

The genus *Ptiloneura* Enderlein, 1901 (Psocodea, 'Psocoptera', Ptiloneuridae) in the Brazilian Amazon Forest and Atlantic Forest: new species, variations in forewings and a key to the species

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COUVERTURE / *COVER*:

Right forewing of *Ptiloneura leonardoï* n. sp., detail.

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The genus *Ptiloneura* Enderlein, 1901 (Psocodea, 'Psocoptera', Ptiloneuridae) in the Brazilian Amazon Forest and Atlantic Forest: new species, variations in forewings and a key to the species

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ABSTRACT

The ptiloneurid genus *Ptiloneura* Enderlein, 1901 presently includes 34 species, and only one is recorded from Brazil. Two new Brazilian species of this genus, *P. castroi* n. sp. (Pará: Marabá, Serra Norte) from Amazon Forest and *P. leonardo* n. sp. (Santa Catarina: Nova Teutônia) from Atlantic Forest, are here described and illustrated. We discuss on the forewing venation variation for *P. leonardo* n. sp. and for another, already known species, i.e. *P. baiana* (Silva-Neto, García Aldrete & Rafael, 2018). We also provide an identification key and a geographic distribution map for the Brazilian species. The new species of *Ptiloneura* constitute the first record for the Brazilian Amazon Forest and the second record for the Atlantic Forest. The number of species of *Ptiloneura* is raised to 36, of which 25 species are Colombian, three species each are found in Brazil and Peru, one species each from Nicaragua and Venezuela and the three last species are shared by Colombia, Peru, and Venezuela.

RÉSUMÉ

Le genre Ptiloneura Enderlein, 1901 (Psocodea, 'Psocoptera', Ptiloneuridae) dans la forêt amazonienne brésilienne et la forêt atlantique : nouvelles espèces, variations des ailes antérieures et clé des espèces.

Le genre *Ptiloneura* Enderlein, 1901 comprend actuellement 34 espèces, et une seule est signalée du Brésil. Deux nouvelles espèces brésiliennes de ce genre, *P. castroi* n. sp. (Pará : Marabá, Serra Norte) de la forêt amazonienne et *P. leonardo* n. sp. (Santa Catarina : Nova Teutônia) de la forêt atlantique sont ici décrites et illustrées. Nous discutons de la variation de la nervation de l'aile antérieure pour *P. leonardo* n. sp. et pour une espèce déjà connue, *P. baiana* (Silva-Neto, García Aldrete & Rafael, 2018). Nous fournissons également une clé d'identification et une carte de répartition géographique pour les espèces brésiliennes. Les nouvelles espèces de *Ptiloneura* constituent la première signalisation pour la forêt amazonienne brésilienne et la deuxième signalisation pour la forêt atlantique. Le nombre d'espèces de *Ptiloneura* passe à 36, dont 25 espèces sont colombiennes, trois espèces se trouvent au Brésil, trois autres au Pérou, une espèce au Nicaragua, une de plus au Vénézuéla, les trois dernières espèces étant communes à la Colombie, au Pérou et au Vénézuéla.

KEY WORDS

Neotropics,
South America,
Epipsocetae,
Psocids,
new record,
new species.

MOTS CLÉS

Néotropiques,
Amérique du Sud,
Epipsocetae,
Psocidés,
signalisation nouvelle,
espèces nouvelles.

INTRODUCTION

Ptiloneuridae Roesler, 1940 is one of the five families in the infraorder Epipsocetae Pearman, 1936 (Lienhard & Smithers 2002; Yoshizawa & Johnson 2014). This family is known from the Neotropical region and presently includes more than 270 species, distributed in 12 genera. One of these genera, *Ptiloneura* Enderlein, 1901, presently includes 34 species, 25 from Colombia, three from Peru, one species from Brazil, one from Nicaragua, one from Venezuela, two species are shared by Colombia and Peru, and one species by Colombia and Venezuela (González Obando *et al.* 2020). To date, the only Brazilian species recorded for the genus is *P. baiana* (Silva-Neto, García Aldrete & Rafael, 2018a) from the northeastern Atlantic Forest (Silva-Neto *et al.* 2018a) with both sexes described (Silva-Neto *et al.* 2021).

Ptiloneura was recently redefined by García Aldrete *et al.* (2020), who transferred eight species of *Loneura* Navás, 1927 to *Ptiloneura*, synonymized *Loneuroides* García Aldrete, 2006 and transferred all its eight species to *Ptiloneura* and described two new species in this genus. González Obando *et al.* (2020), described 15 species of *Ptiloneura*, 13 from Colombia, one from Peru, and one species shared by Colombia and Peru.

