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Research article

Two new species of *Psyllocarpus* (Spermacoceae, Rubiaceae) from the state of Minas Gerais, southeastern Brazil

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Abstract. Two new species of *Psyllocarpus* sect. *Psyllocarpus*, *P. itakangapyra* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov. and *P. vianae* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov., from the "campo rupestre" of the state of Minas Gerais, southeastern Brazil, are here described and illustrated. We provide comments on their distribution, habitat, and preliminary conservation status, and discuss their taxonomy. In addition, we analyse floral, fruit, and seed micromorphology, as well as pollen grains of the new species. We also provide an updated identification key to the species of *P.* sect. *Psyllocarpus*.

Keywords. "campo rupestre", Itacambira, Serra do Cabral, *Spermacoce* clade, taxonomy.

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Introduction

Psyllocarpus Mart. & Zucc. belongs to the *Spermacoce* clade (Kårehed *et al.* 2008; Salas *et al.* 2015), a major lineage in the primarily herbaceous tribe Spermacoceae Bercht. & J.Presl (Rubiaceae Juss., Rubioideae Verdc.). The species of *Psyllocarpus* are mainly saxicolous or terrestrial erect subshrubs with the capsules compressed parallel to the septum. It is an endemic genus from Brazil, currently

comprising 11 species, occurring in the phytogeographical domains of Amazonia, Caatinga, and the Cerrado (Kirkbride 1979; BFG 2018; Carmo *et al.* 2018).

In the last revision of the genus, Kirkbride (1979) expanded its original circumscription (Martius 1824; Martius & Zuccarini 1824), and classified it in two sections, *Psyllocarpus* sect. *Psyllocarpus* and *P.* sect. *Amazonica* J.H.Kirkbr., based on morphology and geographic distribution. The former is characterized by the terete leaves, homostylous flowers, prolate-spheroidal pollen grains, psilate tectum with microspines along each side of the colpi exine, and weakly bilobate to rarely capitate stigma. This section occurs in the Cerrado and "campo rupestre" from the Espinhaço range and the Planalto Central of eastern and central Brazil, in the states of Bahia, Goiás, and Minas Gerais, and the Distrito Federal; it currently comprises seven species (*P. asparagoides* Mart. & Zucc., *P. bahiensis* J.A.M.Carmo, Sobrado & R.M.Salas, *P. goiasensis* J.H.Kirkbr., *P. laricoides* Mart. & Zucc., *P. phyllocephalus* K.Schum., *P. scatignae* J.A.M.Carmo, Sobrado & R.M.Salas, and *P. schwackei* K.Schum.). On the other hand, *Psyllocarpus* sect. *Amazonica* presents planar leaves, heterostylous flowers, oblate-spheroidal pollen grains, perforated tectum, finely and evenly microspinose exine, and deeply bifid stigma. The three species included in this section (*P. campinorum* (Krause) J.H.Kirkbr., *P. cururuensis* J.H.Kirkbr., and *P. psyllocarpoides* (Sucre) J.H.Kirkbr.) are restricted to white-sand Amazonian "campinas" from the northern states of Amazonas, Pará, and Rondônia (Kirkbride 1979).

The two remaining species described in *Psyllocarpus* (*P. intermedius* E.L.Cabral & Bacigalupo (Cabral & Bacigalupo 1997) and *P. densifolius* Zappi & Calió (Zappi *et al.* 2014)) were not included in any section, as they present morphological features divergent from those of *P.* sect. *Psyllocarpus*, despite occurring in the same geographical region. More recently, Carmo *et al.* (2021) have recognized the new monotypic genus *Diadorimia* J.A.M.Carmo, Florentín & R.M.Salas to accommodate *P. densifolius*, while molecular phylogenetic analyses have indicated that *P.* sect. *Psyllocarpus* would appear to be monophyletic with maximum to high support, even though sampling was low (Salas *et al.* 2015; Florentín *et al.* 2017; Miguel *et al.* 2018), pending further investigation to test the monophyly of the genus as currently circumscribed, as well as its sections.

The analysis of specimens collected in the state of Minas Gerais, southeastern Brazil, have revealed that these do not correspond to any described species in *Psyllocarpus*, and are in fact new to science. As a part of our revision of the genus, we describe here two new species of *Psyllocarpus* sect. *Psyllocarpus*. We provide their descriptions, illustrations, and photographs, as well as comments on their distribution, habitat, preliminary conservation status, and taxonomy. Micromorphological characteristics of flowers, pollen grains, fruits, and seeds are also described and illustrated. We also provide an updated key to the species of *P.* sect. *Psyllocarpus*.

Material and methods

This study is based on field collections and analysis of specimens deposited at the BHCB, CTES, and UEC herbaria (acronyms of herbaria follow Index Herbariorum (Thiers continuously updated)). For descriptions and morphological comparison, we used conventional taxonomic methods. We followed the Systematics Association Committee for Descriptive Biological Terminology (1962), Clopton (2004), and Simpson (2010) for general morphological terminology, and Weberling *et al.* (1997) and Rua (1999) for inflorescence terminology. The distribution map was created using QGIS ® software (QGIS Development Teams 2021). A preliminary conservation status assessment was carried out by range size (B criterion), following the IUCN Standards and Petitions Committee (2019) recommendations. The extent of occurrence (EOO) and area of occupancy (AOO) were estimated using GeoCAT (Bachman *et al.* 2011). Pollen grains were acetolyzed according to Erdtman (1966) and mounted in glycerine jelly for analysis using a light microscope (LM). Conventional parameters (polar (P) and equatorial (E) axis, apertures, exine) in at least 20 mature grains were measured under LM and the exine details (architecture

and ornamentation) were analysed using scanning electron microscopy (SEM). The terminology used to describe the pollen followed Punt *et al.* (2007). Fresh buds, mature flowers, fruits, and seeds fixed in alcohol 70% were also analysed using SEM. We used the terminology proposed by Stearn (1986) for seed descriptions. For the images, the dehydrated material and acetolyzed pollen grains were sputter-coated with gold and then photographed with a Jeol 5800 LV SEM (SGCyT - UNNE, Corrientes, Argentina).

Results

Taxonomy

Class Magnoliopsida Brongn.
Order Gentianales Juss. ex Bercht. & J.Presl.
Family Rubiaceae Juss.
Subfamily Rubioideae Verdc.
Tribe Spermacoceae Bercht. & J.Presl
Genus *Psyllocarpus* Mart. & Zucc.
Psyllocarpus section *Psyllocarpus* Mart. & Zucc.

Psyllocarpus itakangapyra Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.
urn:lsid:ipni.org:names:77296003-1
Figs 1, 3A–I, 4A–H, 5A–D, 6A–F, 7

Diagnosis

Psyllocarpus itakangapyra sp. nov. is similar to *P. laricoides* Mart. & Zucc., but differs by the leaves 1.45–3.4 mm long (vs (4)5–16(21) mm long in *P. laricoides*), flowering branches determinate (vs indeterminate), inflorescences in terminal glomerules, rarely with axillary inflorescences in 1-flowered cymes (vs axillary inflorescences in 1-flowered cymes), corolla tube 1.78–2.08 mm long (vs 2.9–6.7 mm long), calyx tube absent to vestigial (vs present), and seeds broadly obovate in outline (vs elliptic to broadly elliptic in outline).

