









First record and description of the female genitalia of *Palingonalia subta* Freytag & Vargas, 2007 (Hemiptera, Cicadellidae, Cicadellini) from Amazonas state, Brazil, and distribution map for the genus

ALEXANDRE CRUZ DOMAHOVSKI^{1*}, LUÍSA ALASMAR², RODNEY RAMIRO CAVICHIOLI², ANDRIELLI OLIVEIRA³, JEFFERSON MARCELO ARANTES-DA-SILVA⁴, SÂMIA LETICIA REOLON DA CRUZ³, NAYANE SILVA DE OLIVEIRA⁴, TORBJØRN HAUGAASEN⁵, CARLOS A. PERES⁶, ANDRESSA PALADINI²


¹ Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro, RJ, Brazil • ACD: domahovskiac@yahoo.com.br  <https://orcid.org/0000-0003-4588-4236>

² Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, PR, Brazil • LA: lualasmar@gmail.com <https://orcid.org/0000-0001-8210-1080> • RRC: cavich@ufpr.br  <https://orcid.org/0000-0001-5996-0629> • AP: andri.paladini@gmail.com  <https://orcid.org/0000-0001-8894-6092>

³ Programa de Pós-graduação em Biodiversidade Animal, Universidade Federal de Santa Maria, Santa Maria, RS, Brazil • AO: bio-and91@gmail.com  <https://orcid.org/0009-0009-9246-1317>

⁴ Programa de Pós-Graduação em Ambiente e Sistema de Produção Agrícola, Universidade do Estado de Mato Grosso, Tangará da Serra, MT, Brazil • JMAS: jefferson.m.a.da.silva@gmail.com <https://orcid.org/0000-0002-7384-5341> • SLRC: samiac16@gmail.com  <https://orcid.org/0000-0001-6244-035X> • NSO: nayaneoliveira07@gmail.com  <https://orcid.org/0000-0001-5990-7502>

⁵ Faculty of Environmental Sciences and Natural Resource Management, Norwegian University of Life Sciences, Ås, Norway • TH: torbjorn.haugaasen@nmbu.no <https://orcid.org/0000-0003-0901-5324>

⁶ School of Environmental Sciences, University of East Anglia, Norwich, Norfolk, United Kingdom • CAP: c.peres@uea.ac.uk  <https://orcid.org/0000-0002-1588-8765>

* Corresponding author

Abstract. *Palingonalia* Young, 1977 is a small, poorly known genus of Neotropical leafhoppers comprising only three described species. Here, we describe for the first time the female genitalia of *Palingonalia* and provided the first record of *P. subta* Freytag & Vargas, 2007 from Amazonas state, Brazil. Additionally, a distributional map for the genus, discussion about its distribution, and key to species are provided.

Keywords. Amazon forest, Auchenorrhyncha, biodiversity, leafhoppers, Neotropical Region, taxonomy

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Introduction

Tropical forests represent the greatest knowledge frontier in advancing contemporary biodiversity science on Earth. Amazonian upland forests likely host the least investigated of tropical forest biotas, particularly in terms of the Linnean knowledge deficit (Moura and Jetz 2021), due to gaps in sampling effort across the region (Carvalho et al. 2023).

The Cicadellidae represent a family of insects that feed on a wide variety of shrubs, grasses, and woody plants, and it is currently the largest known extant family of Hemiptera with more than 2,500 genera and 21,000 species worldwide (Bartlett et al. 2018). According to Nielson and Knight (2000), the family's distribution spans all zoogeographic regions, with its greatest diversity in the Neotropical and Afrotropical realms. The subfamily Cicadellinae comprises two tribes: the

New World Proconiini and the worldwide Cicadellini; the latter tribe presents about 2,300 species distributed in 319 genera (Young 1977; Bartlett et al. 2018). In Brazil, 98 genera and 455 species of Cicadellini have been recorded (Takiya et al. 2023). This includes the small Neotropical genus *Palingonalia*; this genus was erected by Young (1977) to accommodate *Tettigonia bigutta* Signoret, 1854, which was based on specimens from French Guiana and Bahia state, Brazil. Later, *P. subta* Freytag & Vargas, 2007 and *P. hypera* Freytag & Vargas, 2007 were described based on specimens from Colombia. The genus is considered closely related to *Soosiulus* Young, 1977 due to their external resemblance, but *Palingonalia* can be differentiated by the long median sclerite beyond the connective, the lobate aspect of the male sternite VIII, and the acute second valvulae of females (Young 1977).