The purpose of this paper is to describe and illustrate two new species of *Ptiloneura* from Brazil, present the variation in the forewing venation for one of them, increase the knowledge of the variation in the forewing of *P. baiana*, provide an identification key to the Brazilian species based on male characters, and a geographic distribution map for the Brazilian species.

MATERIAL AND METHODS

Four specimens of *Ptiloneura* were available for study. Two males collected in the states of Pará (Brazilian Amazon Forest) and Santa Catarina (Atlantic Forest), and one male and one female collected in the state of Bahia (Atlantic Forest). They were dissected in 80% ethanol, and their parts were mounted on slides in Canada balsam. Standard measurements (in μm) were taken with a filar micrometer. The phallosome sclerites terminology and abbreviations follow González Obando *et al.* (2020).

The specimens were stored in CD boxes, as described by Silva-Neto *et al.* (2016a). Photographs of the mounted parts were taken with a Leica DFC500 digital camera attached to a Leica M205C stereomicroscope, connected to a computer with the Leica Application Suite LAS V3.6 software, which includes an Auto-Montage module (Synscopy software). The specimens studied specimens of the new species will be deposited in the Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA), and the specimens of *P. baiana* will be deposited in the Museu Nacional do Rio de Janeiro (MNRJ).

ABBREVIATIONS

Measurements

D and d antero-posterior and transverse diameter, respectively, of right compound eye in dorsal view of head;

FW, HW right fore- and hind- wing lengths;
 F, T, t1, t2, t3 lengths of femur, tibia and tarsomeres 1, 2 and 3 of right hind leg;
 f1...fn lengths of flagellomeres 1...n of right antenna;
 IO minimum distance between compound eyes in dorsal view of head;
 Mx4 length of fourth segment of right maxillary palpus;
 PO d/D; IO/d.

Institutions

INPA Instituto Nacional de Pesquisas da Amazônia, Manaus;
 MNRJ Museu Nacional do Rio de Janeiro, Rio de Janeiro.

SYSTEMATICS

Infraorder EPIPSOCETAE Pearman, 1936
 Family PTILONEURIDAE Roesler, 1940

Genus *Ptiloneura* Enderlein, 1901

Ptiloneura Enderlein, 1901: 147 (original description). — Smithers 1972: 109 (taxonomy). — Wolda & Broadhead 1985: 523 (ecology). — Lienhard & Smithers 2002 (world catalogue). — Yoshizawa 2002: 371 (morphology). — García Aldrete *et al.* 2020: 293 (taxonomy, phylogeny).

TYPE SPECIES. — *Ptiloneura bidorsalis* Enderlein, 1901, by original designation.

DIAGNOSIS. — See Enderlein (1901: 147) and García Aldrete *et al.* (2020: 293).

Ptiloneura castroi n. sp.
 (Fig. 1)

[urn:lsid:zoobank.org:act:FA5B33B0-07C9-4977-A47D-A7D40F9197A4](https://doi.org/10.21203/rs.3.rs-1917974/v1)

TYPE MATERIAL. — **Holotype.** Brazil • 1 ♂; Pará, Marabá, Serra Norte; 6°05'03.1"S, 50°10'35.5"W; XI.1982; Michael Miles leg.; Light trap; INPA.

HOLOTYPE CONDITION. — Mounted on microslide. The left fore- and hind- wings, legs, antennae, maxillary palps, left lateral sclerite of the hypandrium, side struts of the phallosome and remaining body parts missing.

ETYMOLOGY. — The species honors Jacinto Campos Moreira de Castro, born in the state of Pará, father of Marcelo Cutrim, for his support and fellowship.

GEOGRAPHICAL RECORDS. — Known only from the type locality, Brazil, Pará state, Marabá city, Serra Norte locality on Brazilian Amazon in northern Brazil.

DIAGNOSIS. — Posterior process of the central sclerite of the hypandrium stout, mid-sized, slightly concave distally; posterior side sclerites of the hypandrium long, curved, anteriorly rounded, posteriorly dilated, curved outward, acuminate (Fig. 1E). Mesal endophallic sclerite of the phallosome transverse, with lateral posterior processes club-shaped, with inner borders denticulate (Fig. 1F).

