European Journal of Taxonomy 885: 99–133
https://doi.org/10.5852/ejt.2023.885.2193

ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2023 · Alves A.A. *et al.*

Research article

urn:lsid:zoobank.org:pub:AFC1FF4A-715D-4FEC-BD21-3E4427520444

Born from rock: eight new species of *Itauara* Müller, 1888 (Trichoptera: Glossosomatidae) from southeastern Brazil, including phylogenetic and distributional comments on the genus

André Almeida ALVES[1,*], Leandro Lourenço DUMAS[2], Jorge Luiz NESSIMIAN[3] &
Allan Paulo Moreira SANTOS[4]

[1,3,4] Programa de Pós-graduação em Zoologia, Museu Nacional / Universidade Federal do Rio de Janeiro, Horto Botânico, Quinta da Boa Vista, s/n, São Cristóvão, CEP 20940-040
Rio de Janeiro, RJ, Brazil.
[1,2,3] Laboratório de Entomologia, Departamento de Zoologia, Instituto de Biologia, Universidade Federal do Rio de Janeiro – UFRJ, Caixa Postal: 68044, CEP 21941-902, Rio de Janeiro, RJ, Brazil.
[2] Universidade Federal Rural do Rio de Janeiro – UFRRJ, Instituto de Ciências Biológicas e da Saúde, Departamento de Biologia Animal, Rodovia BR 465, Km 7, Zona Rural, CEP 23890-000,
Seropédica, RJ, Brazil.
[4] Laboratório de Sistemática de Insetos, Departamento de Zoologia, Instituto de Biociências, Universidade Federal do Estado do Rio de Janeiro – UNIRIO, Instituto de Biociências, Departamento de Zoologia, Av. Pasteur 458, Urca, CEP 22290-240, Rio de Janeiro, RJ, Brazil.

[*] Corresponding author: andrerjpe@gmail.com
[2] Email: lldumas82@gmail.com
[3] Email: jnessimian@gmail.com
[4] Email: allanpms@gmail.com

[1] urn:lsid:zoobank.org:author:3A4D224E-9EE7-4112-9A20-5806529D7BB5
[2] urn:lsid:zoobank.org:author:55D870A2-6CE2-492E-8E05-2077D5C0CB11
[3] urn:lsid:zoobank.org:author:6FF1B417-72F2-4E5C-84C9-28D58B6A762F
[4] urn:lsid:zoobank.org:author:FDBB2390-430F-4769-A3A3-E8DD1CF36EBC

Abstract. Eight new species of *Itauara* Müller, 1888 are described based on specimens collected in southeastern Brazil: *I. bispinata* sp. nov., *I. caparao* sp. nov., *I. cipoensis* sp. nov., *I. cristata* sp. nov., *I. holzenthali* sp. nov., *I. mangaratiba* sp. nov., *I. robertsonae* sp. nov., and *I. rupicola* sp. nov. In addition, we provided an updated distributional list of species of *Itauara*, with new records of *I. jamesii* Robertson & Holzenthal, 2011 and *I. lucinda* Robertson & Holzenthal, 2011 for Espírito Santo State (Brazil), *I. plaumanni* (Flint, 1974) for Paraná State (Brazil), and *I. tusci* Robertson & Holzenthal, 2011 for Minas Gerais State (Brazil). We performed an equal weighted parsimony analysis adding the new species to the dataset provided by Robertson & Holzenthal (2013), with modification of the interpretation of some morphological characters. The genus was recovered as monophyletic, but overall statistic support for clades was weak. *Itauara* is restricted to South America and has a disjunct distribution, with some species occurring in northern South America and others in southeastern South America. Probably, the diversification of *Itauara* in South America is related to the connections between the Amazon Forest and the Atlantic Forest through historical events at different times.

Key words. Caddisflies, Neotropics, taxonomy, Amazon, Atlantic Forest.

Alves A.A., Dumas L.L., Nessimian J.L. & Santos A.P.M. 2023. Born from rock: eight new species of *Itauara* Müller, 1888 (Trichoptera: Glossosomatidae) from southeastern Brazil, including phylogenetic and distributional comments on the genus. *European Journal of Taxonomy* 885: 99–133. https://doi.org/10.5852/ejt.2023.885.2193

Introduction

The family Glossosomatidae Wallengren, 1891 is cosmopolitan and divided into three subfamilies: Agapetinae Martynov, 1913, Glossosomatinae Wallengren, 1891, and Protoptilinae Ross, 1956 (Holzenthal *et al.* 2007), only the latter being recorded from Brazil (Santos *et al.* 2021). This subfamily is the most diverse in the family, with over 350 species worldwide (Morse 2021). Robertson & Holzenthal (2013) provided a detailed revision of Protoptilinae, including phylogenetic analyses for this subfamily, in which they recovered a monophyletic Protoptilinae. Five out of eleven genera are reported from Brazil: *Canoptila* Mosely, 1939, *Itauara* Müller, 1888, *Mortoniella* Ulmer, 1906, *Protoptila* Banks, 1904, and *Tolhuaca* Schmid, 1964, for a total of 57 species (Holzenthal & Calor 2017; Henriques-Oliveira & Santos *et al.* 2021).

The name *Itauara* Müller, 1888, from the Tupi-Guarani language family, could be translated as “born from rock”, likely referring to glossosomatid larval cases, often found conspicuously on the surface of submerged rocks (Robertson & Holzenthal 2011). This behavior is found in other glossosomatids, and the family is also known by their saddle- or tortoise-cases. *Itauara* was established by Müller (1888), but no species were included in his work, which dealt with larvae morphology only. Subsequently, Müller (1921) illustrated a female wing, assigning it to the genus. Ulmer (1957) drew attention to the similarity of the wing designated by Müller for *Itauara* with the wings of *Antoptila brasiliana* Mosely, 1939, but he did not come to synonymize them. It was only in the late 1990s that Flint *et al.* (1999) synonymized *Itauara* with *Antoptila* Mosely, 1939, designating *A. brasiliana* as the type species and also transferring three other described species – *A. amazonica* Flint, 1971, *A. plaumanni* Flint, 1974, and *A. guarani* Angrisano, 1993.

Robertson & Holzenthal (2011) revised the genus *Itauara*, proposing a standard terminology for male genitalic structures and adding 18 new species, totaling 22 species for the genus. According to Robertson & Holzenthal (2013), *Itauara* is supported by the synapomorphic dorsal sheath covering a ventral membranous portion of the phallus, referred to as phallicata by these authors. Two species groups are currently recognized: the *amazonica* species group, characterized by inferior appendages fused into a single process, and by parameres arising laterally from the endotheca; and the *brasiliana* species group, recognized by the absence of inferior appendages, and by the parameres (when present) arising ventrobasally from the phallobase, often being fused to it (Robertson & Holzenthal 2011).

Itauara is exclusively South American, known from Argentina, Brazil, Guyana, Peru, and Venezuela (Robertson & Holzenthal 2011; Holzenthal & Calor 2017). The genus is particularly diverse in Brazil, with 15 recorded species, 13 of them endemic to the country (Santos *et al.* 2021). Species of *Itauara* have an interesting geographic distribution, with seven species occurring exclusively in the Amazon Forest and 14 species recorded from the Atlantic Forest, nine of them endemic to this biome. Records of species of *Itauara* from the Cerrado biome, including *I. charlotta* Robertson & Holzenthal, 2011, known only from this biome, are all near to the Atlantic Forest. *Itauara brasiliana* (Mosely, 1954) and

I. plaumanni (Flint, 1974), both recorded from the Atlantic Forest, also occur in the Pampa biome, a southern region, where grasslands are predominant.

Based on recent collecting efforts in southeastern Brazil, we describe eight new species of *Itauara* in this paper, bringing the total known for the genus to thirty. With this work, the number of species of *Itauara* in Brazil reaches 22, being surpassed only by *Mortoniella* (25 species) as the most species-rich genus in glossosomatid caddisflies in the country. Other genera of Glossosomatidae occuring in the country include *Protoptila* (13 species), *Canoptila* (2 species), and *Tolhuaca* (1 species) (Santos *et al.* 2021). The specimens of the new species were collected in the states of Espírito Santo, Minas Gerais, and Rio de Janeiro. In addition, new distributional records are provided for *I. jamesii* Robertson & Holzenthal, 2011, *I. plaumanni*, and *I. tusci* Robertson & Holzenthal, 2011, from different Brazilian states. We used the morphological matrix of Robertson & Holzenthal (2013), slightly modifying some characters as indicated below, to perform an equal weighted parsimony analysis, including the new species described here.

Material and methods

Study area

Specimens were collected at several localities in southeastern Brazil (Fig. 1A−F), including the mountainous regions of Serra do Cipó and Serra do Caparaó, the Itatiaia Massif, as well as an area of lower elevation in Rio de Janeiro State.

The Serra do Cipó (Fig. 1A−E) mountain range comprises an area of 2500 km^2 in Minas Gerais State and is situated in the Espinhaço Range Biosphere Reserve. This area exhibits an altitudinal gradient from 700 m to 1670 m (Madeira 2009), and is in a transition zone between the Cerrado and Atlantic Forest, two biomes which are biodiversity hotspots (Mittermeier *et al.* 2011), as well as bordering the area between the Rio São Francisco and Rio Doce river basins. Inside Parque Nacional da Serra do Cipó (PNSC), a national conservation unit, some streams are in almost pristine condition (Galdean *et al.* 2000), such as the Córrego Água Escura (Fig. 1A). This is a third order stream, at an elevation of over 1200 m, where specimens of *I. cipoensis* sp. nov. and *I. rupicola* sp. nov. were collected. The area has a typical vegetation of "campos rupestres", or "campos rupícolas" (rupestrian grasslands), which is a rocky montane savanna dominated by grasses and sedges, with scattered small trees and shrubs (Giulietti *et al.* 1987), common in the Cerrado at elevations above 900 m (Alves *et al.* 2014). The stream has darkly colored water, with a preponderance of bedrock substrate at its collecting point, with gravel and sandy substrates in pools. Córrego Indaiá stream has the same characteristics, but is a second order stream, with low flow and clear water, with a substrate composed mainly of boulders at its collecting point, and with a dense canopy along its margins. *Itauara rupicola* sp. nov. was also collected in the Córrego da Farofa, at an elevation of about 800 m. This second order stream is dominated by boulder and gravel substrate, has clear water, and a vegetated riparian margin with some scattered taller trees and an open canopy.

Ribeirão Mascates (Fig. 1B) is also located in the Cerrado biome, but at a lower elevation of 800 m. This is a fifth order stream where *I. robertsonae* sp. nov. was found. The stream has dark colored water and, at its collecting point, a wide channel, with the main substrate consisting of boulders and gravel, and bearing a large amount of riparian vegetation and open canopy. Although the sample point is located within the PNSC, the region has been modified by the presence of human development. *Itauara robertsonae* sp. nov. was also collected in two other rivers: a second order tributary of the Mascates River (Fig. 1C), with a clear and low current, with a boulder and gravel substrate; and at Cipó River, a sixth order river, with dark colored water, modified by human activities, and bearing a large waterfall with a heavy water flow, where the specimens were collected.

Córrego Água Limpa (Fig. 1D) is a second order stream located in an Atlantic Forest area with almost 1000 m of elevation in which *I. bispinata* sp. nov. was found. The stream has a low flow, clear water, and is mainly composed of bedrock substrate at the collecting point, with a lot of tall riparian vegetation and dense canopy. *Itauara cristata* sp. nov. was also collected in the Atlantic Forest third order stream (Fig. 1E). It has clear water and is located at an elevation of almost 700 m, characterized by a mostly sandy substrate with some boulders, and having a densely vegetated riparian zone and canopy.

The Serra do Caparaó mountain range comprises an area of about 320 km^2 in Espírito Santo and Minas Gerais states, and is located in Atlantic Forest Biosphere Reserve. This area exhibits an altitudinal gradient from 600 m to 2890 m (ICMBIO 2015) and has an important remnant of Atlantic Forest. Within

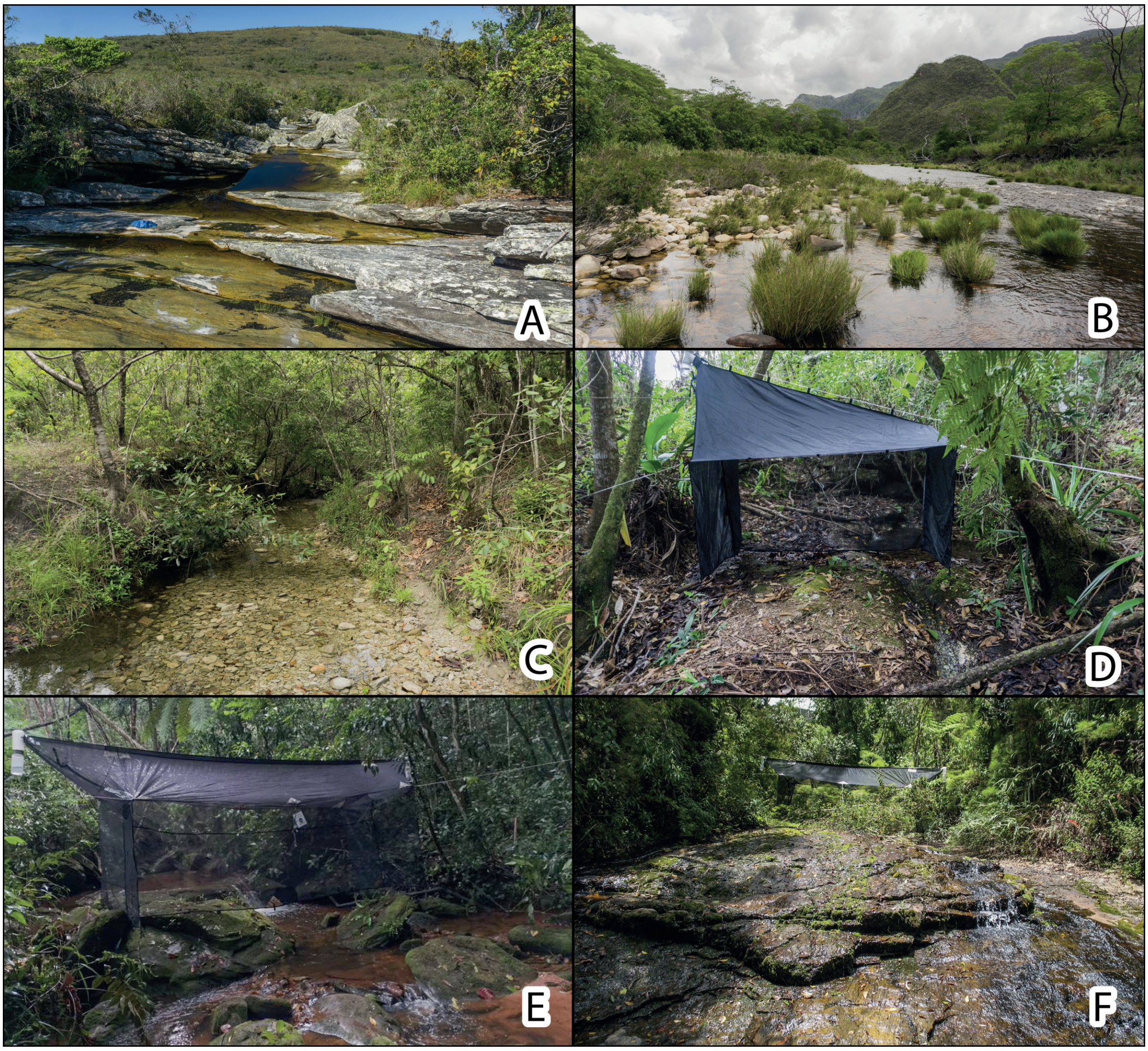

Fig. 1. Localities where the new species were collected. **A**. Córrego Água Escura, type locality of *I. cipoensis* sp. nov. and *I. rupicola* sp. nov. **B**. Ribeirão Mascates, type locality of *I. robertsonae* sp. nov. **C**. Tributary of Ribeirão Mascates, locality where specimens of *I. robertsonae* were also collected. **D**. Córrego Água Limpa, type locality of *I. bispinata* sp. nov. **E**. Tributary of Rio Picão, type locality of *I. cristata* sp. nov. **F**. Tributary of Rio Preto, type locality of *I. caparao* sp. nov. (photo by A.L. Henriques-Oliveira).

