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A New Species of *Lychnophora* Mart. (Vernonieae: Asteraceae) from Minas Gerais State, Brazil

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Abstract—The genus *Lychnophora* (Vernonieae: Asteraceae) comprises ca. 23 species restricted to Bahia, Goiás, Minas Gerais, and São Paulo States, Brazil. Diamantina's Plateau in the Espinhaço Range of Minas Gerais State is the Brazilian area considered to have the highest endemism and microendemism of *Lychnophora*. *Lychnophora semirii*, a new species of the campo rupestre vegetation is described, illustrated, and the affinities between species are discussed. *Lychnophora semirii* is easily recognized by glutinous leaves with auriculate bases, isolated heads disposed in a corymbiform branches, and a pappus with a conspicuous coroniform outer series. This species currently appears to be a microendemic, as it was found so far only in the Parque Estadual do Biribiri at Diamantina municipality. It is critically endangered due to restricted distribution and habitat vulnerability.

Keywords—Campo rupestre, Compositae, Cadeia do Espinhaço, Planalto de Diamantina.

Lychnophora Mart. is a genus of subtribe Lychnophorinae (Vernonieae: Asteraceae) with 23 species (Siniscalchi et al. 2016). It is endemic to the campos rupestres (highland rocky fields) that occur in Bahia, Goiás, Minas Gerais, and a small border area of northern São Paulo, Brazil (Semir et al. 2011). Campos rupestres occur in mountain areas above 900 m on quartzitic rocks along the Espinhaço Range of Minas Gerais and Bahia, and the Brazilian Central Plateau of Goiás, and in scattered highland formations in southern Minas Gerais (Giulietti and Pirani 1988) and northern São Paulo, and have a high rate of endemism (Giulietti et al. 2000). Diamantina municipality in Minas Gerais is inserted in the northern Espinhaço Range of Minas Gerais State and is considered to have the highest endemism and microendemism of *Lychnophora* (Semir 1991).

Lychnophora was described by Martius (1822), based on the presence of heads in glomerules and cypselae with a deciduous pappus. For almost two hundred years, many authors studied this genus and its relatives, and proposed different classifications (Schultz-Bipontinus 1863; Baker 1873; Coile and Jones 1981; Robinson 1981, 1983, 1992; Semir 1991; Loeuille 2011). In this way, *Lychnophora* has been a genus with difficult taxonomic delimitation, requiring several character states together to identify it (Loeuille 2011; Semir et al. 2011). Basically, the genus can be recognized by its shrub to tree habit, rarely a subshrub, a leaf indumentum consisting of 3- to 5-armed, stellate and T-shaped trichomes with short arms or asymmetric long arms, a revolute leaf margin, heads in glomerules at the apex of the branches, and a glabrous cypselae with a biseriate pappus with the inner series paleaceous, twisted, and caducous (Loeuille 2011; Loeuille et al. 2015).

Considering the floristic richness of Asteraceae in the municipality of Diamantina, a floristic survey was carried out in Biribiri State Park, Diamantina, Minas Gerais. During this floristic survey for the tribe Vernonieae, the first author recognized a new *Lychnophora* species. Therefore, the aim of this work is to describe and illustrate this new taxon, and to discuss its affinities with other species.

MATERIALS AND METHODS

Biribiri State Park is located in the center of the Espinhaço Range denominated the Diamantina Plateau (Fig. 1), and has different physiognomies, mainly campos rupestres (Instituto Estadual de

Florestas 2004). The park is located at 18°14'53"–18°02'15"S and 43°39'57"–43°29'36"W, 15 km from the center of the Diamantina city (Instituto Estadual de Florestas 2004).

The microendemism of this new species was verified by examination of all specimens of this genus from various herbaria (BHCB, CEN, ESA, HUFU, K, MBM, P, R, RB, OUPR, UB, UEC, SP, and SPF), and also visiting other similar places in the park. All morphological studies were carried out at a laboratory and the herbarium of Corrientes, Argentina. For morphological analysis of trichomes, vegetative and reproductive parts were softened in boiling water including a drop of detergent, and dissected under a stereomicroscope. Samples were then mounted in Hoyer's solution (Anderson 1954; King and Robinson 1970) and examined with a Zeiss Axioplan. Trichomes were classified according to Payne (1978), Theobald et al. (1979), and Wagner et al. (2014). Modified terminology was used, when needed, such as biseriate vesicular glandular hair and swollen terminal celled hair, following Narayana (1979).