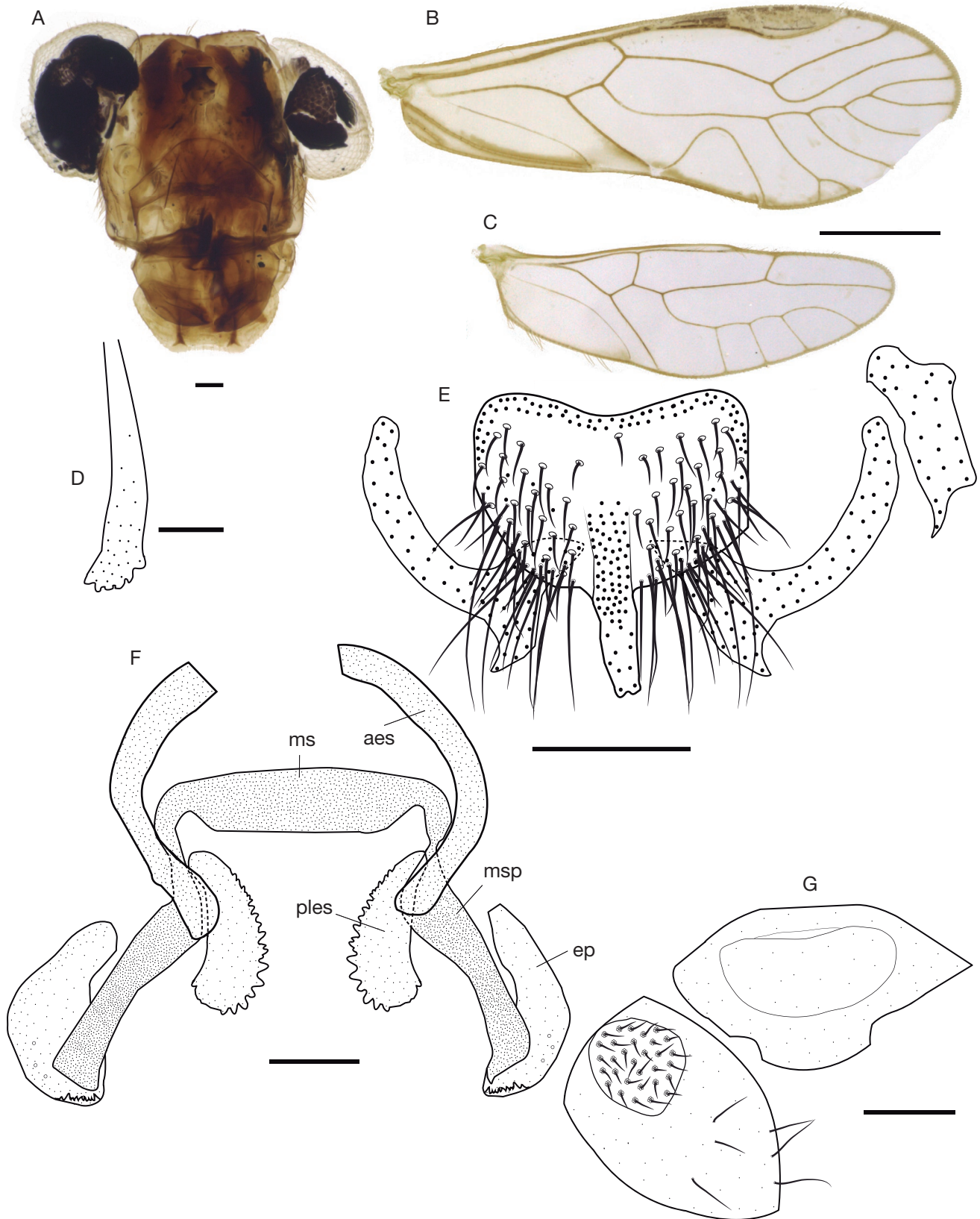


FIG. 1. — *Ptiloneura castroi* n. sp., holotype: **A**, front view of head; **B**, right forewing; **C**, right hindwing; **D**, lacinia; **E**, hypandrium; **F**, phallosome; **G**, left paraproct and epiproct. Abbreviations: **aes**, anterior endophallic sclerites; **ep**, external parameres; **ms**, mesal sclerite; **mSP**, mesal sclerite processes; **ples**, postero-lateral endophallic sclerites. Scale bars: A, D-G, 0.1 mm; B, C, 1 mm.

DESCRIPTION

Male (holotype)

Color. Compound eyes black, ocelli hyaline; head pattern (Fig. 1A). Forewings (Fig. 1B) veins brown, pterostigma brown, slender brown marginal band from M₅ to A2. Hindwings (Fig. 1C) almost hyaline, with a pale brown spot at CuP.

