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Lopesia indaiensis (Diptera, Cecidomyiidae), a new species of gall midge feeding on *Andira fraxinifolia* Benth (Fabaceae), an endemic plant in Brazil

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ABSTRACT

Lopesia indaiensis (Diptera, Cecidomyiidae), a new species of gall midge found causing galls on *Andira fraxinifolia* (Fabaceae), an endemic plant species in Brazil, is described based on larva, pupa, male and female. *L. indaiensis* galls were collected in Dores do Indaiá, State of Minas Gerais, Southeastern Brazil. Larvae were removed from the galls and pupae and adults were obtained by rearing. The specimens were mounted on slides and the most important morphological characters were illustrated. The new species was compared to the other species of *Lopesia*.

Introduction

Andira fraxinifolia Benth (Fabaceae) is a heliophytic, evergreen, woody plant, which is endemic in Brazil (Lorenzi, 1992). It occurs in the Atlantic forest, Cerrado and Caatinga and has been found from Rio Grande do Sul to Piauí States. Due to its good propagation and fast germination, this species has great importance for recovering disturbed areas (Backes and Irgang, 2004).

Four gall morphotypes have been recorded on this plant species. One of them (Fig. 1) is a vermiform leaf fold found in several areas of Atlantic forest (Southeastern Brazil: Bertioga/State of São Paulo, Mangaratiba and Maricá/State of Rio de Janeiro; Northeastern Brazil: Tamandaré/State of Pernambuco), as well as in a Cerrado area (Southeastern Brazil: Dores do Indaiá, State of Minas Gerais) (Table 1). This gall is induced by a new species of *Lopesia* Rübsaamen, 1908 (Diptera, Cecidomyiidae).

Similar galls have been recorded on *Andira* sp. in Bahia (Northeastern) (Tavares, 1920) and *Andira humilis* Mart. ex Benth. in Mato Grosso (Midwestern), São Paulo and Bahia (Garcia et al., 2017). The former is induced by *Andirodiplosis bahiensis* Tavares, 1920 (Cecidomyiidae) and the latter by *Lopesia andirae* Garcia, Lima, Calado and Urso-Guimarães, 2017.

Fig. 1. Galls of *Lopesia indaiensis*, sp. n., on leaf of *Andira fraxinifolia* Benth (Fabaceae), general aspect.

In this study, we describe a new species of *Lopesia* that induces vermiform galls on leaves of *A. fraxinifolia* based on material from Minas Gerais. This genus is known from 25 described species, 20 of them from the Neotropics. The other species are Afrotropical (three spp.), Nearctic (one sp.) and Australasian (one sp.) (Gagné and Jaschhof, 2017; Maia and Monteiro, 2017).

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Table 1
Insect galls in *Andira fraxinifolia* Benth (Fabaceae): characterization, locality and reference.

Galled organ	Gall shape	Galling insect	Locality	Domain phytogeopraphic	Reference
Leaf	Vermiform	Cecidomyiidi	Bertioga/SP	Atlantic forest	Maia et al. (2008)
		Lopesia sp.	Mangaratiba/RJ	Atlantic forest	Rodrigues et al. (2014)
		Cecidomyiidae	Tamandaré/PE	Atlantic forest	Santos et al. (2012)
		Lopesia indaiensis, sp. n.	Dores do Indaiá/MG	Cerrado	Present work
Leaf	Globoid	Asphondyliina	Bertioga/SP	Atlantic forest	Maia et al. (2008)
		Asphondylia sp.	Mangaratiba/RJ	Atlantic forest	Rodrigues et al. (2014)
		Asphondyliina	Santa Teresa/ES	Atlantic forest	Maia et al. (2014)
Stem	Fusiform	Curculionidae	Bertioga/SP	Atlantic forest	Maia et al. (2008)
		Not determined	Tamandaré/PE	Atlantic forest	Santos et al. (2012)
		Curculionidae	Santa Teresa/ES	Atlantic forest	Maia et al. (2014)
Leaf	Lenticular	*Meunieriella* sp.	Maricá	Atlantic forest	Maia et al. (2002)
		Meunieriella sp.	Araruama and Arraial do Cabo/RJ	Atlantic forest	Carvalho-Fernandes et al. (2016)

Material and methods

Branches of *A. fraxinifolia* with leaf galls were collected at Porcos Farm (19°30′18.99″ S–45°41′00.88″ W), municipality of Dores do Indaiá, State of Minas Gerais (Southeastern Brazil), in April of 2009. Galls were found on an individual plant situated in the border of a Cerrado fragment. Most leaves were galled and leaflets hosted one to several galls. The presence of more than three galls on the same leaflet caused its distortion.

