European Journal of Taxonomy 677: 1–11
https://doi.org/10.5852/ejt.2020.677
ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2020 · Desidério G.R. *et al.*

Research article

urn:lsid:zoobank.org:pub:21205634-5160-48F3-B605-649AD771C58C

Triplectides Kolenati (Trichoptera: Leptoceridae) from Brazil: A new species, new records and an identification key

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Abstract. The long-horned caddisfly genus *Triplectides* Kolenati, 1859 is the most species-rich within Triplectidinae, comprising about 90 species. Eight species have been recorded so far in Brazil, mainly distributed in the Southeast Region, and only one species has been recorded from the North Region. In this paper a new species of *Triplectides* is described and illustrated, *Triplectides nessimiani* Desidério & Pes sp. nov., based on adult males from Serra do Aracá, Amazonas, Brazil. We also provide the first record for Brazil of *T. neblinus* Holzenthal, 1988 and *T. nevadus* Holzenthal, 1988. In addition, an updated identification key to *Triplectides* species with occurrence in Brazil is presented.

Keywords. Aquatic insects, Triplectidinae, long-horned caddisflies, Neotropical, Amazon.

Desidério G.R., Pes A.M., Barcelos-Silva P. & Hamada N. 2020. *Triplectides* Kolenati (Trichoptera: Leptoceridae) from Brazil: A new species, new records and an identification key. *European Journal of Taxonomy* 677: 1–11. https://doi.org/10.5852/ejt.2020.677

Introduction

Leptoceridae Leach, 1815, or long-horned caddisflies, is one of the three largest trichopteran families. Four subfamilies are currently recognized: Leptorussinae Morse, 1981, Grumichellinae Morse, 1981, Leptocerinae, and Triplectidinae Ulmer, 1906 (Malm & Johanson 2011), of which the latter three occur in the Neotropical Region (Holzenthal & Calor 2017).

Triplectides Kolenati, 1859, with about 90 species worldwide, is the most species-rich genus within Triplectidinae (Morse 2018). The genus is characterized in the adult stage by an apically broad discoidal cell that usually extends posteriorly and a thyridial cell two or three times as long as the discoidal cell in the forewing, and male inferior appendages with mesal and basoventral processes or lobes (Morse & Neboiss 1982; Holzenthal 1988). *Triplectides* larvae build cases of a hollowed-out twig or from the discarded case of another trichopteran larva. Larvae of this genus are shredders and inhabit pool areas in small streams (Holzenthal & Calor 2017).

The genus occurs in Central and South America, Southern-East Asia and Oceania. Its highest diversity occurs in the Australian Region, with 15 species recorded from New Caledonia and 25 from Australia (Malm & Johanson 2008). In the Neotropical Region there are 17 species described, distributed from southern Mexico to southern Chile (Holzenthal & Calor 2017; Desidério *et al*. 2017). So far, eight species have been recorded from Brazil: *T. cipo* Henriques-Oliveira & Dumas, 2015, *T. egleri* Sattler, 1963, *T. gracilis* (Burmeister, 1839), *T. itatiaia* Dumas & Nessimian, 2010, *T. maranhensis* Desidério, Barcelos-Silva & Pes, 2017, *T. misionensis* Holzenthal, 1988, *T. neotropicus* Holzenthal, 1988 and *T. ultimus* Holzenthal, 1988 (Santos *et al*. 2019).

In this study, we describe and illustrate a new species of *Triplectides* based on adult males from Serra do Aracá, Amazonas state, Brazil. We also provide the first record for Brazil of *T. neblinus* Holzenthal, 1988 and *T. nevadus* Holzenthal, 1988. In addition, an updated identification key to species of *Triplectides* with occurrence in Brazil is presented.

Material and methods

Specimens were collected with Malaise traps (Gressit & Gressit 1962), Pennsylvania light traps (Frost 1957) and Suspended traps (Rafael & Gorayeb 1982). All collected specimens were preserved in 80% ethanol. In order to observe male genital structures, the abdomen was removed and cleared using hot 10% KOH as detailed by Blahnik & Holzenthal (2004). After clearing, the abdomen was examined with a Leica EZ4 stereo microscope; it was then stored in 80% ethanol in a plastic microvial, together with the remainder of the respective specimen.