Morphology. Outer cusp of lacinial tips broad, with six short denticles (Fig. 1D). Forewing pterostigma long (Fig. 1B), narrow proximally, wider in the middle; areola postica wide, tall, apically rounded; Rs longer than its branches, almost straight, R₂₊₃ almost straight with a slight distal concave curve, R₄₊₅ with a median convex curve; M stem concave proximally, then almost straight, with five primary branches, M₅ distally forked, resulting in M_{5a} and M_{5b}. Hindwings (Fig. 1C) Rs almost straight, R₂₊₃ straight, R₄₊₅ with a slight concavity distally; M stem concave proximally with four primary branches. Hypandrium (Fig. 1E) of five sclerites, central sclerite broad, with anterior margin concave, with field of long macrosetae on each side of the longitudinal midline, that reach or surpass the apex of the median posterior process; posterior side processes long curved outward with a triangular posterior projection; lateral sclerite irregular. Phallosome (Fig. 1F) relatively simple, external parameres proximally slender, curved inward, wider distally, with rounded apices, bearing a field of pores and a row of little teeth at the posterior margin. Three pairs of endophallic sclerites, an anterior pair long, curved inward, with rounded end; a mesal with anterior and posterior margin almost straight, laterally curved, and strong narrowing, from where it arises a posterior process, these almost straight, distally dilated; a postero-lateral pair, short, curved outward, proximally, and distally rounded, with a row of strong teeth along inner margin. Epiproct (Fig. 1G) anteriorly convex, sides converging to posterior elongate process, setae absent. Paraprocts (Fig. 1G) straight based, lateral margins converging to pointed apex, with sensory fields with 31 trichobothria on basal rosettes, setae as illustrated.

Measurements (in microns). FW: 4551, HW: 3281, IO: 491, D: 536, d: 395, IO/d: 1.24, PO: 0.73.

Ptiloneura leonardo n. sp.
(Fig. 2)

[urn:lsid:zoobank.org:act:13EFDBFB-79B6-4C5A-AF4A-2E35DD9B941F](https://doi.org/10.21203/rs.3.rs-1328111/v1)

TYPE MATERIAL. — **Holotype.** Brazil • 1 ♂; Santa Catarina, Nova Teutônia; 27°09'1"S, 52°25'4"W; VI.1972; Fritz Plaumann leg.; INPA.

HOLOTYPE CONDITION. — Head, fore and hind wings, phallosome, hypandrium, epiproct, and paraproct mounted on microslide. The remaining body parts are preserved in 70% ethanol.

ETYMOLOGY. — The species honors Leonardo de Assis Castro, son of Marcelo Cutrim.

GEOGRAPHICAL RECORDS. — Known only from the type locality, Brazil, Santa Catarina state, Nova Teutônia city, on Atlantic Forest in southeastern Brazil.

DIAGNOSIS. — Central sclerite of the hypandrium with two curved, postero-lateral processes, distally acuminate, curved outward resulting in a U-shaped posterior concavity; side sclerites short, almost rectangular (Fig. 2G); forewings with a slender, marginal pigmented band from R₄₊₅ to areola postica (Fig. 2B); mesal endophallic sclerite of phallosome transverse, with large, median, pointed process, and long, slender, postero-lateral processes (Fig. 2F).

DESCRIPTION

Male (holotype)

Color. Compound eyes black, ocelli hyaline; head pattern (Fig. 2A). Scape and pedicel pale yellow, f1–f3 pale brown. Mx4 brown. Femora pale yellow; tibiae pale yellow with a brown band distally; tarsomeres 1-3 pale yellow. Forewing (Fig. 2B) veins brown, pterostigma brown with a median hyaline area, a brown spot in R₂₊₃ and R₄₊₅ at wing margin. Hindwings (Fig. 2C) hyaline.