Galled branches were removed from the host plant and transported in plastic bags to the laboratory of the *Departamento de Ciências Biológicas/Faculdade de Filosofia, Ciências e Letras do Alto São Francisco*, where some galls were dissected under a stereoscopic microscope to obtain larvae and pupae. Other galled branches were wrapped in wet cotton at the basis and kept in plastic pots covered by a fine screening until adults' emergence, when these pots were put in a refrigerator to cause insects' lethargy. Then, midges were collected using a 70% ethanol soaked paintbrush.

All specimens were first preserved in 70% ethanol, then mounted on microscope slides, following the methods outlined by Gagné (1994) and deposited in the Entomological Collection of the *Museu Nacional/Universidade Federal do Rio de Janeiro* (MNRJ).

Samples of the host plant were pressed, dried, identified by Dr. Fernando Augusto de Oliveira e Silveira (*Universidade Federal de Minas Gerais*) and kept in his laboratory as a voucher material.

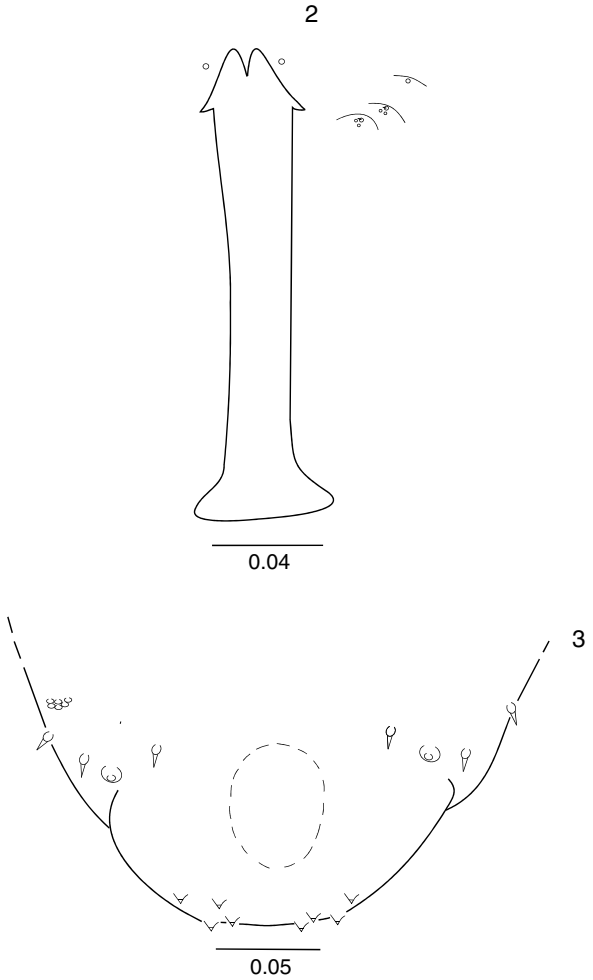
Results

Lopesia indaiensis, sp. n. (Figs. 2–13)

The new species was placed in *Lopesia* due to four-segmented palpi, R5 curved at its juncture with Rs, Rs situated near the midlength of R1, short female postabdomen and its cerci with many short, sensory setae, and larva with corniform terminal papillae, each on a terminal projection.

Diagnosis. Adults with 1st–11th antennal flagellomeres neck partially setulose in both sexes, 12th flagellomere with apical process entirely setulose in both sexes, four-segmented palpi, male circumfila with all loops similar in length, tarsal claw with two teeth, 8th male tergite narrow, elongated, with only basal pair of trichoid sensilla; pupa with antennal basis modified into anteriorly pointed projection, with inner margin slightly serrated, apical plate deeply bilobed, prothoracic spiracle long and abdominal dorsal spines absent; larva with spatula two-toothed and four pairs of corniform terminal papillae.