Photographs were obtained using a Leica DMC4500 video camera attached to a Leica M205A stereo microscope using an LED illumination dome. Stacks of images of each structure were produced at different focal distances and then combined automatically into a single image with a greater depth of field using Helicon Focus® (version 6.7.1 Pro) stacking software. Stacked images of the genitalia were used as templates in Adobe Illustrator® to create vector graphic illustrations. Photographs and drawings were assembled into plates using Adobe Photoshop®.

The morphological terminology used for male genitalia follows that of Holzenthal (1988). The map showing the geographical distribution of the species was created using QGis ver. 2.18.10 free software.

The types and all other examined specimens are deposited at the Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil.

Abbreviations of genital structures:

ap. lo. = apicodorsal lobe
bv. lo. = basoventral lobe
me. lo. = mesal lobe
ph. bs. = phallobase
ph. sc. = phallotremal sclerite

pr. ap. = preanal appendages
2nd art. = second article

Institutional abbreviations

INPA = Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, Brazil
NMNH = National Museum of Natural History, Washington, DC, USA

Results

Class Insecta Linnaeus, 1758
Order Trichoptera Kirby, 1813
Suborder Integripalpia Martynov, 1924
Superfamily Leptoceroidea Leach, 1815
Family Leptoceridae Leach, 1815
Subfamily Triplectidinae Ulmer, 1906
Genus *Triplectides* Kolenati, 1859

Triplectides nessimiani Desidério & Pes sp. nov.
urn:lsid:zoobank.org:act:0B5D5E41-9729-47F5-8108-8CAD58114588
Figs 1–3

Diagnosis

The male of *Triplectides nessimiani* sp. nov. is similar to that of *T. ultimus* by fork I in the hindwing having a very short petiole and both having a short, subtriangular mesal lobe on the inferior appendage. However, in *T. nessimiani* sp. nov. the mesal lobe has a slightly acute lateral projection and 5–7 stout ventral setae in the middle region, whereas *T. ultimus* has bifid lateral projection and three stout ventral setae. Furthermore, the new species can easily be distinguished by the preanal appendages, which are digitate with apices rounded (slender with apices pointed in *T. ultimus*), tergum X with apex obliquely truncated (rounded in *T. ultimus*) and phallotremal sclerite well developed, subpentagonal-shaped in dorsal view (simple in *T. ultimus*).

Etymology

The new species is named in honor of Prof. Dr. Jorge Luiz Nessimian (Universidade Federal do Rio de Janeiro, Brazil) who helped collect the type specimens and in recognition of his contributions to the study of the Neotropical caddisflies.

Material examined

Holotype

BRAZIL • ♂; Amazonas, Barcelos, Parque Estadual Serra do Aracá, Igarapé da Anta (#S05); 00°54′38.70″ N, 63°25′54.70″ W; alt. 1130 m; 26 Jul.–2 Aug. 2009; N. Ferreira Jr, J.L. Nessimain, F.F. Salles, A.P.M. dos Santos, U.G. Neiss and J.O. da Silva leg.; Malaise trap; INPA-TRI 000014.

Paratype

BRAZIL • 1 ♂; Amazonas, Barcelos, Parque Estadual Serra do Aracá, Igarapé de 1º ordem (#S03); 00°54′22.03″ N, 63°27′33.23″ W; alt. 1110 m; 23 Jul.–1 Aug. 2009; J.O. Silva, J.L. Nessimian and U.G. Neiss leg.; suspended trap; INPA-TRI 000015.