For SEM analysis, samples were first dehydrated and then immersed in CO₂ for critical point drying before sputter-coating with gold-palladium. These samples were examined and photographed using a JEOL 5800 LV scanning electron microscope.

Pollen samples were obtained by removing one or two florets. The pollen grains were acetolyzed according to the methodology of Erdtman (1960). For light microscopy (LM), pollen grains were mounted on glass slides using glycerine jelly and subsequently examined with a Zeiss Axioplan. Permanent slides were deposited at the Palynological Laboratory of the Universidad Nacional del Nordeste (PAL-CTES). For scanning electron microscopy, acetolysed pollen grains were first washed in 96%, and later in 100% ethanol. The pollen grains were sputter-coated with gold-palladium and observed using a JEOL 5800 LV scanning electron microscope. The terminology proposed by Erdtman (1966), Keeley and Jones (1979), and Punt et al. (2007) was used to describe pollen structure. Pollen measurement data were calculated from 90 grains.

TAXONOMIC TREATMENT

Lychnophora semirii D.Marq. & J.N.Nakaj., sp. nov. TYPE: BRAZIL, Minas Gerais, Diamantina, Parque Estadual do Biribiri, Serra dos Cristais, 18°09.514'S, 43°36.213'W, altitude 1352 m, 20.I.2015, D. Marques & F.L. Contro 549 (holotype: HUFU!; isotypes: DIAM! CTES! UEC! K!).

Lychnophora semirii is characterized by its glutinous leaves, a feature absent in almost all *Lychnophora* species. This "stickiness" remains even in the dried pressed specimens. Other important characteristics differentiating *L. semirii* from similar species of the genus are: isolated heads, outer phyllaries green but sometimes magenta, and capitula with 18–20 florets (Table 1).

Shrub, ca. 3 m tall, highly branched, branches 0.18–0.34 cm diam, thin, striated, highly tomentose to shortly villous, white

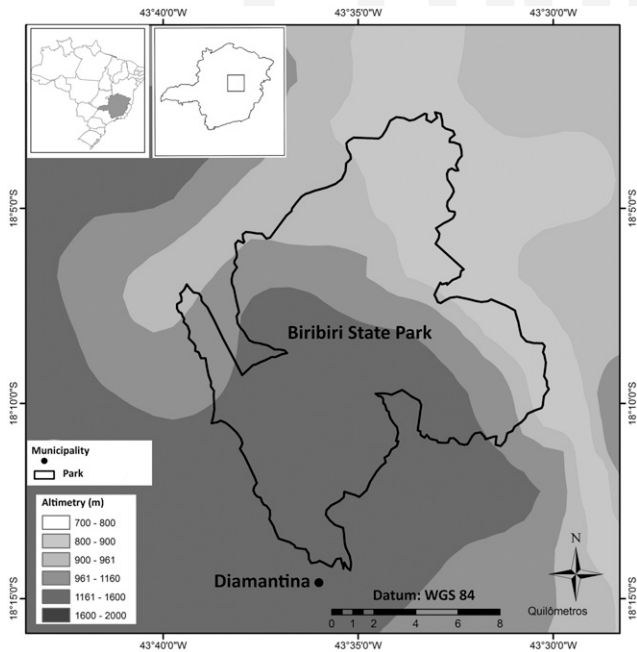


FIG. 1. Map of Parque Estadual do Biribiri, Diamantina, Minas Gerais, Brasil.