In this contribution, we describe the colour polymorphism together with a detailed description of the female genitalia of *P. subta*. We also provide updated occurrence map, including the first record for Amazonas state, Brazil. To enrich the knowledge of this leafhopper genus, we discuss morphological aspects also observed in *Soosiulus* Young, 1977.

Methods

The studied specimens are deposited in the Coleção Entomológica Pe. Jesus Santiago Moure, Universidade Federal do Paraná, Curitiba, Brazil (DZUP). The descriptive terminology adopted herein follows Young (1968, 1977). Terms for female terminalia structures are those of Hill (1970) and Davis (1975). Techniques used for the dissection of genitalia followed Oman (1949), with modifications described by Cavichioli and Takiya (2012). Digital images of habitus were obtained with a Leica MZ12.5 stereomicroscope with attached ToupTek SCMO5-05100KPB eyepiece camera. Images were focus stacked using CombineZ5 software. First and second valvulae with gonoplares were separated and mounted on a temporary slide and then photographed using the same eyepiece camera as above attached to a Nikon optical microscope at 40 and 100× magnification.

The *Palingonalia* distribution map was created in QGIS v. 3.16.4 (<https://qgis.org/>) using the following shapefiles: Neotropical regions of Morrone (2022) with the biogeographical regionalization provided by Lowenberg-Neto (2014). The distribution records of the genus were taken from GBIF (<https://www.gbif.org/>) and from label data of the specimens. In total, we include 57 distribution occurrences.

Results

Genus *Palingonalia* Young, 1977

Palingonalia Young 1977: 427.

Diagnosis. (1) Black and orange leafhoppers; (2) subgenital plate short, nearly as long as wide, with

uniseriate row of macrosetae, inner margin with triangular process directed inward of pygofer; (3) connective T-shaped with stem very long, extending posteriorly much beyond styles apices; (4) style short, truncated apically; (5) aedeagus falciform, ending as a long and slender apical process, directed ventrally, that usually can be seen in unclarified specimens, surpassing the pygofer margins; (6) gonopore opening subapically on posterior margin of the apical process; (7) paraphysis slender, standing dorsally and articulated with aedeagus; (8) female sternite VII with posterior margin produced, tapering to apex.

Species of *Palingonalia*

P. bigutta (Signoret, 1854): 6 (*Tettigonia*). Brazil (Bahia), French Guiana.

P. hypera Freytag & Vargas, 2007: 225. Colombia.

P. subta Freytag & Vargas, 2007: 223. Brazil (Amazonas [new record]), Colombia.

Key to species of *Palingonalia*

- 1 Colour predominantly orange; dorsum with 3 large black maculae: 1 trapezoid near posterior margin of head, extending to anterior portion of pronotum; 1 rectangular on posterior margin of pronotum, covering all mesonotum and extending to adjacent portion of clavus; and 1 forming a triangle on midlength of claval commissure; forewing with a large black stripe extending from base of corium to near apex (Young 1977: 428, fig. 347a). Female sternite VII abruptly tapering to a produced, truncated apex (Young 1977: 428, fig. 347i) ***P. bigutta***
- Colour predominantly black; pronotum with pair of oblique lateral orange stripes; forewing frequently with a short orange stripe on clavus, near apex of scutellum (may be absent); with 2 long, longitudinal, orange stripes, with 1 on clavus, extending from base to apex, and 1 on corium, extending from near base to near apex (Fig. 1A–D). Female sternite VII with apex not as above **2**
- 2 Pronotum with median, U-shaped, orange macula near posterior margin (sometimes reduced, fragmented, or absent); mesonotum completely black (Fig. 1A, C). Male pygofer rounded apically (Freytag and Vargas 2007: 225, fig. 5). Female sternite VII narrowing to bifurcate apex (Fig. 2A, B) ***P. subta***
- Pronotum with median, orange, macula near anterior third; mesonotum with a median, small, orange macula on anterior margin (Freytag and Vargas 2007: 224, fig. 2). Male pygofer apically truncated (Freytag and Vargas 2007: 225, fig. 6). Female sternite VII narrowing to somewhat pointed apex (Freytag and Vargas 2007: 224, fig. 4) ***P. hypera***