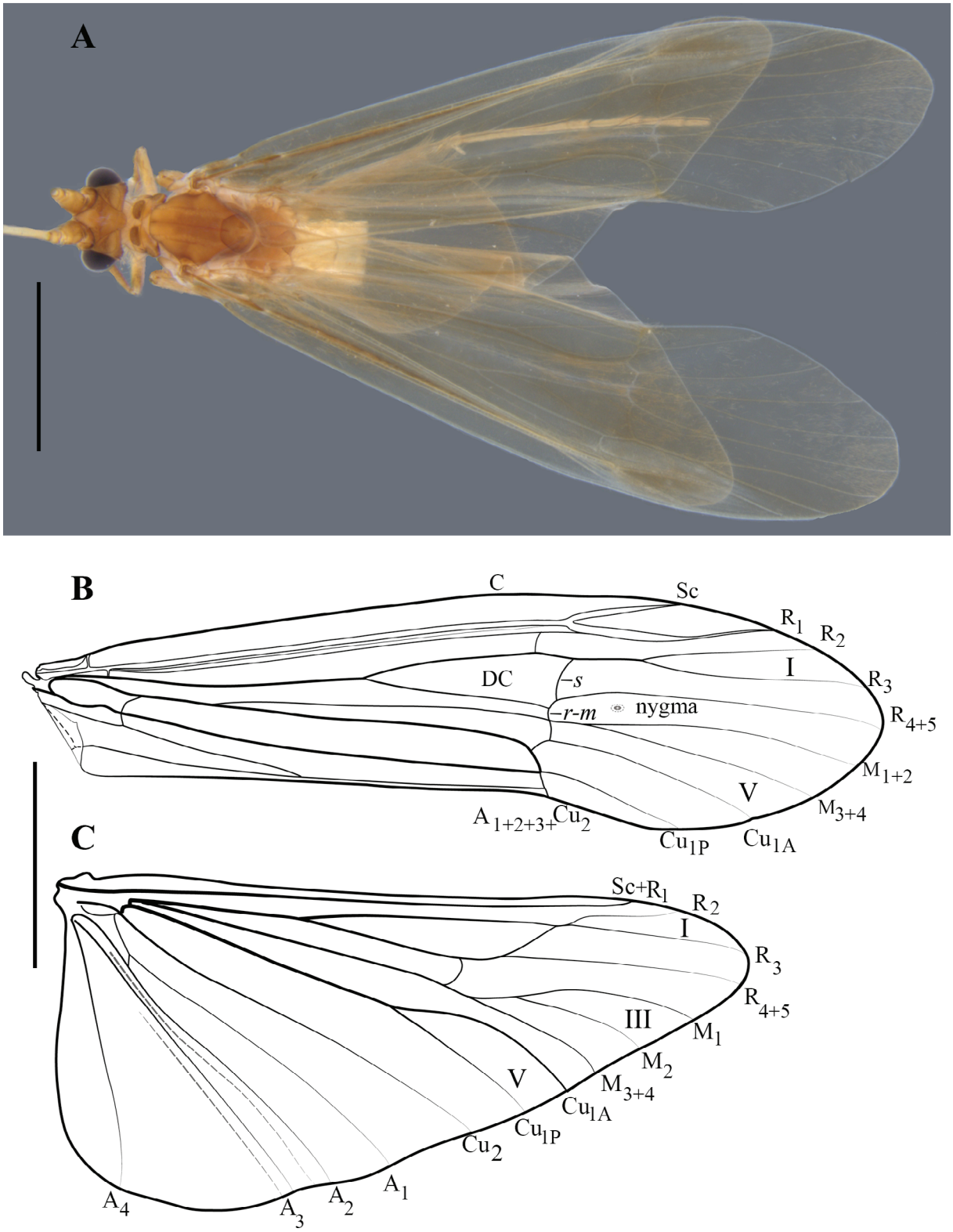

Fig. 1. *Triplectides nessimiani* Desidério & Pes sp. nov., ♂ holotype (INPA-TRI 000014). **A**. Dorsal habitus. **B**. Venation of the forewing. **C**. Venation of the hind wing. Scale bars = 2 mm.