to greyish, leaf scar 2.3–3 mm diam, transversely elliptical. **Leaves** spirally alternate, simple, imbricate, ericoid, coriaceous-chartaceous, discolor, glutinous, upper leaves ascending, lower leaves reflexed, sessile, blade 5.5–6.4 × 0.17–0.31 cm, usually linear, sometimes linear-ovate, base cordate-auriculate, apex acuminate, margin revolute, adaxial surface glandular, green-brown, abaxial surface tomentose to shortly villous, whitish, brochidodromous, principal vein protuberant, tomentose. **Corymbiform inflorescence** of isolated heads, 2.6–4.5 × 9.1–13 cm, leafy, subinvolucral bract 1.63–1.89 cm long, leafy, linear to linear-lanceolate, tomentose. **Heads** homogamous, discoid, peduncles 1–1.82 cm long; involucre campanulate, 1.4–1.58 × 0.9–1 cm, receptacle foveolate; phyllaries 24–27, 3–4 seriate; outer phyllaries 7.6–7.8 × 2.1–2.3 mm., lanceolate, apex apiculate, margin serrulate, highly villous, sparsely glandular, magenta or bronze, inner phyllaries 14.8–15.2 × 2–2.15 mm, lanceolate to linear-lanceolate, apex apiculate to caudate, margin serrulate, sparsely villous, highly glandular, bronze. **Florets** 18–20, hermaphroditic; corolla actinomorphic, lilac, tube 8–9.3 mm long, cylindrical, glabrous, lobes 6–6.5 mm long, oblong-lanceolate, with few hairs at the apex, apex obtuse; anther 5–5.2 mm long, apical anther appendages obtuse, basal anther appendages sagittate; style 16.6–17.3 mm long, purplish, with hairs below the bifurcation

point of the style arms; stylopodium cylindrical, brown. **Cypselae** cylindrical to obconic, 2.3–2.5 cm long, angled, 10–12 ribbed, ribs strigose; carpopodium annular, strigose, twin trichomes, foot thickened, red; pappus biseriate, outer series 1.6–2 mm long, crown-form, bronze, inner series 7.2–8.4 mm long, subpaleaceous, slightly twisted, deciduous, golden. **Pollen grains** prolate-spheroidal 1 (P/E: 1.1 μm), tricolporate, subechinolphate, polar axis 28.56 (33.86) 36.72 μm; equatorial axis 25.84 (30.64) 34 μm; porus 5.4–8.16 × 8.18–10.88 μm, lalongate; exine, excluding the spines, 2.72 (3.85) 5.44 μm thickness; tectum continuous, microperforate, irregular cavity, spinate; spines 2.72 (3.99) 6.8 μm long, apex obtuse. Figures 2, 3.

[E2] [E3]

Additional Specimens Examined—Brazil. —MINAS GERAIS: Diamantina, Parque Estadual do Biribiri, Serra dos Cristais, 18°09'21"S, 43°36'16"W, 20 Feb 2013, I.M. Franco 1217 (HUFU, MBM, SP); idem, 18°09.514'S, 43°36.213'W, lt. 1352 m, 20.I.2015, D. Marques & F.L. Contro 548 (HUFU, RB, SPF); idem, 18°09.514'S, 43°36.213'W, lt. 1352 m, 20.I.2015, D. Marques & F.L. Contro 550 (HUFU, NY, P).

Distribution and Habitat—This species is endemic to campos rupestres, around 1352 m in the Parque Estadual do Biribiri in the Espinhaço Range, Minas Gerais State, Brazil.

Vernacular Name—The only known name is arnica.

Etymology—*Lychnophora semirii* is named in honor of Dr. João Semir, a Brazilian taxonomist who dedicated much of his work to the study of *Lychnophora*.

Notes—*Lychnophora semirii* is an atypical species according to its morphological characteristics, mainly glutinous leaves, terminal solitary heads with 18–20 florets, and a pappus with a prominent (1.6–2 mm long) coroniform outer series. *Lychnophora semirii* resembles *L. souzae* H. Rob. by its habit and shares some characteristics such as magenta outer phyllaries and coroniform outer pappus (Fig. 4). Both species occur only in the Biribiri State Park, being endemic to the Diamantina Plateau. However, the morphological differences between these two species are clear (Table 1). Besides, *Lychnophora souzae* has a leaf sheath (Loeuille et al. 2015), and currently has an uncertain position within *Lychnophorinae* (Siniscalchi et al. 2016). *Lychnophora spiciformis* also has the general habit and coroniform pappus of *L. semirii*, but *L. spiciformis* has some characteristics that differentiate it from *L. semirii*, such as glomeruliform capitulescences and its distribution (Siniscalchi et al. 2016) (see Table 1).

[E4]

Conservation Status—If all IUCN (2010) criteria and categories were followed in a formal assessment, *L. semirii* would likely be considered critically endangered since the only known population inhabits an area of less than 10 km² and the population is estimated to include less than 50 mature individuals. Although the species was collected in a conservation unit, the area of occurrence of the species is close to Cachoeira dos Cristais, a waterfall frequently visited by tourists. In addition, there are still residents in the park who use the species as a medicinal.

