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Two New Threatened Species of *Psyllocarpus* (Rubiaceae; Spermacoceae) from Eastern Brazil

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Abstract—Two new species of *Psyllocarpus* sect. *Psyllocarpus* are here described and illustrated. ***Psyllocarpus bahiensis*** and ***Psyllocarpus scatignae***, from the campo rupestre s. l. of Bahia and Minas Gerais states, respectively. We provide comments on their distribution, habitat, conservation status, and taxonomy. In addition, we analysed 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, conservation, Spermacoce clade, Spermacoceae, taxonomy.

The Spermacoce clade in the Spermacoceae (Rubiaceae) comprises 22 genera that were recognized as the tribe as traditionally delimited, excluding *Gomphocalyx* Baker and *Phylohydrax* Puff (Kårehed et al. 2008). Salas et al. (2015) showed that *Carajasia* R.M.Salas, E.L.Cabral & Dessein also belongs in the Spermacoce clade. Representatives of this clade are characterized by the presence of raphides and uniovulate ovary locules often (but not always) in combination with an herbaceous habit, fimbriate stipules, and three to four colporate pollen grains, with long and narrow ectocolpi, endoapertures laterally joined forming an endocingulum, psilate tectum, and spinules mainly located around ectoapertures (Pire 1996; Dessein 2003; Kårehed et al. 2008; Salas and Cabral 2014; Salas et al. 2015).

Within the Spermacoce clade, molecular data refute some traditional generic circumscriptions, e.g. *Borreria* G.Mey. and *Spermacoce* L., leading to divergent opinions among specialists (Delprete and Jardim 2012). Nevertheless, at least for the Americas, there are some morphologically well-defined genera which are preliminarily supported in phylogenetic studies, despite their low sampling (Kårehed et al. 2008; Groeninckx et al. 2009; Salas et al. 2015). One example of such genus is the Brazilian endemic *Psyllocarpus* Mart. & Zucc., which was found monophyletic with maximum to high support in an analysis which sampled two of its species for two nuclear regions, related to a clade composed of American and one Australian *Spermacoce* species (Salas et al. 2015).

Psyllocarpus was established by Martius and Zuccarini (1824a), who proposed four species. They diagnosed the genus based on its calyx with two distinct lobes, infundibuliform corolla with four lobes and trichomes on the throat, four included stamens, short style with capitate stigma, and bivalvate capsules with two locules bearing one peltate compressed seed each. Martius and Zuccarini (1824b) provided a more detailed description of the genus, which presents linear to subulate leaves, compressed capsules, and a membranous septum parallel to the valves (Figs. 1, 2). They further compared it to *Borreria*, distinguishing them by the complete septum, separate valves, and peltate seeds in *Psyllocarpus*. This concept was followed by Schumann (1888, 1898) for his taxonomic revision of the genus and description of two new species, respectively.

Kirkbride (1979) classified *Psyllocarpus* in two sections based on morphology and geographic distribution, expanding the original concept of the genus. *Psyllocarpus* sect. *Psyllocarpus*, which follows the concept of Martius and Zuccarini (1824a, b), is characterized by terete leaves, homostylous flowers, prolate-spheroidal pollen grains, psilate tectum with spinules 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 Brazil, in the states of Bahia, Goiás, and Minas Gerais, and the Distrito Federal, comprising five species (*P. asparagoides* Mart. & Zucc., *P. goiasensis* J.H.Kirkbr., *P. laricoides* Mart. & Zucc., *P. phyllocephalus* K.Schum. and *P. schwakei* K.Schum.). *Psyllocarpus* sect. *Amazonica* J.H.Kirkbr. also presents capsules compressed parallel to the septum, but is characterized by planar leaves, heterostylous flowers, oblate-spheroidal pollen grains, perforated tectum, finely and evenly spinulose exine, and deeply bifid stigma. This section is restricted to white-sand Amazonian campinas in the states of Amazonas, Pará, and Rondônia, comprising three species (*P. campinorum* (Krause) J.H.Kirkbr., *P. cururuensis* J.H.Kirkbr. and *P. psyllocarpoides* (Sucre) J.H.Kirkbr.). Later, two species from the Espinhaço range were described in *Psyllocarpus* (*P. intermedius* E.L.Cabral & Bacigalupo (Cabral and Bacigalupo 1997a), and *P. densifolius* Zappi & Calió (Zappi et al. 2014)), although they were not classified in any section.

Psyllocarpus is now under revision by the authors. The analysis of herbarium vouchers and field expeditions carried out in Minas Gerais and Bahia have revealed specimens that could not be ascribed to any described species in the genus. We propose here two new species of *Psyllocarpus* sect. *Psyllocarpus*, and provide their descriptions, illustrations, and photographs, as well as comments on their distribution, habitat, conservation status, and taxonomy. In addition, we analysed their floral, fruit, and seed micromorphology, as well as their pollen grains, which are also described and illustrated.

Materials and Methods

This study is based on field collections and analysis of specimens deposited at the CEPEC, CTES, ESA, MBM, MO, RB, SPF, and UEC herbaria, whose acronyms are listed according to Thiers (2017). We follow