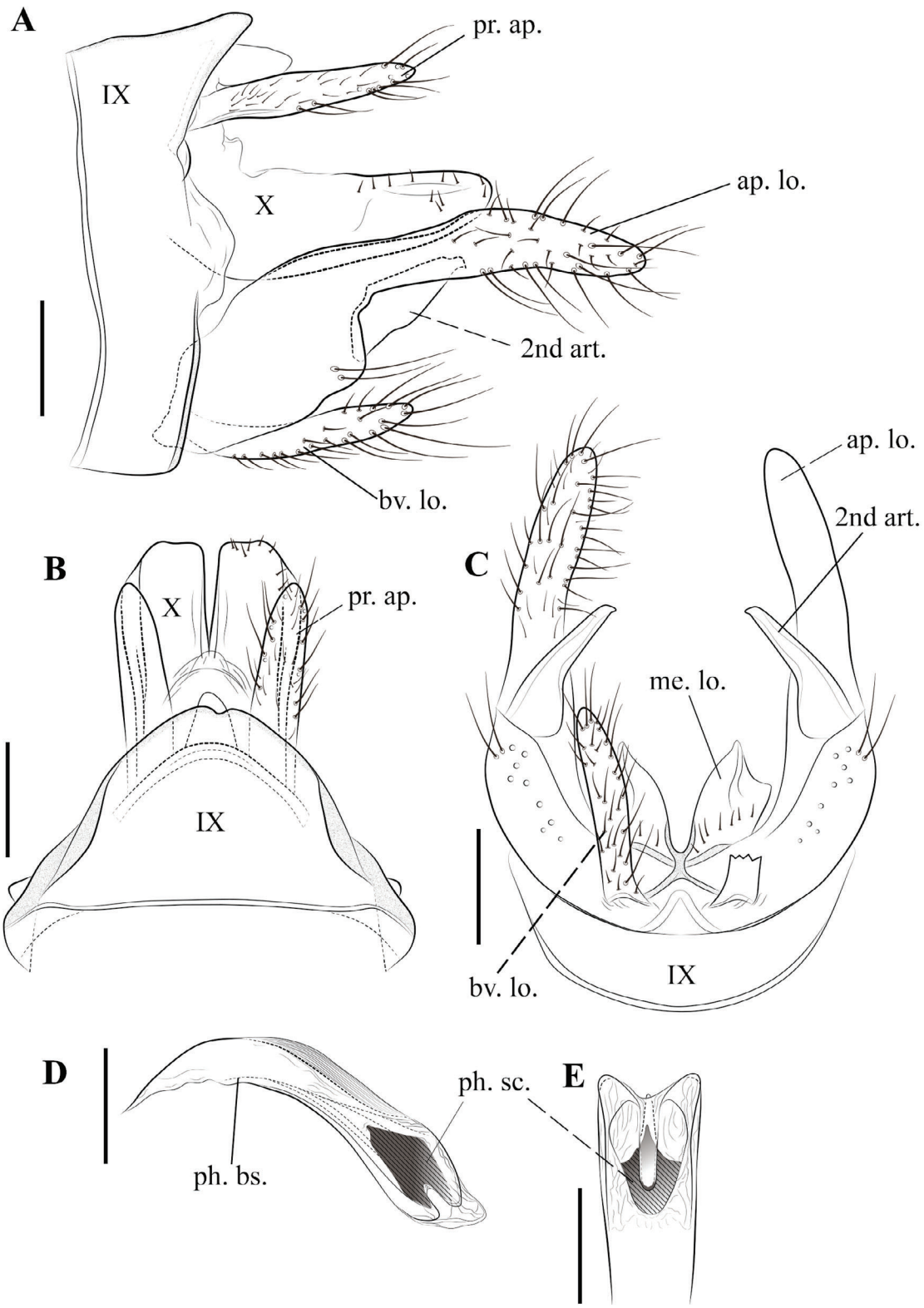

Fig. 2. *Triplectides nessimiani* Desidério & Pes sp. nov., ♂ genitalia, holotype (INPA-TRI 000014). **A**. Lateral view. **B**. Dorsal view. **C**. Ventral view. **D**. Phallic apparatus, lateral view. **E**. Phallotremal sclerite, dorsal view. Scale bars = 0.2 mm.

Description

Adult male (Figs 1A–C, 2A–E)

LENGTH OF FOREWING. 8.12–8.22 mm (n = 2).