TABLE 1. Diagnostic morphological characters of *Lychnophora semirii*, *L. spiciformis*, and *L. souzae*. Source material for scoring *L. souzae*: D. Marques et al. 385 (HUFU) and D. Marques et al. 477 (HUFU).

	<i>L. semirii</i>	<i>L. souzae</i>	<i>L. spiciformis</i>
Blade shape	Linear or linear-lanceolate	Digitiform	Subulate or lanceolate
Leaf length	5.5–6.4 cm	0.4–0.8 cm	0.45–0.84 cm
Leaf base	Cordate-auriculate	Acuminate	Cordate
Leaf glutinous	Present	Absent	Absent
Inflorescence	Corymbiform with isolated heads	Spike-like, of small glomerula	Spike-like structure of capitula or glomerules of capitula
Number of florets per head	18–20	1–2	3
Cypselae indument	Strigose	Glabrous	Glabrous
Distribution	Minas Gerais State	Minas Gerais State	Bahia State

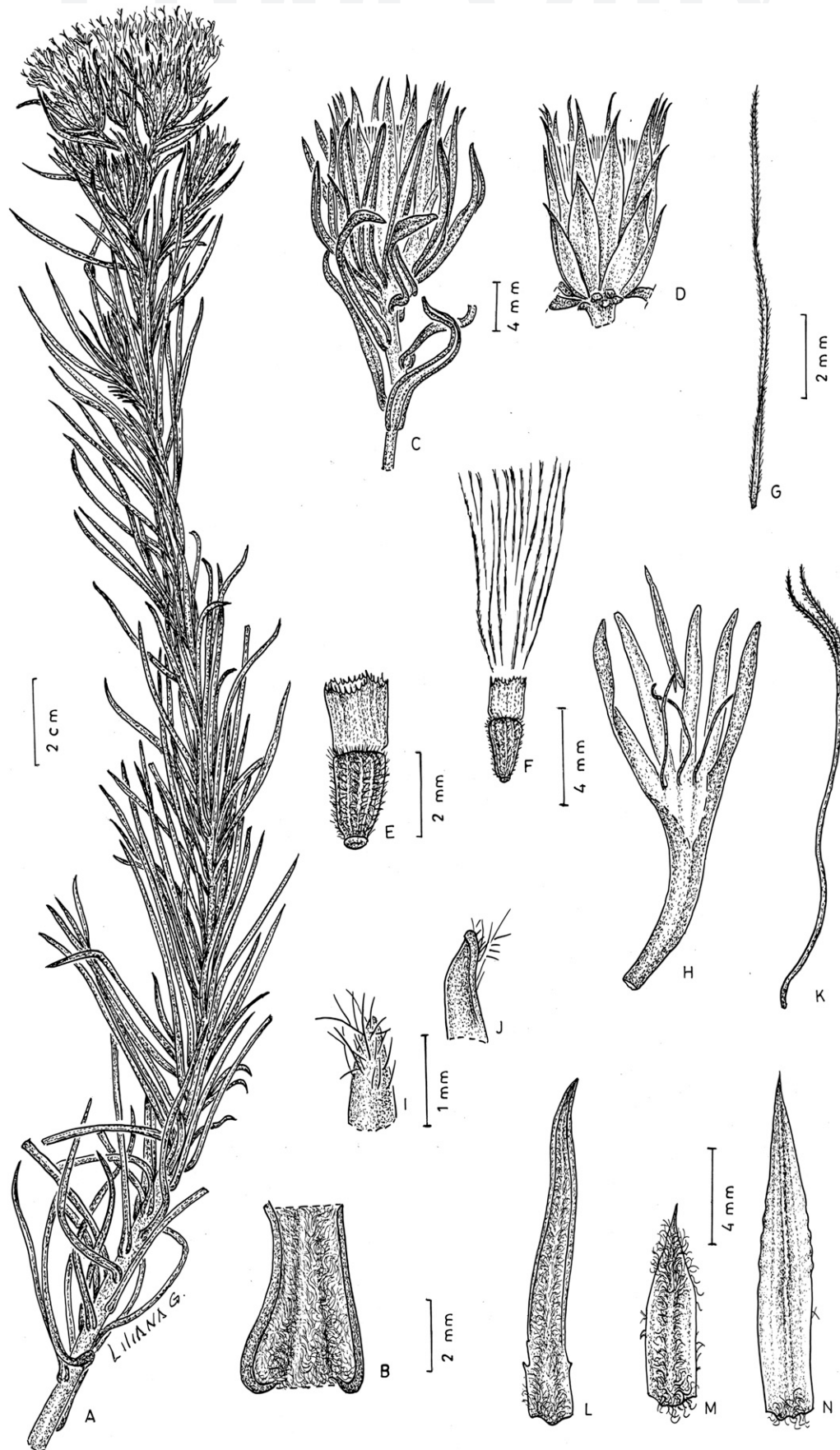


FIG. 2. *Lychnophora semirii*. A. Flowering branch. B. Auriculate leaf base. C. Head with subinvolucral bract. D. Involucre. E. Cypsel with outer pappus. F. Cypsel with biseriate pappus. G. Inner pappus. H. Floret. I-J. Details of corolla lobe. K. Style L-N. Phyllaries.