Etymology

The specific epithet refers to the municipality of Itacambira, in the state of Minas Gerais, where the species is found. '*Itakangapyra*' means 'stone with a pointed head' and derives from the ancient Tupi, an extinct Tupi language that was spoken by the Tupi tribes that inhabited most of the Brazilian coast in the 16th century.

Material examined

Type

BRAZIL • Minas Gerais, Itacambira, Serra Resplandescente, "no caminho para a torre de Itacambira" [on the way to the Itacambira tower]; 17°04′56″ S, 43°18′20″ W; 1304 m a.s.l.; 28 Oct. 2009; *Viana, Cardoso, Hattori & Salas 4415*; holotype: BHCB[134173]!; isotype: CTES!.

Paratypes

BRAZIL – **Minas Gerais** • Itacambira, MG 308, km 98; 17°04′58″ S, 43°18′35″ W; 17 Jan. 2015; *Carmo & Scatigna 297*; CTES!, UEC[207471]! • Itacambira, MG 308, km 99; 17°04′59″ S, 43°18′35″ W; 17 Jan. 2015; *Carmo & Scatigna 298*; CTES!, UEC[208470]!.

Description

Subshrubs, 0.4–2 m tall, sympodial. *Stems* branched, erect, internodes 1.25–8.11 mm long, 1.68–3.11 mm wide at the apex, tetragonal to subtetragonal and scabridous, 0.26–1.6 mm wide at the base, subterete and

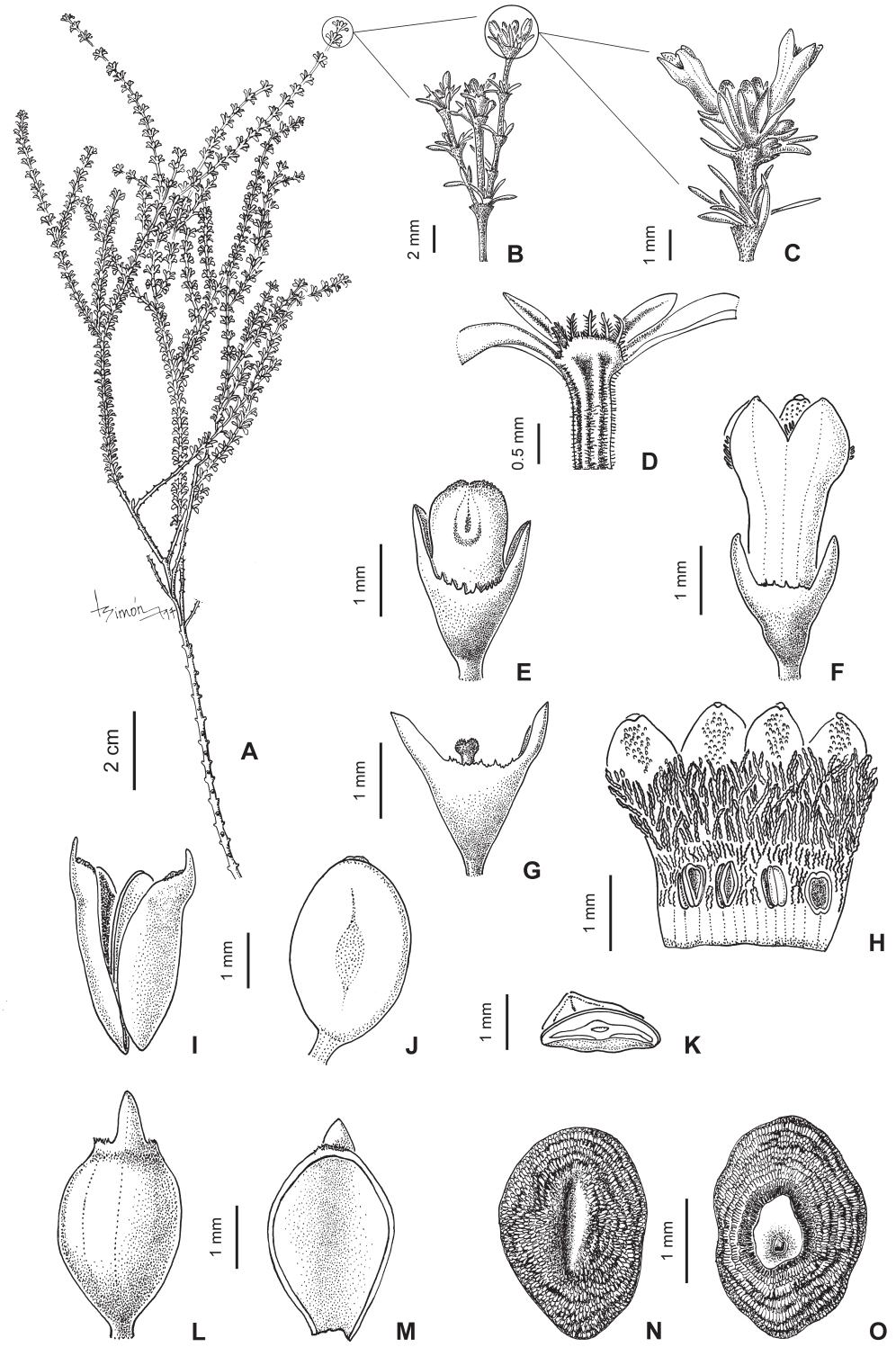

Fig. 1. *Psyllocarpus itakangapyra* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.; *P.L. Viana et al. 4415* (CTES). **A**. Branch portion. **B**. Inflorescences at the apex of flowering branches. **C**. Detail of an inflorescence. **D**. Stipular sheath. **E**. Preanthetic flower bud. **F**. Flower. **G**. Hypanthium, calyx, style, and stigma. **H**. Opened corolla. **I–M**. Fruit. **I**. Dehiscent capsule, lateral view. **J**. Septum. **K**. Valve, seed, and septum, cross section. **L**. Valve, dorsal view. **M**. Valve, ventral view. **N–O**. Seed. **N**. Dorsal view. **O**. Ventral view. Illustration: L. Simón.