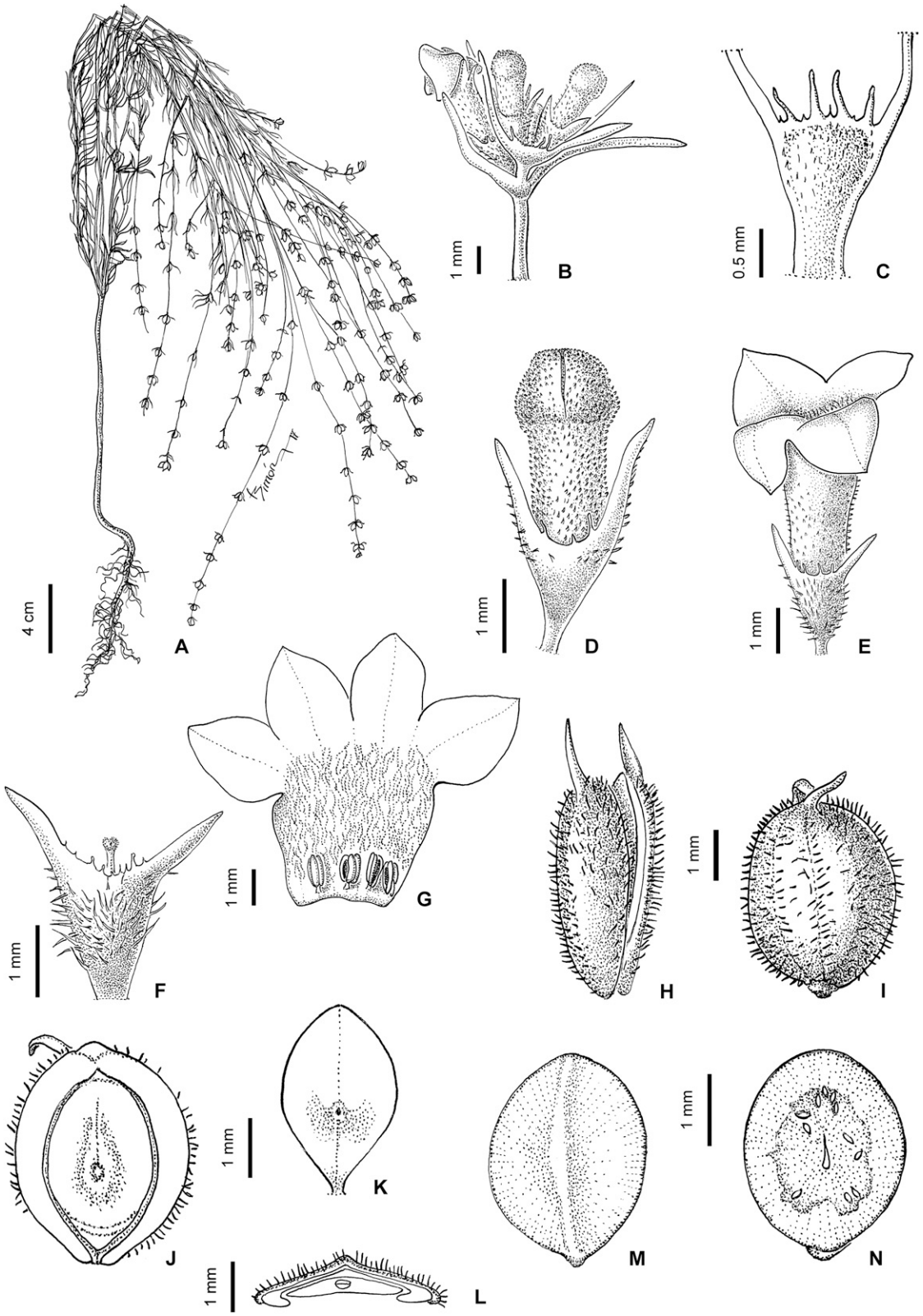

FIG. 1. *Psyllocarpus bahiensis*. A. Habit. B. Inflorescence at the apex of a flowering branch. C. Stipular sheath. D. Preanthetic flower bud. E. Flower. F. Hypanthium, calyx, style, and stigma. G. Opened corolla. H–L. Capsule. H. Dehiscent capsule, lateral view. I. Dehiscent capsule, dorsal view. J. Valve, ventral view. K. Septum. L. Valve, cross section. M–N. Seed. M. Dorsal view. N. Ventral view. [A, M–N. *G. Hatschbach et al. 65130* (CTES); B–L. *J. A. M. Carmo & A. V. Scatigna 376* (CTES)]. Illustration: L. Simón.

Anonymous (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 ArcGIS® software, intellectual property of Esri, used herein under license. Informal conservation status categories were assessed by range size (B criterion), following IUCN Standards and Petitions Subcommittee (2016) recommendations. The extent of occurrence (EOO) and area of occupancy (AOO) were estimated using GeoCAT (Bachman et al. 2011).

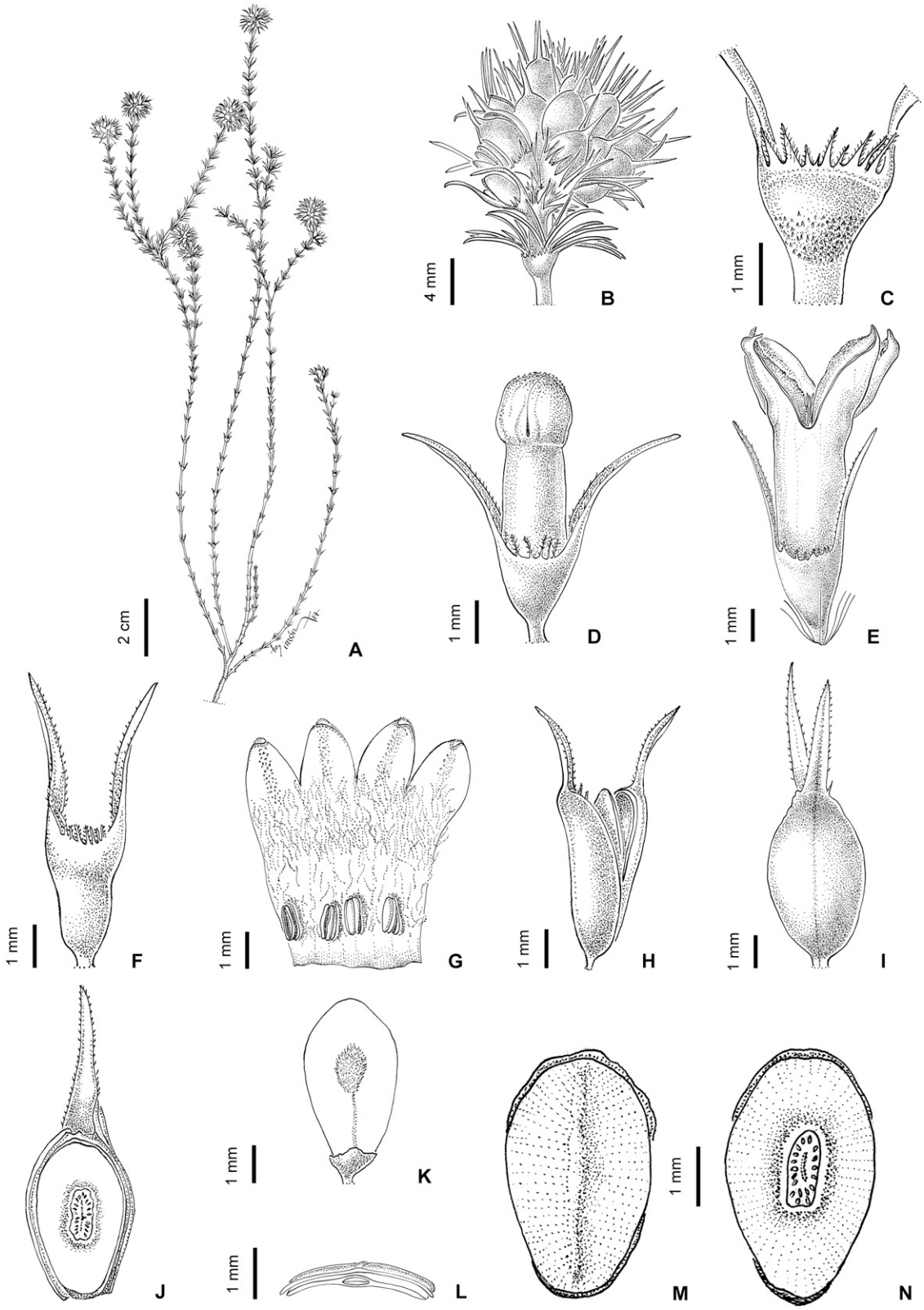

FIG. 2. *Psyllocarpus scatignae*. A. Branch portion. B. Inflorescence at the apex of a flowering branch. C. Stipular sheath. D. Preanthetic flower bud. E. Flower. F. Hypanthium and calyx. G. Opened corolla. H–L. Capsule. H. Dehiscent capsule, lateral view. I. Dehiscent capsule, dorsal view. J. Dehiscent valve, ventral view. K. Septum. L. Valve, cross-section. M–N. Seed. M. Dorsal view. N. Ventral view. [A–N. *J. A. M. Carmo & A. V. Scatigna 446* (CTES)]. Illustration: L. Simón.

Pollen grains were acetolyzed according to Erdtman (1966) and mounted in glycerine jelly for analysis using a light microscope (LM). Conventional parameters (P, polar axis; E, equatorial axis), in at least 20 grains were measured under LM and the exine details were analysed using scanning electron microscopy (SEM). The terminology used to describe the pollen follows Punt et al. (2007). Fresh buds, mature flowers, fruits, and seeds fixed in alcohol 70% were also analysed using SEM. We use 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).

Taxonomic Treatment

Psyllocarpus bahiensis Carmo, Sobrado & R.M.Salas, sp. nov. Type: Brazil, Bahia: Macaúbas, Estrada para Tinguis, 13°05′03″S 42°46′37″W, 904 m, 18 Apr 2015, *J. A. M. Carmo & A. V. Scatigna 376* (holotype: UEC!; isotypes: CTES!, MO!, RB!, SPF!).