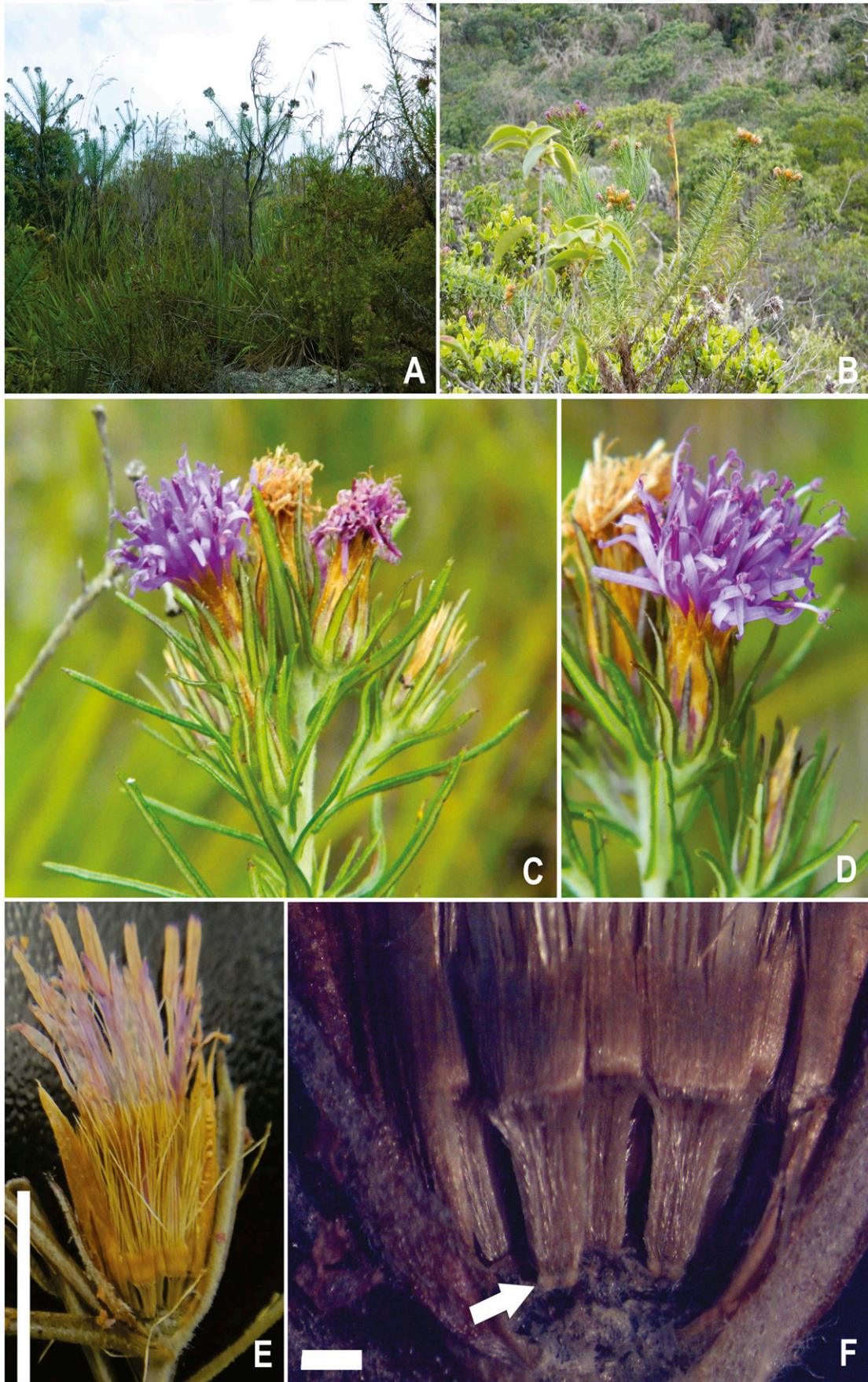


FIG. 3. *Lychnophora semirii*. A. Habit. B. Branches with heads. C. Capitulescence. D. Heads. E. Dissected head. F. Receptacle of the head and cypselsae with carpodium (white arrow). Scale bars: E = 1 cm, F = 1 mm.



FIG. 4. *Lychnophora souzae*. A. Habit. B. Branch with heads. C. Capitulescence.

Phenology—It flowers from January and February.

Pollen—The new species has pollen grain type “A” characteristic of the subtribe Lychnophorinae (Keeley and Robinson 2009; Fig. 5). This pollen type is similar to those

found in *Eremanthus* (Loeuille et al. 2012) and *Paralychnophora* (Souza-Souza et al. 2016). However, due to lack of median constriction (present in *Paralychnophora*) on the endoaperture, the pollen grains observed in the new species