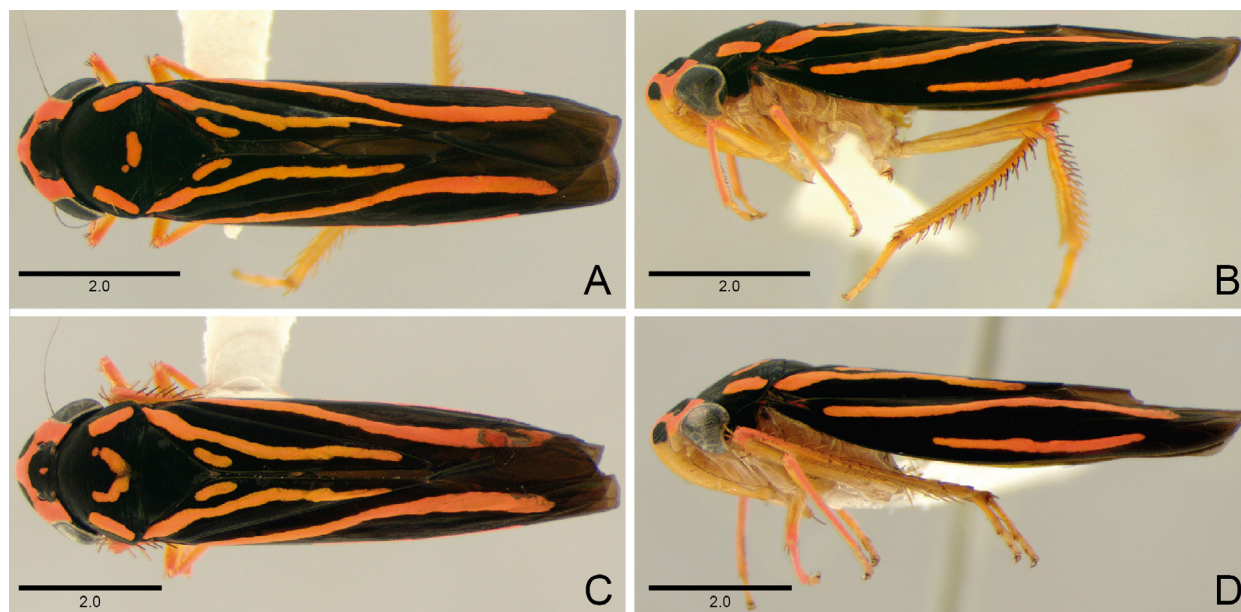


Figure 1. *Palingonalia subta* Freytag & Vargas, 2007. **A, B.** Habitus of male. **C, D.** Habitus of female. **A, C.** Dorsal view. **C, D.** Lateral view. Scales in mm.

Palingonalia subta Freytag & Vargas, 2007

Figures 1, 2

Materials examined. BRAZIL – Amazonas • Alvarães, Marizal; 04°51'06"S, 066°36'20"W; 23–27.VI.2022; L.A. Oliveira leg.; Malaise trap; 12 ♂, DZUP • Carauari, Lago Surara, 04°31'03"S, 066°44'53"W, 30.VI–03.VII.2022; L.A. Oliveira leg.; Malaise trap; 2 ♂, 1 ♀, DZUP.

Identification. The key to genera of Cicadellini provided by Young (1977) was used to determine *Palingonalia*. The species was identified as *P. subta* (by RRC) based on the morphological comparison using overall coloration and male and female genitalia versus those in the original description of Freytag and Vargas (2007).

Colour polymorphism. The shape of the orange maculae (Fig. 1A–D) can vary among specimens and between sides of the same specimen. The typical U-shaped macula of the pronotum (Fig. 1A, C) and stripes of forewings can be uniform or fragmented. Also, in some specimens, the pronotal U-shaped macula is reduced (Fig. 1A) or even absent.