Morphology. Outer cusp of lacinial tips broad, with seven short denticles (Fig. 2A). Right forewing (Fig. 2B) pterostigma narrow proximally, wider in the middle; areola postica wide, tall, apically rounded; Rs shorter than its branches, slightly concave, R₂₊₃ almost straight, R₄₊₅ with a median concave curve; M stem concave proximally, then almost straight, with six primary branches. Right hindwing (Fig. 2C) Rs almost straight, R₂₊₃ straight, R₄₊₅ with a median concave curve; M with four primary branches, M₂ forked. Left forewing (Fig. 2D) differing from the right forewing in having M stem with five primary branches, M₅ forked, resulting in M_{5a} and M_{5b}. Left hindwing (Fig. 2E) differing from the right hindwing in having the M stem with four primary branches. Hypandrium (Fig. 2G) of three sclerites, central sclerite with fields of long macrosetae on each side of the longitudinal midline, that do not reach the apices of the postero-lateral processes. Phallosome (Fig. 2F) side struts slender, V-shaped, anteriorly independent, long, narrow, distal ends almost triangular as an outward directed hook, not fused posteriorly to external parameres, these slender, proximally dilated, elongated, narrowing distally, with a field of pores and an apical end inwardly directed. Four pairs of endophallic sclerites, an anterior small pair with two acuminate projections, the longest directed inward almost touching in the middle and the short, directed outward; a lateral bow-shaped pair curved inward, proximally wide, triangular, distally narrow, with a radular end area; a posterior pair, long, slightly wide proximally, almost straight, slightly curved outward distally and a mesal triangular sclerite, with two wide lateral process distally rounded. Epiproct (Fig. 2H) rhomboid, with three short central setae, two long lateral and a set of posterior ones. Paraprocts straight based, broad, sensory fields with 33 trichobothria on basal rosettes, setae as illustrated (Fig. 2H).

Measurements (in microns). FW: 5503, HW: 3618, F: 1310, T: 2249, t1: 879, t2: 67, t3: 165, f1: 927, f2: 904, f3: 567, Mx4: 270, IO: 545, D: 489, d: 317, IO/d: 1.71, PO: 0.58.