Psyllocarpus bahiensis is similar to *P. laricoides*, but differs by the monopodial branching pattern (vs. sympodial in *P. laricoides*), determinate flowering branches (vs. indeterminate), inflorescences in terminal and axillary pauciflorous cymes (vs. axillary 1-flowered cymes), hirsute to sparsely hirsute hypanthium and capsules (vs. glabrous), calyx tube absent (vs. present), corolla lobes clavate in preanthetic bud (vs. rounded), capsules 3-ribbed on dorsal surface (vs. smooth) with deciduous valves forming a ventral rim of carpel tissue, keeping the seed inside after dehiscence (vs. persistent valves, from which the seeds are shed after dehiscence), and ventral surface of the seeds covered by diffuse strophiole (vs. delimited strophiole).

Subshrubs, 0.15–1 m tall, monopodial. Stems sparsely branched, erect, internodes 0.5–3.5 cm long, terete to slightly compressed or tetragonal, puberulent to glabrous, bark peeling from older internodes. Stipular sheaths 0.5–1 mm long, puberulent, 3–7-fimbriate on each side of the stem, fimbriae 0.3–1.5 mm long, narrowly triangular to subulate, strigulose to glabrous. Leaves opposite, 4.7–20 × 0.1–0.4 mm, sessile, linear to terete, apex acute to obtuse, strigose to glabrate, axillary brachyblasts forming fascicles. Flowering branches determinate, (1.5)3–19 cm long, internodes 1.5–3.7 cm long, tetragonal to subtetragonal, narrowly winged, glabrous, inflorescences axillary and terminal cymes, 3–9 pairs per flowering branch, (2)4–5-flowered, external bracts 2, 4.3–5.5 × 0.3–0.4 mm, narrowly triangular to linear, apex acute to obtuse, strigulose to glabrate, peduncle 0.6–1.2 mm long, internal bracts per cyme 2, 2.2–3.5 mm long, narrowly triangular, glabrous, 5–10 colleter tipped fimbriae at the base of each flower, 0.3–0.6 mm long, linear, glabrous. Flowers sessile, homostylous; hypanthium 0.5–3 × 0.8–2 mm, turbinate, hirsute to sparsely hirsute; calyx 2(4)-lobate, if four lobes then 2 longer and 2 shorter opposite to each other, 1–4 fimbriae along the calyx rim between the lobes, 0.1–0.3 mm long, colleter tipped, lobes (0.9)1.2–2 × 0.2–0.3 mm, triangular to narrowly triangular, glabrous or with sparse trichomes along the medium line; corolla infundibuliform, lower 2/3 purple, upper third white, 3.8–5(6) mm long, tube 1.5–3 mm long, 0.7–1.5 mm diam, purple, throat white, external surface papillate and scabrous, internal surface glabrous at the first third, pubescent to sparsely pubescent on the tube above the base, with a ring of moniliform trichomes on the throat, (3)4-lobate, lobes 1.1–2.3 × 1.3–1.8 mm, ovate, apex mucronulate, lilac, external surface papillate and sparsely scabrous, internal surface papillate, clavate in the preanthetic bud, ca. 1.6 mm diam, apex rounded; stamens included, filaments 0.1–0.5 mm long, anthers 0.4–0.8 mm long, orbicules present covering uniformly the inner wall of dehiscent anthers, pollen 4–5-zonocolporate, subquadrangular to circular outline in polar view, small-sized (P = 15.4–7.7; E = 12.8–14.9), prolate-spheroidal to subprolate (P/E = 1.1–1.3), long and narrow ectocolpi (9–11.6 μm long), endocingulum 2.4–3.3 μm wide, tectum psilate spinulate, tipped spinules 0.2–0.4 μm long, uniformly distributed over the entire surface, exine 0.8–1.4 μm thick; style included, 0.15–0.3 mm long, stigma 0.1–0.14 mm long, bilobate, lobes inconspicuous; nectariferous disk entire, 0.4–0.5 mm diam, with striate cells. Capsule 2.3–4.8 × 2.7–3.8 mm, broadly elliptic to broadly obovate in outline, strongly compressed parallel to the septum, 3 acrodromous ribs on the dorsal surface, hirsute to sparsely hirsute, calyx lobes persistent, dehiscent from the apex downwards, dehiscence line on the septum forming a broadly elliptic to broadly obovate section, uncovering a ventral rim of carpel tissue on the edge of the deciduous valves, 0.5–0.7 mm wide, keeping the seed inside after dehiscence, septum persistent, 3.5–4 × 2–2.6 mm, broadly elliptic to broadly obovate, attenuate at the base, white to slightly translucent. Seeds 2, 2–4.5 × 2–3.2 mm, broadly elliptic to broadly obovate in outline, strongly compressed, ventral surface covered by diffuse strophiole, 2–2.1 × 1.4–1.5 mm, dorsal surface slightly convex, testa subtuberculate, with digital-like cells pressed (66–140 × 19–21 μm), with small smooth, orbicular to elliptic apical projections (27.2–64.6 × 25.6–36 μm) radially arranged. Figures 1, 3A–J, 4A–H, 5A–C, 6A–C.

***Paratypes*—Brazil.**—Bahia: Macaúbas, estrada para Canatiba, subida para a Serra Poção, próximo ao alto, 20 Apr 1996, *G. Hatschbach et al. 65130* (CEPEC, CTES, ESA, MBM, MO); Macaúbas, estrada para Tinguis, 13°04′57″S, 42°46′26″W, 904 m, 18 Apr 2015, *J. A. M. Carmo & A. V. Scatigna 368* (UEC); idem, 13°05′04″S, 42°46′41″W, 900 m, 18 Apr 2015, *J. A. M. Carmo & A. V. Scatigna 375* (UEC); idem, 13°06′43″S, 42°41′43″W, 693 m, 18 Apr 2015, *J. A. M. Carmo & A. V. Scatigna 378* (CTES, UEC).

Distribution and Habitat*—Psyllocarpus bahiensis* is endemic to the municipality of Macaúbas, Bahia (Fig. 7). The species grows on patches of sandy soil usually associated with rocky outcrops amidst the seasonally dry forest (Caatinga), at elevations from 700 to 900 m. The habitat and area where this species occurs are included in the concept of campo rupestre s. l. by Silveira et al. (2016), which is a montane, grassy-shrubby, fire-prone vegetation mosaic with rocky outcrops of quartzite, sandstone, or ironstone, along with sandy, stony, and waterlogged grasslands. It is an azonal ecosystem embedded mainly within the Cerrado and Caatinga, characterized by its nutrient-poor soils supporting grassland and scrub (Mucina 2018).

Conservation*—Psyllocarpus bahiensis* does not occur within the limits of any protected area in Bahia. It was collected in two locations in Macaúbas. The first botanical collections made in this municipality date to 1924, as the more recent ones were made in 2016, accounting for ca. 1400 botanical records in 92 yr (SpeciesLink Network 2017). Except for the first collection of *P. bahiensis* (*G. Hatschbach et al. 65130*), made in 1996, this species has been collected again only by us, in 2015.

Psyllocarpus bahiensis presents EOO and AOO equal to 1.647 km^2 and 12 km^2 respectively (.kml file available at https://figshare.com/articles/_/4754428). According to the IUCN Standards and Petitions Subcommittee (2016), if EOO is less than AOO, it should be changed to make them equal and ensure consistency with the definition of AOO as an area within EOO. The IUCN Standards and Petitions Subcommittee (2016) also states that for species with linear elongated distributions, the EOO (minimum convex polygon) may lead to an overestimate of extinction risk. This seems to be the case for *P. bahiensis*, since we could identify patches of sandy soil along the top of the mountain range when driving on its unpaved roads trying to find new populations during fieldwork, and by analyzing satellite images on Google Earth©.