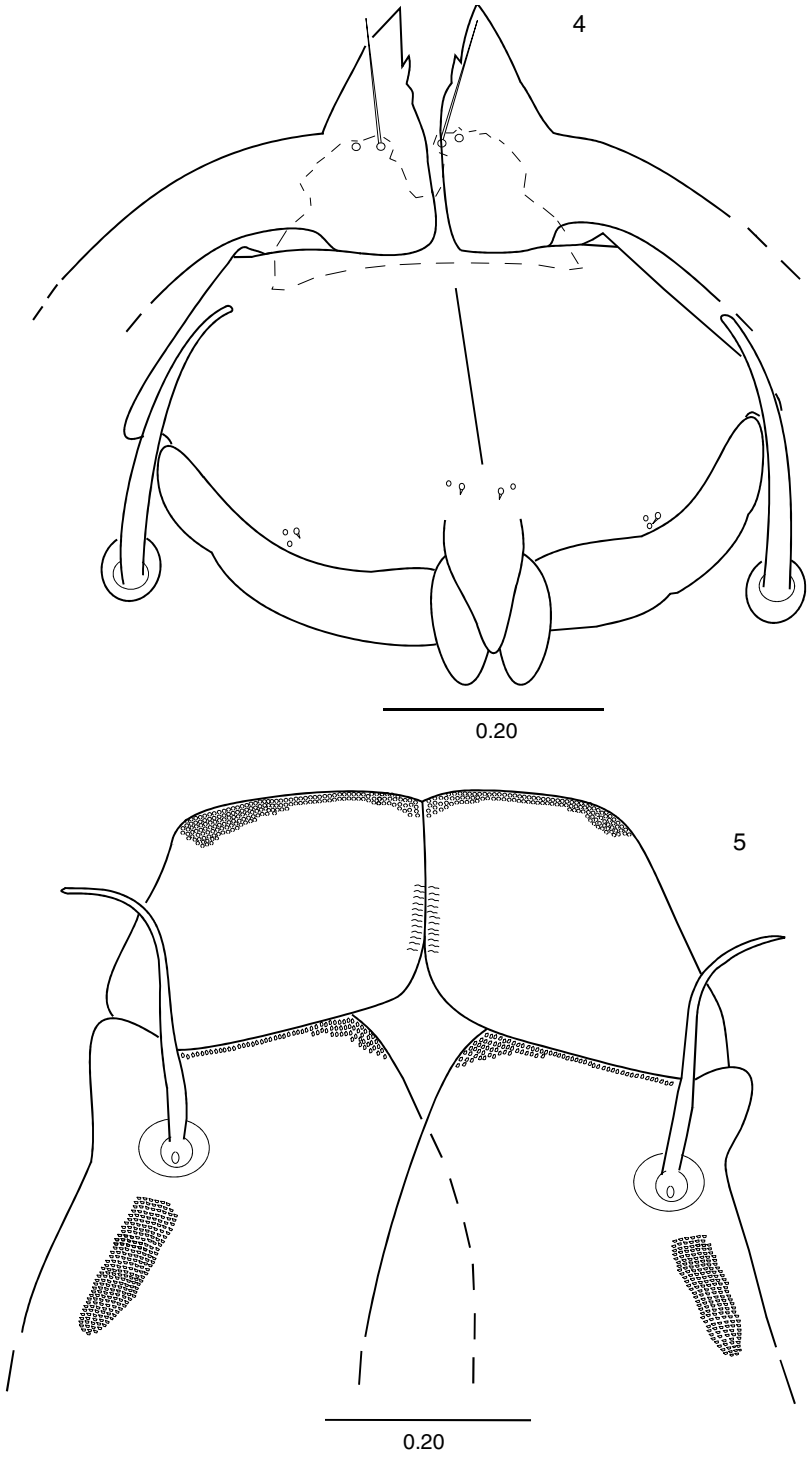
Larva. Fusiform and cylindrical body; 1.90–2.60 mm long ($n = 05$). Integument rough. Spatula (Fig. 2): 0.17–0.26 mm long ($n = 05$), two-toothed, apical teeth triangular, stalk long. Two groups of three lateral papillae on each side of spatula (two pairs setose and a single setose papilla in each group) (Fig. 2). Terminal segment (Fig. 3): four pairs of corniform papillae similar in length.



Figs. 2–3. *Lopesia indaiensis*, sp. n. 2. Larva, sternal spatula with adjacent papillae (ventral view). 3. Larva, terminal segments (dorsal view).