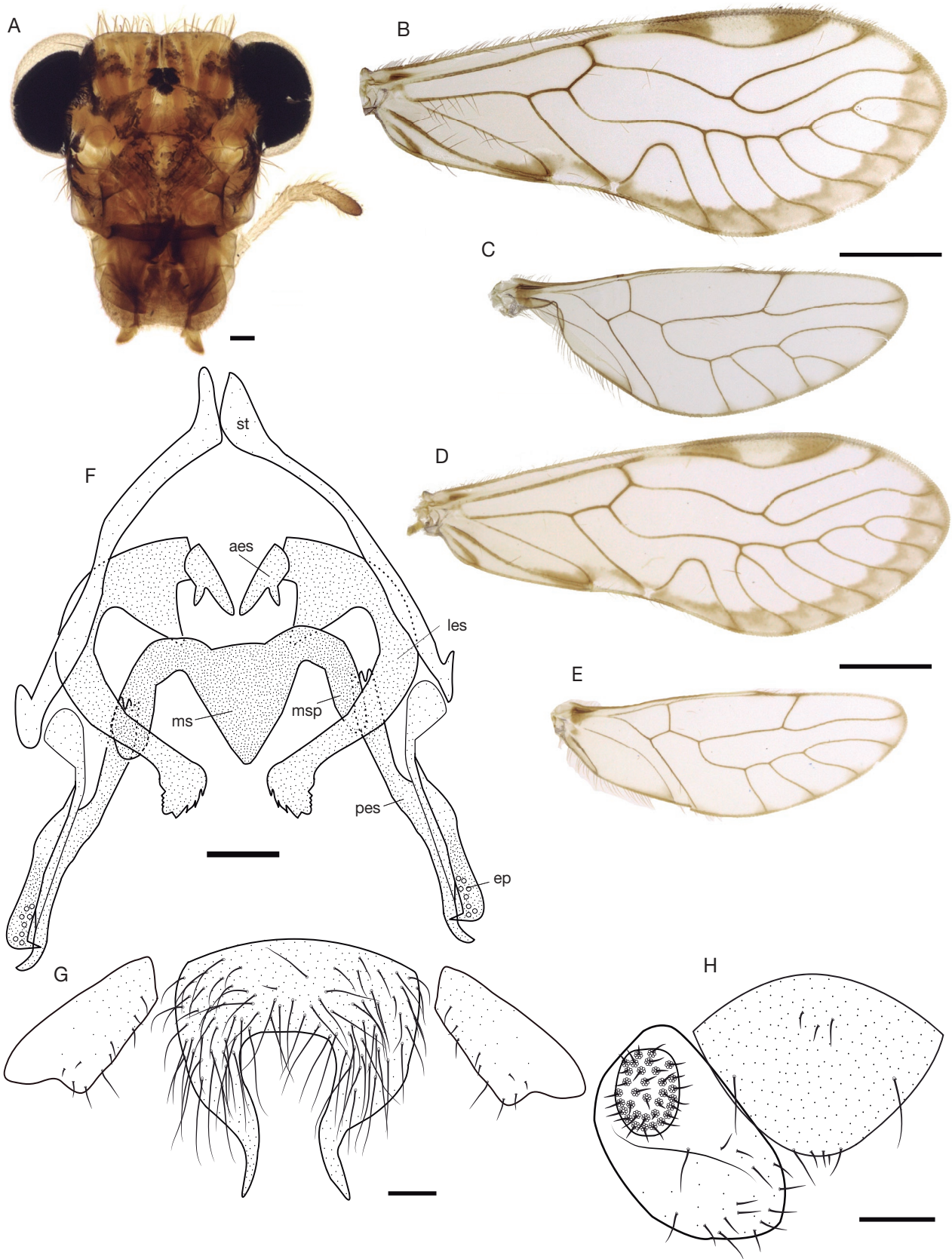


FIG. 2. — *Ptiloneura leonardoï* n. sp. holotype: **A**, front view of head; **B**, right forewing; **C**, right hindwing; **D**, left forewing; **E**, left hindwing; **F**, phallosome; **G**, hypandrium; **H**, left paraproct and epiproct. Abbreviations: **aes**, anterior endophallic sclerites; **ep**, external parameres; **les**, lateral endophallic sclerites; **ms**, mesal sclerite; **msp**, mesal sclerite processes; **pes**, posterior endophallic sclerites; **st**, side struts. Scale bars: A, F-H, 0.1 mm; B-E, 1 mm.

VARIATION. — There are variations in the fore and hindwing venation in this specimen as seen in the right forewing (Fig. 2B) with six primary branches differing from the left forewing (Fig. 2D) with five primary branches with M5 forked, resulting in M5_a and M5_b, and in the right hindwing (Fig. 2C) with four primary branches with M2 forked, resulting in M2_a and M2_b differing from the left hindwing (Fig. 2E) with four simple primary branches.

Ptiloneura baiana

(Silva-Neto, García Aldrete & Rafael, 2018)

(Fig. 3)

Loneuroides baianus Silva-Neto, García Aldrete & Rafael, 2018a: 2, figs 1-8 (original description).

Ptiloneura baianus – García Aldrete *et al.* 2020: 2 (phylogeny and taxonomy). — González Obando *et al.* 2020: 2 (taxonomy).

Ptiloneura baiana – Silva-Neto & García Aldrete 2020: 4 (checklist and nomenclatural amendment). — Silva-Neto *et al.* 2021: 45, figs 1-11 (taxonomy).

MATERIAL EXAMINED. — Brazil • 1 ♂; Bahia, Camacan, Reserva Particular do Patrimônio Natural Serra Bonita; 15°25'06"S, 39°28'58"W; light trap; 15.II.2013; Calor & Gomes leg.; MNRJ • 1 ♀; same data as for the male; MNRJ.

GEOGRAPHICAL RECORDS. — Known only from the type locality, Brazil, Bahia state, Camacan city, Reserva Particular do Patrimônio Natural Serra Bonita, on Atlantic Forest in northeastern Brazil.

VARIATION. — It is the first record of this species with a variation in the forewing venation in which the stem of the vein M has six primary branches and a crossvein between vein A2 and wing margin on the right and left forewings (Fig. 3D, E). Also is the first record of a spur vein before the above mentioned crossvein, only in the right forewing (Fig. 3D).

DISCUSSION

P. baiana, the first Brazilian *Ptiloneura*, was up to now known only from two specimens. A third specimen is now known from the type locality, increasing the knowledge of the variation in the forewing venation. This species has intraspecific variation in the forewing venation as above described. This third specimen differs from all the other known specimens by having a set of forewing venation characters different from both female holotype by the right forewing venation (Fig. 3A) and males described by Silva-Neto *et al.* (2021) by the right and left forewing venation (Fig. 3B, C). The color pattern

is the same in these three specimens, that proves that it is a good character to associate males and females (Fig. 3A-E). This use of the forewing color pattern to associate male and female is also made for the genus *Loneura* Navás, 1927 (Cutrim *et al.* 2021) and can probably be applied to the entire Ptiloneuridae family.

