no Espírito Santo, Sudeste do Brasil. – *Natureza on line* **7**: 80–91.
- Feuille C. & MacDougal J. M. 2003: A new infrageneric classification of *Passiflora* L. (*Passifloraceae*). – *Passiflora* **13**: 34–38.
- Fraga C. N. de & Feres F. 2007: *Luxemburgia misteriosa* (*Ochnaceae*), a new species from the Atlantic rain forest of Espírito Santo, Brazil. – *Harvard Pap. Bot.* **12**: 405–408. Crossref.
- Fraga C. N., Formigoni M. H. & Chaves F. G. 2019: Fauna e flora ameaçadas de extinção no estado do Espírito Santo. – Santa Teresa: Instituto Nacional da Mata Atlântica.
- Gonella P. M., Rivadavia F. & Fleischmann A. 2015: *Drosera magnifica* (*Droseraceae*): the largest New World sundew, discovered on Facebook. – *Phytotaxa* **220**: 257–267. Crossref.
- IBGE 2019: Biomas e sistema costeiro-marinho do Brasil: compatível com a escala 1: 250 000. Coordenação de Recursos Naturais e Estudos Ambientais. – Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística.
- IBGE 2020: Brasil: mapas de referência – mapas políticos – mapa político – 1: 2 500 000. – Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística.
- Imig D. C., Milward-de-Azevedo M. A. & Cervi A. C. 2018: *Passifloraceae* sensu stricto de Minas Gerais, Brasil. – *Rodriguésia* **69**: 1701–1735. Crossref.
- IUCN 2012: IUCN Red List categories and criteria. Version 3.1. Second edition. – Gland & Cambridge: IUCN. – Published at <https://www.iucnredlist.org/resources/categories-and-criteria>
- Joly C. A., Aidar M. P. M. & Klink C. A. 1999: Evolution of the Brazilian phytogeography classification systems: implications for biodiversity conservation. – *Ci. & Cult.* **51**: 331–348.
- Killip E. P. 1938: The American species of *Passifloraceae*. – *Publ. Field Mus. Nat. Hist., Bot. Ser.* **19**: 1–613. Crossref.
- Kollmann L. J. C. & Gonella P. M. 2021: Novelties in *Begonia* (*Begoniaceae*) from the campos rupestres of Serra do Padre Ângelo, Minas Gerais, Brazil: a new species and a new record. – *Phytotaxa* **510**: 69–77. Crossref.
- Krosnick S. E., Ford A. & Freudenstein J. 2009: Taxonomic revision of *Passiflora* subgenus *Tetrapathea* including the monotypic genera *Hollrungia* and *Tetrapathea* (*Passifloraceae*), and a new species of *Passiflora*. – *Syst. Bot.* **34**: 375–385. Crossref.
- Krosnick S. E., Porter-Utley K. E., MacDougal J. M., Jorgensen P. M. & McDade L. A. 2013: New insights into the evolution of *Passiflora* subgenus *Decaloba* (*Passifloraceae*): phylogenetic relationships and morphological synapomorphies. – *Syst. Bot.* **38**: 692–713. Crossref.
- Martinelli G. 2007: Mountain biodiversity in Brazil. – *Revista Brasil. Bot.* **30**: 587–597. Crossref.
- Monge M., Volet D. P. & Semir J. 2018: Five new species of *Vernonieae* (*Asteraceae*) from Espírito Santo, Brazil. – *Rodriguésia* **69**: 595–610. Crossref.
- Moraes A. M., Milward-de-Azevedo M. A. & Faria A. P. G. de 2018: *Passifloraceae* sensu stricto no Parque Estadual da Serra do Brigadeiro, Minas Gerais, Brasil. – *Rodriguésia* **69**: 815–840. Crossref.
- Myers N., Mittermeier R. A., Mittermeier C. G., Fonseca G. A. B. da & Kent J. 2000: Biodiversity hotspots for conservation priorities. – *Nature* **403**: 853–858. Crossref.
- Paula L. F. A. de, Azevedo L. O., Mauad L. P., Cardoso L. J. T., Braga J. M. A., Kollmann L. J. C., Fraga C. N., Menini Neto L., Labiak P. H., Mello-Silva R., Porembski S. & Forzza R. C. 2020: Sugarloaf land in south-eastern Brazil: a tropical hotspot of lowland inselberg plant diversity. – *Biodivers. Data J.* **8**: e53135. Crossref.
- Porembski S., Martinelli G., Ohlemüller R. & Barthlott W. 1998: Diversity and ecology of saxicolous vegetation mats on inselbergs in the Brazilian Atlantic rainforest. – *Diversity & Distrib.* **4**: 107–119. Crossref.
- Porembski S., Silveira F. A. O., Fiedler P. L., Watve A., Rabarimanarivo M., Kouame F. & Hopper S. D. 2016: Worldwide destruction of inselbergs and related rock