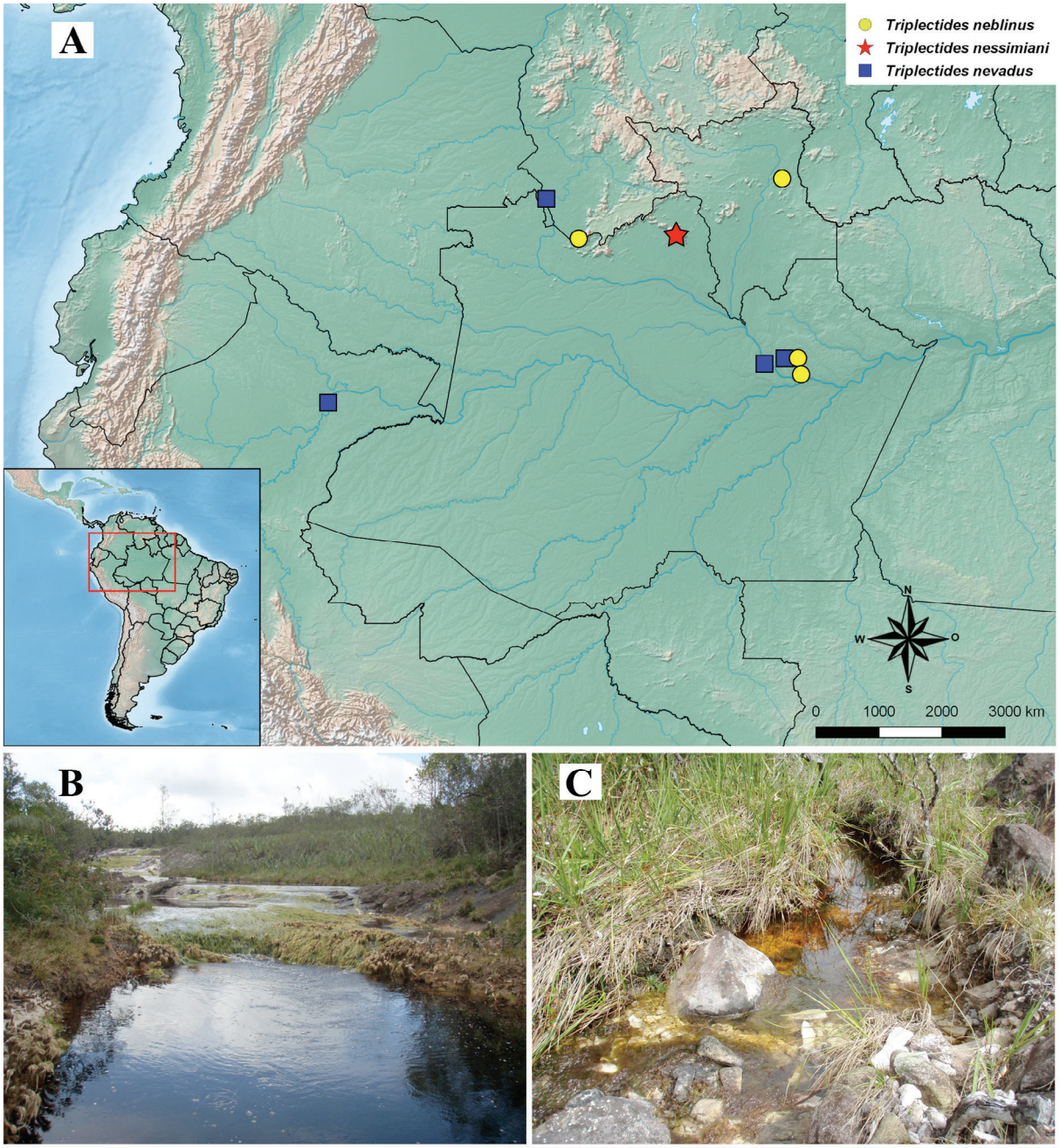

Fig. 3. Distribution of *Triplectides* species treated in this study and general view of the streams where *Triplectides nessimiani* Desidério & Pes sp. nov. was collected. **A**. Distribution map of *T. neblinus*, *T. nessimiani* Desidério & Pes sp. nov. and *T. nevadus*. **B**. Igarapé da Anta, Amazonas, Brazil, stream where *T. nessimiani* Desidério & Pes sp. nov. holotype was collected. **C**. First order stream, Amazonas, Brazil, collection site of *T. nessimiani* Desidério & Pes sp. nov. paratype.

Color. General color brown (in alcohol). Antennae with scape and pedicel golden-brown, flagellum pale-yellow (Fig. 1A) and palps brown. Forewing pale-brown (Fig. 1A), with small pale spots; with forks I and V present; discoidal cell about as broad as apical cells, nearly parallel-sided distally; cross vein *s* long, curved; crossvein *r-m* curved (Fig. 1B). Hind wing with forks I, III and V present; fork I with very short petiole (Fig. 1C). Legs pale-brown. Tibial spur formula 2:2:4.