Parque Nacional do Caparaó (PNC), specimens of *I. caparao* sp. nov. were collected in a second order tributary of Rio Preto at 1500 m elevation (Fig. 1F). The stream has clear water and is mainly composed of bedrock substrate at the sample point, with dense riparian vegetation and an open canopy.

In Rio de Janeiro State, two localities were sampled, both in the Atlantic Forest Biosphere Reserve. *Itauara holzenthali* sp. nov. was collected in the Rio Palmital, at an elevation of about 600 m. This third order stream has clear water, and its substrate is mainly composed of bedrock and boulders. The area is in the Atlantic Forest, in the Itatiaia Massif, near the border of Parque Nacional do Itatiaia and close to a small tourist district. Although the stream has dense vegetation along its margins, the region has been significantly changed by human activities, and at some points buildings are seen very close to the stream channel. The second sample locality is a first order tributary of the Rio do Saco, in which specimens of *I. mangaratiba* sp. nov. were collected, at an elevation of about 200 m. The stream has clear, shallow water, bordered with vegetation which shades the stream course.

Specimen collection and identification

Malaise traps (Frost 1957), Pennsylvania light traps (Gressitt & Gressitt 1962), and a white sheet, were used to collect the specimens, which were stored in 96% ethanol. In order to observe genital structures, the abdomens of male specimens were removed and cleared using a solution of 10% KOH heated for a few minutes (Ross 1944). After the reaction, the abdomen was cleaned with distilled water to stop the clearing process and to remove residual tissue. Abdomens were placed on temporary slides using glycerin jelly (Zander 2014), and then observed under a compound microscope. After examination, the abdomen was returned to ethanol and stored in a microvial with the respective specimen.

Species descriptions, illustrations and maps

Initial sketches of the genitalia were made under a compound microscope (Carl Zeiss, model Axiolab) equipped with a camera lucida. These sketches were used as templates to render final digital illustrations in Adobe Illustrator® CC (ver. 22.0.1). Maps were made with the software QGIS (ver. 3.10.8 – A Coruña), using data from the Brazilian Institute of Geography and Statistics (available from https://www.ibge.gov.br/geociencias/informacoes-ambientais/estudos-ambientais/15842-biomas.html) and including the approximate distribution of major terrestrial South American biomes/ecoregions modified from Olson *et al.* (2001) by Turchetto-Zolet *et al.* (2013).

Terminology used for wing venation follows the interpretation of Ross (1956) and Schmid (1998) for the Comstock-Needham system. Terminology for male genitalia follows that presented by Robertson & Holzenthal (2011), homologized from previous works (Blahnik & Holzenthal 2006, 2008; Holzenthal 2004; Holzenthal & Blahnik 2006; Morse 1988).

Phylogenetic analysis

For a phylogenetic analysis, we used the morphological dataset provided by Robertson & Holzenthal (2013), intended to establish relationships among protoptiline genera. Since our focus was to resolve relationships of species within the genus *Itauara*, we reduced the number of taxa in the matrix, maintaining 14 species as outgroups (all other genera of Protoptilinae and *Glossosoma* Curtis, 1834), including the eight new species described here. Due to our more restricted focus, we also reinterpreted some of the characters provided by Robertson & Holzenthal (2013) or deleted broader and uninformative characters within this context. In total, we removed 14 characters and divided another seven characters, resulting in a matrix with 43 taxa (29 species of *Itauara*) and 93 morphological characters. As female genitalia are very similar among different species, we assume that states referring to the characters of this structure (91, 92, and 93) were the same for the new species described here, even though their females are not known so far. Deleted and modified characters, as well as the matrix, are indicated in the Supplementary File S1.

Phylogenetic analyses were carried out in PAUP* ver. 4.a168 (Swofford 1991) under the parsimony criterion with characters being equally weighted and unordered. Analyses were run using 1000 random addition replicates and tree bisection and reconnection (TBR) branch swap. Parsimony analyses were run on the Cipres Science Gateway (Miller *et al.* 2010). Branch support was evaluated with 1000 bootstrap pseudoreplicates.

Institutional abbreviations

DZRJ = Coleção Entomológica Professor José Alfredo Pinheiro Dutra, Departamento de Zoologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil
MNRJ = Coleção Entomológica do Museu Nacional/Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil, as indicated in the species descriptions

Abbreviations of genitalic structures

dgt. pr. = digitate process
dl. pr. = dorsolateral process
dm. sp. = dorsomesal spine
el. scl. ar. = elliptical sclerotized area
enph. = endophallus
inf. ap. = inferior appendage
l. scl. reg. = lightly sclerotized region
m. fl. = membranous flange
phb. = phallobase
phc. = phallicata
pmr. = paramere
pmr. spl. pr. = paramere spiral process
s. dgt. pr. = small digitate process
scl. l. = sclerotized lobe
scl. con. dsc. = sclerotized concave disc
t. X = tergum X
vl. fl. = ventrolateral flange
vl. pr. = ventrolateral process

Results

Taxonomy

Class Insecta Linnaeus, 1758
Order Trichoptera Kirby, 1813
Family Glossosomatidae Wallengren, 1891
Subfamily Protoptilinae Ross, 1956
Genus *Itauara* Müller, 1888

Itauara bispinata sp. nov.

urn:lsid:zoobank.org:act:7CAEB59B-2363-47A0-A5D5-98D55DAE45E1
Fig. 2

Differential diagnosis

This very distinctive species, known only from the male holotype, belongs to the *amazonica* species group. It was recovered as sister species to *I. caparao* sp. nov., supported by the character 67(0), tergum X without median process at posterior margin. This clade, *I. bispinata* sp. nov. + *I. caparao* sp. nov.,

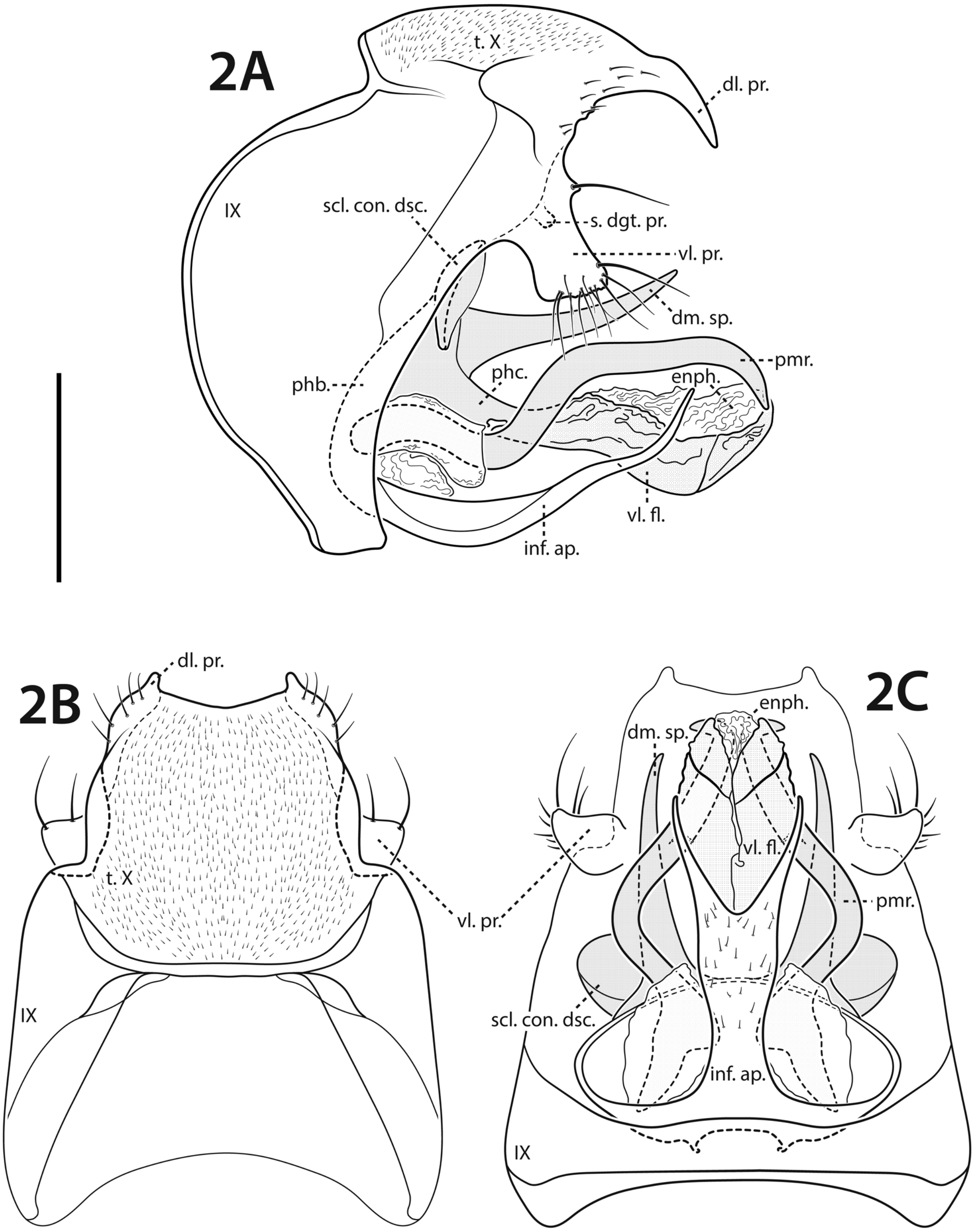

Fig. 2. *Itauara bispinata* sp. nov., holotype (DZRJ 7639), male genitalia. **A**. Lateral view. **B**. Dorsal view. **C**. Ventral view. Scale bar = 0.1 mm.

was recovered as sister group to the clade representing the *brasiliana* species group. Despite the close relationship with *I. caparao*, *I. bispinata* is easily distinguished by the spoon-like phallicata, and the presence of a pair of tusk-like dorsomesal spines, emerging basally from the phallicata (Fig. 2A). Moreover, the extremely sinuous parameres with pointed and outwardly directed apices in ventral view (Fig. 2C), and the apically forked inferior appendages similar to a snake tongue (Fig. 2C) complement the list of characteristics that contribute to the easy recognition of *I. bispinata*.

Etymology

From the Latin '*bi*' ('two'), '*spina*' ('spine') and '*-ata*' ('possession'), in reference to the basal pair of tusk-like dorsomesal spines of phallicata.

Material examined

Holotype

BRAZIL • ♂; Minas Gerais, Morro do Pilar, Rodovia MG-232, Km 198, Córrego Água Limpa; 19°14′26.8″ S, 43°27′57.9″ W, elev. 989 m; 19 Nov. 2018; A.A. Alves and A.P.M. Santos leg.; Pennsylvania trap; DZRJ 7639.

Paratype

BRAZIL • 1 ♂; same collection data as for holotype; 19 Nov. 2018; A.A Alves and A.P.M. Santos leg.; DZRJ 7640.

Description

Adult

Length of each forewing 2.7–3.0 mm (n = 2). Head, thorax, and appendages, in alcohol, light brown. Forewings covered with brown setae, slightly broad after anastomosis, with anterior and posterior margins approximately parallel, apex slightly rounded; forks I, II, and III present; Sc and R1 veins not fused; forks I and II sessile; fork III petiolate, with stem longer than fork; Cu1 vein complete, reaching wing margin; Cu1 and Cu2 separating near anastomosis; Cu2 vein with row of erect setae; A3 vein absent; crossveins constituting relatively straight transverse line; Rs vein shorter than discoidal cell. Hind wings with margins approximately parallel, with apical portion tapered; forks II and V present; Sc and R1 veins converging very near to wing margin; A2 vein absent. Spur formula 1, 4, 4, foretibial spur reduced and hairlike.Sternum VI with thumb-like process, rounded at apex.

Male genitalia

Preanal appendages absent. Segment IX ventrally narrow, broad medially; anterior margin rounded (Fig. 2A); posterolateral margin slightly sclerotized (Fig. 2A–B). Tergum X partially fused to tergum IX (Fig. 2A); dorsomesal margin slightly concave, without processes (Fig. 2B–C); dorsolateral margin with paired, downturned, acute processes (Fig. 2A–B); ventrolateral margin with a subquadrate, setose process in lateral view (Fig. 2A), lobe-like in ventral view (Fig. 2C), with pair of small digitate processes between ventrolateral processes (Fig. 2A). Inferior appendages present as single process, sinuous, tapering to apex when viewed laterally (Fig. 2A),with apical third bifid and deeply incised, resembling snake tongue, each apex pointed (Fig. 2C). Parameres present, paired, inserted in membranous lobe, arising laterally from endotheca, sclerotized and rod-like, extremely sinuous, apices pointed and downturned in lateral view (Fig. 2A), outwardly directed in ventral view (Fig. 2C). Phallobase reduced, slightly sclerotized. Phallicata spoon-like (Fig. 2A), with sclerotized base, median and apical portions divided in two juxtaposed, slightly sclerotized ventrolateral flanges (Fig. 2A, C); basally with pair of tusk-like, dorsomesal spines (Fig. 2A, C); with pair of small, sclerotized concave discs, positioned basolaterally to dorsomesal spines (Fig. 2A, C). Endophallus membranous, apparently small, arising dorsoapically from ventrolateral flanges of phallicata (Fig. 2A, C).

Female and immatures

Unknown.

Distribution

Brazil [state of Minas Gerais (municipality of Morro do Pilar)].

Itauara caparao sp. nov.

urn:lsid:zoobank.org:act:34C47854-6FDF-4417-8780-EA9EB0F5F3EE

Fig. 3

Differential diagnosis

This new species belongs to the *amazonica* species group. As mentioned for the preceding species, *Itauara caparao* sp. nov. and *I. bispinata* sp. nov. form a clade supported by the tergum X without median process at posterior margin [67(0)]. This clade was recovered as sister group to the *brasiliana* species group clade. As *I. jamesii* Robertson & Holzenthal, 2011 and *I. spiralis* Robertson & Holzenthal, 2011, *I. caparao* has a very broad ventrolateral processes on the tergum X, presenting several small irregular lobes (Fig. 3A). However, in the new species this processes are much larger and widely projected laterally. In dorsal view, the tergum X has two broad subtriangular processes (Fig. 3F), which also was not observed in any other species. The phallicata is dorsally directed in this new species, with a uniform curvature along its length (Fig. 3A).

Etymology

The specific epithet, used as a noun in apposition, refers to the region where the holotype was collected, the Serra do Caparaó mountain range.

Material examined

Holotype

BRAZIL • ♂; Espírito Santo, Dores do Rio Preto, Pedra Menina, Parque Nacional do Caparaó, afluente do Rio Preto (cachoeirinha-paredão); 20°29′26.2″ S, 41°49′17.1″ W; alt. 1507 m; 11−15 Jan. 2015; J.L. Nessimian, A.L.H. Oliveira, S.P. Gomes and C.S. Portela leg.; Malaise trap; DZRJ 7647.

Paratypes

BRAZIL • 2 ♂♂; same collection data as for holotype; DZRJ 7631 • 3 ♂♂; same collection data as for holotype; MNRJ-ENT10-185 • 1 ♂; same collection data as for holotype; 30 Mar.–3 Apr. 2016; J.L. Nessimian, A.L.H. Oliveira, A. Antunes, A. Alves and J. Queiroz. leg.; DZRJ 7646.

Description

Adult

Length of each forewing 2.8–3.4 mm (n = 7). Head, thorax, and appendages, in alcohol, light brown. Forewings covered with brown setae, slightly broad after anastomosis, with margins approximately parallel, apex slightly rounded; forks I, II, and III present; Sc and R1 veins not fused; fork I sessile; forks II and III petiolate, with stem longer than fork; Cu1 vein complete, reaching wing margin; Cu1 and Cu2 veins separating at anastomosis; Cu2 vein with row of erect setae; A3 vein absent; crossveins constituting relatively straight transverse line; Rs vein shorter than discoidal cell. Hind wings with margins approximately parallel, with apical portion tapered; forks II and V present; Sc and R1 veins converging very near to wing margin; A2 vein absent. Spur formula 1, 4, 4, foretibial spur reduced and hairlike. Sternum VI with digitate process, with acute apex.