glabrous, bark peeling from older internodes, foliar scars conspicuous. *Stipular sheaths* 0.48–0.94(1.29) mm long, scabridous to glabrous, 3–5-fimbriate on each side of the stem, fimbriae 0.17–0.68 mm long, linear to narrowly triangular, colleter tipped, margin scabridous. *Leaves* opposite, with axillary brachyblasts forming fascicles, leaf blades 1.45–3.4 × 0.2–0.45 mm, slightly reflexed, decussate, apparently fleshy, sessile, linear to terete, apex obtuse, glabrous. *Flowering branches* determinate, 1–4.72 cm long, unbranched or with 3–5 branches per axis, inflorescences in terminal glomerules, 6–10-flowered, 3.4–5.93 mm wide, rarely a 2–3-flowered cyme axillary, peduncle 2.07–9.28 mm long, external bracts 2, 1.43–2.24 × 0.18–1 mm, patent, linear to terete, apex obtuse, glabrous. *Flowers* sessile, homostylous; hypanthium 1.03–1.47 × 0.56–1.29 mm, obconic, glabrous; calyx tube absent to vestigial, 2-lobate, 3–5 fimbriae along the calyx rim between the lobes, 0.12–1.61 mm long, colleter tipped, calyx lobes (0.7)0.91–1.14 × 0.22–0.61 mm, narrowly triangular to linear, spatulate, glabrous; corolla 3–3.58 mm long, infundibuliform, lower half of the tube purple, the upper half and lobes light blue, corolla tube 1.78–2.08 mm long, 0.93–1.6 mm diam., external surface papillate, internal surface with a dense ring of moniliform trichomes from the anthers apex to the lobes base, sparsely pubescent between the anthers, and glabrous on the base, 4-lobate, corolla lobes 0.93–1.51 × 0.66–1.11 mm, subtriangular, external and internal surface papillate, rounded in preanthetic bud, this ca 1.09 mm diam., apex rounded; stamens included, inserted at the middle of the corolla tube, filaments 0.22–0.27 mm long, anthers 0.62–0.93 mm long, orbicules present covering uniformly the inner wall of dehiscent anthers, pollen 5-zonocolpate, circular outline in polar view, small-sized (P = 17–22 µm), prolate-spheroidal to prolate (P/E = 1.13–1.4), long and narrow ectocolpi (10–12 µm long), endocingulum (3)4–5 µm wide, tectum psilate microspinose, tipped microspines 0.2–0.4 µm long, distributed mostly around the ectocolpi, exine 0.8–1.4 µm thick; style included, 0.16–0.26 mm long, stigma 0.19–0.27 mm long, bilobate, lobes inconspicuous; nectariferous disk entire, 0.52–0.79 mm diam., with striate cells. *Capsule* 3–3.74 × 1.73–2.67 mm, obovate in outline, strongly compressed parallel to the septum, 1–3 acrodromous ribs slightly marked on the dorsal surface, glabrous, calyx lobes persistent, dehiscent from the apex downwards, valves persistent from which the seeds are shed after dehiscence, septum persistent, 2.69–3.65 × 1.54–2.15 mm. *Seeds* 2, 2.15–2.92 × 1.37–1.9 mm, broadly obovate in outline, strongly compressed, ventral surface covered by diffuse strophiole, 0.68–0.96 × 0.35–0.62 mm, dorsal surface slightly convex, testa subtuberculate, with digital-like cells pressed (37.37–93.87 × 17.98–34.18 µm), radially arranged.

Distribution, habitat, and phenology

Psyllocarpus itakangapyra sp. nov. grows on sandy and rocky soils in the "campo rupestre" vegetation (sensu Silveira *et al.* 2016), at ca 1300 m a.s.l. Currently it is only known from the municipality of Itacambira, in the micro-region of Grão Mogol, northern Minas Gerais (Fig. 7). However, future botanical expeditions to this region may increase the distributional range of this species. Specimens with flowers and fruits were collected in October and January.

Preliminary conservation status

Psyllocarpus itakangapyra sp. nov. does not occur within the limits of any protected area in Minas Gerais. It presents EOO and AOO equal to 1471 km^2 and 20 km^2 (kml file available as Supp. file 1). Therefore, we believe that this species would be considered endangered (EN B2abiii) in an official IUCN red list assessment, based on its EOO less than 5000 km^2 and AOO less than 500 km^2, occurrence in five locations, and continuing decline inferred on quality of habitat due to the impacts on the "campo rupestre" vegetation, which in this case is associated with the expansion of eucalyptus plantations in the region, as noticed by us during fieldwork.

Psyllocarpus vianae Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.
urn:lsid:ipni.org:names:77296004-1
Figs 2, 3J–R, 4I–P, 5E–H, 6G–M, 7

Diagnosis

Psyllocarpus vianae sp. nov. is similar to *P. laricoides*, but differs by the flowering branches determinate (vs indeterminate in *P. laricoides*), inflorescences in terminal glomerules (vs axillary inflorescences in 1-flowered cymes), corolla urceolate (vs infundibuliform), completely purple or the lower half of the tube white (vs tube purple and lobes light blue), tube 1.22–1.6 mm long (vs 2.9–6.7 mm long), the upper third of the lobes reflexed in mature flowers and the rest forming a false tube (vs plane to slightly reflexed in mature flowers, not forming a false tube), filaments 0.41–0.73 mm long (vs 0.2–0.4 mm long), style 0.14–0.24 mm long (vs 0.3–0.7 mm long), and seeds broadly obovate in outline (vs elliptic to broadly elliptic in outline).

Etymology

The specific epithet honours the Brazilian botanist Pedro Lage Viana, who works on the systematics of the Poaceae Barnhart with emphasis on the Bambusoideae Luerss., as well as floristic inventories in many Brazilian phytogeographic domains, but currently concentrated in the Brazilian Amazon. 'Pedrinho' collected the first specimens of both species described in this paper, as he is also known to have greatly contributed to the knowledge of the flora of the Espinhaço range, especially in Minas Gerais.

Material examined

Type

BRAZIL • Minas Gerais, Joaquim Felício, Serra do Cabral, campos rupestres, "con áreas de suelos arenosos blanquecinos" [with areas of white sandy soils]; 17°41′57″ S, 44°16′29″ W; 1140 m a.s.l.; 17 Apr. 2012; *Viana, Salas, Sobrado & Mota 5887*; holotype: BHCB[158411]!; isotype: CTES!.

Paratype

BRAZIL • Minas Gerais, Joaquim Felício, Serra do Cabral, "estrada passando pelo Parque Estadual da Serra do Cabral (acesso Joaquim Felício), próximo ao talhão de Eucalipto" [road passing through the Serra do Cabral State Park (entrance Joaquim Felício), near the Eucalyptus stand]; 17°41′57″ S, 44°16′28″ W; 15 Jan. 2015; *Carmo & Scatigna 294*; UEC[208461]!.