Pupa. Body length: 3.10–4.40 mm ($n = 17$). Head (Fig. 4): apical setae 0.07–0.13 mm long ($n = 11$); vertical plate deeply bilobed at upper margin, antennal projections slightly serrated, 0.10–0.17 mm long ($n = 17$) (from apex to the upper antennal margin); two pairs of lower facial papillae (one asetose and the other setose), three pairs of lateral facial papillae, one pair setose and two without seta. Prothoracic spiracle (Fig. 4) elongate 0.25–0.35 mm long ($n = 17$), sclerotized. Prothoracic integument partially rough (Fig. 5). Abdominal segments 2–8 without dorsal spines.

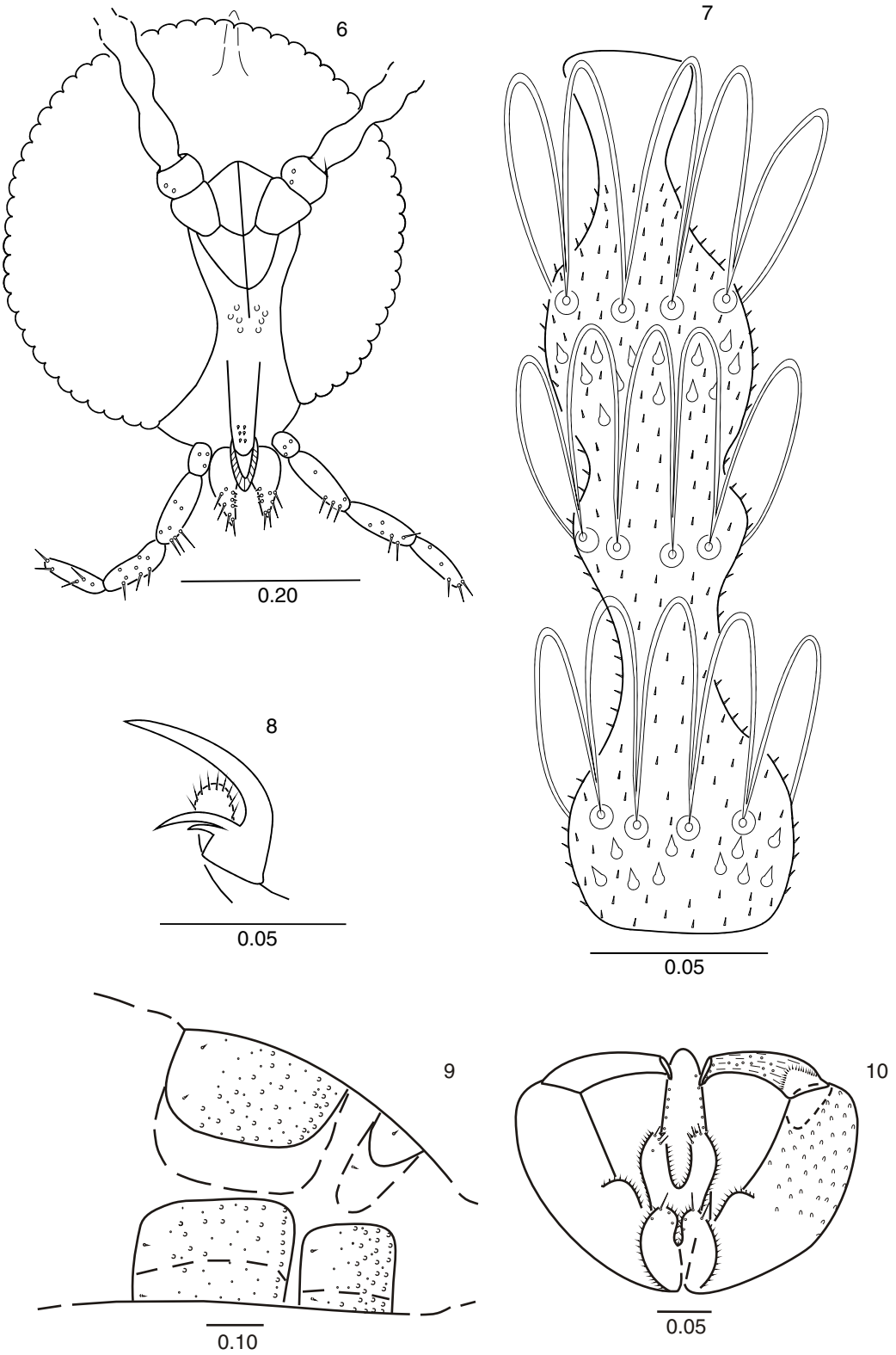
Male. Body length 2.70–3.80 mm long ($n = 12$) (including terminalia). Head (Fig. 6): apical process absent. Eye facets circular, all closely approximated. Antenna ($n = 05$): scape obconical,



Figs. 4–5. *Lopesia indaiensis*, sp. n. 4. Pupa, face (ventral view). 5. Pupa, anterior part (dorsal view). Scale bars in mm.