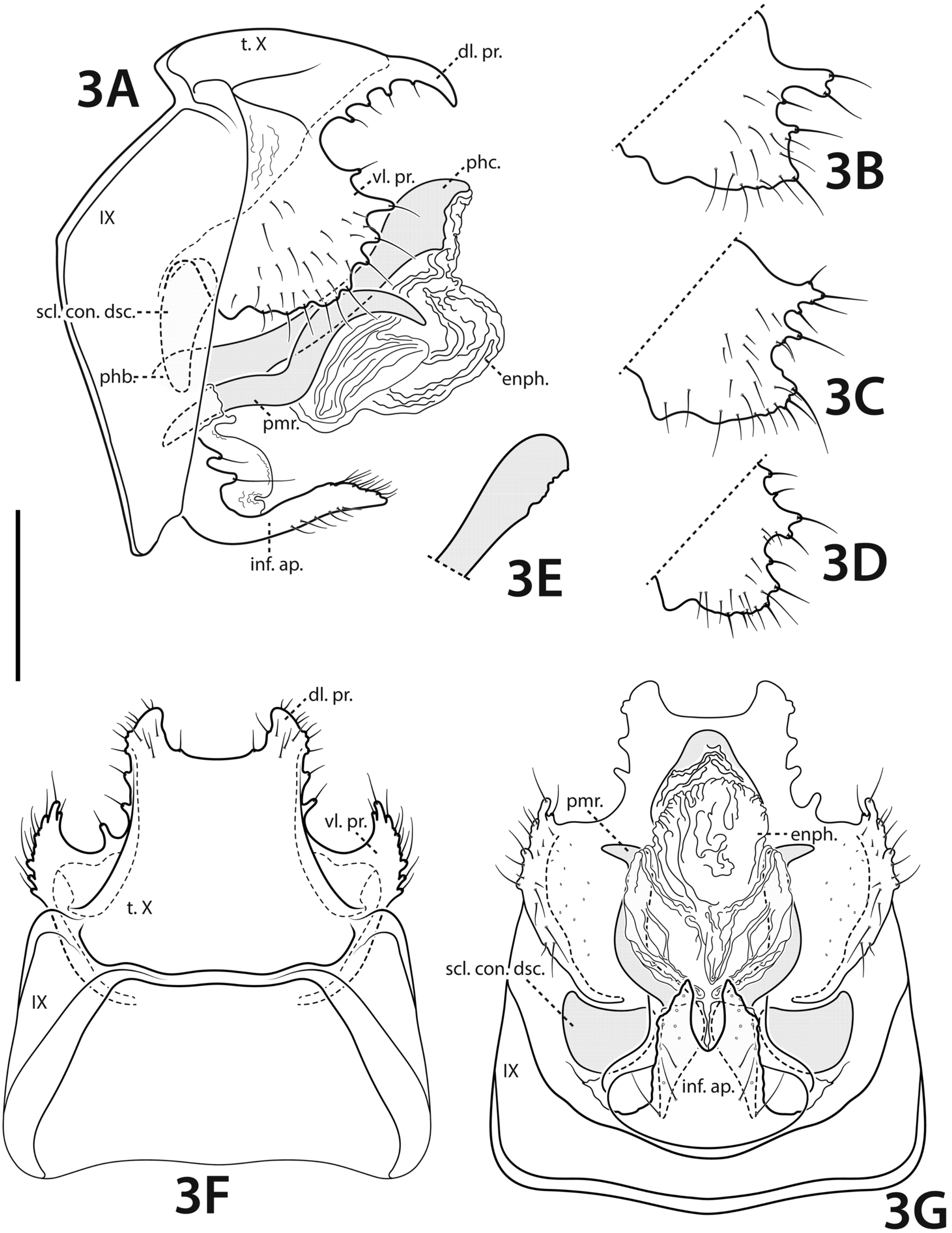

Fig. 3. *Itauara caparao* sp. nov., holotype (DZRJ 7647),male genitalia. **A**. Lateral view. **B–D**. Variations at the ventrolateral processes of tergum X found in three paratypes. **E**. Variation at the phallicata apex found in a paratype. **F**. Dorsal view. **G**. Ventral view. Scale bar = 0.1 mm.

Male genitalia

Preanal appendages absent. Segment IX ventrally narrow (Fig. 3G), broad medially (Fig. 3A); anterior margin rounded; posterolateral margin slightly sclerotized. Tergum X partially fused to tergum IX; dorsomesal margin without processes (Fig. 3F); dorsolateral margin with paired, broad, slightly downturned, subtriangular processes (Fig. 3F); ventrolateral margin with paired, very broad flange-like setose process consisting of several small irregular lobes (Fig. 3A, F–G), which vary (Fig. 3B–D). Inferior appendages present as single setose process, apically bifid, with each apex pointed (Fig. 3G). Parameres present, paired, inserted in membranous lobe, arising laterally from endotheca, sclerotized and rod-like, sinuous, apices pointed and downturned in lateral view (Fig. 3A), outwardly directed in ventral view (Fig. 3G). Phallobase reduced, slightly sclerotized; laterally with pair of small, sclerotized concave discs (Fig. 3A, G). Phallicata forming long, sclerotized dorsal sheath extending from phallobase, with apex spoon-like, and with dorsally directed curvature along its length (Fig. 3A), with some specimens having apex more rounded (Fig. 3E). Endophallus membranous, large, and convoluted (Fig. 3A, G).

Female and immatures

Unknown.

Distribution

Brazil (state of Espírito Santo [municipality of Dores do Rio Preto]). This is the first record of *Itauara* for this state.

Itauara cipoensis sp. nov.

urn:lsid:zoobank.org:act:FBACA693-0227-44FC-9C07-5EE885820BE7

Fig. 4

Differential diagnosis

This species is known only from the holotype and belongs to the *brasiliana* species group. Relationships among species in the *brasiliana* group are not resolved in the analysis presented here, and most of these species are placed in a polytomy, including *I. cipoensis* sp. nov. and other two new species described below. *Itauara cipoensis* can be easily recognized by having paired spiral processes arising dorsobasally from the parameres (Fig. 4A, C), and by the distinct shape of the phallicata, which is ribbon-like, and folds anteroventrally under itself (Fig. 4A). The tergum X of this new species resembles that of *I. flinti* Robertson & Holzenthal, 2011 and *I. guarani* (Angrisano, 1993), having an elongate process and irregular dorsolateral margins. However, in *I. cipoensis*, the dorsolateral margin, in dorsal view, is slightly retracted beneath the tergum X itself (Fig. 4A–B). Moreover, in lateral view, the dorsomesal process of the tergum X of this new species is longer, and has a strong downturned curvature, with a truncate apex (Fig. 4A). *Itauara cipoensis* and *I. guarani* have similarly shaped tergum X ventrolateral processes, but in the new species, this structure is digitate, while in *I. guarani* it is subtriangular.

Etymology

The specific name refers to the region where the holotype was collected, the Serra do Cipó mountain range.

Material examined

Holotype

BRAZIL • ♂; Minas Gerais, Morro do Pilar, Parque Nacional da Serra do Cipó, Córrego Água Escura; 19°16′02.7″ S, 43°30′56.8″ W; alt. 1239 m; 18–21 Nov. 2018; A.A. Alves, A.P.M. Santos, A.S. Freitas and A.L.D. Ferreira leg.; Malaise trap; DZRJ 7634.

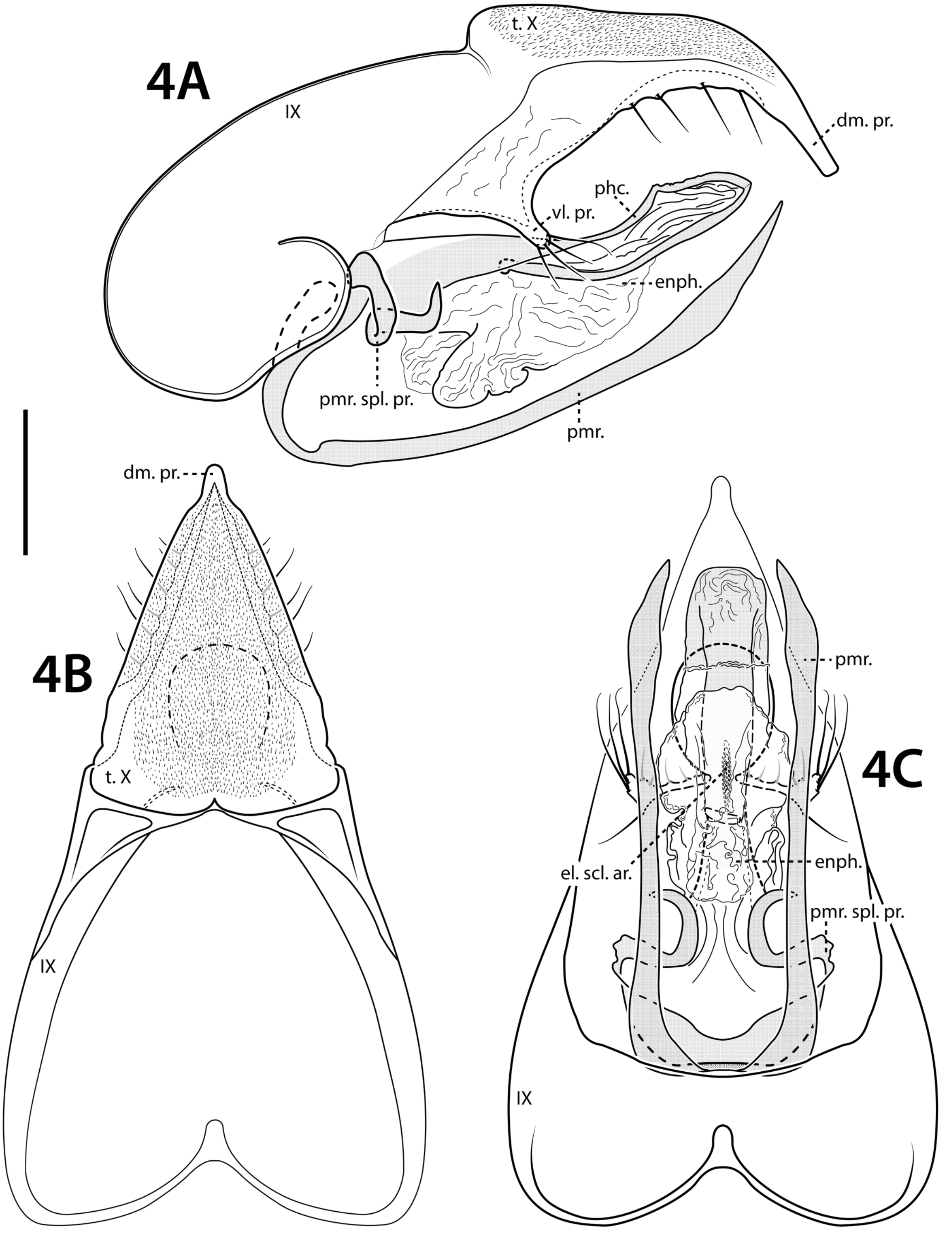

Fig. 4. *Itauara cipoensis* sp. nov., holotype (DZRJ 7634), male genitalia. **A**. Lateral view. **B**. Dorsal view. **C**. Ventral view. Scale bar = 0.1 mm.

Description

Adult

Length of each forewing 2.5 mm (n = 1). Head, thorax, and appendages, in alcohol, light brown. Forewings covered with brown setae, and with slight spot of white setae near Cu2 vein, slightly broad after anastomosis, with margins approximately parallel, apex slightly rounded; forks I, II, and III present; Sc and R1 veins not fused; fork I sessile; fork II petiolate, with stem shorter than fork; fork III petiolate, with stem longer than fork; Cu1 vein complete, reaching wing margin; Cu1 and Cu2 veins separating close to anastomosis; Cu2 vein with row of erect setae; A3 vein absent; crossveins constituting relatively straight transverse line; Rs vein shorter than discoidal cell. Hind wings with anterior and posterior margins approximately parallel, with apical portion tapered; forks II and V present; Sc and R1 converging very near to wing margin; A2 vein absent. Spur formula 1, 4, 4, foretibial spur reduced and hairlike. Sternum VI with digitate process, with acute apex.

Male genitalia

Preanal and inferior appendages absent. Segment IX dorsally narrow, broad ventrally; anterior margin rounded (Fig. 4A); posterolateral margin slightly sclerotized (Fig. 4A–B); anterior margin with ventromesal process projecting posteriorly (Fig. 4B–C). Tergum X partially fused to tergum IX (Fig. 4A); dorsomesal margin with elongate downturned process, and truncate apex in lateral view (Fig. 4A), rounded in dorsal and ventral views (Fig. 4B–C); dorsolateral margin slightly irregular, with some setae (Fig. 4A); ventrolateral margin, in lateral view, with pair of small digitate processes, with some apical setae (Fig. 4A). Parameres present, paired, arising ventrobasally from fused endotheca and phallobase, sclerotized and rod-like, slender and elongate, with strong basal curvature posteriorly directed, with subapical portion slightly broader, directed dorsally, apex pointed (Fig. 4A, C); and with pair of spiraled processes arising dorsobasally from parameres (Fig. 4A), in ventral view with apex acute and outwardly directed (Fig. 4C). Phallobase reduced, slightly sclerotized basoventrally. Phallicata forming very long, sclerotized dorsal sheath, ribbon-like, with slightly acuminated projection subapically, followed by strong curvature, with apical portion curved anteroventrally under itself (Fig. 4A), with elliptical area more sclerotized on mesoapical region (Fig. 4C). Endophallus membranous, with slightly sclerotized lobe basoventrally (Fig. 4A).

Female and immatures

Unknown.

Distribution

Brazil [state of Minas Gerais (municipality of Morro do Pilar)]

Itauara cristata sp. nov.

urn:lsid:zoobank.org:act:63D69058-6934-4203-B925-E9A498AD3994

Fig. 5

Differential diagnosis

This species belongs to the *amazonica* species group and is known only from the holotype. In the phylogenetic analysis, this new species was recovered as sister group to the clade of (*brasiliana* group + (*I. bispinata* sp. nov. + *I. caparao* sp. nov.)). *Itauara cristata* sp. nov. is most similar to *I. alexanderi* Robertson & Holzenthal, 2011 and *I. stella* Robertson & Holzenthal, 2011. The tergum X of these three species has many similarities in general aspect, including the processes of the dorsomesal and ventrolateral margins. The main difference among these species is the phallicata apex. In *I. cristata*, this structure is broad, as in *I. alexanderi*, but it is unique in the new species by the presence of a sclerotized dorsal crest (Fig. 5B–C). The parameres of *I. stella* and *I. alexanderi* are much more outwardly directed

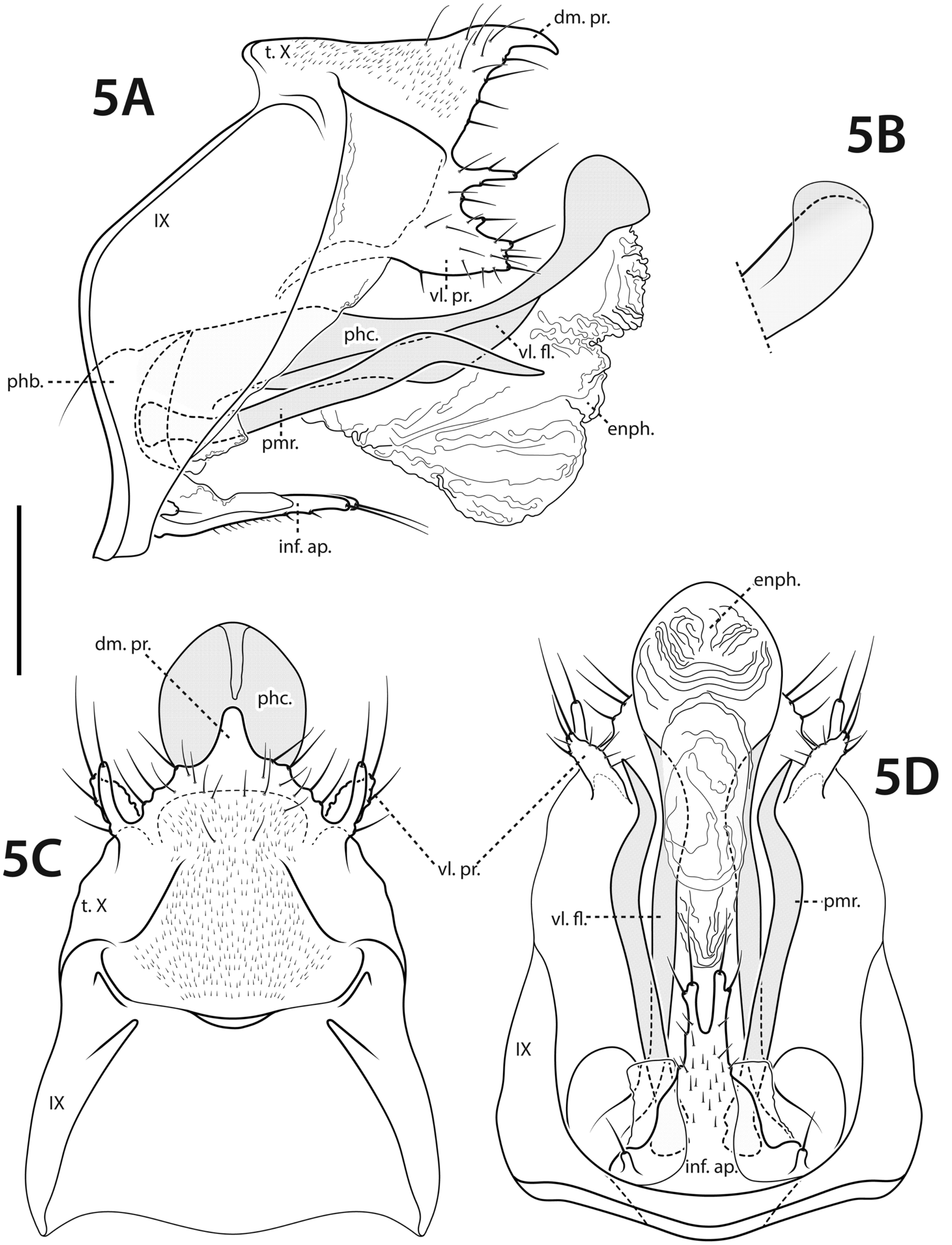

Fig. 5. *Itauara cristata* sp. nov., holotype (DZRJ 7641), male genitalia. **A**. Lateral view. **B**. Lateral oblique view of apex of the phallicata, showing the dorsal crest. **C**. Dorsal view. **D**. Ventral view. Scale bar = 0.1 mm.

apically than in the new species. Moreover, in *I. cristata*, the segment IX is subtriangular, being more rounded in *I. alexanderi*, and parameres exceed half the length of the phallicata (Fig. 5A, D), while in *I. alexanderi* they are much shorter.