Description

Subshrubs, 0.5–1.2 m tall, sympodial. *Stems* sparsely branched distally, erect, internodes 1.78–7.24 mm long, 2.02–4.62 mm wide at the apex, 0.46–1.24 mm wide at the middle, tetragonal to subtetragonal and scabridous, bark peeling from older internodes, foliar scars conspicuous. *Stipular sheaths* 0.48–1.12 mm long, scabridous to glabrous, (4)5–6-fimbriate on each side of the stem, fimbriae 0.2–0.76 mm long, narrowly triangular, scabridulous. *Leaves* opposite, with axillary brachyblasts forming fascicles, leaf blades 2.22–6.95 × 0.23–0.6 mm, erect to slightly reflexed, decussate, sessile, linear to terete, apex obtuse to acuminate, glabrous, margin scabridulous. *Flowering branches* determinate, 1.12–6.69 cm long, unbranched or with 3–5 branches per flowering axis, inflorescences in terminal glomerules, 4–12-flowered, 5.37–11.29 mm wide, peduncle 2.97–6.06 mm long, external bracts 2, 2.28–3.22 × 0.24–0.6 mm, linear to terete, apex obtuse, glabrous. *Flowers* sessile, homostylous; hypanthium 1.14–2.06 × 0.76–1.31 mm, obconic, glabrous; calyx tube 0.15–0.45 mm long, 2-lobate, 6–10 fimbriae along the calyx rim between the lobes, 0.12–0.63(1.14) mm long, colleter tipped, calyx lobes 1.32–2.18 × 0.19–0.49 mm, narrowly elliptic to linear, glabrous, margin slightly scabridulous; corolla 2.63–3.55 mm long, urceolate, completely purple or the lower half of the tube white, corolla tube 1.22–1.6 mm long, 1.07–1.6 mm diam., external surface papillate, internal surface glabrous from the base up to the base of the filaments, and sparsely

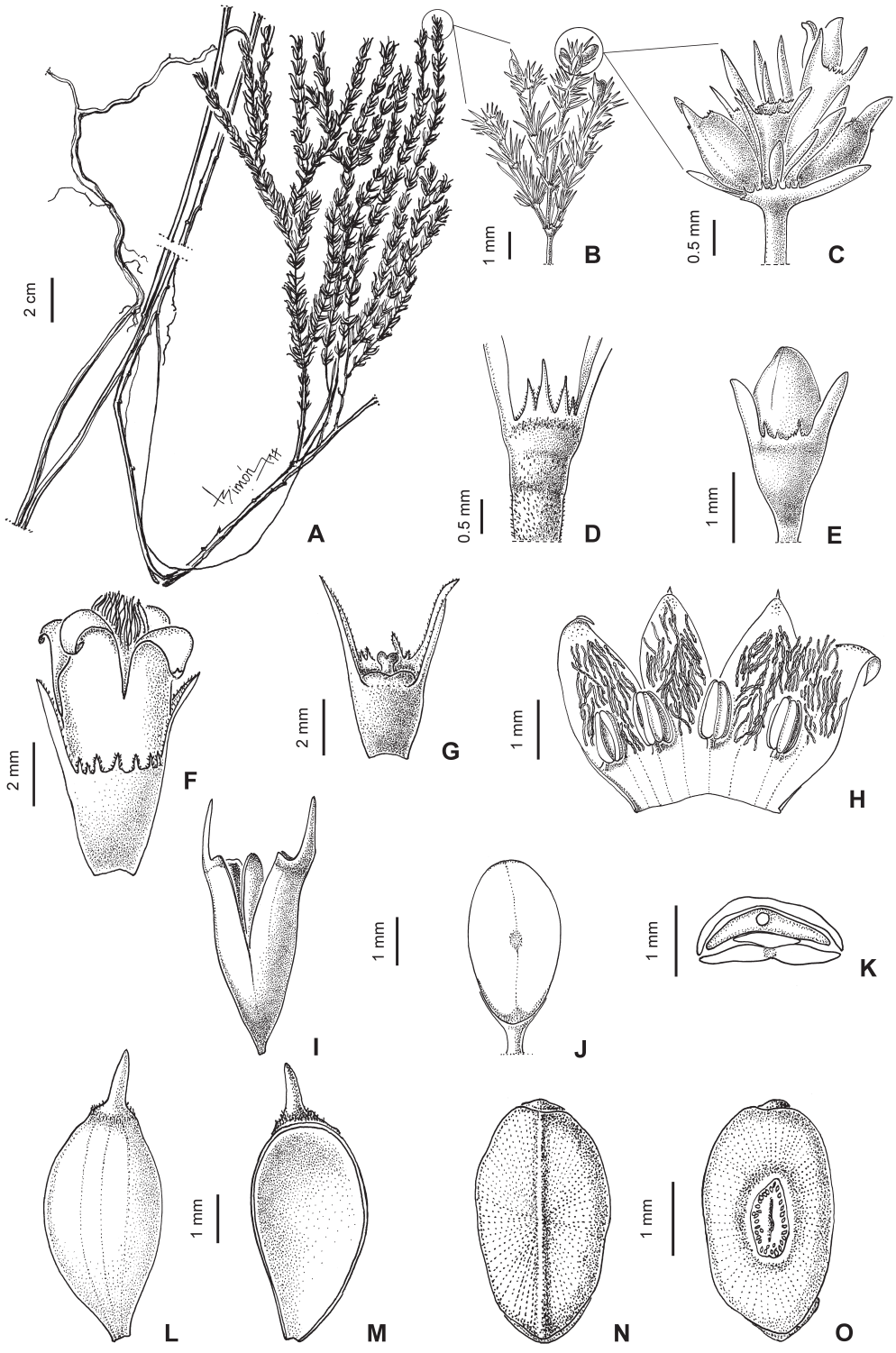

Fig. 2. *Psyllocarpus vianae* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.; *P.L. Viana et al. 5887* (CTES). **A**. Habit. **B**. Inflorescences at the apex of flowering branches. **C**. Detail of an inflorescence. **D**. Stipular sheath. **E**. Preanthetic flower bud. **F**. Flower. **G**. Hypanthium, calyx, style, and stigma. **H**. Opened corolla. **I–M**. Fruit. **I**. Dehiscent capsule, lateral view. **J**. Septum. **K**. Valve, seed, and septum, cross section. **L**. Valve, dorsal view. **M**. Valve, ventral view. **N–O**. Seed. **N**. Dorsal view. **O**. Ventral view. Illustration: L. Simón.