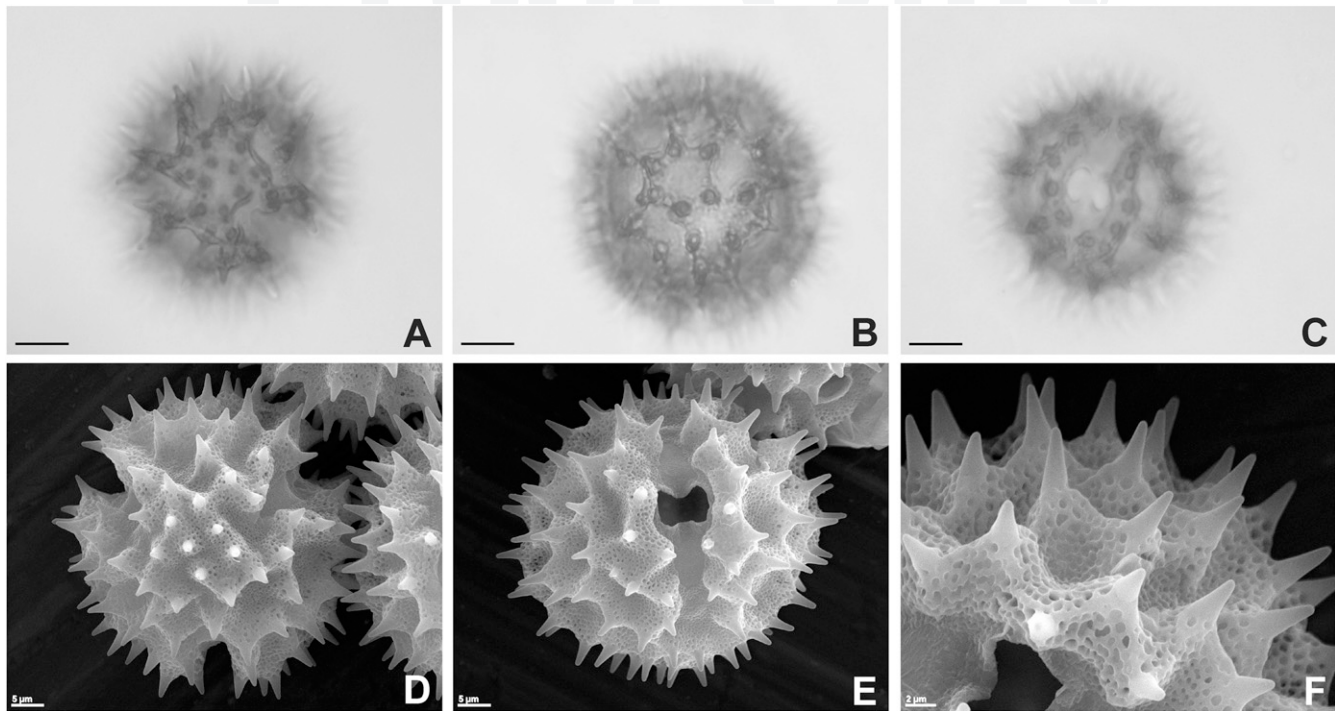


FIG. 5. Pollen of *Lychnophora semirii* (LM and SEM). A. Polar view, high focus. B. Equatorial view, mesocolpium. C. Equatorial view, high focus. D. Polar view. E. Equatorial view. F. Close up, perimeter of equatorial view showing colporous, microperforate tectum and spines. Scale bars (A–C) = 100 μm .

are more similar to pollen of most *Eremanthus* species (Souza-Souza et al. 2016). In addition to this characteristic, *Lychnophora semirii*, as well as *Eremanthus argenteus* and *E. veadeiroensis*, have prolate-spheroidal pollen grains (Loeuille et al. 2012), whereas species of *Paralychnophora* only have spheroidal pollen grains (Souza-Souza et al. 2016). Phylogenetic analysis based on molecular and morphological data have shown that *Eremanthus* and *Lychnophora* are closely related genera (Loeuille et al. 2015). However, there are no palynological studies in the genus *Lychnophora*. Despite the lack of pollen studies for this genus, palynology as a taxonomic tool has been important to differentiate species of Vernoniaeae. Studies such as Via do Pico and Dematteis (2013) and Souza-Souza et al. (2016) demonstrated that pollen morphology can be used to differentiate species in the

tribe. Therefore, the inclusion of pollen types in descriptions of species of the *Lychnophora* may be important for their classification and identification.