Etymology

From Latin '*crista*' ('crest'), and '*-ata*' ('possession'), in reference to the sclerotized crest present dorsally on phallicata apex.

Material examined

Holotype

BRAZIL • ♂; Minas Gerais, Morro do Pilar, Estrada de terra para Cachoeira do Pica-pau, afluente do Rio Picão; 19°14′25.9″ S, 43°24′06.8″ W; alt. 669 m; 7–15 Jan. 2021; A.A. Alves, L. Hoehne, A.S. Freitas and E.J. Oliveira-Jr leg.; Malaise trap; DZRJ 7641.

Description

Adult

Length of each forewing 2.6 mm (n = 1). Head, thorax, and appendages, in alcohol, dark brown. Forewings covered with dark brown setae, slightly broad after anastomosis, with anterior and posterior margins approximately parallel, apex slightly rounded; forks I, II, and III present; Sc and R1 veins not fused; fork I sessile; forks II and III petiolate, with stem longer than fork; Cu1 vein complete, reaching wing margin; Cu1 and Cu2 veins separating on the anastomosis; Cu2 vein with row of erect setae; A3 vein absent; crossveins constituting relatively straight transverse line; Rs vein shorter than discoidal cell. Hind wings with anterior and posterior margins approximately parallel, with apical portion tapered; forks II and V present; Sc and R1 veins converging very near to wing margin; A2 vein absent. Spur formula 1, 4 ,4, foretibial spur reduced and hairlike. Sternum VI with digitate process present, with acute apex.

Male genitalia

Preanal appendages absent. Segment IX subtriangular, ventrally narrow, broad medially; anterior margin rounded; posterolateral margin slightly sclerotized. Tergum X partially fused to tergum IX; dorsomesal margin with single, slightly downturned process (Fig. 5A, C); dorsolateral margin slightly irregular, without processes (Fig. 5A, C); ventrolateral margin with paired, broad flange-like setose process, divided into digitate upper lobe and subtrapezoidal lower lobe (Fig. 5A). Inferior appendages present as singlesetose process, apically bifid, assymetrical (left apex shorter than right), broader at base, ventrolaterally with small digitate lobes, each one bearing an apical seta (Fig. 5A, D). Parameres present, paired, inserted in membranous lobe, arising laterally from endotheca, sclerotized and rod-like, sinuous, apex pointed and slightly downturned in lateral view (Fig. 5A), outwardly directed in ventral view (Fig. 5D). Phallobase reduced, slightly sclerotized. Phallicata forming long, sclerotized, dorsal sheath extending from phallobase, broad basally, ventrolaterally with pair of sclerotized flanges (Fig. 5A, D), medial portion straight, apical portion broad and dorsally with short and rounded crest (Fig. 5B–C). Endophallus membranous, enlarged and convoluted (Fig. 5A).

Female and immatures

Unknown.

Distribution

Brazil (state of Minas Gerais [municipality of Morro do Pilar]).

Itauara holzenthali sp. nov.

urn:lsid:zoobank.org:act:0925210F-ADEA-45A4-9E25-CCA96BFA28F3

Fig. 6

Differential diagnosis

This species belongs to the *brasiliana* species group. Since the results of the parsimony analysis were unresolved in this group, this new species appears in a polytomy in the strict consensus tree. *Itauara holzenthali* sp. nov. is similar to *I. flinti* and *I. simplex* Robertson & Holzenthal, 2011 in the general aspect of the tergum X, but in the new species this structure has a characteristic dorsomesal process with a truncated apex in dorsal view (Fig. 6B). In addition, *I. holzenthali* can be distinguished from other species by the presence of a pair of short digitate processes between the ventrolateral processes of tergum X (Fig. 6A, C).

Etymology

This new species is named in honor of Dr Ralph W. Holzenthal, for his important contributions to the knowledge of Neotropical caddisflies.

Material examined

Holotype

BRAZIL • ♂; Rio de Janeiro, Itatiaia, Penedo, Rio Palmital; 22°25′34″ S, 44°32′52″ W; alt. 637 m; 6 Mar. 2008; L.L. Dumas and J.L. Nessimian leg.; DZRJ 7642.

Paratype

BRAZIL • 1 ♂; same collection data as for holotype; DZRJ 7643.

Description

Adult

Length of each forewing 2.9–3.0 mm (n = 2). Head, thorax, and appendages, in alcohol, light brown. Forewings covered with brown setae, slightly broad after anastomosis, with anterior and posterior margins approximately parallel, apex slightly rounded; forks I, II, and III present; Sc and R1 veins not fused; fork I sessile; fork II petiolate, with stem shorter than fork; fork III petiolate, with stem longer than fork; Cu1 vein complete, reaching wing margin; Cu1 and Cu2 veins separating on anastomosis; Cu2 vein with row of erect setae; A3 vein absent; crossveins constituting relatively straight transverse line; Rs vein shorter than discoidal cell. Hind wing with margins approximately parallel, with apical portion tapered; forks II and V present; Sc and R1 veins converging very near to wing margin; A2 vein absent. Spur formula 1, 4 ,4, foretibial spur reduced and hairlike. Sternum VI with digitate process, with acute apex.

Male genitalia

Preanal and inferior appendages absent. Segment IX dorsally narrow, broad ventrally; anterior margin rounded; posterolateral margin slightly sclerotized. Tergum X partially fused to tergum IX; dorsomesal margin produced into single process, tapering to truncate apex, in dorsal view (Fig. 6B), and acute and downturned in lateral view (Fig. 6A); dorsolateral margin slightly irregular, setose, without processes (Fig. 6A–B); ventrolateral margin with paired setose processes, and medially, between ventrolateral processes, with pair of short digitate process (Fig. 6A, C). Parameres present, paired, arising ventrobasally from fused endotheca and phallobase, sclerotized and rod-like, slender and elongate, basally with strong curvature posterad, with subapical portion slightly broader, directed dorsally, pointed apically (Fig. 6A, C). Phallobase reduced, slightly sclerotized. Phallicata forming long, slightly sinuous, slender, sclerotized

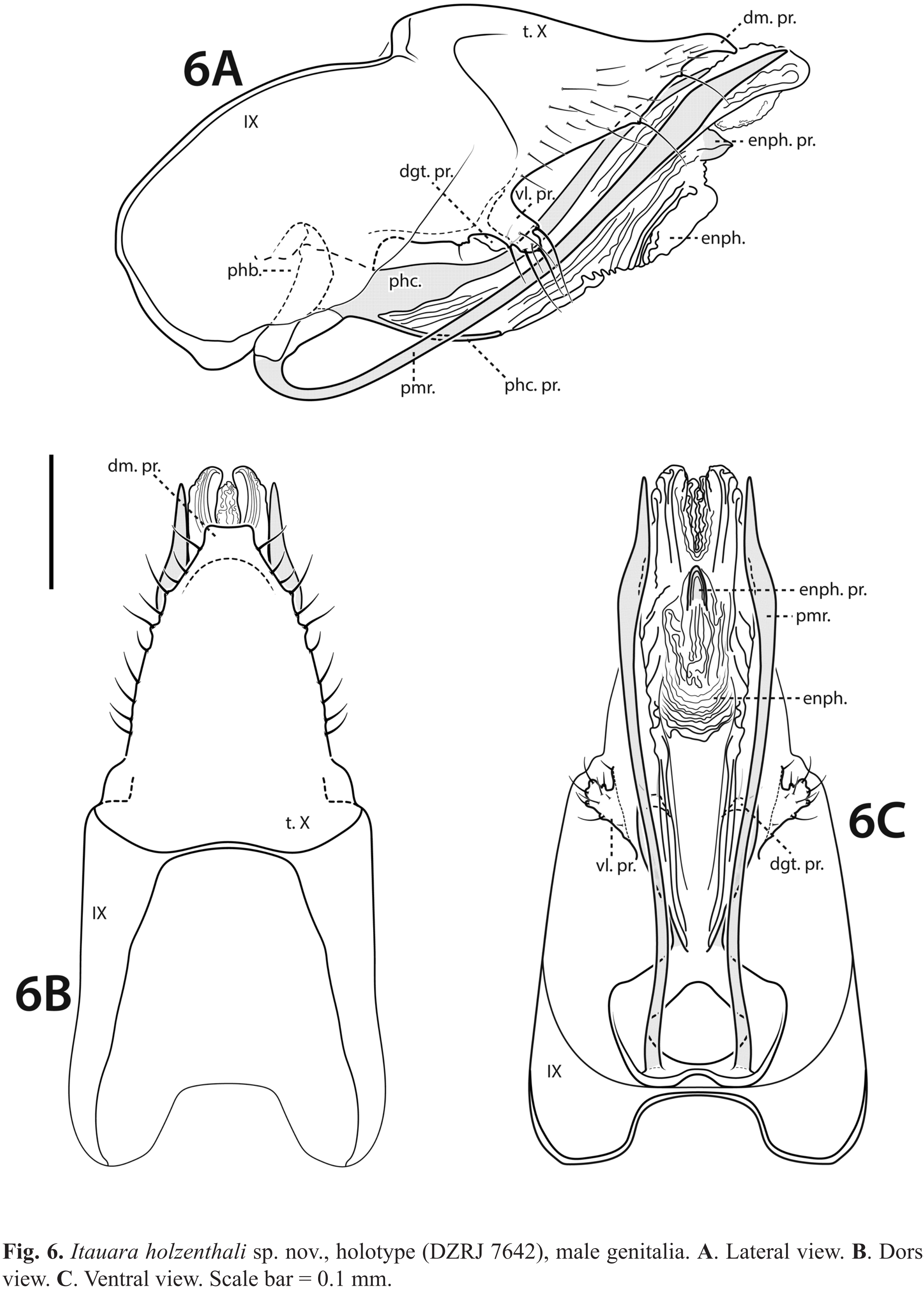

Fig. 6. *Itauara holzenthali* sp. nov., holotype (DZRJ 7642), male genitalia. **A**. Lateral view. **B**. Dorsal view. **C**. Ventral view. Scale bar = 0.1 mm.

dorsal sheath extending from phallobase, with pair of basoventral processes (Fig. 6A, C). Endophallus membranous, enlarged and convoluted, with short, pointed, ventral process near apex (Fig. 6A, C).

Female and immatures

Unknown.

Distribution

Brazil [state of Rio de Janeiro (municipality of Itatiaia)]

Itauara mangaratiba sp. nov.

urn:lsid:zoobank.org:act:A3E06D5A-B50A-4DB5-8A60-DAD0EC3F27F4

Fig. 7

Differential diagnosis

This species belongs to the *amazonica* species group, being recovered as sister group to a clade including *I. cristata* sp. nov., *I. caparao* sp. nov., *I. bispinata* sp. nov., and the *brasiliana* species group. This new species is similar to *I. alexanderi* Robertson & Holzenthal, 2011, *I. emilia* Robertson & Holzenthal, 2011, and *I. lucinda* Robertson & Holzenthal, 2011, each with tergum X presenting a dorsomesal process that is downturned in lateral view, and with similar ventrolateral processes. However, in *I. mangaratiba* sp. nov., the lower lobe of ventrolateral process is globose (Fig. 7A) and in those other species it is subquadrate or subtriangular. Moreover, the new species can be recognized by the phallicata, which is slightly sinuous along its length (Fig. 7A); by the apical portion of parameres being slightly outward and downturned (Fig. 7A, C); and by the inferior appendages undivided at apex (Fig. 7C).

Etymology

The specific epithet, used as a noun in apposition, refers to the locality where the holotype specimen was collected. The name 'Mangaratiba' comes from the Tupi-guarani language and means "place where there are mangarás". Mangará or mangarito is an edible plant (*Xanthosoma* sp., Araceae), similar to taro, that used to be consumed by indigenous people in this region.

Material examined

Holotype

BRAZIL • ♂; Rio de Janeiro Mangaratiba, Serra do Piloto, Parque Estadual Cunhambebe, Pousada Mirante Imperial, afl. 1ª ordem do Rio do Saco; 22°54′15.3″ S, 44°01′20″ W; alt. 197 m; 13–15 May. 2017; L.L. Dumas, J.L. Nessimian, A.L.D. Ferreira and J.F. Barbosa leg.; DZRJ 7645.

Paratype

BRAZIL • 1 ♂; same collection data as for holotype; DZRJ 7644.

Description

Adult

Length of each forewing 2.7–2.8 mm (n = 2). Head, thorax, and appendages, in alcohol, light brown. Forewings covered with brown setae, slightly broad after anastomosis, with anterior and posterior margins approximately parallel, apex subacute; forks I, II, and III present; Sc and R1 veins not fused; fork I sessile; forks II and III petiolate, with stem longer than fork; Cu1 vein complete, reaching wing margin; Cu1 and Cu2 veins intersecting near of anastomosis; Cu2 vein with row of erect setae; A3 vein absent; crossveins constituting relatively straight transverse line; Rs vein and discoidal cell approximately of same length. Hind wings with margins approximately parallel, with apical portion tapered; forks II and V present; Sc and R1 vein converging near to wing margin; A2 vein absent. Spur formula 1, 4, 4, foretibial spur reduced and hair-like. Segment VI with digitate process, with acute apex.