Ptiloneura leonardo n. sp. is the second species recorded from Brazil; it belongs to the assemblage of *P. dapaensis* Mendivil, García Aldrete & González Obando, 2017, and *P. quimbaya* Mendivil, García Aldrete & González Obando, 2017, among which it seems closer to the former by the hypandrium and phallosome characters. The asymmetries and variations of venation detected in this species also occur in different and same specimens of the same species and have already been reported to another species of the same genus, *P. columnaris* García Aldrete, González Obando & Carrejo, 2020 (García Aldrete *et al.* 2020). The same happened to species of other genera as in *Brasineura* Silva-Neto & García Aldrete, 2015 (Silva-Neto *et al.* 2016b, 2018b; Lima *et al.* 2018) and in *Loneura* (Cutrim *et al.* 2021) reinforcing the idea that this is a frequent phenomenon in the family Ptiloneuridae and because of that wing venation is not a good character for separating species from this family.

Ptiloneura castroi n. sp., is the third species recorded from Brazil; it belongs to the assemblage of *P. buitrerensis* González, Carrejo & García Aldrete, 2020, *P. cipeca* García Aldrete, Carrejo & Panche, 2020, *P. hineztrozai* González, Carrejo & Panche, 2020, *P. jinoteagaensis* García Aldrete, 2007, *P. kogui* García Aldrete, González & Carrejo, 2020, *P. mirandaensis* García Aldrete, 2007, and *P. tunkywasi* Carrejo, González & García Aldrete, 2020. The hypandrium of this species is related to *P. cipeca* and the phallosome is more similar to *P. kogui*. The external parameres have a highlighted row of little teeth at its posterior margin as if they were attachment structures with the posterior margin of the mesal sclerite processes.

Brazilian Amazon Forest has its first *Ptiloneura* species record, and Atlantic Forest has its second species record. These three Brazilian species of *Ptiloneura* have notorious distances from each other. *Ptiloneura baiana* recorded from Bahia state, in the north of the Atlantic Forest is distant about 1500 km from *P. castroi* n. sp. which is recorded from Pará state, in the Amazon Forset, and is distant about 1.800 km from *P. leonardo* n. sp. recorded from Santa Catarina state, in the south of the Atlantic Forest. The northern species *P. castroi* n. sp. is distant about 2300 km from the southern species *P. leonardo* n. sp. (Fig. 4).

KEY TO THE BRAZILIAN SPECIES OF *PTILONEURA* ENDERLEIN, 1901 (MALES)

1. Central sclerite of the hypandrium with one posterior projection (Fig. 1E) *P. castroi* n. sp.
— Central sclerite of the hypandrium with two posterior projections 2
2. Posterior projections of the hypandrium short, straight and acuminate distally resulting in a “V”-shaped posterior margin (see fig. 7 in Silva-Neto *et al.* 2021) *P. baiana* (Silva-Neto, García Aldrete & Rafael, 2018).
— Posterior projections of the hypandrium elongate, curved outward and acuminate distally resulting in a “U”-shaped posterior margin (Fig. 2G) *P. leonardo* n. sp.