Female terminalia. Sternite VII (Fig. 2A–C), triangular, strongly tapering towards apex; apical half with median carina and distinctly more sclerotized than basal half; lateral margins slightly emarginate at level of division between apical sclerotized and basal portions; apex forming pair of short branches. “Internal” sternite VIII membranous, without distinct sclerites. Pygofer (Fig. 2B, C) long, in lateral view, surface with several macro setae along ventral half; apex tapered and subacute. First valvifer (Fig. 2D) about as long as high, somewhat elliptical; posterior margin broadly rounded; outer surface with few denticuli near base (Fig. 2E) and distal 3/4 smooth (Fig. 2F). First valvula (Fig. 2D), narrow, 11.5× longer than high, slightly enlarged subapical, curved dorsally near base and straight distally;

ventral interlocking device extending to apical third and slightly curved ventrally at apex (Fig. 2G); dorsal sculptured area (Fig. 2G, H) extending from basal portion to apex of blade, formed mostly by scale-like processes arranged in oblique lines; ventral sculptured area (Fig. 2H) restricted to the apical portion of blade, formed by few scale-like processes; apical portion (Fig. 2H) gradually tapering to acute apex. Second valvula (Fig. 2I–L) broadened beyond basal curvature, narrowing slightly toward apex; blade 7× higher than long; ventral margin approximately rectilinear; dorsal margin slightly rounded, with approximately 30 triangular continuous teeth, extending from expanded basal portion to apical portion of blade; teeth near base of blade rounded, without ducts extending ventrally; denticles distributed on teeth and on apical portion of blade; ventral dentate apical portion distinctly shorter than dorsal portion; blade with ducts attaining teeth or terminating below them, also extending to apex; preapical prominence distinct, obtuse. Second valvifer (Fig. 2M) narrow, 2.6× longer than wide. Gonoploc (Fig. 2M) 5.5× longer than high; dorsoapical margin 1/2 length of gonoploc, mostly straight, slightly curving ventrally near apex; outer surface (Fig. 2N) with many spiniform cuticular projections and scattered short setae along ventral margin; ventral margin nearly straight; apex narrowed and rounded.

General distribution. Brazil, Colombia, and French Guiana.

Distribution known in Brazil. Amazonas and Bahia states.

Discussion

The type species of *Palingonalia*, *P. bigutta*, has similar orange bands to those exhibited by species of *Soosiulus*,