Male genitalia

Preanal appendages absent. Segment IX ventrally narrow, broad medially; anteroventral margin sinuous; posterolateral margin slightly sclerotized. Tergum X partially fused to tergum IX; dorsomesal margin with single, downturned, elongate process (Fig. 7A–B); dorsolateral margin without processes; ventrolateral margin with paired flange-like setose processes, with upper subtriangular lobe and lower globose lobe. (Fig. 7B). Inferior appendages present as single, broad process, broader basally, with rounded apex bearing long setae, and with pair of small digitate lobes ventrolaterally, each bearing

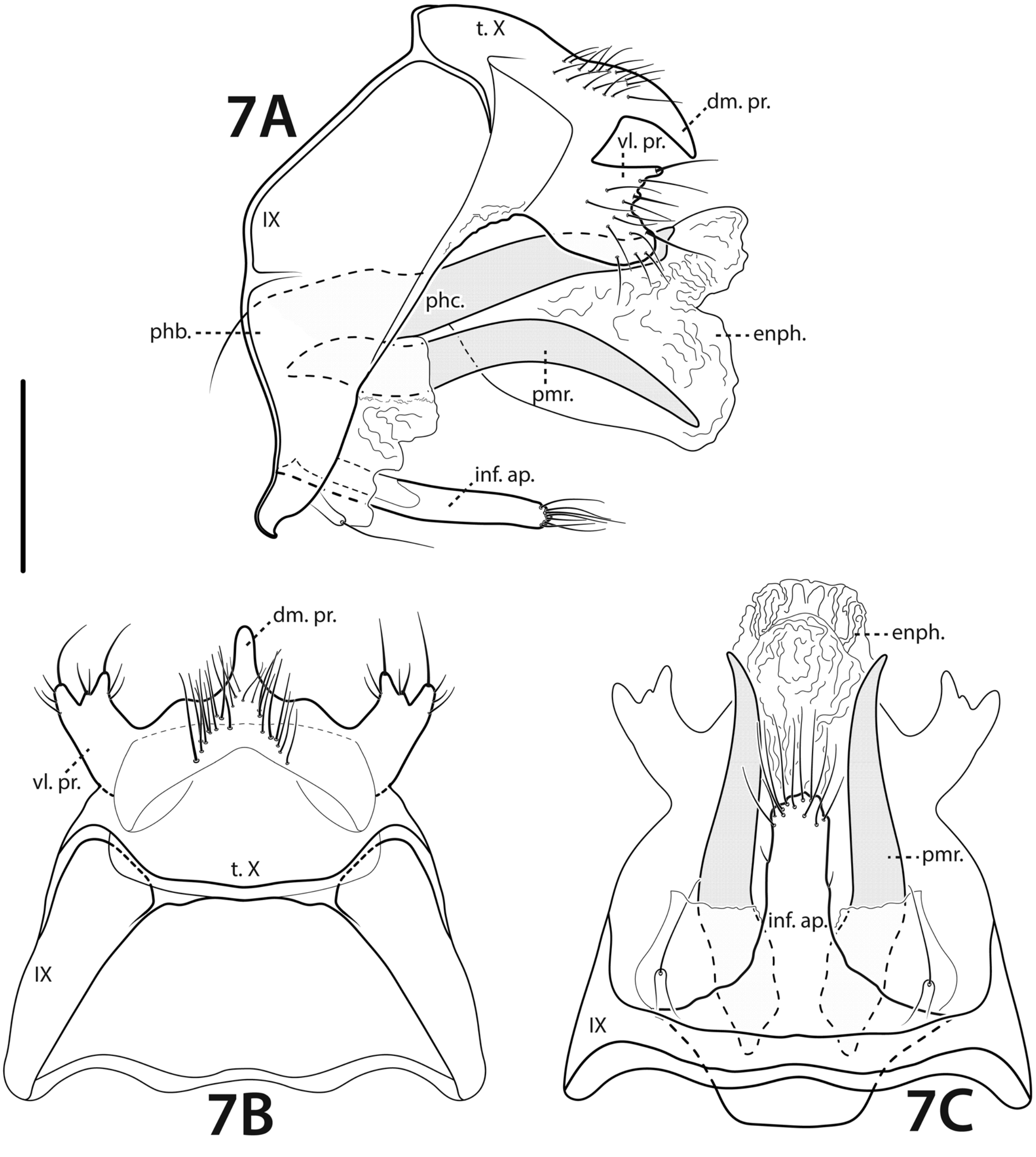

Fig. 7. *Itauara mangaratiba* sp. nov., holotype (DZRJ 7645), male genitalia. **A**. Lateral view. **B**. Dorsal view. **C**. Ventral view. Scale bar = 0.1 mm.

a seta (Fig. 7A, C). Parameres present, paired, inserted in membranous lobe, arising laterally from endotheca, sclerotized and rod-like, long, sinuous, with apical portion ventrally directed (Fig. 7A), and slightly outward (Fig. 7C), apices pointed. Phallobase reduced, slightly sclerotized. Phallicata forming moderate-sized, slightly sinuous, sclerotized, dorsal sheath extending from phallobase, with subacute apex (Fig. 7A). Endophallus membranous, enlarged, and convoluted, divided into upper and lower lobe (Fig. 7A).

Female and immatures

Unknown.

Distribution

Brazil [state of Rio de Janeiro (municipality of Mangaratiba)]

Itauara robertsonae sp. nov.

urn:lsid:zoobank.org:act:B489D6AC-1224-4CD2-BA07-98066F98D52A

Fig. 8

Differential diagnosis

This new species belongs to the *brasiliana* species group and was recovered as sister group to the clade including all other species in the group. *Itauara robertsonae* sp. nov. is similar to *I. flinti*, and *I. simplex* in the lateral view of the tergum X, which has the dorsomesal margin produced and slightly downturned. However, *I. robertsonae* is easily distinguished from other species by the apically bifid tergum X, with each lobe rounded (Fig. 8B). In addition, this new species has a pair of distinctive spiniform processes arising from the phallobase, with strong curvature dorsally directed (Fig. 8A).

Etymology

The specific epithet is in honor of Dr Desiree R. Robertson, in reference to her important contributions to Glossosomatidae systematics.

Material examined

Holotype

BRAZIL • ♂; Minas Gerais, Jaboticatubas, Parque Nacional da Serra do Cipó, Trilha para o Cânion das Bandeirinhas, Rio Mascates; 19°24′31.1″ S, 43°34′35.4″ W; alt. 807 m; 18 Nov. 2018; A.A. Alves and A.P.M. Santos leg.; white sheet; DZRJ 7638.

Paratypes

BRAZIL • 27 ♂♂; same collection data as for holotype; DZRJ 7635 • 10 ♂; same collection data as for holotype; MNRJ-ENT10-186 • 1 ♂; same collection data as for holotype; Trilha para o Cânion das Bandeirinhas, riacho de 2ª ordem; 19°24′20.1″ S, 43°34′44.2″ W; alt. 818 m; 16 Nov. 2018; A.A. Alves and A.P.M. Santos leg.; Pennsylvania trap; DZRJ 7637 • 1 ♂; same collection data as for holotype; Santana do Riacho, Cardeal Mota, Rio Cipó, Cachoeira Grande; 19°20′51.2″ S, 43°38′03.5″ W; alt. 795 m; 21 Apr. 2010; L.L. Dumas and A.P.M. Santos leg.; DZRJ 7636.

Description

Adult male

Length of each forewing 1.9–2.3 mm (n = 39). Head, thorax, and appendages, in alcohol, light brown. Forewings covered with brown setae, slightly broad after anastomosis, with anterior and posterior margins approximately parallel, apex subacute; forks I, II, and III present; Sc and R1 veins not fused; fork I sessile; forks II and III petiolate, with stem longer than fork; Cu1 vein complete, reaching wing

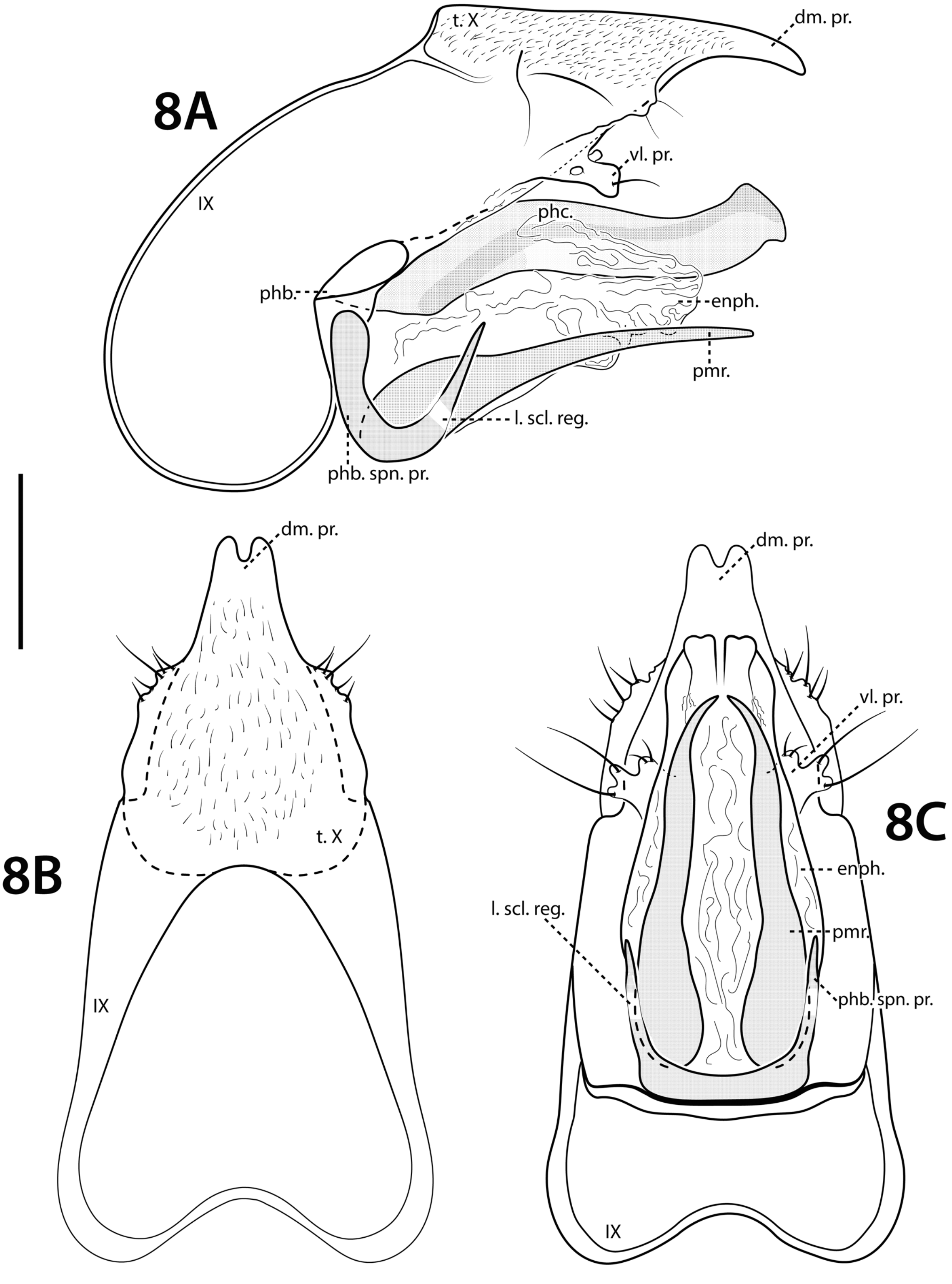

Fig. 8. *Itauara robertsonae* sp. nov., holotype (DZRJ 7638), male genitalia. **A**. Lateral view. **B**. Dorsal view. **C**. Ventral view. Scale bar = 0.1 mm.

margin; Cu1 and Cu2 veins intersecting near of anastomosis; Cu2 vein with row of erect setae; A3 vein absent; crossveins constituting relatively straight transverse line; Rs vein shorter than discoidal cell. Hind wings with anterior and posterior margins approximately parallel, with apical portion tapered; forks II and V present; Sc and R1 veins converging near to wing margin; A2 vein absent. Spur formula 1, 4, 4, foretibial spur reduced and hairlike. Segment VI with digitate process, with acute apex.

Male genitalia

Preanal and inferior appendages absent. Segment IX broad medially; anterior margin rounded, concave in ventral and dorsal views; posterolateral margin slightly sclerotized. Tergum X partially fused to tergum IX; dorsomesal margin with bifid, slightly downturned, elongate process (Fig. 8A–B); dorsolateral margin slightly expanded and irregular, in dorsal and ventral view, with setae (Fig. 8B–C); ventrolateral margin with small trilobed process, with setae (Fig. 8A, C). Parameres present, paired, arising ventrobasally in relation to phallobase, wider basally, gradually tapering to apex, slightly sinuous in ventral view, slightly curved in lateral view (Fig. 8A, C). Phallobase reduced, slightly sclerotized; with pair of spiniform processes, strongly curved dorsally, and with lightly sclerotized region, as window at end of second third of length (Fig. 8A, C). Phallicata forming long sclerotized dorsal sheath extending from phallobase, slightly sinuous, with apical portion dorsally curved; internally with slender portion, which is more sclerotized, following shape of phallicata (Fig. 8A). Endophallus membranous, enlarged, and convoluted (Fig. 8A, C).

Female and immatures

Unknown.

Distribution

Brazil [state of Minas Gerais (municipality of Jaboticatubas)]

Itauara rupicola sp. nov.

urn:lsid:zoobank.org:act:1B42DDFE-5391-4E25-B5DD-D93BB5860129

Fig. 9

Differential diagnosis

This new species belongs to the *brasiliana* species group and, in the strict consensus tree, it appears in an unresolved polytomy within this species group. This new species can be easily recognized by the tergum X with three acute processes in dorsal view, with the median process being larger than the lateral ones (Fig. 9A–B). Moreover, the nearly straight shape of the phallicata, and the basally bifid parameres also easily distinguish *I. rupicola* sp. nov. from other species.

Etymology

From the Latin '*rupes*' ('rock'), and '*-cola*' ('inhabitant'), in reference to the typical environment surrounding the type locality, the "Campos Rupestres" or "Campos Rupícolas".

Material examined

Holotype

BRAZIL • ♂; Minas Gerais, Morro do Pilar, Parque Nacional da Serra do Cipó, Córrego Água Escura; 19°16′02.7″ S, 43°30′56.8″ W; alt. 1239 m; 18–21 Nov. 2018; A.A. Alves, A.P.M. Santos, A.S. Freitas and A.L.D. Ferreira leg.; Malaise trap; DZRJ 7629.

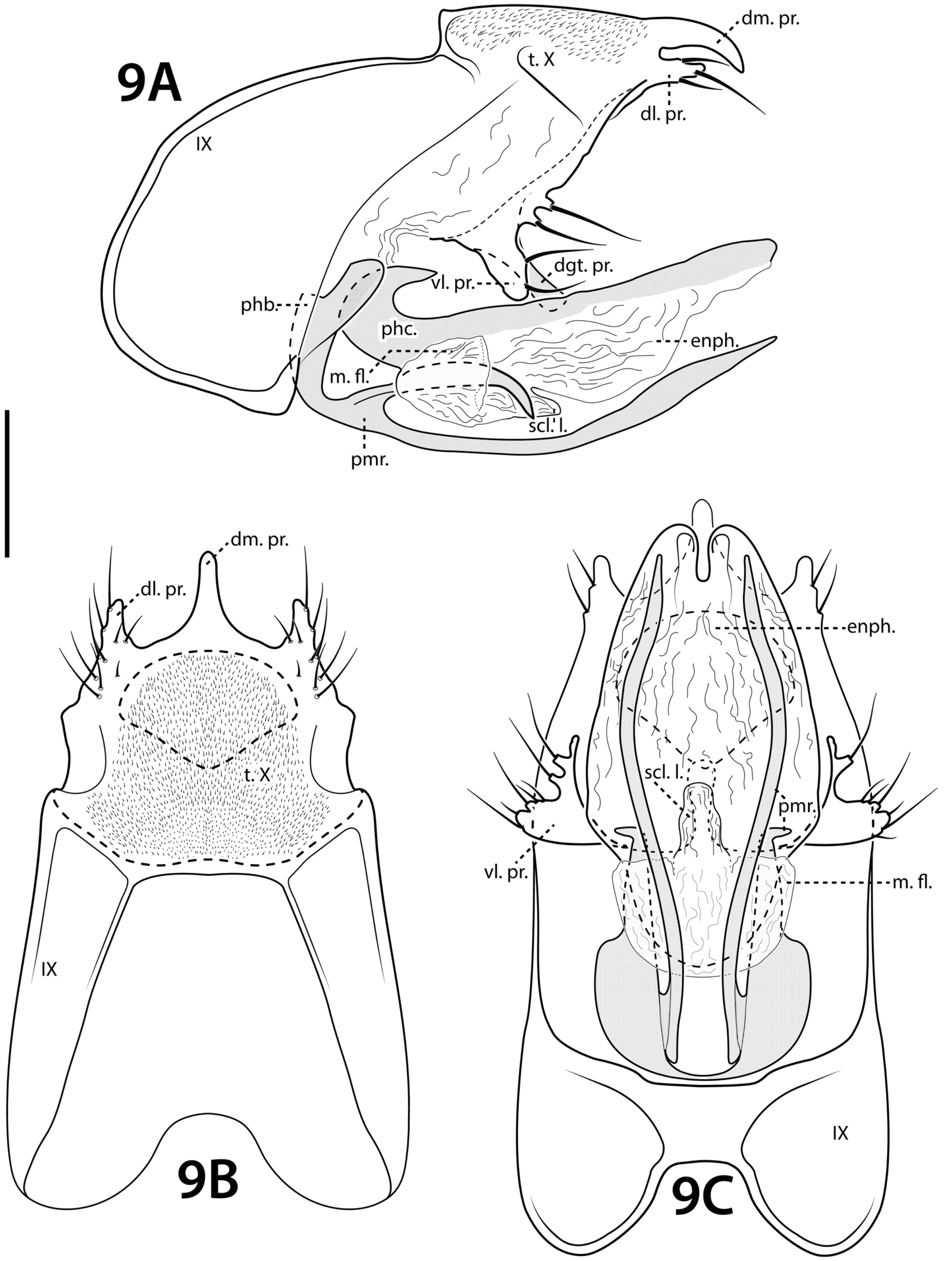

Fig. 9. *Itauara rupicola* sp. nov., holotype (DZRJ 7629), male genitalia. **A**. Lateral view. **B**. Dorsal view. **C**. Ventral view. Scale bar = 0.1 mm.