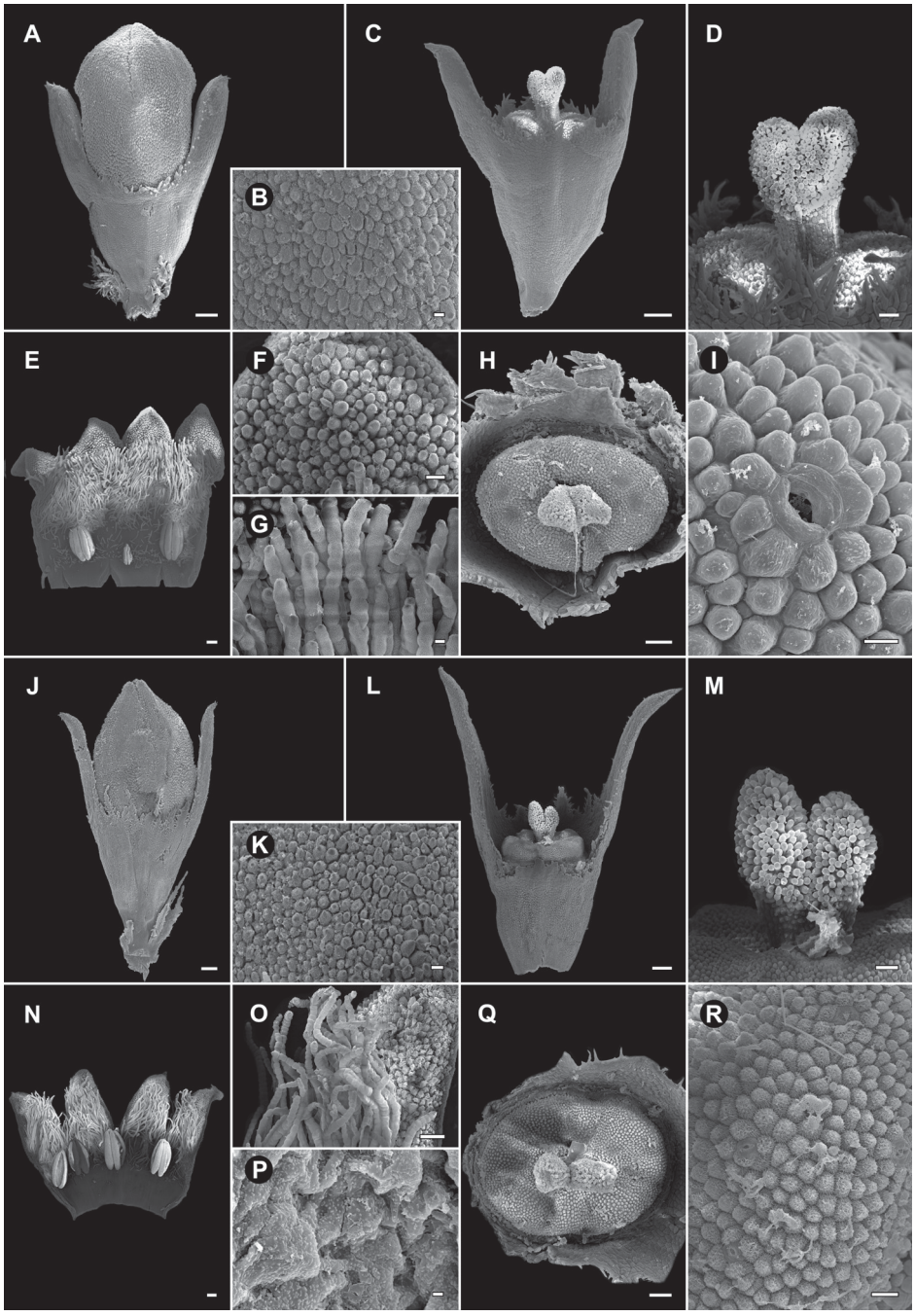

Fig. 3. Flower micromorphology. **A–I**. *Psyllocarpus itakangapyra* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.; *P.L. Viana et al. 4415* (CTES). **A**. Flower bud. **B**. Papillate external surface of the corolla. **C**. Hypanthium, calyx, style, and stigma. **D**. Detail of style and stigma. **E**. Opened corolla. **F**. Papillate internal surface of the corolla lobes. **G**. Moniliform trichomes at internal surface of the corolla. **H**. Nectariferous disk, top view. **I**. Detail of striate nectariferous disk cells and functional stomata. **J–R**. *P. vianae* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.; *P.L. Viana et al. 5887* (CTES). **J**. Flower bud. **K**. Papillate external surface of the corolla. **L**. Hypanthium, calyx, style, and stigma. **M**. Detail of style and stigma. **N**. Opened corolla. **O**. Papillate internal surface of the corolla lobes and moniliform trichomes. **P**. Inner wall of a dehiscent anther, showing the prescence of orbicules. **Q**. Nectariferous disk, top view. **R**. Detail of striate nectariferous disk cells. Scale bars: A, C, E, J, L, N 200 μm; B, G, K, R = 20 μm; D, F, M = 50 μm; H, O, Q = 100 μm; I = 10 μm; P = 2 μm.