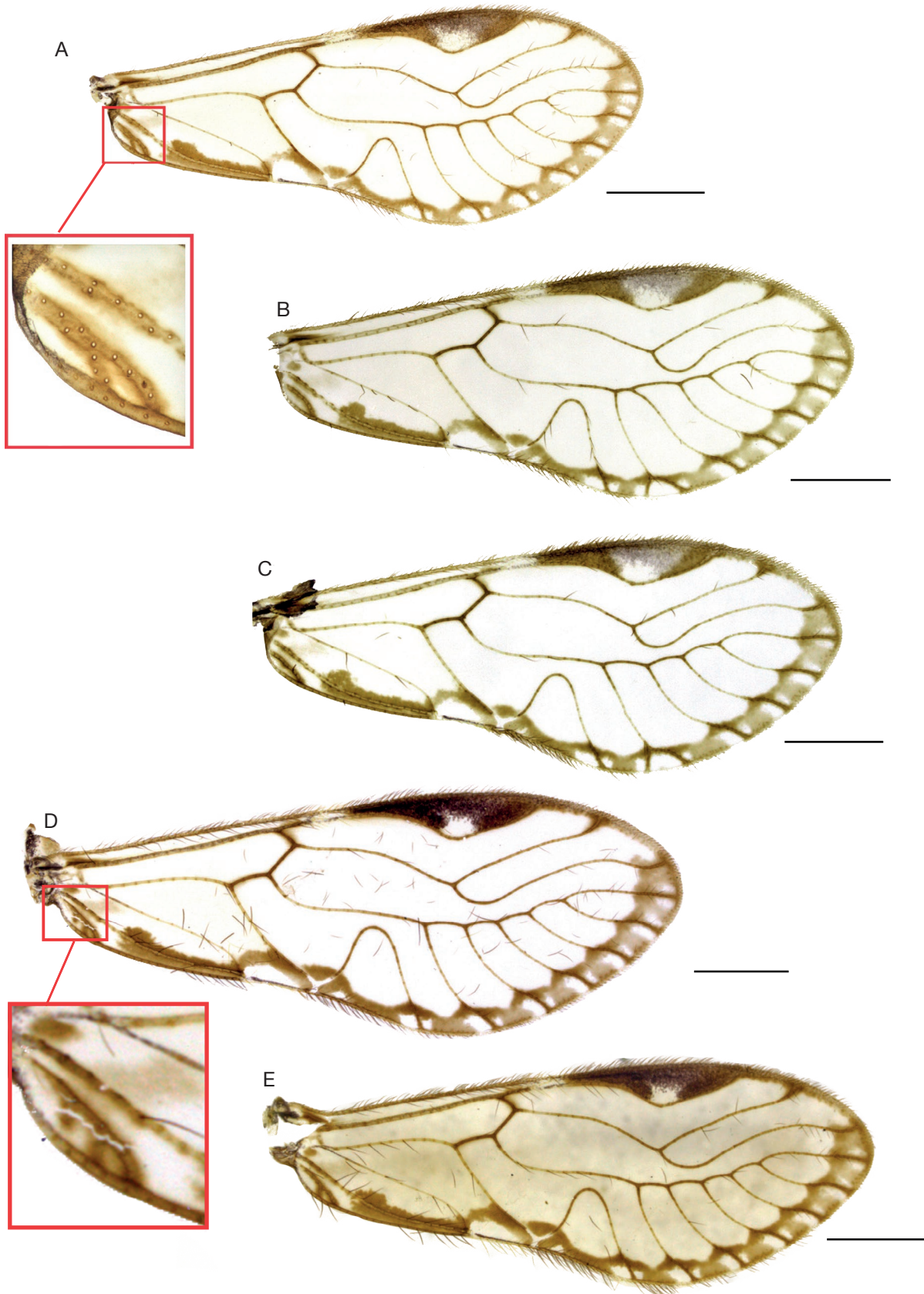


FIG. 3. — Variation of forewing venation in *Ptiloneura baiana* (Silva-Neto, García Aldrete & Rafael, 2018): **A**, right forewing with zoom on crossvein between A2 and wing margin of female holotype (Silva-Neto *et al.* 2018a); **B**, right forewing of male specimen B of Silva-Neto *et al.* 2021; **C**, left forewing of male specimen B of Silva-Neto *et al.* 2021; **D**, right forewing of male with zoom at the spur vein; **E**, left forewing of male. Scale bars: 1 mm.

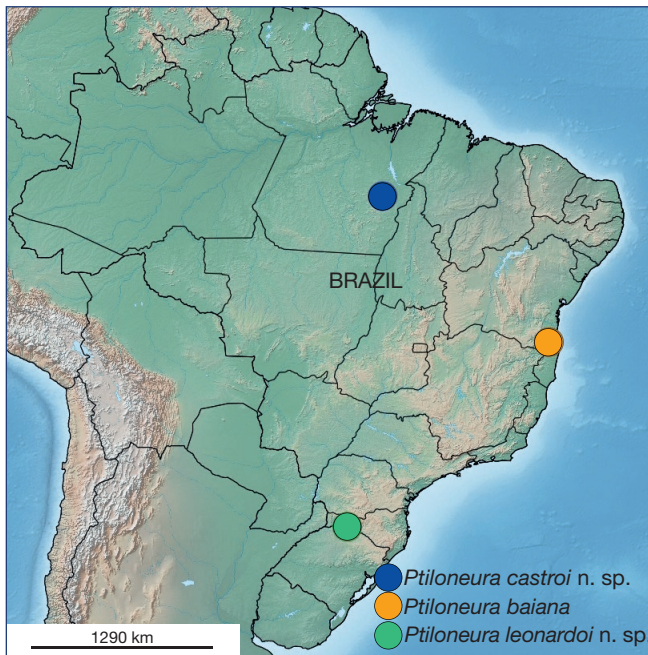


Fig. 4. — Distribution of Brazilian *Ptiloneura* Enderlein, 1901 species.

The number of species of *Ptiloneura* increases to 36, of which 25 (69.5%) are Colombian, three species each are from Brazil and Peru (17%), one species each from Nicaragua and Venezuela (5.5%) and three species are recorded in more than one country (Colombia, Peru, and Venezuela) as stated above (8%).

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