Paratypes

BRAZIL • 1 ♂; same collection data as for holotype; DZRJ 7630 • 2 ♂♂; same collection data as for holotype; 11–14 Oct. 2019; A.A. Alves, J.L. Nessimian, L. Hoehne and G.A. Jardim leg.; Malaise trap; MNRJ-ENT10-187 • 2 ♂♂; same collection data as for holotype; Parque Nacional da Serra do Cipó, Trilha para o Córrego Água Escura, Córrego Indaiá; 19°15′47.9″ S, 43°31′28.8″ W; alt. 1295 m; 18 Nov. 2018; A.A. Alves and A.P.M. Santos leg.; Pennsylvania light trap; DZRJ 7633 • 1 ♂; same collection data as for holotype; Jaboticatubas, Parque Nacional da Serra do Cipó, Trilha para Cachoeira da Farofa, Córrego da Farofa; 19°23′2.6″ S, 43°34′49.1″ W; alt. 812 m; 5–10 Jan. 2019; A.A. Alves, J.L. Nessimian, L. Hoehne and A.L. Henriques-Oliveira leg.; Malaise trap; DZRJ 7632.

Description

Adult

Length of each forewing 2.7–3.0 mm (n = 7). Head, thorax, and appendages, in alcohol, light brown. Forewings covered with brown setae, slightly broad after anastomosis, with anterior and posterior margins approximately parallel, apex subacute; forks I, II, and III present; Sc and R1 veins not fused; forks I and II sessile; fork III petiolate, with stem longer than fork; Cu1 vein complete, reaching wing margin; Cu1 and Cu2 veins intersecting near anastomosis; Cu2 vein with row of erect setae; A3 vein absent; crossveins constituting relatively straight transverse line; Rs vein shorter than discoidal cell. Hind wings with margins approximately parallel, with apical portion tapered; forks II and V present; Sc and R1 veins converging very near to wing margin; A2 vein absent. Spur formula 1, 4, 4, foretibial spur reduced and hair-like. Segment VI with digitate process, with acute apex.

Male genitalia

Preanal and inferior appendages absent. Segment IX broad medially; anterior margin rounded; posterolateral margin slightly sclerotized. Tergum X partially fused to tergum IX; in dorsal view, dorsomesal margin with elongate, digitate mesal process, downturned in lateral view (Fig. 9A–B); dorsolateral margin with pair of lateral setose processes, shorter than dorsomesal process (Fig. 9A–B); ventrolateral margin, with pair of flange-like processes outwardly directed, with small upper protuberances, each one with apical setae (number variable in left-right sides), and larger lower digitate lobe (Fig. 9A, C); and medially, between ventrolateral processes, with long digitate process (Fig. 9A). Parameres present, sclerotized, paired, bifid, arising ventrobasally from fused endotheca and phallobase; lower process long, rod-like, slender, upturned, with apical portion slightly broader, directed dorsally, apices pointed (Fig. 9A, C); upper process, short, acute, and downturned in lateral view (Fig. 9A), with outwardly projecting apex in ventral view (Fig. 9C). Phallobase reduced, slightly sclerotized. Phallicata with long sclerotized dorsally flattened sheath, almost straight (Fig. 9A); dorsobasally with strong curvature posteriorly directed (Fig. 9A). Endophallus membranous, enlarged, and convoluted, with membranous flanges produced ventrobasally, almost forming hollow tube, and with slightly sclerotized lobe basoventrally (Fig. 9A, C).

Female and immatures

Unknown.

Distribution

Brazil [state of Minas Gerais (municipality of Morro do Pilar)].

Distributional records of species of *Itauara*

Based on the analysis of material deposited at DZRJ collection (Appendix A) and the available data in the literature (Mosely 1939; Flint 1971, 1974; Angrisano 1993, 1997; Angrisano & Sganga 2007;

Table 1. Current distribution of species of *Itauara* Müller, 1888, including the new species described here. Names in bold are new records.

Species	**Current distribution**
Itauara alexanderi Robertson & Holzenthal, 2011	Brazil (Rio de Janeiro)
Itauara amazonica Robertson & Holzenthal, 2011	Brazil (Amazonas)
Itauara bidentata Robertson & Holzenthal, 2011	Guyana (Upper Takutu-Upper Essequibo)
Itauara bispinata sp. nov.	Brazil (Minas Gerais)
Itauara blahniki Robertson & Holzenthal, 2011	Brazil (São Paulo)
Itauara brasiliana (Mosely, 1939)	Argentina (Entre Ríos, Misiones), Brazil (Santa Catarina), Uruguay (Cerro Largo, Treinta y Tres)
Itauara caparao sp. nov.	Brazil (Espírito Santo)
Itauara charlotta Robertson & Holzenthal, 2011	Brazil (Minas Gerais)
Itauara cipoensis sp. nov.	Brazil (Minas Gerais)
Itauara cristata sp. nov.	Brazil (Minas Gerais)
Itauara emilia Robertson & Holzenthal, 2011	Brazil (São Paulo)
Itauara flinti Robertson & Holzenthal, 2011	Brazil (São Paulo)
Itauara guarani (Angrisano, 1993)	Argentina (Misiones)
Itauara guyanensis Robertson & Holzenthal, 2011	Guyana (Upper Demerara-Berbice)
Itauara holzenthali sp. nov.	Brazil (Rio de Janeiro)
Itauara jamesii Robertson & Holzenthal, 2011	Brazil (**Espírito Santo**, Minas Gerais)
Itauara julia Robertson & Holzenthal, 2011	Brazil (Rio de Janeiro)
Itauara lucinda Robertson & Holzenthal, 2011	Brazil (**Espírito Santo**, Minas Gerais)
Itauara mangaratiba sp. nov.	Brazil (Rio de Janeiro)
Itauara ovis Robertson & Holzenthal, 2011	Guyana (Upper Takutu-Upper Essequibo), Venezuela (Bolívar)
Itauara peruensis Robertson & Holzenthal, 2011	Peru (Madre de Dios)
Itauara plaumanni (Flint, 1974)	Argentina (Misiones), Brazil (**Paraná**, Santa Catarina), Uruguay (Artigas, Salto, Paysandú)
Itauara robertsonae sp. nov.	Brazil (Minas Gerais)
Itauara rodmani Robertson & Holzenthal, 2011	Brazil (Minas Gerais)
Itauara rupicola sp. nov.	Brazil (Minas Gerais)
Itauara simplex Robertson & Holzenthal, 2011	Brazil (São Paulo)
Itauara spiralis Robertson & Holzenthal, 2011	Guyana (Potaro-Siparuni)
Itauara stella Robertson & Holzenthal, 2011	Brazil (São Paulo)
Itauara tusci Robertson & Holzenthal, 2011	Brazil (**Minas Gerais**, Rio de Janeiro)
Itauara unidentata Robertson & Holzenthal, 2011	Guyana (Upper Takutu-Upper Essequibo)

Robertson & Holzenthal 2011), we provide here an updated distribution list of the species of *Itauara*, including new distributional records (Fig. 10, Table 1).

Phylogenetic analysis

Phylogenetic analysis recovered 42 most parsimonious trees, with length of 242 steps. The strict consensus tree resulting from this analysis is presented in Figure 11. Overall, the clades recovered in

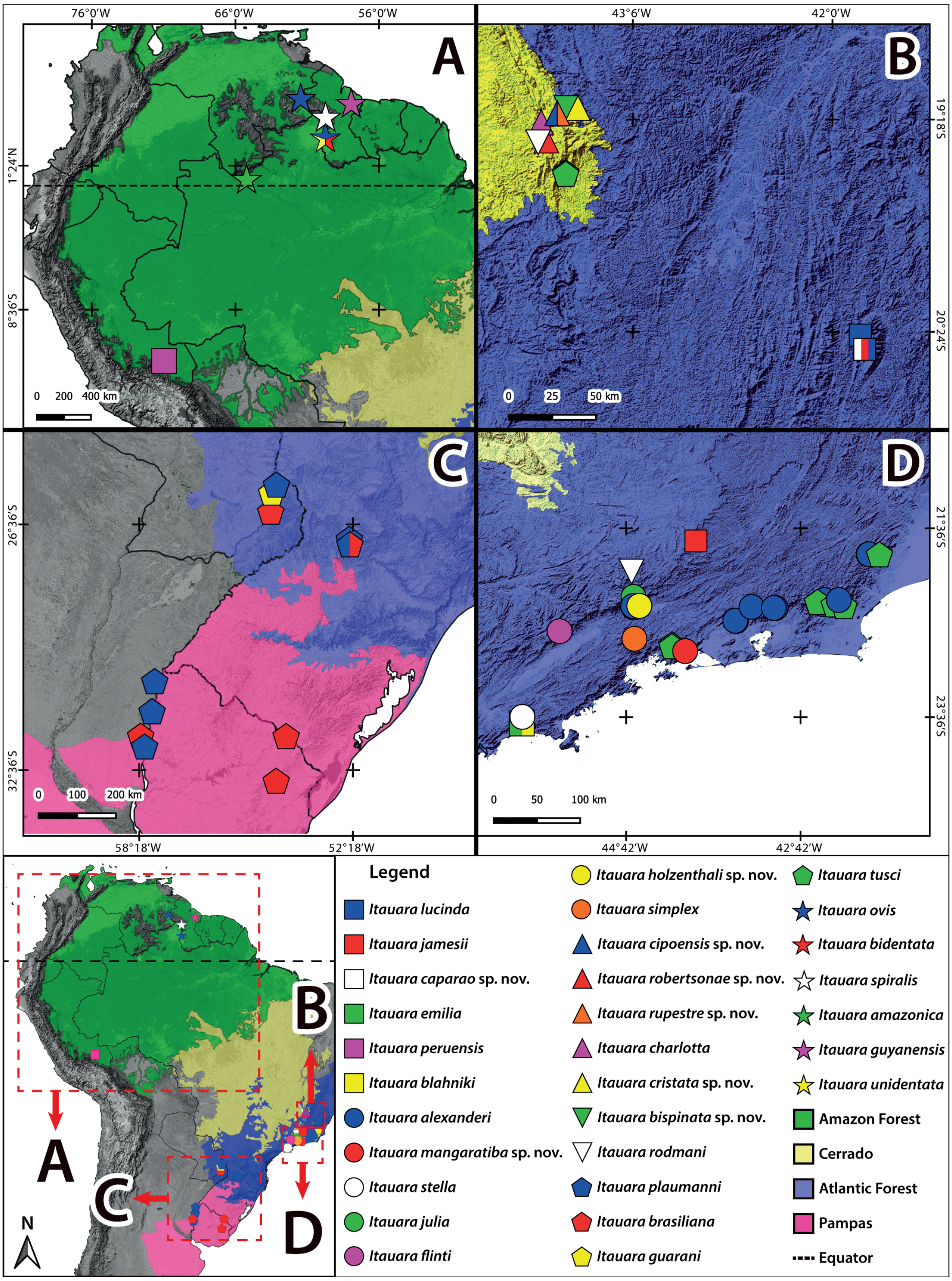

Fig. 10. Distribution map of the species of *Itauara* Müller, 1888, including the new species described here, highlighting the biomes in which the genus occurs.

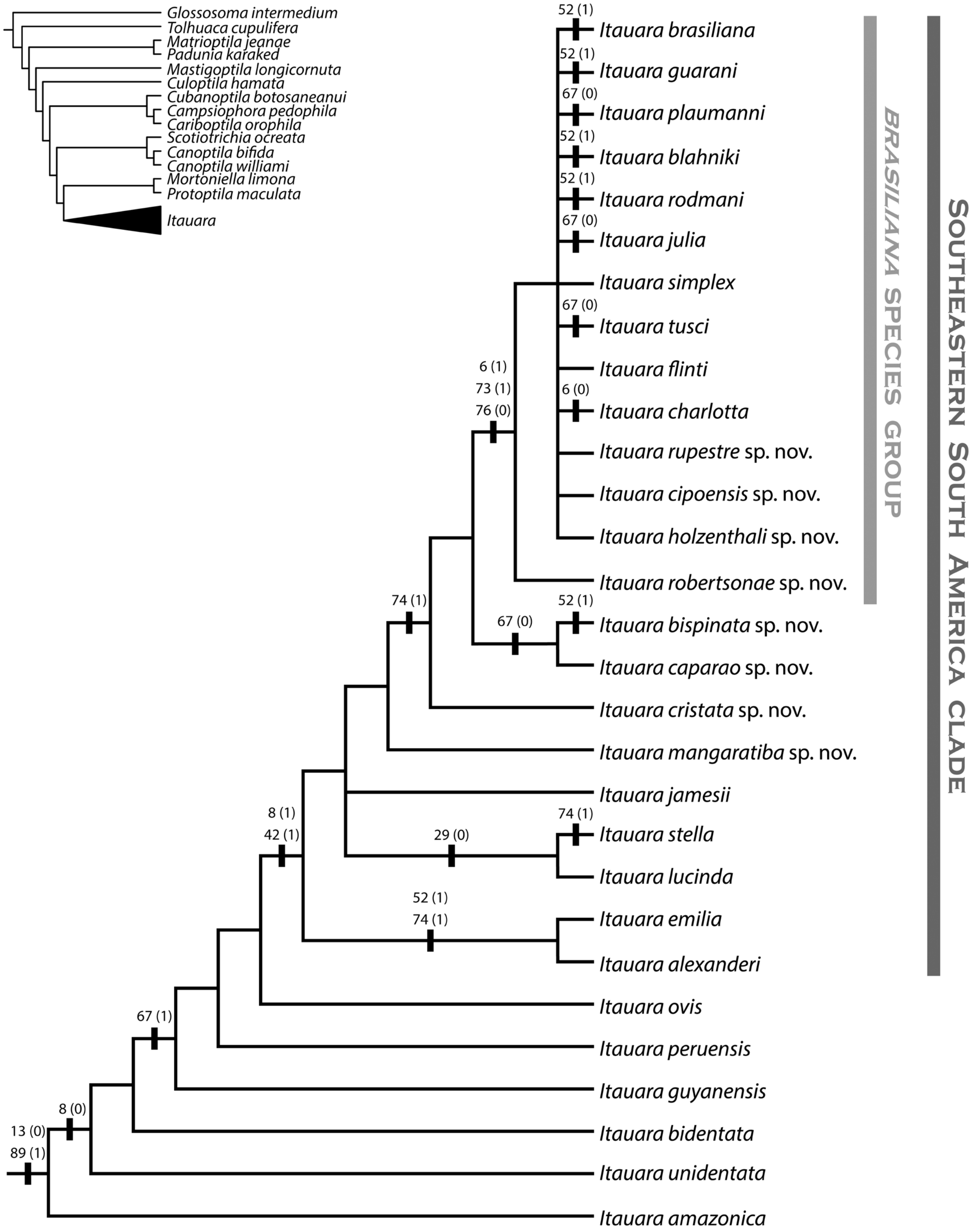

Fig. 11. Strict consensus tree resulting from 42 most parsimonious trees (length = 242 steps; consistency index = 0.4291; retention index = 0.6602) from an equally weighted parsimony analysis of *Itauara* Müller, 1888 based on 93 morphological characters (6 constant, 19 variable and parsimony uninformative) modified from the matrix of Robertson & Holzenthal (2013). Apomorphies for the clades are indicated by the characters, with its states between parentheses. Bootstrap values (> 50%) are indicated under branches within the *Itauara* clade.

the resulting topology had low bootstrap values. The genus *Itauara* was recovered as monophyletic, with low bootstrap support (58), and two characters were unambiguous apomorphies for this clade: the anterior position of the anteromesal mesoscutal wart [13(0)], also observed in *Cubanoptila botosaneanui* Kumanski, 1987, and the phallicata with a dorsal sheath [89(1)].