Male genitalia (Fig. 2A–E). Segment IX, in lateral view, narrow, annular, with tergum IX produced posteriorly, anterior margin nearly straight, posterior margin produced medially (Fig. 2A); tergum IX with sclerotized posterior margin sharply rounded to slightly angulate and with small mesal notch (Fig. 2B), bearing rounded dorsomesal membranous process (absent in male paratype). Preanal appendages setose, about ¾ length of tergum X; in dorsal view, digitate, apices rounded (Fig. 2B). Tergum X, in lateral view, with basal half less sclerotized than apical half, tall at base, narrowing apically (Fig. 2A), with ventral margin straight, apex rounded; in dorsal view, bearing short apical and lateral setae; apex obliquely truncated, with deep, V-shaped apicomesal incision extending anteriorly one-half the length of the segment (Fig. 2B). Inferior appendages long, surpassing tergum X, bearing long setae (Fig. 2A); each with 1st article, in lateral view, enlarged basally, slightly constricted at mid-length (Fig. 2A); apicodorsal lobe digitate, long, extending beyond second article, with long setae (Fig. 2A, C); basoventral lobe digitate, long, apex rounded, bearing long setae (Fig. 2A, C); mesal lobe, in ventral view, shorter than basoventral lobe, subtriangular, bearing a row of 5–7 stout ventral setae basally, with two longitudinal striae, divided into long, blunt apical projection and slightly acute lateral projection, apex concave (Fig. 2C); 2nd article short, slender, with pointed apex, directed apicomesad (Fig. 2C). Phallic apparatus elongate, complex; in lateral view, basal portion of phallobase subtriangular with ventral trough, middle portion curved and slender, apex with pair of wide, semimembranous flanges directed dorsolaterad; phallic membranes non-prominent, striate (Fig. 2D); phallotremal sclerite well developed, subpentagonal-shaped in dorsal view, with acute, thin median tip (Fig. 2E).

Female and immature stages

Unknown.

Bionomics

The males of *T. nessimiani* sp. nov. were collected in 1st and 3rd order streams with altitudes ranging from 1110 to 1130 m a.s.l. located in the Serra do Aracá mountain range, northern part of the Brazilian Amazon (Fig. 3A). The predominant vegetation is highland savanna (Fig. 3B), the water in the streams was black and acidic (pH 4.3–4.5) with low conductivity (10–20 µScm-1). At the sites where specimens were collected water temperatures of 21–22ºC were recorded and the streams were 1–5 m wide, 0.30–3 m deep, with rocky bottoms characterized by boulders and slow-flowing water (Fig. 3B–C).

Distribution (Fig. 3A)

Brazil (Amazonas state).

Triplectides neblinus Holzenthal, 1988
Fig. 3

Triplectides neblinus Holzenthal 1988: 199, figs 18–19 (type locality: Venezuela, Territorio Federal Amazonas, basecamp, 0°51′ N, 66°10′ W, Cerro de la Neblina; NMNH; ♂).

Triplectides neblinus — Holzenthal & Calor 2017: 346 (catalog).

Material examined

BRAZIL • 22 ♂♂; Amazonas, Manaus, Reserva Ducke, Igarapé Ipiranga; 2°58′53.6″ S, 59°54′24.4″ W; alt. 95 m; 7–19 Apr. 2017; G.R. Desidério and A.M.O. Pes leg.; Malaise trap; INPA-TRI 000016 • 59 ♂♂; same collection data as for preceding; 19 Apr.–9 May 2017; G.R. Desidério, A.M.O. Pes and D. De-Paula leg.; Malaise trap; INPA-TRI 000017 • 1 ♂; Amazonas, Manaus, BR-174, km 56, ZF-2, sede (headquaraters), Ramal km 38, Igarapé de 1° ordem (#73); 2º35′50.9″ S, 60º12′54.9″ W; alt. 49 m; 9–12 Nov. 2008; U.G. Neiss, F.F. Sales, P.V. Cruz and F. Laurindo leg.; Suspended trap; INPA-TRI 000018 • 5 ♂♂; Roraima, Cantá, Serra Grande, Cachoeira Véu da Noiva; 2°34′59.8″ N, 60°47′37.7″ W; alt. 103 m; 19–21 Aug. 2019; N. Hamada, J.O. da Silva and R. Koroiva leg.; Malaise trap; INPA-TRI 000019.

Distribution (Fig. 3A)

Brazil (Amazonas and Roraima states) and Venezuela (Territorio Federal Amazonas).