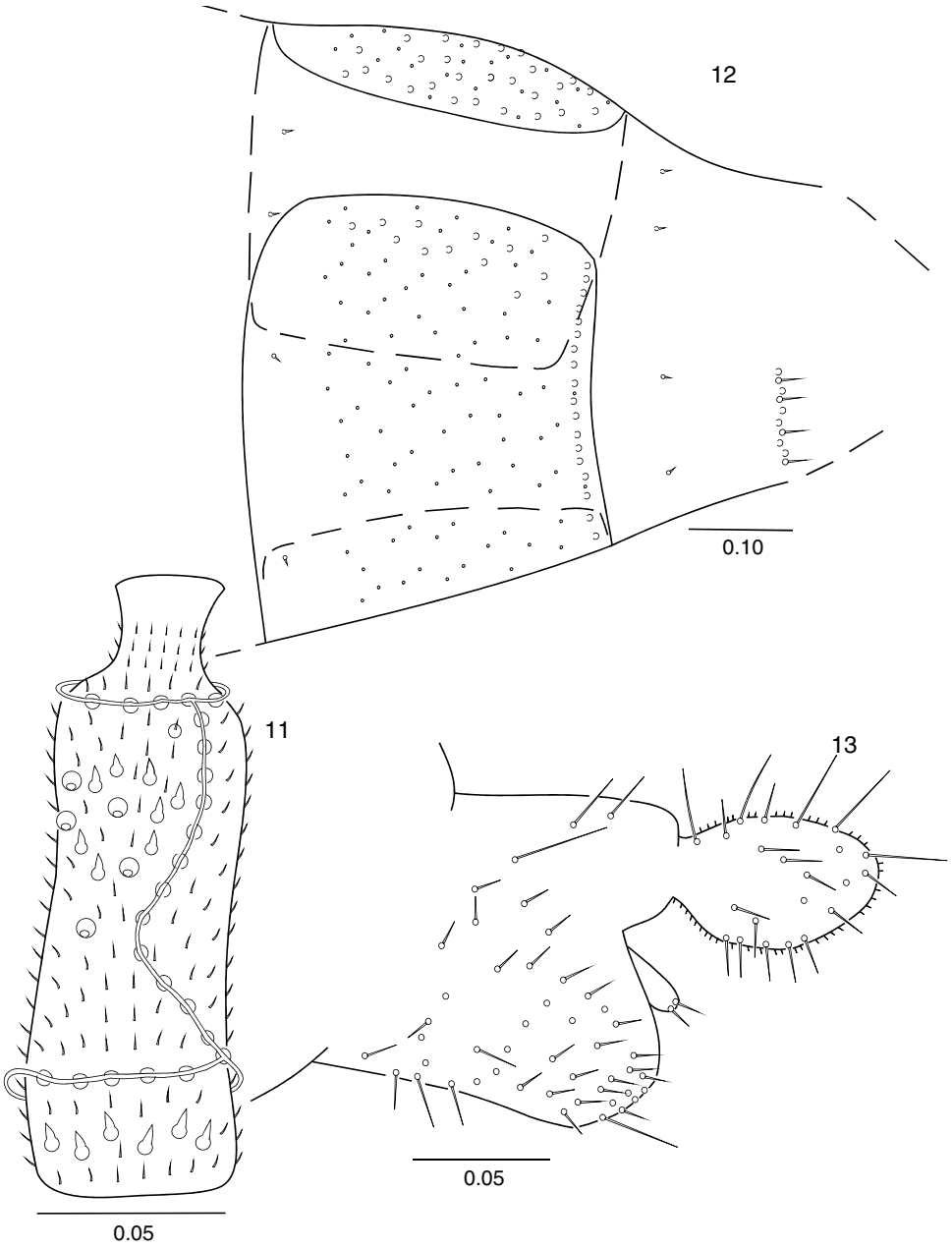
pedicel globose, flagellomeres binodal and tricircumfilar; nodes and internodes setulose, necks partially setulose; three circumfila of each flagellomere with loops regular in length (Fig. 7); 1st and 2nd flagellomeres connate, 12th flagellomere 0.20 mm long ($n = 5$), with apical process entirely setulose. Frontoclypeus with 10–12 setae ($n = 10$). Labrum triangular, long-attenuate, with 3 pairs of ventral sensory setae. Hypopharynx with anteriorly directed lateral setulae. Labella elongate-convex, each with long lateral setae and three pairs of short mesal sensory setae. Palpus ($n = 07$) with four segments, all cylindrical with setae, 1st segment shorter than the others, 0.03–0.04 mm long, 2nd segment 0.08–0.09 mm long, 3rd segment 0.08 mm long, and 4th segment 0.08 mm long.