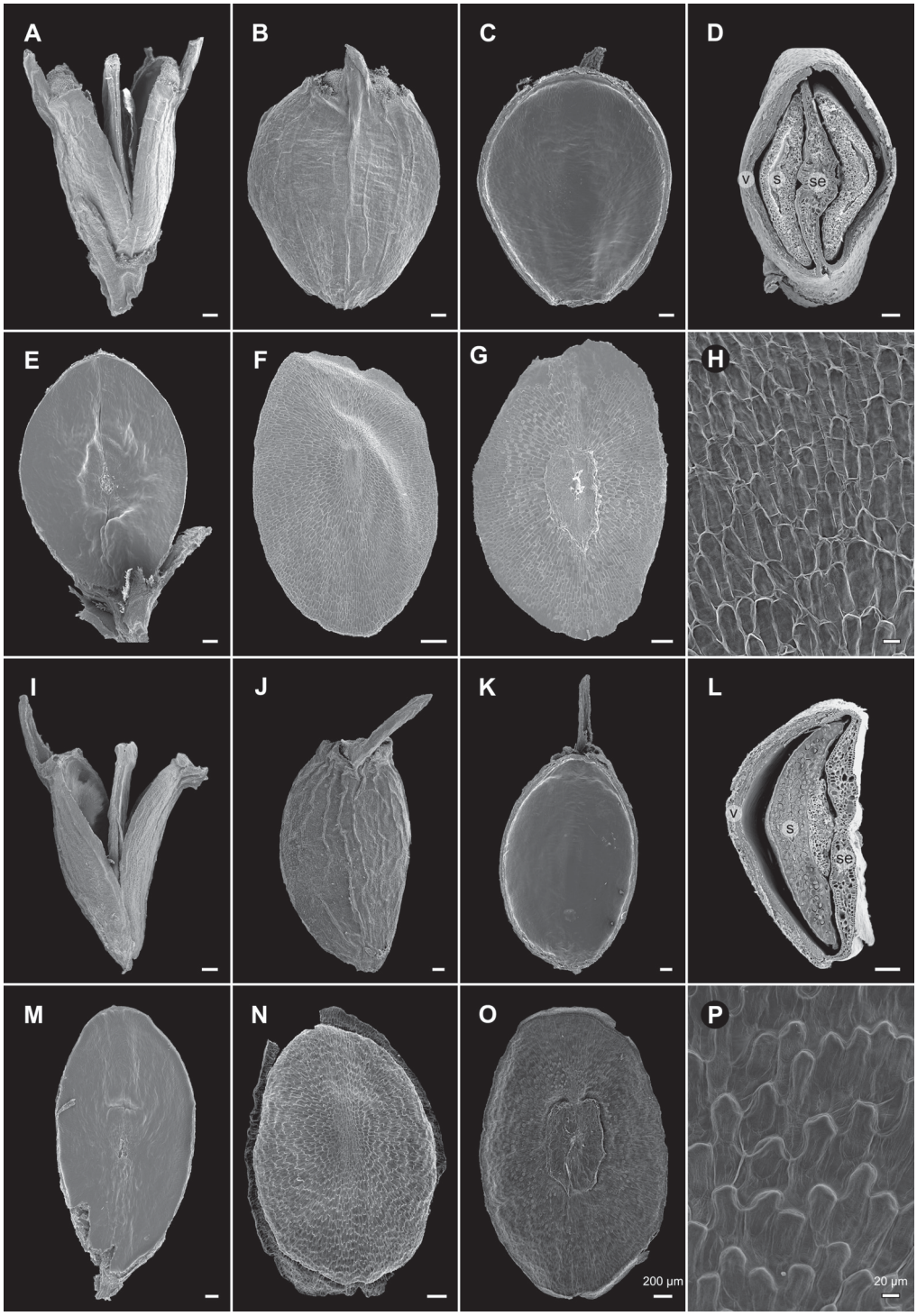

Fig. 4. Fruit and seed micromorphology. **A–H**. *Psyllocarpus itakangapyra* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.; *P.L. Viana et al. 4415* (CTES). **A–E**. Capsule. **A**. Dehiscent capsule, lateral view. **B**. Valve, dorsal view. **C**. Valve, ventral view. **D**. Cross section capsule. **E**. Septum. **F–H**. Seed. **F**. Dorsal view. **G**. Ventral view, with diffuse strophiole. **H**. Detail of the testa. **I–P**. *P. vianae* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.; *P.L. Viana et al. 5887* (CTES). **I–M**. Capsule. **I**. Dehiscent capsule, lateral view. **J**. Valve, dorsal view. **K**. Valve, ventral view. **L**. Cross section of the valve, seed, and septum. **M**. Septum. **N–P**. Seed. **N**. Dorsal view. **O**. Ventral view. **P**. Detail of the testa. Abbreviations: s = seed; se = septum; v = valve. Scale bars: A–G, I–O = 200 µm; H, P = 20 µm.

monoliform trichomes between the anthers, (3)4-lobate, corolla lobes 1.29–2.25 × 0.79–1.29 mm, the upper third reflexed (from posanthetic to mature flowers), the rest aligned with the adjacent lobes forming a false tube, triangular to broadly ovoid, external surface papillate, internal surface papillate on the upper half, with moniliform trichomes densely concentrated on the base, deeply deltoid in preanthetic bud, this ca 1.26 mm diam., apex mucronate; stamens included, inserted near the sinuses of the corolla lobes, filaments 0.41–0.73 mm long, anthers 0.75–1.09 mm long, occasionally with expansion of the connective tissue (0.08–0.1 mm long), orbicules present covering uniformly the inner wall of dehiscent anthers, pollen 5-zonocolpate, circular outline in polar view, small-sized (P = 16–19 µm), prolate-spheroidal to subprolate (P/E = 1.13–1.29), long and narrow ectocolpi (11–16 µm long), endocingulum 3–5 µm wide, tectum psilate microspinose, tipped microspines 0.25–0.3 mm long, distributed around the ectocolpi, exine 0.66–0.71(1) µm thick; style included, 0.14–0.24 mm long, stigma 0.19–0.3 mm long, bilobate, lobes inconspicuous; nectariferous disk entire, 0.83–1.15 mm diam., with striate cells. *Capsule* 3.27–4.69 × 1.98–2.52 mm, pedicel 0.43–0.62 mm long, oblongate to obovate in outline, strongly compressed parallel to the septum, glabrous, calyx lobes persistent, dehiscent from the apex downwards, valves persistent from which the seeds are shed after dehiscence, septum persistent, 2.71–4.26 × 1.43–2.23 mm. *Seeds* 2, 1.86–3.2 × 1.69–2.02 mm, obovate in outline, strongly compressed, ventral surface covered by diffuse strophiole, 0.98 × 0.35–0.61 mm, dorsal surface slightly convex, testa subtuberculate, with digital-like cells pressed (101.22–146.86 × 19.98–32.95 µm), radially arranged.