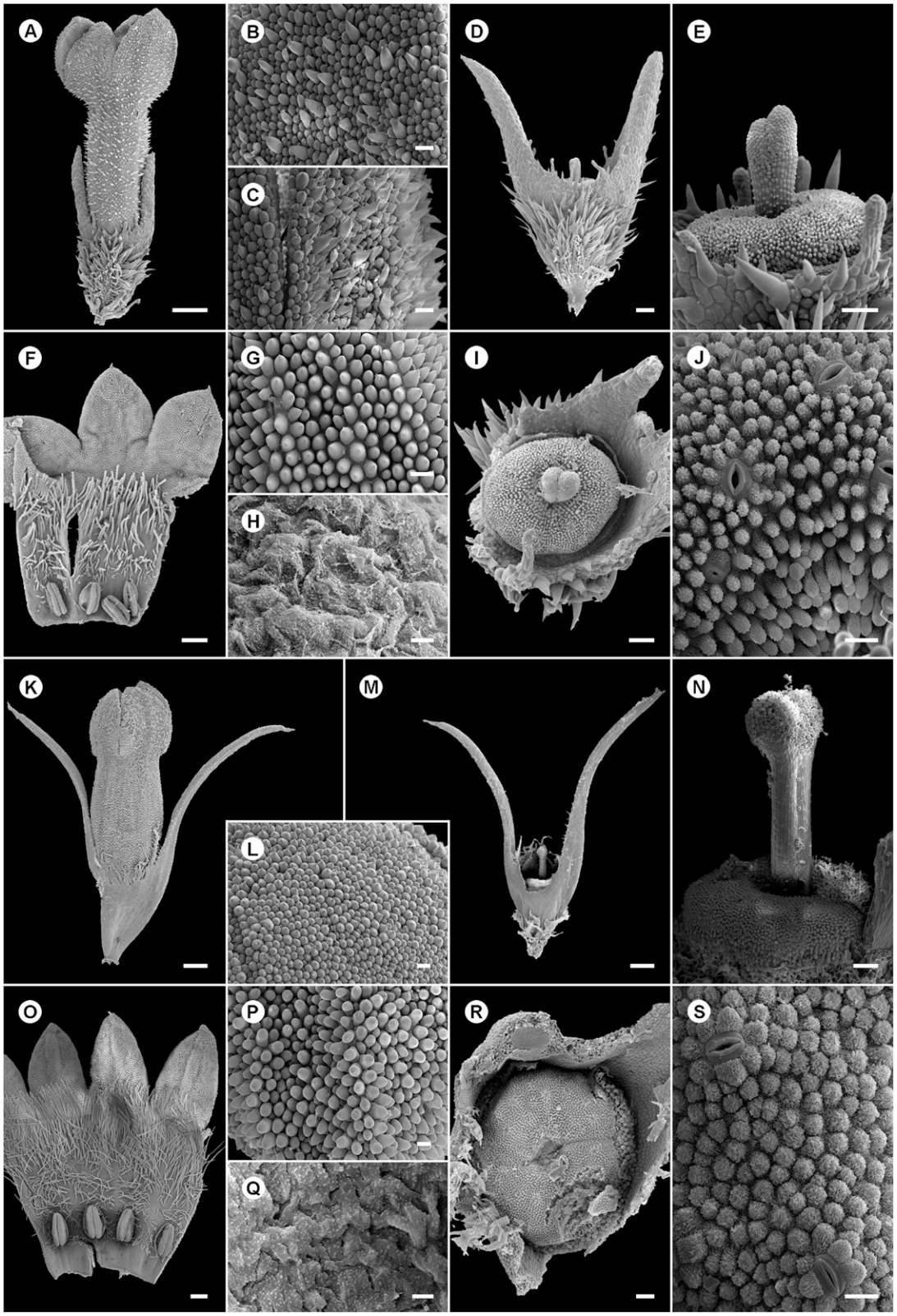

FIG. 3. Flower morphology. A–J. *Psyllocarpus bahiensis*. A. Flower bud. B–C. Papillate and scabrous external surface of the corolla. D. Hypanthium, calyx, style, and stigma. E. Detail of style and stigma. F. Opened corolla. G. Papillate internal surface of the corolla lobes. H. Inner wall of a dehiscent anther, showing the prescence of orbicules. I. Nectariferous disk, top view. J. Detail of the striate nectariferous disk cells. K–S. *P. scatignae*. K. Flower bud. L. Papillate external surface of the corolla. M. Hypanthium, calyx, style, and stigma. N. Detail of style and stigma. O. Opened corolla. P. Papillate internal surface of the corolla lobes. Q. Inner wall of a dehiscent anther, showing the presence of orbicules. R. Nectariferous disk, top view. S. Detail of the striate nectariferous disk cells. Scale bars: A, F, K, M, O = 500 μm; D = 200 μm; E, I, N, R = 100 μm; B–C, G, L, *p* = 50 μm; J, S = 20 μm; H, Q = 5 μm.