Thorax. Wings: length: 2.40–2.70 mm ($n = 12$). Venation: R5 and Rs as in the genus diagnosis, CuA forked, M3 + 4 present. Scutum with 4 longitudinal rows of setae with a few scales intermixed, the 2 dorsocentral rows broadest anteriorly, forming a single row posteriorly, and the 2 lateral as a single row. Scutellum with several setae. Anepisternum bare. Anepimeron with setae. Tarsal claws bent near base and two-toothed, tooth basal shorter than the distal; empodium short, not reaching bent in claws (Fig. 8).



Figs. 6–10. *Lopesia indaiensis*, sp. n. 6. Male head (frontal view). 7. Male flagellomere 5. 8. Male hindleg, tarsal claw and empodium. 9. Male abdominal segments 7–8 (lateral view). 10. Male terminalia (dorsal view). Scale bars in mm.

Abdomen (Fig. 9): 1st–6th tergites sclerotized, rectangular, with a single distal row of setae, few setae mesally and laterally, basal pair of trichoid sensilla, and scattered scales; 7th tergite sclerotized, rectangular, with a double distal row of setae, few setae mesally and laterally, basal pair of trichoid sensilla, and scattered scales; 8th tergite sclerotized, narrow, elongated, with only basal pair of trichoid sensilla. 2nd–7th sternites sclerotized, rectangular, with a single distal row of setae, many setae mesally and laterally, basal pair of trichoid sensilla, and scattered scales; 8th sternite sclerotized, with scattered setae at ½ distal, lateral setae, basal pair of



Figs. 11–13. *Lopesia indaiensis*, sp. n. 11. Female flagellomere 5. 12. Female abdominal segments 7–8 (lateral view). 13. Ovipositor (ventral view). Scale bars in mm.

trichoid sensilla and scattered scales. Terminalia (Fig. 10): gonocoxite partially setose, 0.21–0.22 mm long, 0.07–0.08 mm wide ($n = 07$), with setulose rounded mesobasal lobe; gonostylus setulose basally, striated beyond basis, 0.11–0.12 mm long, 0.02–0.03 mm wide ($n = 07$); cerci apically rounded with setae and setulae, cercal lobes convergent; hypoproct deeply bilobed, with setae and setulae, lobes widely separated and rounded apically; hypoproct much longer than cercus; aedeagus accentuately longer than hypoproct, wider than gonostylus, tapered to apex, rounded apically, bearing several asetose papillae.

Female. Body length 3.90–4.20 mm long ($n = 8$) (including ovipositor). Antenna: scape and pedicel as in male, flagellomeres cylindrical; nodes entirely setulose and necks partially setulose; circumfila made of two rings, connected horizontally, slightly sinuous (Fig. 11), 12th flagellomere 0.11–0.13 mm long ($n = 6$), entirely setulose, apical process 0.05–0.07 mm long ($n = 6$) with basal node 0.02 mm long ($n = 6$). Frontoclypeus with 10–14 setae ($n = 9$). Palpus ($n = 9$): 1st segment shorter than the others, 2nd–4th segments subequal in length, 1st segment 0.04–0.05 mm long, 2nd segment 0.09–0.10 mm long, 3rd segment 0.08–0.09 mm long, 4th segment 0.09–0.10 mm long.

Thorax. Wings: length: 3.00–3.30 mm ($n = 8$).

Abdomen (Fig. 12): 1st–7th tergites as in male; 8th tergite not sclerotized, with basal pair of trichoid sensilla and distal row of setae. 2nd–7th sternites as in male, 8th sternite not sclerotized, with basal pair of trichoid sensilla and a row of distal setae.