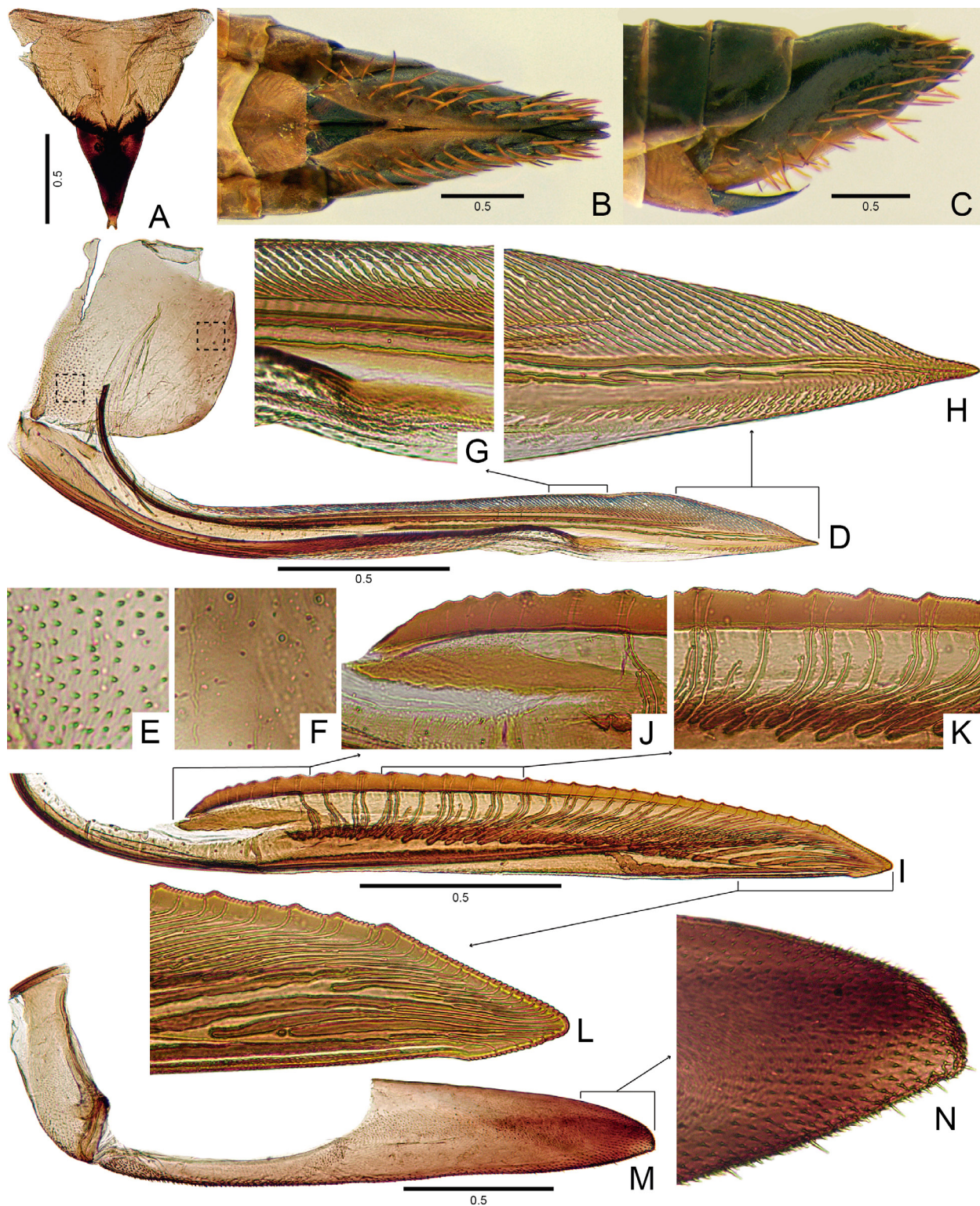


Figure 2. *Palingonalia subta* Freytag & Vargas, 2007, female terminalia. **A.** Sternite VII, ventral view. **B.** Distal portion of abdomen, ventral view. **C.** Distal portion of abdomen, lateral view. **D.** First valvifer and first valvula, lateral view. **E, F.** Outer surface of first valvifer. **E.** Sculpturation of basal portion. **F.** Sculpturation of distal portion. **G.** Terminal portion of ventral interlocking device. **H.** Apical portion of first valvula. **I.** Second valvula, lateral view. **J.** Teeth of basal portion. **K.** Teeth of median portion. **L.** Apical portion of second valvula. **M.** Second valvifer and gonoplac, lateral view. **N.** Apical portion of gonoplac. Scales in mm.

but *P. bigutta* differs from *Soosiulus* by the characters given in the diagnosis. *Palingonalia subta* and *P. hypera* have mainly black colouration, with narrow orange stripes, not broad bands, as found in *Soosiulus*. In addition to colour, the male genitalia in the *Soosiulus* does

not have an aedeagus with a long narrow apical process, have a long subgenital plate, have an elongate style tapering to acute apex, and have a paired paraphyses. Young (1977: 428) described male *Palingonalia* structures as “connective T-shaped, the stalk extending posteriorly