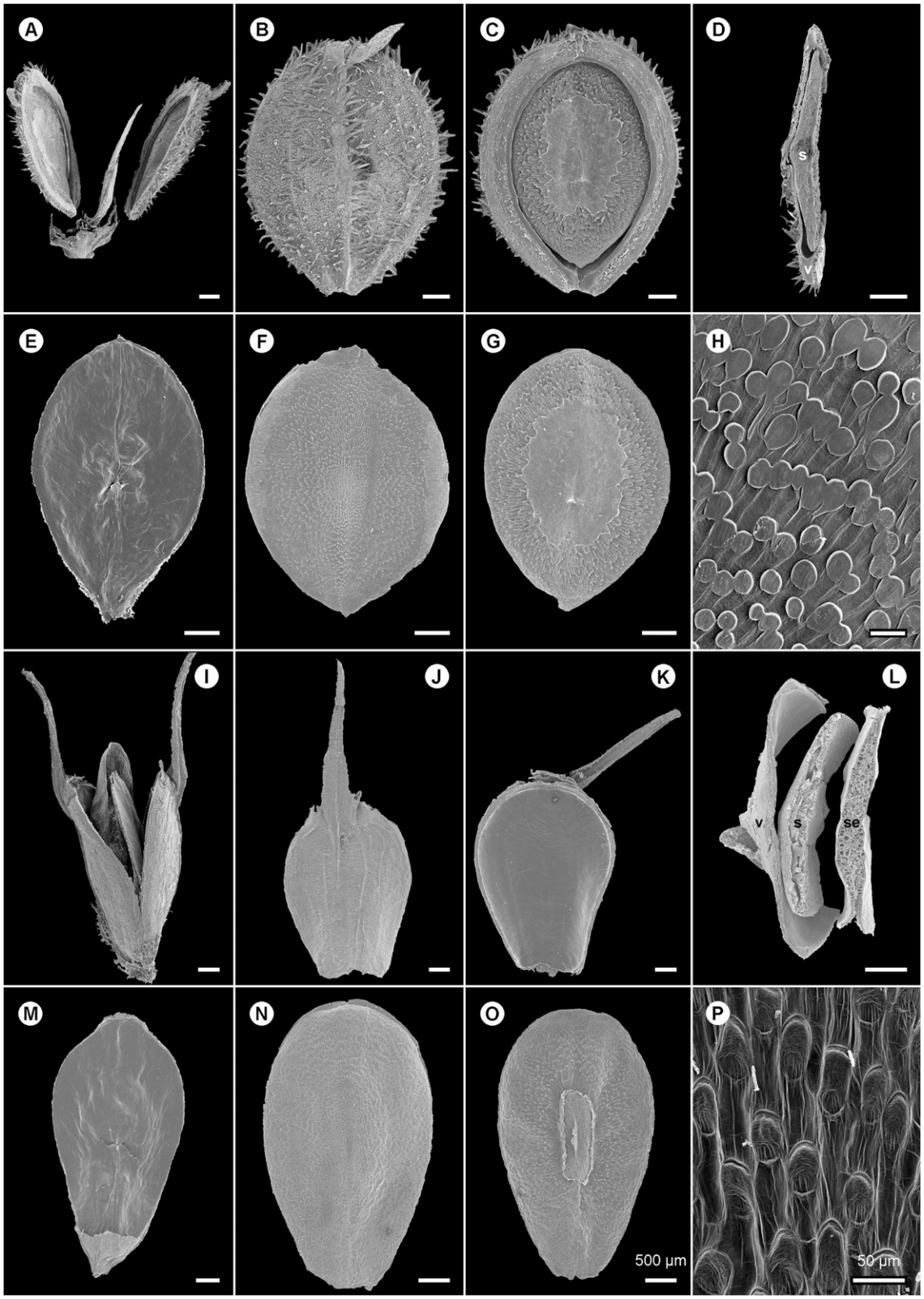

FIG. 4. Fruit and seed morphology. A–H. *Psyllocarpus bahiensis*. A–E. Capsule. A. Dehiscent capsule, lateral view. B–D. Valve. B. Dorsal view. C. Ventral view. D. Cross section, showing the seed kept inside the valve after dehiscence. E. Septum. F–H. Seed. F. Dorsal view. G. Ventral view, with diffuse strophiole. H. Detail of the testa. I–P. *P. scatignae*. I–M. Capsule. I. Dehiscent capsule, lateral view. J–L. Valve. J. Dorsal view. K. Ventral view. L. Cross section, showing the seed, which is shed after dehiscence. M. Septum. N–P. Seed. N. Dorsal view. O. Ventral view. P. Detail of the testa. Abbreviations: s = seed; se = septum; v = valve.

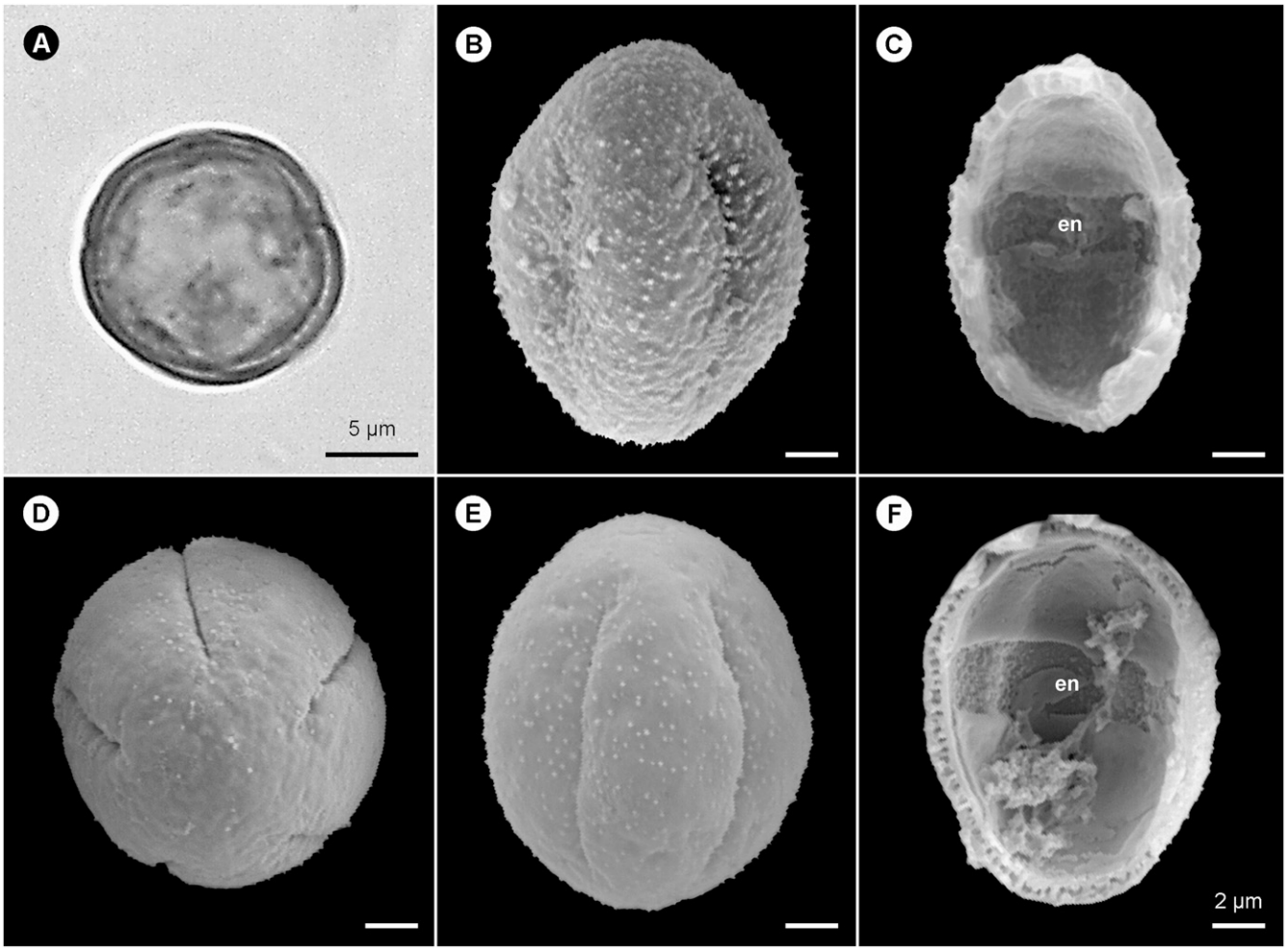

FIG. 5. Pollen morphology. A–C. *Psyllocarpus bahiensis*. A. Polar view (LM). B. Ventral view. C. Detail of the inner side of pollen fragment showing the endocingulum. D–F. *P. scatignae*. D. Polar view. E. Ventral view. F. Detail of the inner side of pollen fragment showing the endocingulum. Photographs: LM (A); SEM (B–F). Abbreviations: en = endocingulum.

Therefore, for the purposes of this evaluation, we informally consider *P. bahiensis* to be endangered (EN B2abiii) based on its AOO (less than 500 km^2), number of locations less than five, and continuing decline inferred on quality of habitat, due to human interference on the native vegetation cover. The impacts on the Caatinga, in which patches of campo rupestre s. l. are intermingled, are associated with agriculture, livestock, and logging for the production of firewood and charcoal (Martinelli and Moraes 2013), whereas in the campo rupestre s. l. the impacts are associated with opencast mining, annual anthropogenic burnings to support the cattle industry, wood extraction, invasive species, harvesting ornamental plants (orchids, bromeliads, everlastings), road construction, and uncontrolled urbanization, especially linked to tourism expansion and eucalyptus plantations (Silveira et al. 2016). *Psyllocarpus bahiensis* occurs in the interior of Bahia, relatively far from big urban centers. Nevertheless, the advance of human occupation in this region is noticeable due to the opening of roads, yet unpaved, and the settlement of properties by the removal of significant portions of the native vegetation cover, as we observed during fieldwork and on Google Earth© (for reference please see the .kml file available at https://figshare.com/articles/_/4754428).