Ovipositor (Fig. 13) barely protrusible, 0.18–0.21 mm long (from basal margin of segment 9 to cerci apex) ($n = 3$), cerci separate elongate-ovoid, 0.07–0.08 mm long ($n = 4$) and setose, hypoproct wide with setae and setulae.

Etymology. The name *indaiensis* refers to the type locality.

Material examined. Holotype male. Brazil, Minas Gerais: Dores do Indaiá, IV.2009, L. Oliveira col., MNRJ. Paratypes, data as holotype– 10 males, 9 females, 18 pupal exuviae and 06 larvae, MNRJ.

Distribution. Brazil: Pernambuco (Tamandaré), Rio de Janeiro (Mangaratiba) and São Paulo (Bertioga) in Atlantic forest areas, and Minas Gerais (Dores do Indaiá) in Cerrado areas.

Comments. *Lopesia* includes adults with bare or setulose flagellomere necks. The new species has setulose flagellomeres neck as in *L. andirae*, *L. brasiliensis* Rübsaamen, 1908; *L. caulinaris* Maia, 2003; *L. conspicua* Maia, 2003; *L. davillae* Maia, 2017; *L. eichhorniae* Urso-Guimarães, 2014; *L. elliptica* Maia, 2013; *L. erythroxyli* Rodrigues & Maia, 2010; *L. linearis* Maia, 2003; *L. marginalis* Maia, 2001; *L. maricaensis* Rodrigues & Maia, 2010; *L. similis* Maia, 2004; *L. simplex* Maia, 2002; and *L. tibouchinae* Maia, 2004. Among them, nine species have male flagellomeres with basal and distal circumfila with well developed loops and midcircumfila with shorter loops or without loops (linear circumfila), namely: *L. andirae*, *L. conspicua*, *L. davillae*, *L. eichhorniae* Urso-Guimarães, 2014, *L. linearis*, *L. marginalis*, *L. similis*, *L. simplex* and *L. tibouchinae*; two have gynecoid circumfila (*L. caulinaris* and *L. elliptica*), three including the new species have all circumfila with developed loops (*L. erythroxyli*, *L. brasiliensis* and the new species) and a single one, *L. maricaensis*, has all circumfila with reduced loops.

Adults of the new species differ from those of *L. erythroxyli* and *L. brasiliensis* mainly by the shape of male terminalia. Gonocoxites, gonostyli and aedeagus are wider in *L. indaiensis* than in the others; the hypoproct of the new species has longer lobes than those of the others, and its cercal lobes are convergent (divergent in the two other species). Pupae differ mainly in the shape and length and of the antennal projections (slightly serrated and conspicuously longer in *L. indaiensis*, not serrated and shorter in the others), shape of the apical plate (deeply bilobed only in the new species), and number of abdominal dorsal spines (none in *L. indaiensis*, several in *L. brasiliensis* and *L. erythroxyli*). Besides, the prothoracic spiracles are clearly shorter in the new species than in *L. brasiliensis*.

As *L. andirae* and *L. indaiensis* are the only two congeneric species associated with *Andira* Lam., both are compared: larva – the spatula teeth of *L. andirae* are far apart from each other, while those of *L. indaiensis* are more closely approximated and the spatula basis of the former is narrow while in the latter is anchor-shaped; pupa – the vertical plate conspicuously more deeply bilobed at upper margin in *L. indaiensis*, the antennal projections have serrated inner margin only in the new species, the prothoracic spiracle is clearly longer in the new species (0.16 mm in *L. andirae* and 0.25–0.35 mm in *L. indaiensis*), as well as the apical setae (0.06 mm in *L. andirae* and 0.07–0.13 mm in *L. indaiensis*); male – the medial circumfilum has short whorls while in the new species they are long, the 8th tergite of *L. andirae* is setose whereas that of *L. indaiensis* has no setae, the cercus of *L. andirae* is more acute than that of the new species and the hypoproct has sinuous margin while in *L. indaiensis* its margin is rounded; and female – the circumfila of *L. andirae* are more sinuous than that of the new species, the 8th tergite of *L. andirae* has no setae whereas that of *L. indaiensis* has a distal row of setae and a basal pair of trichoid sensilla (not described in *L. andirae*).

Conflicts of interest

The authors declare no conflicts of interest.

Acknowledgments

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