- outcrops threatens a unique ecosystem. – *Biodiversity & Conservation* **25**: 2827–2830. Crossref.
- QGIS Development Team 2021: QGIS Geographic information system. Open source geospatial foundation project. – Published at <https://qgis.org/> [accessed 12 Jun 2021].
- Radford A. E., Dickison W. C., Massey J. R. & Bell C. R. 1974: *Vascular plant systematics*. – New York: Harper & Row Publishers.
- Reflora 2021: Reflora. Herbário virtual. – Published at: <http://reflora.jbrj.gov.br/reflora/herbarioVirtual/> [accessed 1 Nov 2021].
- Restrepo J. J., Ocampo J. & Giraldo W. 2019: *Passiflora nebulosae* (*Passifloraceae*, subgenus *Tryphostemma-toides*) a distinctive new critically endangered species discovered in the Colombian Andes. – *Phytotaxa* **400**: 237–245. Crossref.
- Safford H. D. 1999: Brazilian páramos I. An introduction to the physical environment and vegetation of the campos de altitude. – *J. Biogeogr.* **26**: 693–712. Crossref.
- Silveira F. A. O., Negreiros D., Barbosa N. P. U., Buisson E., Carmo F. F., Carstensen D. W., Conceição A. A., Cornelissen T. G., Echternacht L., Fernandes G. W., Garcia Q. S., Guerra T. J., Jacobi C. M., Lemos-Filho J. P., Le Stradic S., Morellato L. P. C., Neves F. S., Oliveira R. S., Schaefer C. E., Viana P. L. & Lambers H. 2016: Ecology and evolution of plant diversity in the endangered campo rupestre: a neglected conservation priority. – *Pl. & Soil* **403**: 129–152. Crossref.
- SpeciesLink. 2021: Sistema de informação distribuído para coleções biológicas: a integração do Species Analyst e do SinBiota (FAPESP). – Published at: <http://splink.cria.org.br/> [accessed 1 Nov 2021].
- Thiers B. 2021+ [continuously updated]: Index herbariorum: a global directory of public herbaria and associated staff. New York Botanical Garden's virtual herbarium. – Published at <http://sweetgum.nybg.org/science/ih/> [accessed 15 Mar 2021].
- Ulmer T. & MacDougal J. M. 2004: *Passiflora: passionflowers of the world*. – Portland: Timber Press.
- Vasconcelos M. F. 2011: O que são campos rupestres e campos de altitude nos topos de montanha do leste do Brasil? – *Revista Brasil. Bot.* **34**: 241–246. Crossref.
- Vitta F. A. & Pirani J. R. 2015: Flora da Serra do Cipó, Minas Gerais: *Passifloraceae*. – *Bol. Bot. Univ. São Paulo* **33**: 29–38. Crossref.

Willdenowia

Open-access online edition bioone.org/journals/willdenowia



Online ISSN 1868-6397 · Print ISSN 0511-9618 · 2020 Journal Impact Factor 0.985

Published by the Botanic Garden and Botanical Museum Berlin, Freie Universität Berlin

© 2021 The Authors · This open-access article is distributed under the CC BY 4.0 licence