Trichomes—Trichomes have been shown to be a valuable source of characters in the taxonomy of the tribe Vernoniaeae for Old and New World groups (Faust and Jones 1973; Robinson 2009; Redonda-Martínez et al. 2012; Angulo and Dematteis 2014; Angulo et al. 2015; Via do Pico et al. 2016). The subtribe *Lychnophorinae* displays a great diversity of non-glandular trichomes (Wagner et al. 2013). *Lychnophora semirii* presents nine types of non-glandular trichomes and also glandular trichomes were observed, in both vegetative and reproductive organs (Fig. 6; Table 2). The types of trichomes observed are similar to the trichomes of other species of the subtribe *Lychnophorinae* (Wagner et al. 2013). Despite morphological variability observed, trichomes were not taxonomically useful to describe the new species or differentiate it from other related taxa.

Fig 12

TABLE 2. Trichome types found in *Lychnophora semirii*.

Trichome type	Organography
Type I: Unbranched, long, thin, curly	Branches, leaves, vein, style
Type II: Swollen terminal celled	Apex of corolla
Type III: Biseriate	Cypselae
Type IV: Branched, 3- to 5-armed	Leaves, vein, phyllaries, apex of corolla
Type V: Simple stellate	Branches, subinvolucral bract, phyllaries, apex of corolla
Type VI: Stellate, porrect	Branches, subinvolucral bract, phyllaries
Type VII: Stellate, geminate, porrect	Apex of corolla
Type VIII: Stellate, bladder-like	Leaves, vein
Type IX: Biseriate vesicular glandular	Leaves, vein, subinvolucral bract, phyllaries

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AUTHOR CONTRIBUTIONS

DM and JNN contributed to the taxonomic treatment; DM and GMVP contributed to images, terminology of trichomes and pollen, and analysis of specimens. All authors contributed to the writing of the manuscript.