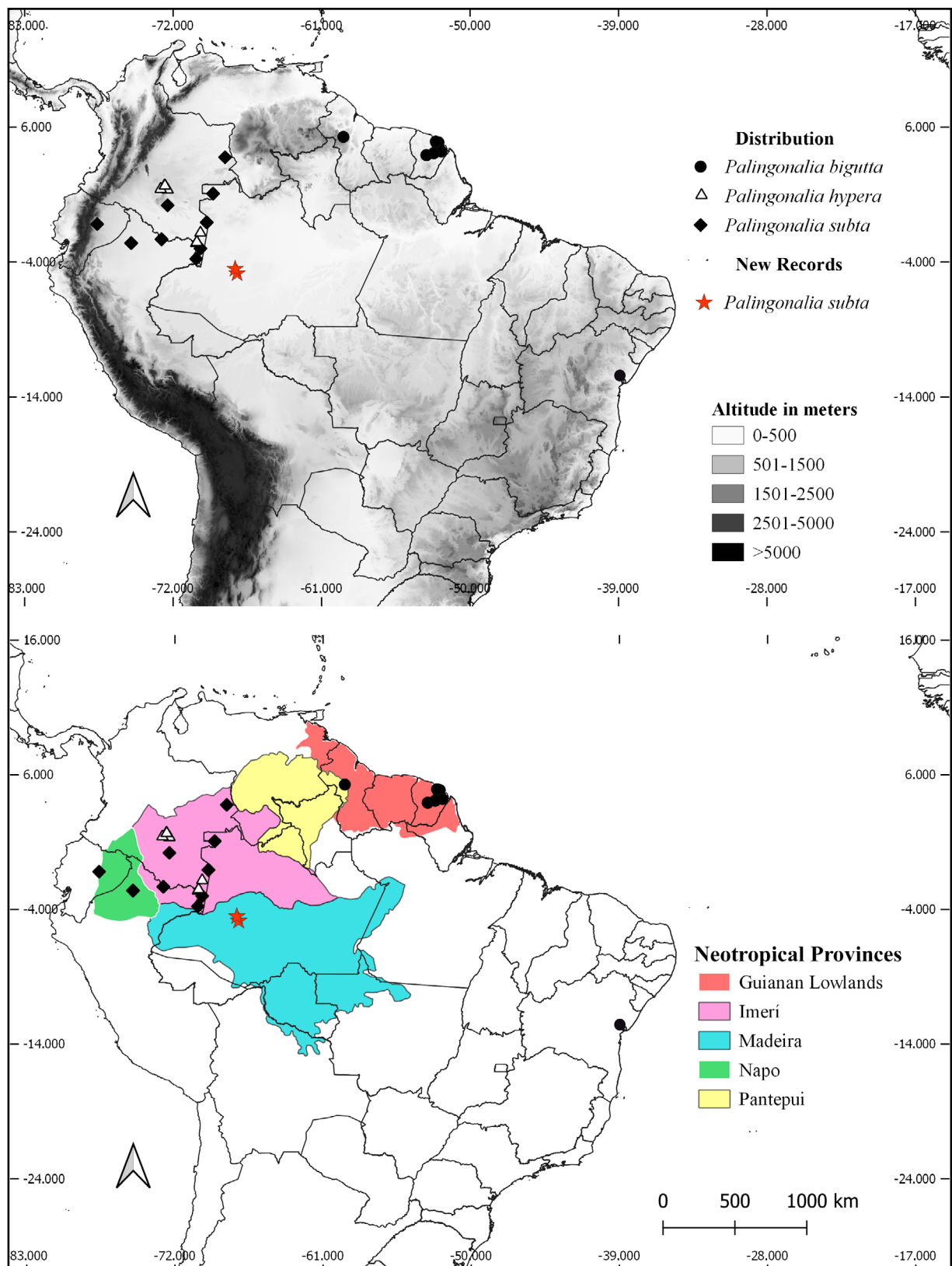


Figure 3. Distribution records of *Palingonalia* Young, 1977.

much beyond the style apices and articulating with a slender median sclerotized structure that extends dorsally and articulates with aedeagus". Furthermore, the description also mentions "paraphysis absent (perhaps represented by extra segment of aedeagus described above)" (Young 1977: 428). However, Young (1968: 13) described the paraphysis as "an accessory genital

structure, that most commonly occur between the apex of connective and the base of aedeagus they occasionally are reduced to a platelike structure which may appear as an extra sclerite between connective and aedeagus". After examining specimens of *P. subta* and comparing with the illustrations of *P. bigutta* and *P. hypera*, we conclude that a long, slender paraphysis is present.

Another characteristic used by Young (1977) to differentiate between *Palingonalia* and *Soosiulus* was the bilobate aspect of the male sternite VIII in *P. bigutta*. However, in the other two species of *Palingonalia*, this feature is absent.

Palingonalia is largely distributed across the northern part of South America, within the Boreal Brazilian Dominion and the South Brazilian Dominion, two domains specified by Morrone (2022). The distribution of this genus includes records from Ecuador, Peru, Colombia, northern Brazil, Guyana, and French Guiana. More specifically, *P. bigutta* is distributed in the Guianan Lowland Province, with a record in Guyana (Kaieteur National Park) at an elevation of 610 m. The other records come from French Guiana, at elevations of 20–158 m, with two of them from the Nouragues National Nature Reserve. *Palingonalia hypera* occurs in the Imeri Province in Colombia at 97–420 m. *Palingonalia subta* has the broadest distribution and the most records of the three *Palingonalia* species. This species is found in the provinces of Napo, Imeri, and Madeira, occurring in Ecuador, Colombia, and northern Brazil, respectively. The two new records described here show that the species is also present in the Amazon region.

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Author Contributions

Conceptualization: ACD, AP. Data curation: ACD, LA, AP. Funding acquisition: TH, CAP. Investigation: ACD, LA, AP. Methodology: ACD, LA, AP. Resources: RRC. Supervision: ACD, AP. Visualization: ACD, AP. Writing – original draft: ACD, LA, AP. Writing – review and editing: ACD, LA, RRC, AO, JMAS, SLRC, NSO, TH, CAP, AP.

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