According to our results, *I. amazonica* was the first species to diverge from the main *Itauara* clade (Fig. 11). After this, other species with occurrences in northern South America diverged sequentially from the main lineage, in the order: *I. unidentata* Robertson & Holzenthal, 2011, *I. bidentata* Robertson & Holzenthal, 2011, *I. guyanensis* Robertson & Holzenthal, 2011, *I. peruensis* Robertson & Holzenthal, 2011, and *I. ovis* Robertson & Holzenthal, 2011 (Fig. 11). A clade with all species from southeastern South America was supported by two synapomorphies (Fig. 11): posterior setal wart of the head small, not extending from lateral ocellus or meeting at medial suture [8(1)]; and hind wings with margins nearly parallel at medial region [42(1)]. Moreover, *Itauara emilia* + *I. alexanderi* form a clade also present in the analysis of Robertson & Holzenthal (2013: fig. 35), here supported by the mesal process of the sternum VI having a rounded apex [52(1), homoplastic, also observed in *I. bispinata* sp. nov. *I. rodmani* Robertson & Holzenthal, 2011, *I. blahniki* Robertson & Holzenthal, 2011, *I. guarani*, and *I. brasiliana*], and by the inferior appendages with apex bifurcated [74(1), homoplastic, also observed in *I. stella*, and in the clade (*I. cristata* sp. nov.,((*I. bispinata* sp. nov., *I. caparao* sp. nov.),(*brasiliana* species group)))]. In addition, other clades were recovered in our analysis, such as *I. stella* + *I. lucinda*, supported by the forewing with petiole shorter than fork III, or up to the same length [29(0), homoplastic], and *I. bispinata* sp. nov. + *I. caparao* sp. nov., supported by the tergum X with posterior margin without median process [67(0), homoplastic, also observed in *I. tusci*, *I. julia* Robertson & Holzenthal, 2011, and *I. plaumanni*]. In addition, the *brasiliana* species group was recovered as monophyletic, supported by three synapomorphies (Fig. 11): head with each anterior setal wart constricted at medial region [6(1)]; inferior appendages absent [73(1)]; and parameres arising ventrobasally from fused endotheca and phallobase [76(0)].

Discussion

Until 2011, *Itauara* contained only four described species: *I. amazonica* (Flint, 1971), *I. brasiliana* (Mosely, 1953), *I. guarani* (Angrisano, 1993), and *I. plaumanni* (Flint, 1973). Robertson & Holzenthal (2011) reviewed this genus and described 18 more species. In this study, we added eight new species to the genus, bringing the diversity of *Itauara* to 30 species.

Some species, such as *I. alexanderi*, *I. jamesii*, and *I. tusci*, previously known only from their type localities, are now recorded from other localities. *Itauara alexanderi* and *I. tusci* were previously recorded only from Serra dos Órgãos, a small portion of a mountainous area of Rio de Janeiro State, are now known from a more extended area throughout the state. In addition, *I. tusci* is also recorded for the first time from Minas Gerais State, and *I. jamesii*, previously known only for Minas Gerais, is recorded from Espírito Santo State, 250 km away from its type locality. Interestingly, five of the eight new species described here (*I. bispinata* sp. nov., *I. cipoensis* sp. nov., *I. cristata* sp. nov., *I. robertsonae* sp. nov., and *I. rupicola* sp. nov.) were discovered in a recent survey in the Serra do Cipó mountain range (Brazil). It is even more interesting that specimens of *I. charlotta* Robertson & Holzenthal, 2011, previously described from the Serra do Cipó mountain range, were not found in this survey, even though collecting points were very close to its type locality.

The high degree of specificity of these species for certain environments may explain the pattern of endemism and diversity that occurs not only in the Serra do Cipó mountain range, but throughout the Atlantic Forest biome, especially in southeastern Brazil (Flint *et al.* 1999b). This region contains 20 out of 30 species known in the genus, and many of them are restricted to the type locality. Typically, the tropical mountains are home to many endemic species (Steinbauer *et al.* 2016), and this seems to be the case for caddisflies in southeastern Brazil (Flint *et al.* 1999), which has three large mountain ranges: Serra do Mar, Serra da Mantiqueira, and the southern portion of Serra do Espinhaço. However, we must also take into account sampling bias, since this region has been historically more studied due to the presence of large urban centers and easier access to protected areas, in addition to a high concentration of research centers (Moura *et al.* 2018; Santos *et al.* 2020). The Cerrado biome, in turn, occupies a larger area than the Atlantic Forest and encompasses the most extensive woodland-savanna in South America, also being a biodiversity hotspot (Mittermeier *et al.* 2011). However, caddisfly diversity in this area is poorly understood (Santos *et al.* 2020), and such work as presented here helps to fill this knowledge gap.

As in Robertson & Holzenthal (2013), our phylogenetic analysis recovered *Itauara* as monophyletic (Fig. 11), but, in addition to the phallicata [89(1)], another synapomorphy recovered for the clade was the anterior position of the anteromesal mesoscutal wart [13(0)]. A morphological analysis presented by Robertson & Holzenthal (2013: fig. 35) recovered Amazonian species (*I. amazonica*, *I. unidentata*, *I. bidentata*, *I. guyanensis*, *I. peruensis*, and *I. ovis*) as the first lineages to diverge from the main clade of *Itauara*. The other species, distributed throughout southeastern South America, formed a clade (Robertson & Holzenthal 2013: fig. 35), also recovered here with the inclusion of the new species (Fig. 11). This clade is supported by the short length of the posterior setal wart of the head [8(1), synapomorphic for this clade, but homoplastic, recovered independently in outgroup taxa], and by the margins of the posterior wings being approximately parallel to each other in the medial region [42(1), homoplastic, also observed in the outgroups (*Matrioptila jeanae*, *Padunia karaked*),(*Scotiotrichia ocreata*,(*Canoptila bifida*, *Canoptila williami*)), *Mastigoptila longicornuta*, *Mortoniella limona*].

Robertson & Holzenthal (2013: figs 32–25) recovered the brasiliana species group as monophyletic in parsimony and bayesian analyses, with morphological and with morphological + molecular characters. Here, the brasiliana species group was also recovered as monophyletic based on three apomorphic characters. The group was established based on the absence of the inferior appendages, and the parameres (when present) arising ventrobasally from the phallobase (Robertson & Holzenthal 2013). Here, these two characters were apomorphic to the group, in addition to the anterior setal warts of the head with constriction at medial region [6(1)]. Relationships among species within the brasiliana species group were unresolved, with I. robertsonae sp. nov. being recovered as sister group to all other species in this group, all of them represented in a polytomy in the strict consensus tree (Fig. 11).

Itauara has a disjunct distribution, with species occurring in northern South America, the Amazonian rainforest, and in southeastern South America, mainly in the Atlantic Forest. Such as in this genus, other organisms show a similar disjunct distribution, with related lineages being found in the Amazon and the Atlantic Forests (Vivo 1997; Batalha-Filho *et al.* 2013; Rivera *et al.* 2020). These two Neotropical forests were a single forest until drastic changes in the climate of South America occurred as a result of tectonic events, such as the uplift of the Andes Mountains (Costa 2003; Hoorn *et al.* 2010; Sobral-Souza *et al.* 2015). This event culminated in the formation of the South American dry diagonal, a dry corridor comprising the Caatinga, Chaco and Cerrado biomes (Ab'Saber 1977). However, recurring events of expansion and retraction of forests occurred, and this made an exchange between the biota of Amazon and Atlantic forests possible (Costa 2003; Sobral-Souza *et al.* 2015; Sobral-Souza & Lima-Ribeiro 2017; de Sá *et al.* 2019).

The caddisfly diversity in South America is still poorly known, but the distribution of species seems to be related with this dry corridor, with two main components, one northwestern and another southeastern (Santos *et al.* 2020). For *Itauara*, based on the phylogenetic hypothesis presented here, it seems that the Amazon region was the ancestral area. On the other hand, the genus seems more diverse and more widely distributed in southeastern South America. In accordance with the phylogenetic relationships recovered here (Fig. 11), the presence of *Itauara* in this area may have been the result of an invasion by a single lineage that reached the Atlantic Forest, probably using connections between these two Neotropical forests in the past (Costa 2003; Sobral-Souza *et al.* 2015).

Conclusion

Despite being the most diverse group of primarily aquatic insects, caddisflies are still poorly studied (Dijkstra *et al.* 2014). Given that 68% of the species of these insects are threatened due to various anthropogenic factors (Sánchez-Bayo & Wyckhuys 2019), many species can disappear even before they are known. A better understanding of the caddisfly diversity in the Neotropics will only be achieved with more taxonomic efforts, coupled with phylogenetic, molecular, and biogeographic studies. In the case of *Itauara*, molecular data can help to elucidate the phylogenetic relationships among the species, as well as the biogeographical history of the genus.

Acknowledgements

We are grateful to Dr Desiree Robertson and Dr Ralph Holzenthal for suggestions and comments that improved this manuscript. We thank the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Instituto Estadual do Ambiente (INEA-RJ), and the Instituto Estadual de Florestas de Minas Gerais (IEF-MG) for issuing collecting permits. AAA is grateful to Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq (proc. 134269/2019-5) and Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro – FAPERJ (proc. E-26/201.214/2020) by master's fellowship and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – CAPES for financial support; JLN is grateful to CNPq (proc. 420573/2016-0); LLD is grateful to Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001 and Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro – FAPERJ (proc. E-26/101.393/2014). We are also thankful to researchers who helped during field trips, in particular to Dr Ana L. Henriques-Oliveira for providing important specimens studied in this work and for the photo in Figure 1F, and also to BSc Christina Novais for specimens.

References

Ab'Saber A.N. 1977. Os Domínios Morfoclimáticos da América do Sul: Primeira Aproximação. *Geomorfologia* 52: 1–21.

Alves R.J.V., Silva N.G., Oliveira J.A. & Medeiros D. 2014. Circumscribing campo rupestre – megadiverse Brazilian rocky montane savanas. *Brazilian Journal of Biology* 74 (2): 355–362. https://doi.org/10.1590/1519-6984.23212

Angrisano E.B. 1993. Contribucion al conocimiento del genero *Antoptila* Mosely (Trichoptera: Glossosomatidae). *Revista de la Sociedad Entomologica Argentina* 52 (1–4): 57–62.

Angrisano E.B. 1997. Los Trichoptera del Uruguay. III. Familias Philopotamidae, Hydrobiosidae y Glossosomatidae. *Revista de la Sociedad Entomologica Argentina* 56 (1–4): 55–58.

Angrisano E.B. & Sganga J.L. 2007. Guía para la Identificación de los Tricópteros (Insecta) del Parque Nacional El Palmar (Provincia de Entre Ríos, República Argentina). *Natura Neotropicalis* 38: 1–55. https://doi.org/10.14409/natura.v1i38.3858

Batalha-Filho H., Fjeldså J., Fabre P.H. & Miyaki C.Y. 2013. Connections between the Atlantic and the Amazonian forest avifaunas represent distinct historical events. *Journal of Ornithology* 154 (1): 41–50. https://doi.org/10.1007/s10336-012-0866-7

Blahnik R.J. & Holzenthal R.W. 2006. Revision of the genus *Culoptila* (Trichoptera: Glossosomatidae). *Zootaxa* 1233: 1–52. https://doi.org/10.11646/zootaxa.1233.1.1

Blahnik R.J. & Holzenthal R.W. 2008. Revision of the Mexican and Central American species of *Mortoniella* (Trichoptera: Glossosomatidae: Protoptilinae). *Zootaxa* 1711: 1–72. https://doi.org/10.11646/zootaxa.1711.1.1

Costa L.P. 2003. The historical bridge between the Amazon and the Atlantic Forest of Brazil: a study of molecular phylogeography with small mammals. *Journal of Biogeography* 30 (1): 71–86. https://doi.org/10.1046/j.1365-2699.2003.00792.x

de Sá R.O. Tonini J.F.R., van Huss H., Long A., Cuddy T., Forlani M.C., Peloso P.L.V., Zaher H. & Haddad C.F.B. 2019. Multiple connections between Amazonia and Atlantic Forest shaped the phylogenetic and morphological diversity of *Chiasmocleis* Mehely, 1904 (Anura: Microhylidae: Gastrophryninae). *Molecular Phylogenetics and Evolution* 130: 198–210. https://doi.org/10.1016/j.ympev.2018.10.021

Dijkstra K.D.B., Monaghan M.T. & Pauls S.U. 2014. Freshwater biodiversity and aquatic insect diversification. *Annual Review of Entomology* 59: 143–163. https://doi.org/10.1146/annurev-ento-011613-161958

Flint O.S. Jr. 1971. Studies of Neotropical Caddisflies, XII: Rhyacophilidae, Glossosomatidae, Philopotamidae, and Psychomyiidae from the Amazon Basin (Trichoptera). *Amazoniana* 3 (1): 1–67.

Flint O.S. Jr. 1974. Studies of Neotropical Caddisflies, XVIII: new species of Rhyacophilidae and Glossosomatidae (Trichoptera). *Smithsonian Contributions to Zoology* 169: 1–30. https://doi.org/10.5479/si.00810282.169

Flint O.S. Jr., Holzenthal R.W. & Harris S.C. 1999. *Catalog of the Neotropical Caddisflies (Insecta: Trichoptera)*. Special Publication, Ohio Biological Survey. Columbus, Ohio.

Frost S.W. 1957. The Pennsylvania Insect Light Trap. *Journal of Economic Entomology* 50 (3): 287–292. https://doi.org/10.1093/jee/50.3.287

Galdean N., Callisto M., & Barbosa F.A. R. 2000. Lotic ecosystems of Serra do Cipó, southeast Brazil: water quality and a tentative classification based on the benthic macroinvertebrate community. *Aquatic Ecosystem Health & Management* 3 (4): 545–552. https://doi.org/10.1080/14634980008650691

Giulietti A.M., Menezes N.L., Pirani J.R., Meguro M. & Wanderley M.G.L. 1987. Flora da Serra do Cipó, Minas Gerais: Caracterização e lista das espécies. *Boletim de Botânica da Universidade de São Paulo* 9: 1–151. https://doi.org/10.11606/issn.2316-9052.v9i0p1-151

Gressitt J.L. & Gressitt M.K. 1962. An improved Malaise trap. *Pacific insects* 4 (1): 87–90.

Holzenthal R.W. 2004. Three new species of Chilean caddiflies (Insecta: Trichoptera). *Proceedings of the Entomological Society of Washington* 106 (1): 110–117.

Holzenthal R.W. & Blahnik R.J. 2006. The caddisfly genus *Protoptila* in Costa Rica (Trichoptera: Glossosomatidae). *Zootaxa* 1197: 1–37. https://doi.org/10.11646/zootaxa.1197.1.1

Holzenthal R.W. & Calor A.R. 2017. Catalog of the Neotropical Trichoptera (Caddisflies). *ZooKeys* 654: 1–566. https://doi.org/10.3897/zookeys.654.9516

Holzenthal R.W., Blahnik R.J., Prather A.L. & Kjer K.M. 2007. Order Trichoptera Kirby, 1813 (Insecta), Caddisflies. *Zootaxa* 1668: 639–698. https://doi.org/10.11646/zootaxa.1668.1.29

ICMBio. Instituto Chico Mendes de Conservação da Biodiversidade. 2015. *Plano de Manejo do Parque Nacional do Caparaó*. Avaliable from https://www.icmbio.gov.br/parnacaparao/images/stories/PM_PNC--completo__PDF.pdf [accessed 8 Jun. 2021].

Madeira J.A. 2009. *Plano de manejo do Parque Nacional da Serra do Cipó e Área de Proteção Ambiental Morro da Pedreira. Encarte 2*. Instituto Chico Mendes de Conservação da Biodiversidade. Brasília.

Mittermeier R.A., Turner W.R., Larsen F.W., Brooks T.M. & Gascon C. 2011. Global biodiversity conservation: the critical role of hotspots. *In*: Zachos F.E. & Habel J.C. (eds) *Biodiversity Hotspots*: 3–22. Springer, Berlin / Heidelberg. https://doi.org/10.1007/978-3-642-20992-5_1

Morse J.C. 1988. *Protoptila morettii* (Trichoptera: Glossosomatidae), a new caddisfly species from the southeastern United States. *Rivista di Idrobiologia* 27 (2–3): 299–308.