Phenology—Both flowering and fruiting and only fruiting specimens were collected in April.

Etymology—The specific epithet refers to the state of Bahia, Brazil, where *P. bahiensis* is endemic.

Taxonomy—*Psyllocarpus bahiensis* belongs in *P.* section *Psyllocarpus* due to the linear to terete leaves, homostylous flowers with included stamens and style (Figs. 1E, 3A, 6B–C), prolate-spheroidal to subprolate pollen grains with long and narrow ectocolpi, endocingulum, and endoaperture, psilate spinulate exine (Fig. 5A–C), bilobate stigma with inconspicuous lobes (Fig. 3E), and capsules compressed parallel to a persistent septum (Figs. 1H, 4A). This species presents character states reported for the first time in the genus, such as the inflorescences in pauciflorous cymes (Figs. 1B, 6B), and hirsute to sparsely hirsute hypanthium and capsules (Figs. 1E–F, H–I, 3A, D), which present deciduous valves forming a ventral rim of carpel tissue, keeping the seed inside after dehiscence (Fig. 4A–D). This manner of dehiscence has been reported for only two species in the Spermacoceae, *Staelia catechosperma* K.Schum. (≡ *Anthospermopsis catechosperma* (K.Schum.) J.H.Kirkbr.), which is also endemic to Bahia (Cabral and Salas 2015), and *Spermacoce omissa* J.R.Clarkson, in Australia (Harwood and Dessein 2005), both associated with sandy soils. Further phylogenetic investigation is needed to assess how these taxa relate to each other in the Spermacoce clade and how the dehiscence of capsules has evolved.

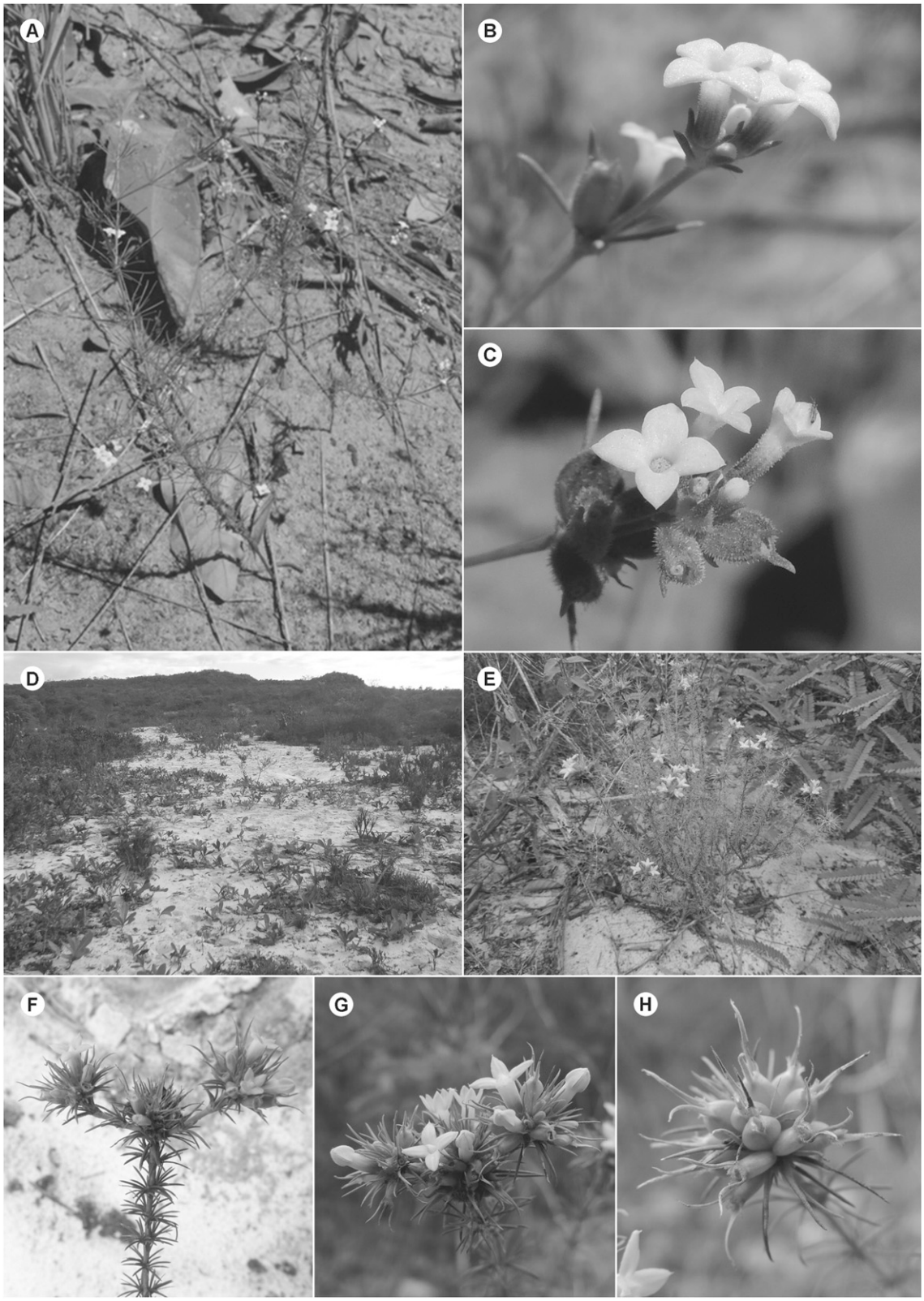

FIG. 6. A–C. *Psyllocarpus bahiensis*. A. Habit. B. Inflorescences at the apex of a flowering branch. C. Detail of flowers and fruits. D–H. *P. scatignae*. D. Habitat, white sand patch in Botumirim, Minas Gerais. E. Habit. F–G. Flowering branch dichasially branched. H. Flowering branch unbranched, inflorescence in glomerule. Photographs: J. A. M. Carmo (A–C, E–H); M. A. Sartori (D).

The first collection of *P. bahiensis* (*G. Hatschbach et al. 65130*) had been identified as *P. laricoides*. They are both subshrubs with opposite leaves and axillary brachyblasts forming fascicles but can be easily differentiated, not only by the unique set of character states mentioned above for the new species but also by the monopodial branching pattern, determinate flowering branches bearing terminal and axillary cymes (Figs. 1B, 6B), calyx tube absent (Fig. 3D), capsules with 3 acrodromous ribs on