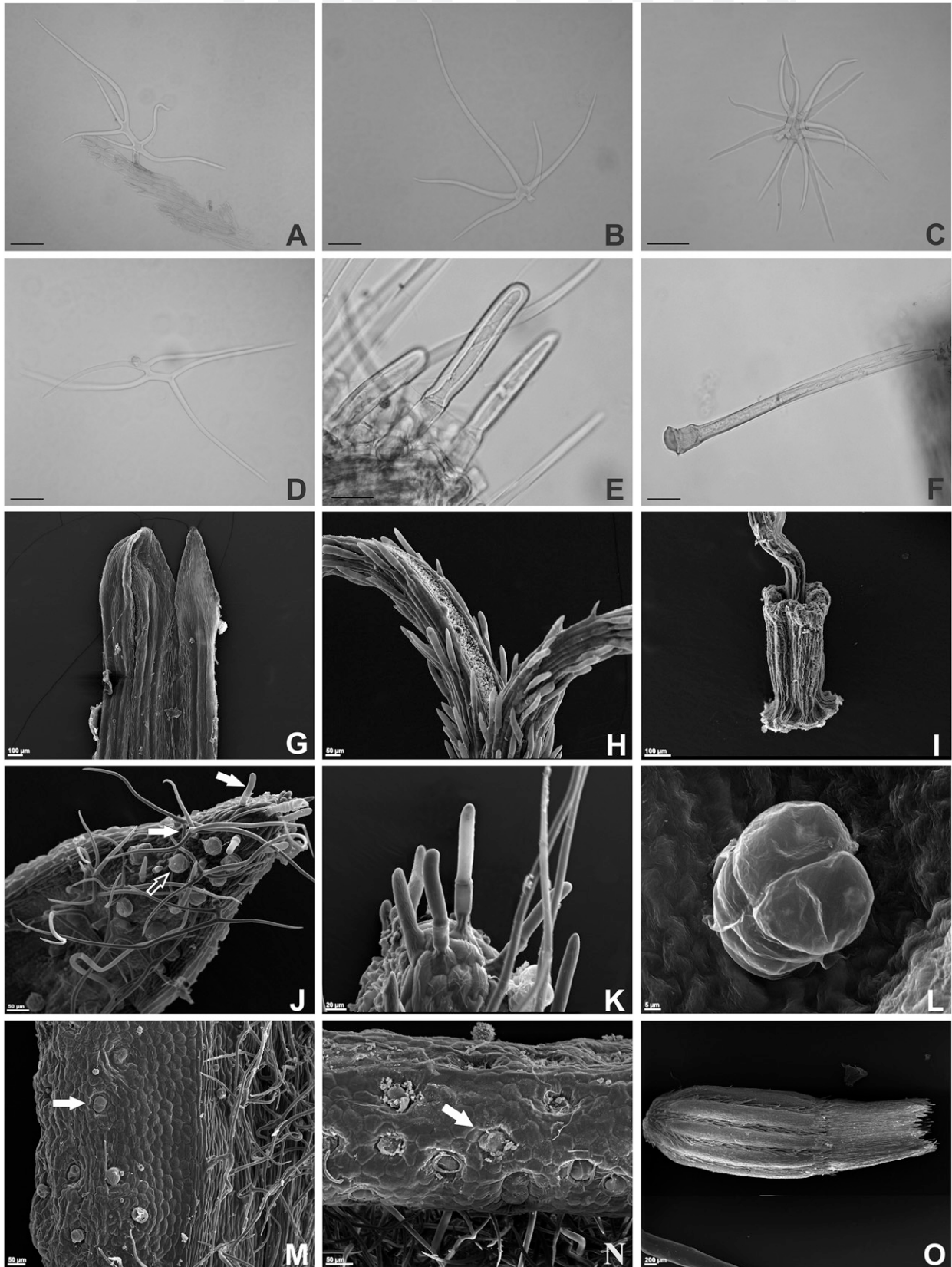


FIG. 6. Vegetative and reproductive microcharacters of *Lychnophora semirii* (LM and SEM). A. Stellate, geminate, pectinate trichome of phyllaries. B. Stellate, pectinate trichome of phyllaries. C. Stellate, bladder-like trichome of leaf. D. Branched, 3- to 5-armed trichome of phyllaries. E. Swollen terminal celled trichome of corolla lobe. F. Twin trichome of cypselum. G. Apical anther appendages. H. Style arms. I. Stylopodium. J. Corolla lobe with glandular (black arrow) and non-glandular trichomes (white arrow). K. Detail of non-glandular trichome. L. Detail of biseriolate glandular trichome of corolla. M. Sub-phyllary with stellate and glandular biseriolate trichomes (white arrow). N. Abaxial surface of leaf, tomentose to shortly villous with glandular biseriolate trichomes (white arrow). O. General view of cypselum with crown-form outer pappus. Scale bars (A–F) = 100 μm .

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