Morse J.C. 2021. *Trichoptera World Checklist*. Available from https://entweb.sites.clemson.edu/database/trichopt/ [accessed 3 Mar. 2021].

Mosely M.E. 1939. The Brazilian Hydroptilidae (Trichoptera). *Novitates Zoologicae* 41: 217–239.

Moura M.R., Costa H.C., Peixoto M.A., Carvalho A.L.G., Santana D.J. & Vasconcelos H.L. 2018. Geographical and socioeconomic determinants of species discovery trends in a biodiversity hotspot. *Biological Conservation* 220: 237–244. https://doi.org/10.1016/j.biocon.2018.01.024

Rivera J., Herculano J.F., Lanna L.M., Cavalcante S. & Teixeira M.L.F. 2020. A new species and first record of Vates Burmeister, 1838 from the Atlantic Rainforest (Mantodea: Vatinae). *European Journal of Taxonomy* 598: 1–25. https://doi.org/10.5852/ejt.2020.598

Robertson D.R. & Holzenthal R.W. 2011. Revision of the Neotropical caddisfly genus *Itauara* Müller, 1888 (Trichoptera, Glossosomatidae). *ZooKeys* 114: 41–100. https://doi.org/10.3897/zookeys.114.1405

Robertson D.R. & Holzenthal R.W. 2013. Revision and phylogeny of the caddisfly subfamily Protoptilinae (Trichoptera: Glossosomatidae) inferred from adult morphology and mitochondrial DNA. *Zootaxa* 3723 (1): 1–99. https://doi.org/10.11646/zootaxa.3723.1.1

Ross H.H. 1944. The Caddis Flies, or Trichoptera, of Illinois. *Illinois Natural History Survey Bulletin* 23 (1–5): 1–326. https://doi.org/10.21900/j.inhs.v23.199

Ross H.H. 1956. *Evolution and Classification of the Mountain Caddisflies*. The University of Illinois Press, Urbana.

Sánchez-Bayo F. & Wyckhuys K.A. 2019. Worldwide decline of the entomofauna: A review of its drivers. *Biological Conservation* 232: 8–27. https://doi.org/10.1016/j.biocon.2019.01.020

Santos A.P.M., Dumas L.L., Henriques-Oliveira A.L., Souza W.R.M. de, Camargos L.M.D., Calor A.R. & Pes A.M. 2020. Taxonomic catalog of the Brazilian fauna: order Trichoptera (Insecta), diversity and distribution. *Zoologia (Curitiba)* 37: 1–13. https://doi.org/10.3897/zoologia.37.e46392

Santos A.P.M., Dumas L.L., Henriques-Oliveira A.L., Souza W.R.M., Camargos L.M., Calor A.R. & Pes A.M.O. 2021. Glossosomatidae *In*: *Catálogo Taxonômico da Fauna do Brasil*. PNUD. Available from http://fauna.jbrj.gov.br/fauna/faunadobrasil/1553 [accessed 3 Mar. 2021].

Schmid F. 1998. Genera of the Trichoptera of Canada and adjoining or adjacent United States. *The Insects and Arachnids of Canada* 7: 1–311.

Sobral-Souza T., Lima-Ribeiro M.S. & Solferini V.N. 2015. Biogeography of Neotropical Rainforests: past connections between Amazon and Atlantic Forest detected by ecological niche modeling. *Evolutionary Ecology* 29 (5): 643–655. https://doi.org/10.1007/s10682-015-9780-9

Sobral-Souza T., & Lima-Ribeiro M.S. 2017. De volta ao passado: revisitando a história biogeográfica das florestas neotropicais úmidas. *Oecologia Australis* 21 (2): 93–107. https://doi.org/10.4257/oeco.2017.2102.01

Steinbauer M.J., Field R., Grytnes J.-A., Trigas P., Ah-Peng C., Attorre F., Birks H.J.B., Borges P.A.V., Cardoso P., Chou C.-H., Sanctis M.D., Sequeira M.M. de, Duarte M.C., Elias R.B., Fernández-Palacios J.M., Gabriel R., Gereau R.E., Gillespie R.G., Greimler J., Harter D.E.V., Huang T.-J., Irl S.D.H., Jeanmonod D., Jentsch A., Jump A.S., Kueffer C., Nogué S., Otto R., Price J., Romeiras M.M., Strasberg

D., Stuessy T., Svenning J.-C., Vetaas O.R. & Beierkuhnlein C. 2016. Topography-driven isolation, speciation and a global increase of endemism with elevation. *Global Ecology and Biogeography* 25 (9): 1097–1107. https://doi.org/10.1111/geb.12469

Turchetto-Zolet A.C., Pinheiro F., Salgueiro F. & Palma-Silva C. 2013. Phylogeographical patterns shed light on evolutionary process in South America. *Molecular Ecology* 22 (5): 1193–1213. https://doi.org/10.1111/mec.12164

Vivo M. de. 1997. Mammalian evidence of historical ecological change in the caatinga semiarid vegetation of northeastern Brazil. *Journal of Comparative Biology* 2 (1): 65–73.

Zander R.H. 2014. Four water-soluble mounting media for microslides. *Phytoneuron*: 32: 1–4.

Manuscript received: 29 January 2022
Manuscript accepted: 15 March
Published on: 31 July 2023
Topic editor: Tony Robillard
Section editor: Helen M. Barber-James
Desk editor: Eva-Maria Levermann

Supplementary material

Supp. file 1. Morphological matrix of characters used in the parsimony analyses presented here based on modified data provided by Robertson & Holzenthal (2013). Deleted and modified / reinterpreted characters are indicated. https://doi.org/10.5852/ejt.2023.885.2193.9421

Appendix

Appendix A. List of additional material analyzed deposited at DZRJ collection.

Itauara alexanderi Robertson & Holzenthal, 2011

Material examined

BRAZIL – **Rio de Janeiro** • 2 ♂♂; Itatiaia, Maromba, Rio Preto; 25–31 Dec. 2010; Monné and Monné leg.; DZRJ • 2 ♂♂; Itatiaia, PN Itatiaia, trilha para Véu da Noiva, Córrego da Maromba; 22°25′38.2″ S, 44°37′5.8″ W; alt. 1032 m; 7 Jul. 2016; L.L. Dumas leg; DZRJ • 1 ♂; Nova Friburgo, Rio Bonito de Lumiar, afluente do Rio Bonito, 22°24′15.3″ S, 42°26′46.2″ W; alt. 863 m; 23 Oct. 2010; F.A. Capistrano leg.; DZRJ • 2 ♂♂; Nova Friburgo, Macaé de Cima, estrada de terra ao lado do Rio Macaé, white sheet; 22°21′48.3″ S, 42°25′20.1″ W; alt 847 m; 5 Dec. 2019; A.A. Alves, V. Quintas, N.H. Pecly, A.L.D. Ferreira and G. Mejdalani leg.; DZRJ • 1 ♂; Nova Friburgo, Cascata, Córrego da Cascata; 22°21′50.1″ S, 42°15′33″ W; alt. 413 m; 8. Mar. 2009; G.A. Jardim and J.L. Nessimian leg.; DZRJ

• 1 ♂; Nova Iguaçu, Tinguá, REBIO Tinguá (atrás da brigada); 22°35′08.4″ S, 43°26′14.4″ W; alt. 159 m; 13 Sep. 2016; L.L. Dumas, J.L. Nessimian and J.F. Barbosa leg.; DZRJ • 3 ♂♂; Nova Iguaçu, Tinguá, REBIO Tinguá, Rio Macuco; 22°34′58.9″ S, 43°26′49.2″ W; alt. 241 m; 13–16 Sep. 2016; L.L. Dumas, J.L. Nessimian and J.F. Barbosa leg; DZRJ • 1 ♂; Petrópolis, REBIO Araras, Rio Araras, trilha do caneco (ponte); 22°26′13.8″ S, 43°15′37.4″ W; alt. 1086 m, 13 Apr.–7 May 2018; L.L. Dumas, J.L. Nessimian, C. Novais and A.L.D. Ferreira leg.; DZRJ • 5 ♂♂; Petrópolis, REBIO Araras, Rio Araras, trilha do caneco (ponte); 22°26′13.8″ S, 43°15′37.4″ W; alt. 1086 m; 20 Mar.–13 Apr. 2018; L.L. Dumas, J.L. Nessimian, C. Novais and A.L.D. Ferreira leg.; DZRJ • 2 ♂♂; Petrópolis, REBIO Araras, Rio Araras, trilha do caneco (ponte); 22°26′13.8″ S, 43°15′37.4″ W; alt. 1086 m; 17 Nov.–13 Dec. 2018; L.L. Dumas, J.L. Nessimian, C. Novais and A.A. Alves leg.; DZRJ • 2 ♂♂; Petrópolis, REBIO Araras, Rio Araras, trilha do caneco (ponte); 22°26′13.8″ S, 43°15′37.4″ W; alt. 1086 m; 17 Oct.–17 Nov. 2018; L.L. Dumas, J.L. Nessimian, C. Novais and A.A. Alves leg.; DZRJ • 2 ♂♂; Miguel Pereira, Vale das Princesas, afluente de 3ª ordem do Rio Sapucaia; 22°28′16.9″ S, 43°19′7.3″ W; alt. 919 m; 14 Dec. 2018; L.L. Dumas, J.L. Nessimian, C. Novais and A.A. Alves leg.; DZRJ • 1 ♂; Sta. Maria Madalena, PE do Desengano, Morumbeca dos Marreiros, Ribeirão Macapá; 21°52′35.5″ S, 41°55′05,4″ W; alt. 1039 m; 13 Apr. 2016; L.L. Dumas, J.L. Nessimian, C.S. Portela and J.F. Barbosa leg.; DZRJ • 1 ♂; São Fidélis, PE do Desengano, Morumbeca dos Marreiros, Ribeirão Macapá; 21°52′36.1″ S, 41°54′43,8″ W; alt. 1111 m; 13 Apr. 2016; L.L. Dumas, J.L. Nessimian, C.S. Portela and J.F. Barbosa leg.; DZRJ • 10 ♂♂; Teresópolis, PN da Serra dos Órgãos, Rio Paquequer, Cachoeira do Coreto; 22°26′52″ S, 42°59′5″ W; alt. 933 m; 17 Sep. 2011; D.M. Takiya and A.P.M. Santos leg.; DZRJ • 11 ♂♂; Teresópolis, PN da Serra dos Órgãos, Rio Beija-Flor; 22°26′50.9″ S, 43°0′19.4″ W; alt. 1187 m; 11–15 Nov. 2011; A.P.M. Santos, B. Camisão and J.L. Nessimian leg.; DZRJ.

Itauara jamesii Robertson & Holzenthal, 2011

Material examined

BRAZIL – **Espírito Santo** • 1 ♂; Dores do Rio Preto, Pedra Menina, Parque Nacional do Caparaó, afluente do Rio Preto (cachoeirinha-paredão); 20°29′26.2″ S, 41°49′17.1″ W; alt. 1507 m; 30 Mar.–3 Apr. 2016; J.L. Nessimian, A.L.H. Oliveira, A. Antunes, A. Alves and J. Queiroz leg.; Malaise trap; DZRJ.

Itauara julia Robertson & Holzenthal, 2011

Material examined

BRAZIL – **Rio de Janeiro** • 1 ♂; Itatiaia, PN do Itatiaia, Rio Campo, Belo, Cachoeira Poranga; 22°26′30.9″ S, 44°36′48.9″ W; alt. 916 m; 9 Apr. 2016; L.L. Dumas, I.C. Rocha and J.L. Nessimian leg.; DZRJ • 10 ♂♂; Itatiaia, Maromba, Rio Preto, Cachoeira do Escorrega; 22°19′49.7″ S, 44°36′55.5″ W; alt. 1381 m; 26 Jan. 2012; B.H.L. Sampaio and A.L.H. Oliveira leg.; DZRJ.

Itauara lucinda Robertson & Holzenthal, 2011

Material examined

BRAZIL – **Espírito Santo** • 2 ♂♂; Dores do Rio Preto, Pedra Menina, Parque Nacional do Caparaó, afluente do Rio Preto (cachoeirinha-paredão); 20°29′26.2″ S, 41°49′17.1″ W; alt. 1507 m; 11–15 Jan. 2015; J.L. Nessimian, A.L.H. Oliveira, S.P. Gomes, and C.S. Portela leg.; Malaise trap; DZRJ. – **Minas Gerais** • 1 ♂; Alto Caparaó, PN Caparaó, Vale Verde, afluente do Rio Caparaó; 20°25′9.7″ S, 41°50′47.4″ W; alt. 1370 m; 4–6 Apr. 2016; J.L. Nessimian, A.L.H. Oliveira, A. Antunes, A. Alves and J. Queiroz leg.; DZRJ.

Itauara plaumanni (Flint, 1974)

Material examined

BRAZIL – **Paraná** • 1 ♂; Foz do Iguaçu, Parque Nacional do Iguaçu, praça Santos Dumond, Rio Iguaçu, Cataratas; 25°41′33.5″ S, 54°26′03.1″ W; alt 188 m; 7 Nov. 2012; A.P.M. Santos and D.M. Takiya leg.; DZRJ.

Itauara rodmani Robertson & Holzenthal, 2011

Material examined

BRAZIL – **Minas Gerais** • 2 ♂♂; Jaboticatubas, PN Serra do Cipó, Canyon Bandeirinha; 19°25′5.6″ S, 43°37′17″ W; alt. 786 m; 11 Dec. 2011; A.P.M. Santos leg.; DZRJ.

Itauara tusci Robertson & Holzenthal, 2011

Material examined

BRAZIL – **Minas Gerais** • 1 ♂; Itabira, Ipoema, estr. para Morro Redondo, Córrego Cachoeira, ponte; 19°35′05.2″ S, 43°28′31.8″ W; alt. 710 m; 14 Dec. 2019; A.A. Alves, A.P.M. Santos, A.L. Henriques-Oliveira and B.M.S. Cavalcante leg.; white sheet; DZRJ • 1 ♂; same collection data as for preceding; Ipoema, P.E. Mata do Limoeiro, estr. para Comunidade do Cedro, Córrego Taquaruçu; 19°34′48.6″ S, 43°28′28.7″ W; alt. 715 m; 15 Dec. 2019; white sheet; DZRJ. – **Rio de Janeiro** • 6 ♂♂; Campos dos Goytacazes, Babilônia, Ribeirão Morumbeca; 21°52′35.9″ S, 41°47′50,4″ W; alt. 35 m; 18 Apr. 2016; L.L. Dumas, J.L. Nessimian, C.S. Portela and J.F. Barbosa leg.; DZRJ • 12 ♂♂; Campos dos Goytacazes, Babilônia, Rio Sampainho; 21°52′34.6″ S, 41°47′49.8″ W; alt. 30 m; 18 Apr. 2016; L.L. Dumas, J.L. Nessimian, C.S. Portela and J.F. Barbosa, J.F. leg.; DZRJ • 90 ♂♂; Casimiro de Abreu, Ribeirão da Luz; 22°25′48.2″ S, 42°12′14.9″ W; alt. 77 m; 5 Apr. 2009; J.L. Nessimian, L.L Dumas and G.A. Jardim leg.; DZRJ • 2 ♂♂; Nova Friburgo, Macaé de Cima, ponte sobre o riacho; 17 Feb. 2016; N. Ferreira Jr. and R. Pires leg.; DZRJ • 1 ♂; Nova Friburgo, Rio Bonito de Lumiar, Toca da Onça; 22°24′51.3″ S, 42°19′10.5″ W; alt. 702 m; 23 Jun. 2014; A.P.M. Santos and W.R.M. Souza leg.; DZRJ • 2 ♂♂; same collection data as for preceding; 28 Nov. 2014; DZRJ • 2 ♂♂; Rio Claro, Lídice, PE do Cunhambebe, Rio Parado, Lajinha; 22°50′40.3″ S, 44°10′59.8″ W; alt. 541 m; 14 May 2017; L.L. Dumas, J.L. Nessimian, A.L.D. Ferreira and J.F. Barbosa leg.; DZRJ • 1 ♂; Rio Claro, Lídice, PE do Cunhambebe, Rio Parado, cachoeira Três Quedas; 22°51′8″ S, 44°10′25.2″ W; alt. 573 m; 14 May 2017; L.L. Dumas, J.L. Nessimian, A.L.D. Ferreira and J.F. Barbosa leg.; DZRJ.