Triplectides nevadus Holzenthal, 1988
Fig. 3

Triplectides nevadus Holzenthal 1988: 202, figs 22, 24 (type locality: Venezuela, Territorio Federal Amazonas, 2 km east of San Carlos de Río Negro; NMNH; ♂; ♀).

Triplectides nevadus — Holzenthal & Calor 2017: 347 (catalog).

Material examined

BRAZIL • 1♂; Amazonas, Manaus, BR-174, km 56, ZF-2, sede, Ramal km 38, 1st order stream (#73); 2º35′50.9″ S, 60º12′54.9″ W; alt. 49 m; 9–12 Nov. 2008; U.G. Neiss, F.F. Sales, P.V. Cruz and F. Laurindo leg.; suspended trap; INPA-TRI 000020 • 1 ♂; Amazonas, Novo Airão, AM-352, km 9, Sítio São Sebastião, Sr. Valdenor, 2nd order stream (#15); 2º42′04.5″ S, 60º55′23.4″ W; alt. 50 m; 6 Apr. 2008; J.L. Nessimian, R. Querino, M. Pepinelli, C.A.S. Azevedo and U.G. Neiss leg.; Pennsylvania trap; INPA-TRI 000021.

Distribution (Fig. 3A)

Brazil (Amazonas state), Peru (Loreto) and Venezuela (Territorio Federal Amazonas).

Key to males of Triplectides *species with occurrence in Brazil (modified from Holzenthal 1988)*

1. Tibial spur formula 0-2-2 or 0-2-3 2
– Tibial spur formula 2-2-3 or 2-2-4 4

2. Preanal appendages very broad, rounded (see figs 18a–b in Holzenthal 1988) ..... ***T. neblinus*** Holzenthal, 1988
– Preanal appendages clavate or digitate 3

3. Mesal lobe of inferior appendage wrinkled in apical half (see fig. 3c in Desidério *et al*. 2017) ..... ***T. maranhensis*** Desidério, Barcelos-Silva & Pes, 2017
– Mesal lobe of inferior appendage non-wrinkled in apical half (see fig. 22c in Holzenthal 1988) ..... ***T. nevadus*** Holzenthal, 1988

4. Tibial spur formula 2-2-3 ..... ***T. egleri*** Sattler, 1963
– Tibial spur formula 2-2-4 5

5. Mesal lobe of inferior appendage short, subtriangular (see fig. 30c in Holzenthal 1988) 6
– Mesal lobe of inferior appendage long, digitate (see fig. 9c in Holzenthal 1988) 7

6. Preanal appendages slender, with apices pointed; tergum X with rounded apex (see fig. 30b in Holzenthal 1988) ..... ***T. ultimus*** Holzenthal, 1988
– Preanal appendages digitate, with apices rounded; tergum X with truncate apex .... ***T. nessimiani*** Desidério & Pes sp. nov.

7. Mesal lobe of inferior appendage with apex acute, pointed, with small, lateral point (see fig. 15c in Holzenthal 1988) ..... ***T. misionensis*** Holzenthal, 1988
– Mesal lobe of inferior appendage with apex obtuse, rounded, without lateral point 8

8. Apex of mesal lobe of inferior appendage clearly capitate (see fig. 20c in Holzenthal 1988) ..... ***T. neotropicus*** Holzenthal, 1988
– Apex of mesal lobe of inferior appendage rounded, not capitate 9

9. Hind wing fork I sessile or with very short petiole (see fig. 11b in Holzenthal 1988) .... ***T. gracilis*** (Burmeister, 1839)
– Hind wing fork I with distinct petiole (see fig. 1b in Dumas & Nessimian 2010) 10

10. Tergum X with subtruncate apex and apicomesal excision extending anteriorly at half-length of segment (see fig. 2 in Henriques-Oliveira & Dumas 2015) .... ***T. cipo*** Henriques-Oliveira & Dumas, 2015
– Tergum X with rounded apex and apicomesal excision extending anteriorly to less than half length of segment (see fig. 3 in Dumas & Nessimian 2010) ..... ***T. itatiaia*** Dumas & Nessimian, 2010