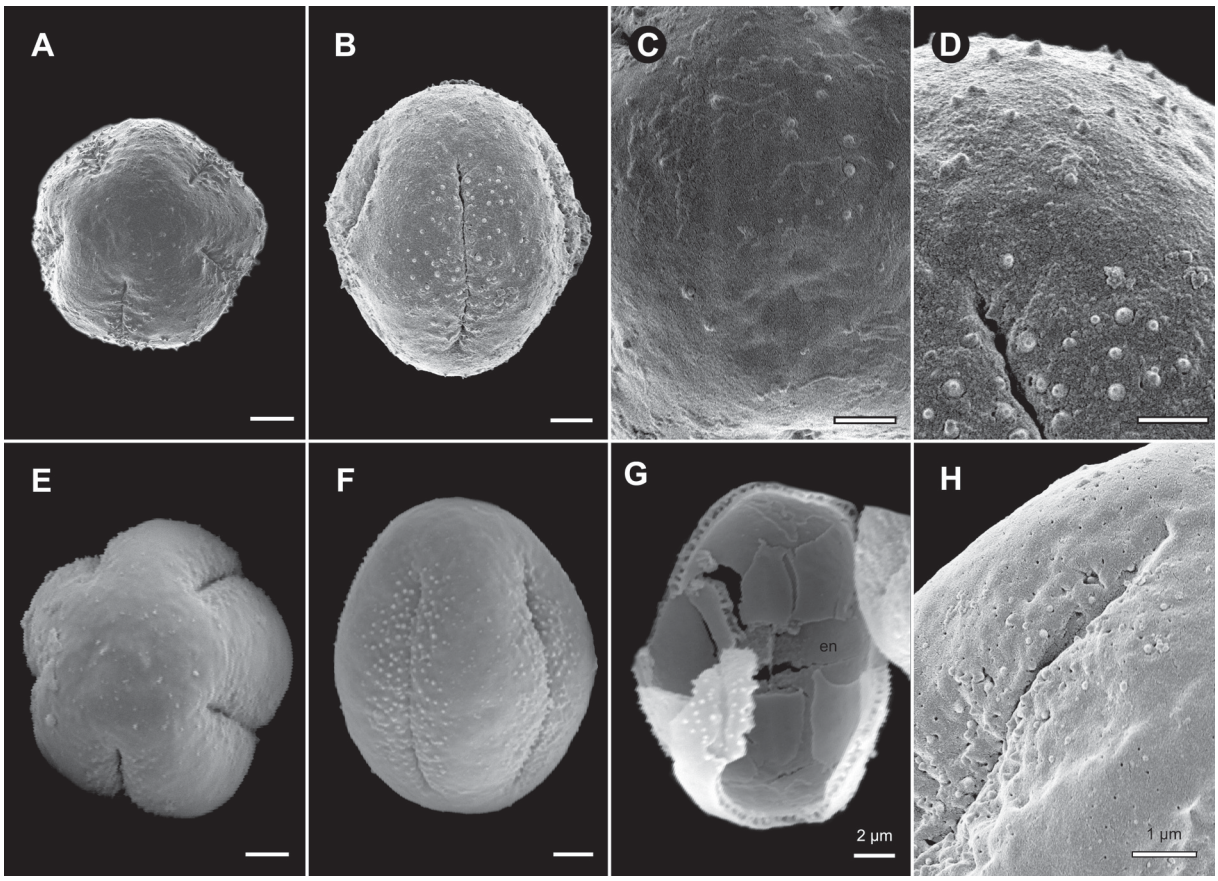

Fig. 5. Pollen morphology (SEM). **A–D**. *Psyllocarpus itakangapyra* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.; *P.L. Viana et al. 4415* (CTES). **A**. Polar view. **B**. Equatorial view. **C**. Detail of apocolpium. **D**. Detail of the colpus and spinules. **E–H**. *P. vianae* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.; *P.L. Viana et al. 5887* (CTES). **E**. Polar view. **F**. Equatorial view. **G**. Detail of the inner side of a pollen fragment showing the endocingulum (en). **H**. Detail of the colpus and spinules. Scale bars: A–B, E–G = 2 µm; C–D, H = 1 µm.

Distribution, habitat, and phenology

Psyllocarpus vianae sp. nov. grows on sandy and rocky soil in the "campo rupestre" vegetation, being recorded from 1100 to 1200 m a.s.l. It is endemic to the Serra do Cabral, in the municipality of Joaquim Felício, Minas Gerais (Fig. 7). Specimens were collected with flowers and fruits on January and April.

Fig. 6. A–F. *Psyllocarpus itakangapyra* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov. **A**. Habitat, "campo rupestre" in Itacambira, Minas Gerais. **B**. Habit. **C**. Branch portion, showing the leaves. **D**. Inflorescences at the apex of flowering branches. **E**. Detail of the flowers. **F**. Capsules. **G–M**. *P. vianae* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov. **G**. Habitat, "campo rupestre" in Serra do Cabral, Minas Gerais. **H**. Habit. **I**. Branch portion, showing the leaves. **J**. Inflorescences at the apex of flowering branches. **K**. Detail of preanthetic flower buds. **L**. Detail of an opened flower. **M**. Dehiscent capsule. Photos: A, C, G–J = R.M. Salas; B, D–F = J.A.M. Carmo; K–L = P.L. Viana; M = S.V. Sobrado.

Preliminary conservation status

Psyllocarpus vianae sp. nov. does not occur within the limits of any protected area in Minas Gerais. However, it may occur within the limits of the Parque Estadual da Serra do Cabral, a conservation unity of integral protection nearby, pending further botanical investigation in the region to evidence this record. *Psyllocarpus vianae* sp. nov. presents AOO equal to 4 km^2. Therefore, we believe that this species would be considered critically endangered (CR B2abiii) in an official IUCN red list assessment, based on its AOO less than 500 km^2 (kml file available as Supp. file 2), occurrence in one location, and continuing decline inferred on quality of habitat due to the impacts on the "campo rupestre" vegetation, which in this case is also associated with the expansion of eucalyptus plantations in the region, as noticed by us during fieldwork.

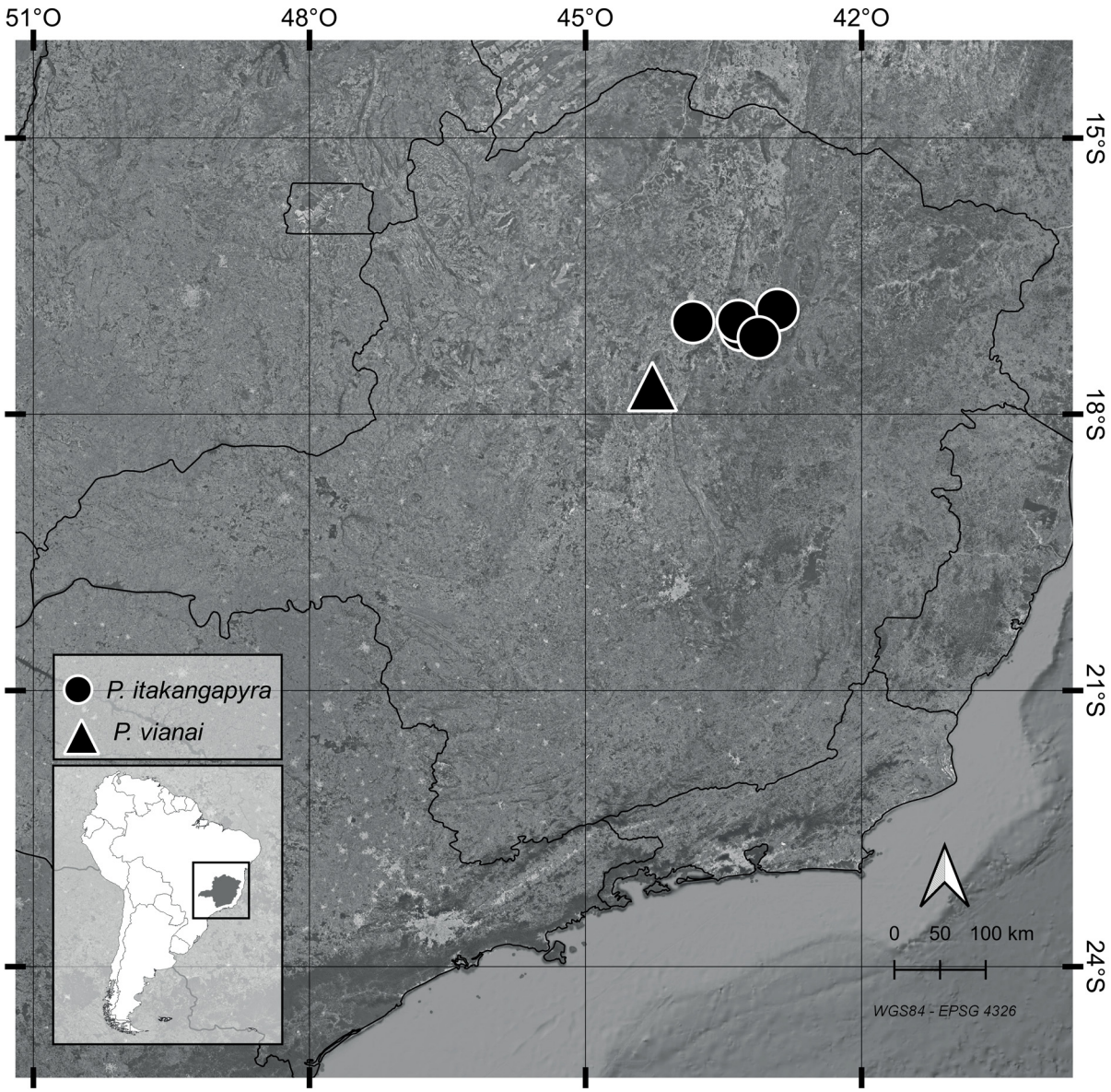

Fig. 7. Distribution map of *Psyllocarpus itakangapyra* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov. and *P. vianae* Sobrado, J.A.M.Carmo & R.M.Salas sp. nov. in the state of Minas Gerais, Brazil.