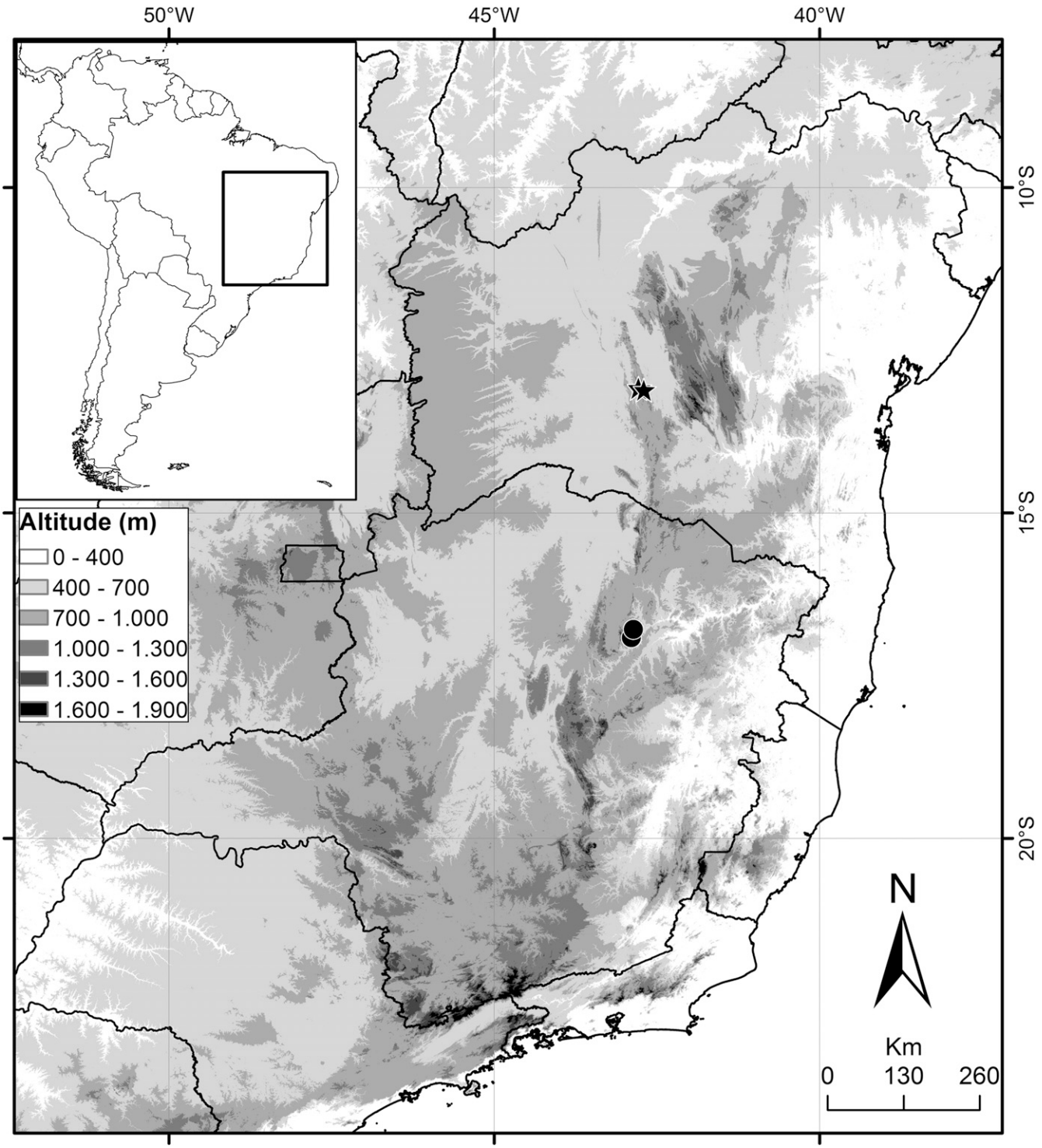

FIG. 7. Distribution map of *Psyllocarpus bahiensis* and *P. scatignae* in Bahia and Minas Gerais states, Brazil. Symbols: star = *P. bahiensis*; circle = *P. scatignae*.

the dorsal surface (Fig. 4B), and ventral surface of the seeds covered by diffuse strophiole (Fig. 4C, G) in *P. bahiensis*. Also, the pollen of this species present tipped spines uniformly distributed over the entire surface of the grains (Fig. 5B), unlike *P. laricoides*, which presents spinules only along the ectocolpi edges (Kirkbride 1979).

Psyllocarpus scatignae Carmo, Sobrado & R.M.Salas, sp. nov. TYPE: BRAZIL, Minas Gerais: Botumirim, Areal próximo a talhão de eucalipto, 16°54′00″S, 42°53′15″W, 23 Jan 2016, *J. A. M. Carmo & A. V. Scatigna 446* (holotype: UEC!; isotypes: CTES!, MO!, RB!, SPF!).

Psyllocarpus scatignae is similar to *P. goiasensis*, but differs by the sympodial branching pattern (vs. monopodial in *P. goiasensis*), determinate flowering branches (vs. indeterminate), unbranched, dichasially or monochasially branched (vs. unbranched), terminal glomerules (vs. axillary 1-flowered inflorescences), calyx tube present (vs. absent), calyx lobes 4.3–4.8 mm long (vs. 2.4–3 mm long), capsules glabrous (vs.

capsules with the upper 1/3 sparsely puberulous), and seeds broadly obovate in outline (vs. narrowly oblong).

Subshrubs, 0.5–1 m tall, sympodial. Stems sparsely branched, erect, internodes 0.1–1.1 cm long, terete to slightly compressed or tetragonal, puberulent to glabrous, bark peeling from older internodes. Stipular sheaths 0.5–1.6 mm long, glabrous to sparsely puberulent, 4–6(8)-fimbriate on each side of the stem, fimbriae 0.2–1.6 mm long, narrowly triangular to subulate, strigulose to glabrous. Leaves opposite, (2.6)3.2–7.6 × 0.1–0.4 mm, sessile, linear to terete, apex acute to obtuse, strigose to glabrate, axillary brachyblasts forming fascicles. Flowering branches determinate, 0.5–1.4 cm long, unbranched or dichasial or monochasially branched, branches 1.8–3.7 cm long, internodes 2.7–4.9 mm long, terete to slightly compressed or tetragonal, puberulent to glabrous, inflorescences in terminal glomerules, (5)7–28-flowered, bracts 2, (2)4–6.9 × 0.2–0.9 mm, linear to terete, apex acute, glabrous, with 3–5 pairs of axillary brachyblasts forming fascicles, peduncle 2–4.4 mm long. Flowers sessile, homostylous; hypanthium 1.3–2.5 × 0.8–1.3 mm, turbinate, glabrous; calyx tube 0.3–0.8 mm long, 2-lobate, 5–10 fimbriae along the calyx rim between the lobes, 0.8–1 mm long, colleter tipped, lobes 3–4.8 × 0.4–0.7 mm, narrowly triangular, glabrous; corolla infundibuliform, lower half to 2/3 purple or pink, the upper half to third white to light blue or light pink, 6.5–7.5 mm long, tube 4.2–5.1 mm long, 2–2.8 mm diam, purple or pink, throat white to light blue or light pink, external surface papillate, internal surface glabrous at the first third, pubescent to sparsely pubescent on the tube from the base of the filaments to the throat, with a dense ring of moniliform trichomes on the throat, 4(5)-lobate, lobes 2.5–3.2 × 1.3–2.2 mm, ovate to obovate, apex mucronulate, blue, light blue, lilac or light pink, external and internal surfaces papillate, roundly ribbed on the medium line, papillae conspicuous on the rib, capitate angulate in the preanthetic bud, ca. 1.8–2 mm diam, apex acute; stamens included, filaments 0.2–0.5 mm long, anthers 0.9–1 mm long, orbicules present covering uniformly the inner wall of dehiscent anthers, pollen 4–5(6)-zonocolporate, nearly circular outline in polar view, small-sized [P = 16.4 (17.5) 19.1; E = 13.9 (15.3) 17.3], prolate-spheroidal to prolate (P/E = 1–1.8), long and narrow ectocolpi (8.3–12.8 μm long), endocingulum 2.7–4.1 μm wide, tectum psilate spinulate, spinules 0.14–0.4 μm long, uniformly distributed around the mesocolpium and sparsely over the apocolpium surface, exine 0.7–1.4 μm thick; style included, 0.4–0.5 mm long, stigma 0.1–0.3 mm long, bilobate, lobes inconspicuous; nectariferous disk entire, 0.7–1 mm diam, with striate cells and a slight transversal slit in the middle part. Capsule 4.2–4.6 × 3–3.3 mm, broadly obovate in outline, compressed parallel to the septum, smooth, glabrous, calyx lobes persistent, dehiscent from the apex downwards, valves persistent from which the seeds are shed after dehiscence, septum 4–4.5 × 2.7–3 mm. Seeds 2, 4–4.3 × 2–2.6 mm, broadly obovate in outline, strongly compressed, ventral surface partially covered by defined narrowly oblong strophiole, 1.4 × 0.5 mm, dorsal surface slightly convex, testa subtuberculate, with digital-like cells pressed (93.5–149.7 × 19.8–33.5 μm), with small striate, elliptic apical projections (47–67.4 × 27.9–28.4 μm) radially arranged. Figures 2, 3K–S, 4I–P, 5D–F, 6D–H.