Discussion

Until now, the diversity of *Triplectides* in Brazil is concentrated in the Southeast region with six species (*Triplectides cipo*, *T. gracilis*, *T. itatiaia*, *T. misionensis*, *T. neotropicus* and *T. ultimus*), followed by the Northeast (*T. maranhensis* and *T. gracilis*) and South (*T. gracilis* and *T. misionensis*) regions, both with two species registered. Only one species of *Triplectides* has been recorded from the North region so far, *T. egleri* (Santos *et al*. 2019), but with the new species described here, *T. nessimiani* sp. nov., and the new records of *T. neblinus* and *T. nevadus*, the number of *Triplectides* species reported from the North Region is increased to four, bringing the total number of species of the genus for Brazil to eleven (Table 1). However, the Midwest region is the only one that still has no recorded *Triplectides* species (Santos *et al*. 2019).

Triplectides neblinus was previously known only from its type locality at the Cerro de la Neblina base camp at 140 m a.s.l. (Holzenthal 1988), a mountainous region located in the southern portion of Venezuela at the border with Brazil. Here the distribution range of this species is extended to Amazonas and Roraima states, representing the first record for Brazil, at a distance of about 800 km from the type locality.

Triplectides nevadus was previously known from large rivers in Venezuela (Rio Negro) and Peru (Rio Nanay) (Holzenthal 1988). In this study the species was collected in two small streams in the Amazonas State, being reported for the first time for Brazil.

Although this study improves our knowledge of the *Triplectides* species that occur in Brazil, it does not represent the actual diversity of the genus. This is due to the scarcity of studies, particularly in neighboring states that share the Amazon biome, such as Acre, Amapá and Rondônia, and in the states of the Midwest

Table 1. Distribution of *Triplectides* species recorded from Brazil. Abbreviations for Brazilian states: AM = Amazonas; BA = Bahia; ES = Espírito Santo; MA = Maranhão; MG = Minas Gerais; PA = Pará; PR = Paraná; RJ = Rio de Janeiro; RR = Roraima; SC = Santa Catarina; SP = São Paulo.

Species	Regions (States)
T. cipo Henriques-Oliveira & Dumas, 2015	Southeast (MG)
T. egleri Sattler, 1963	North (AM, PA)
T. gracilis (Burmeister, 1839)	Northeast (BA); Southeast (ES, MG, RJ, SP); South (PR, SC)
T. itatiaia Dumas & Nessimian, 2010	Southeast (RJ)
T. maranhensis Desidério, Barcelos-Silva & Pes, 2017	Northeast (MA)
T. misionensis Holzenthal, 1988	Southeast (MG, RJ, SP); South (PR, SC)
T. neblinus Holzenthal, 1988	North (AM, RR)
T. neotropicus Holzenthal, 1988	Southeast (MG, RJ, SP)
T. nessimiani Desidério & Pes sp. nov.	North (AM)
T. nevadus Holzenthal, 1988	North (AM)
T. ultimus Holzenthal, 1988	Southeast (MG, RJ)

region (Distrito Federal, Goiás, Mato Grosso and Mato Grosso do Sul). Thus, these data highlight the need for more taxonomic studies focused on *Triplectides* in the Brazilian Amazon specifically and in Central Brazil, where it is highly probable that any specimens of this genus discovered in the future will be new to science or represent new distributional records for these regions.

Acknowledgments

We thank all of the members of the Serra do Aracá expedition in July-August 2009 for their valuable assistance in the fieldwork. Financial support was provided by the PRONEX-CNPq-FAPEAM/INPA. Collections were made under SISBIO license no. 1369-2 and license 17/09 CEUC/SDS-Amazonas. We also thank the Invertebrate Collection of INPA for allowing use of photographic equipment. CNPq provided a doctoral fellowship for GRD (Process n. 141875/2018-6) and a research fellowship for NH (Process n. 307849/2014-7). AMP received post-doctoral fellowships from PDS/CNPq (Process n. 165223/2017-0) and PCI-DB (Process n. 301401/2019-5). We thank Philip M. Fearnside for revising this manuscript. We are grateful to the editor, Dr. Helen M. Barber-James, for the assistance and we highly appreciate the very useful suggestions of the two anonymous reviewers to improve the manuscript.

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Manuscript received: 10 October 2019
Manuscript accepted: 3 April 2020
Published on: 1 July 2020
Topic editor: Nesrine Akkari
Section editor: Helen M. Barber-James
Desk editor: Marianne Salaün