Key to the species of Psyllocarpus sect. Psyllocarpus (adapted from Carmo *et al.* 2018)

1. Inflorescences in pauciflorous cymes; hypanthium hirsute to sparsely hirsute; capsules hirsute, valves deciduous keeping the seed inside after dehiscence ..... ***Psyllocarpus bahiensis*** J.A.M.Carmo, Sobrado & R.M.Salas
– Inflorescences in 1-flowered cymes or glomerules; hypanthium glabrous or the upper ½ puberolous; capsules glabrous or the upper ⅓ sparsely puberulous, valves persistent from which the seeds are shed after dehiscence 2

2. Flowering branches indeterminate, axillary inflorescences in 1-flowered cymes 3
– Flowering branches determinate, terminal inflorescences in glomerules 5

3. Leaf axils generally without brachyblasts, rarely with 1(2) pairs of smaller leaves; stigma capitate ..... ***Psyllocarpus schwackei*** K.Schum.
– Leaf axils always with 2–9 pairs of brachyblasts or short branchlets; stigma bilobate 4

4. Sympodial subshrub; hypanthium glabrous; calyx tube present (0.1–0.5 mm long); corolla lobes rounded in preanthetic buds; capsules glabrous; seeds elliptic to broadly elliptic in outline ..... ***Psyllocarpus laricoides*** Mart. & Zucc.
– Monopodial subshrub; hypanthium with the upper ⅓ puberulous; calyx tube absent; corolla lobes capitate angulate in preanthetic buds; capsules with the upper ⅓ sparsely puberulous; seeds narrowly oblong in outline ..... ***Psyllocarpus goiasensis*** J.H.Kirkbr.

5. Flowering branches dichasial or monochasially branched, or unbranched; calyx lobes 4.3–4.8 mm long; corolla lobes capitate angulate in preanthetic bud, mature corolla 6.5–7.5 mm long ..... ***Psyllocarpus scatignae*** J.A.M.Carmo, Sobrado & R.M.Salas
– Flowering branches unbranched; calyx lobes 1.2–3.6 mm long; corolla lobes rounded or clavate in preanthetic bud, mature corolla 1–3.6 mm long 6

6. Corolla completely white, sometimes the lower half of the tube purple; distributed in Minas Gerais, Bahia, and Goiás, and the Distrito Federal 7
– Corolla completely purple, sometimes with the lower half of the tube white, or the lower half the tube purple, the upper half and lobes light blue; endemic to Minas Gerais 8

7. Flowering branches erect; calyx lobes 1.2–2 mm long; corolla tube 1.1–1.5 mm long; seeds broadly elliptic in outline ..... ***Psyllocarpus asparagoides*** Mart. & Zucc.
– Flowering branches pendulous; calyx lobes 2.2–3.6 mm long; corolla tube 2.2–2.6 mm long; seeds obovate in outline ..... ***Psyllocarpus phyllocephalus*** K.Schum.

8. Calyx tube absent to vestigial, 3–5 fimbriae between calyx lobes; corolla infundibuliform, tube 1.78–2.08 mm long, lower half purple, upper half and lobes light blue, internal surface with a dense ring of moniliform trichomes from the anthers apex to the lobes base, sparsely pubescent between the anthers, and glabrous on the base; corolla lobes rounded in preanthetic bud, apex rounded, and plane to slightly reflexed in mature flowers; stamens inserted at the middle of the corolla tube ..... ***Psyllocarpus itakangapyra*** Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.
– Calyx tube present (0.15–0.45 mm long), 6–10 fimbriae between calyx lobes; corolla urceolate, tube 1.22–1.6 mm long, completely purple or the lower half of the tube white, internal surface glabrous from the base up to the base of the filaments, and sparsely monoliform trichomes between the anthers, corolla lobes deeply deltoid in preanthetic buds, apex mucronate, and the upper third patent reflexed from posanthetic to mature flowers, the rest aligned with the adjacent lobes forming a false tube; stamens inserted near the sinuses of the corolla lobes ..... ***Psyllocarpus vianae*** Sobrado, J.A.M.Carmo & R.M.Salas sp. nov.

Discussion

We here described two new species of *Psyllocarpus*, raising the diversity in the genus, as currently circumscribed, to 13 species, of which nine are classified in *P.* sect. *Psyllocarpus*. Until now, molecular phylogenetic analyses have indicated that *P.* sect. *Psyllocarpus* would appear to be monophyletic (Salas *et al.* 2015; Florentín *et al.* 2017; Miguel *et al.* 2018), however a comprehensive study on the genus is still lacking (Carmo *et al.* in. prep.).

Psyllocarpus itakangapyra sp. nov. and *P. vianae* sp. nov. belong to *P.* section *Psyllocarpus* based on the linear to terete leaves (Figs 1A, 2A, 6C, I), the homostylous flowers with included stamens and style (Figs 1F–H, 2F–H, 3C, E, L, N, 6E, L), the prolate-spheroidal to prolate pollen grains with long and narrow ectocolpi and endocingulum, the psilate exine with spinules mostly around the ectocolpi (Fig. 5), the stigma with two inconspicuous lobes (Fig. 3D, M), and capsules compressed parallel to a persistent septum (Fig. 4A, D, I, L).

In this section, *Psyllocarpus laricoides*, with which *P. itakangapyra* sp. nov. and *P. vianae* sp. nov. are closely related morphologically, appears to represent a species complex (Carmo *et al.* in. prep.). We recognize both entities as new species, as well as the other species in the section, based on morphological, qualitative fixed differences, which provide diagnosability (de Queiroz 2007). Different lines of evidence may provide additional insights for the limits of these species or show otherwise, pending further investigation.

Both species described here are endemic to the "campo rupestre" of Brazil, a montane, grassy-shrubby, fire-prone vegetation mosaic associated with rocky outcrops of quartzite, sandstone, or ironstone, along with sandy, stony, and waterlogged grasslands (Silveira *et al.* 2016). In fact, it is an extremely old, naturally fragmented mountaintop ecosystem characterized by the staggering levels of endemism (Silveira *et al.* 2016). Further botanical investigation in this vegetation may reveal new species of *Psyllocarpus*, which might be under-represented in the Brazilian flora.

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Supplementary files

Supp. file 1. Occurrence data for *Psyllocarpus itakangapyra* sp. nov.
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Supp. file 2. Occurrence data for *Psyllocarpus vianae* sp. nov.
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