***Paratypes*—Brazil.**—Minas Gerais: Botumirim, Areal próximo a talhão de eucalipto, 16°54′S, 42°53′15″W, 23 Jan 2016, *J. A. M. Carmo & A. V. Scatigna 443* (CTES, UEC); idem, *J. A. M. Carmo & A. V. Scatigna 444* (UEC); idem, 16°54′S, 42°53′15″W, 23 Jan 2016, *J. A. M. Carmo & A. V. Scatigna 445* (UEC); idem, 16°54′S, 42°53′15″W, 23 Jan 2016, *J. A. M. Carmo & A. V. Scatigna 448* (CTES, UEC); Cristália, Estrada Cristália-Botumirim, 25 km de Cristália, 1 Jan 2004, *C. S. Sato et al. 20* (SPF).

Distribution and Habitat*—Psyllocarpus scatignae* is endemic to Botumirim and Cristália, Minas Gerais (Fig. 7), occurring in patches of white sand soil ("areais"; Fig. 6D) along one of the roads which connects both municipalities, surrounded by Cerrado and seasonally dry forest (Caatinga), at ca. 800 m elevation. The habitat and area where this species occurs are also included in the concept of campo rupestre s. l. (Silveira et al. 2016).

Conservation*—Psyllocarpus scatignae* does not occur within the limits of any protected area in Minas Gerais. The first botanical collections made in Botumirim date to 1960, as the more recent ones were made in 2017, accounting for ca. 1600 botanical records for the municipality in 57 yr (*species*Link network 2017). Except for the first collection (*C. S. Sato et al. 20*), made in 2004, this species has been collected only by us, in 2016.

Psyllocarpus scatignae presents AOO equal to 4 km^2 (kml. file available at https://figshare.com/articles/_/4754431). Therefore, for the purposes of this evaluation, we informally consider *P. scatignae* as critically endangered (CR B2abiii), based on its AOO (less than 10 km^2), number of locations equal to one and continuing decline inferred on quality of habitat, due to major current disturbances in the campo rupestre region (Silveira et al. 2016). It was collected in the same site as the carnivorous and also critically endangered species *Philcoxia rhizomatosa* Scatigna & V.C.Souza (Scatigna et al. 2015). This area is surrounded by a eucalypt farm and is constantly under disturbance because of the extraction of sand for local housing constructions, as observed by Scatigna et al. (2015) and us, during fieldwork trying to find new populations.

***Phenology*—**Both flowering and fruiting and only fruiting specimens were collected in January.

***Etymology*—**The specific epithet honours the young and talented Brazilian botanist André Vito Scatigna M.Sc., who works on the systematics of the Plantaginaceae and related taxa. André's fieldwork support and knowledge of habitats where *Psyllocarpus* species occur were vital for the collection of both taxa described in the present paper.

Taxonomy*—Psyllocarpus scatignae* belongs in *P.* section *Psyllocarpus* due to the linear to terete leaves, homostylous flowers with included stamens and style (Fig. 2E), prolate-spheroidal to prolate pollen grains, with long and narrow ectocolpi, endocingulum, and endoaperture, psilate and spinulate exine (Fig. 5D–F), bilobate stigma with inconspicuous lobes (Fig. 3N), and capsules compressed parallel to a persistent septum (Fig. 2H, 4I). This species is unique in the genus because of its flowering branches determinate, dichasial or monochasially branched, sometimes unbranched, with terminal inflorescences in glomerules (Fig. 1A–B, 6F–H). This type of branching is rare in the Spermacoce clade, being reported only in some *Galianthe* [*G. cymosa* (Cham.) E. L. Cabral & Bacigalupo, *G. dichasia* (Sucre & C. G. Costa) E. L. Cabral, Cabral and Bacigalupo 1997b)] and *Spermacoce* [*S. eryngioides* Cham. & Schltdl., *S. incognita* (E. L. Cabral) Delprete, and *S. tocantinsiana* (E. L. Cabral & Bacigalupo) Delprete, Florentín et al. 2016] species.

Psyllocarpus scatignae is similar to *P. goiasensis* because they are both subshrubs with opposite leaves and axillary brachyblasts forming fascicles, corolla lobes with internal surface roundly ribbed on the medium line, mucronulate at the apex

and capitate angulate in preanthetic bud, and compressed capsules, but they can be easily differentiated by the sympodial branching pattern, determinate flowering branches dichasial or monochasially branched, terminal inflorescences in glomerules (Fig. 1A–B, 6F–H), calyx tube present (Fig. 2F), glabrous capsules (Fig. 4I–J), and seeds broadly obovate in outline (Fig. 2M–N, 4N–O) in *P. scatignae*. Besides, the pollen grains of this species present spinules uniformly distributed around the mesocolpium and sparsely over the apocolpium surface (Fig. 5D–E), unlike *P. goiasensis*, which presents supratectal elements only on the edges of the colpi (Kirkbride 1979).

Key to the Species of *Psyllocarpus* sect. *Psyllocarpus*

1. Inflorescences in pauciflorous cymes; hypanthium hirsute to sparsely hirsute; capsules hirsute, valves deciduous keeping the seed inside after dehiscence . . . . . *P. bahiensis*
1. Inflorescences in 1-flowered cymes or glomerules; hypanthium glabrous or the upper 1/2 puberulous; capsules glabrous or the upper 1/3 sparsely puberulous, valves persistent from which the seeds are shed after dehiscence 2
   2. Flowering branches indeterminate, axillary inflorescences in 1-flowered cymes 3
      3. Most leaf axils without brachyblasts or pairs of smaller leaves; flowering branches with 2–4 flowers opened at the same time . . . . . *P. schwackei*
      3. Leaf axils with brachyblasts or short branchlets; flowering branches with 4 or more flowers opened at the same time 4
         4. Sympodial subshrub; hypanthium glabrous; calyx tube 0.1–0.5 mm long; corolla lobes rounded in preanthetic buds; capsules glabrous; seeds elliptic to broadly elliptic in outline . . . . . *P. laricoides*
         4. Monopodial subshrub; hypanthium with the upper 1/3 puberulous; calyx tube absent; corolla lobes capitate angulate in preanthetic buds; capsules with the upper 1/3 sparsely puberulous; seeds narrowly oblong in outline . . . . . *P. goiasensis*
   2. Flowering branches determinate, terminal inflorescences in glomerules, rarely also with axillary inflorescences in 1-flowered cymes 5
      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 . . . . . *P. scatignae*
      5. Flowering branches unbranched; calyx lobes 1.2–3.6 mm long; corolla lobes rounded or clavate in preanthetic bud, mature corolla 1–2.6 mm long 6
         6. Flowering branches erect; calyx lobes 1.2–2 mm long; corolla tube 1.1–1.5 mm long; seeds broadly elliptic in outline . . . . . *P. asparagoides*
         6. Flowering branches pendulous; calyx lobes 2.2–3.6 mm long; corolla tube 2.2–2.6 mm long; seeds obovate in outline . . . . . *P. phyllocephalus*

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