European Journal of Taxonomy 813: 33–56
https://doi.org/10.5852/ejt.2022.813.1731

ISSN 2118-9773
www.europeanjournaloftaxonomy.eu
2022 · Polizei T.T.S. *et al.*

Research article

urn:lsid:zoobank.org:pub:122A927A-9DDA-40BC-BF2A-D0C206717C03

Spanglerelmis, a new genus of Elmidae (Insecta: Coleoptera) from Brazil with new species and biological notes

Thiago Tadeu Silva POLIZEI [1,*], Lucas de Souza Machado COSTA [2] & Pitágoras da Conceição BISPO [3]

[1] Laboratório de Coleoptera (LaC), Museu de Zoologia da Universidade de São Paulo (MZSP), Avenida Nazaré, 481, Ipiranga, 04263-000, São Paulo, SP, Brazil.
[2] Escola Técnica Estadual de Itanhaém. Avenida José Batista Campos, 1431, Anchieta, 11740-000, Itanhaém, SP, Brazil.
[3] Laboratório de Biologia Aquática, Departamento de Ciências Biológicas, Faculdade de Ciências e Letras de Assis, Universidade Estadual Paulista (UNESP), Avenida Dom Antônio, 2100, Parque Universitário, 19806-900, Assis, SP, Brazil.

[*] Corresponding author: thiagopolizei@hotmail.com
[2] Email: lucassmcosta@yahoo.com.br
[3] Email: pcbispo@gmail.com

[1] urn:lsid:zoobank.org:author:CB8D27F0-7261-471B-B075-687212674AE3
[2] urn:lsid:zoobank.org:author:8AA350C0-80FD-48B2-BA76-9E5F7AAE6B74
[3] urn:lsid:zoobank.org:author:41852B8E-AEF8-42CC-BA26-9A02BBC342B9

Abstract. In this study, the new genus *Spanglerelmis* Polizei & Bispo is described; *Microcylloepus ochus* Hinton, 1940 is synonymized with *Microcylloepus femoralis* Hinton, 1940, and transferred to the new genus; and two new species, *S. xiririca* gen. et sp. nov. and *S. timburi* gen. et sp. nov. are described. The new genus can be characterized by the combination of the following characters: 1) pronotum without transverse, longitudinal or oblique impressions, sulci or gibbosities on disc; 2) elytra with a carina on interval III and two sublateral carinae on intervals V and VI; 3) mesoventrite with sides strongly raised; and 4) femora with an oblique belt of tomentum dorsally and a transverse belt ventrally. The specimens of the two new species were collected mainly in riffles of unimpacted streams in the Atlantic Forest in São Paulo State, Brazil. Scanning electron microscope images, an identification key for the genus and habitat notes are also presented.

Keywords. Aquatic beetles, riffle beetles, Neotropical, South America, new species, new genus.

Polizei T.T.S., Costa L.S.M. de & Bispo P.C. da 2022. *Spanglerelmis*, a new genus of Elmidae (Insecta: Coleoptera) from Brazil with new species and biological notes. *European Journal of Taxonomy* 813: 33–56. https://doi.org/10.5852/ejt.2022.813.1731

Introduction

Elmidae is one of the most diverse families of aquatic beetles, including approximately 1550 species worldwide in 149 genera (Jäch *et al.* 2016; Polizei *et al.* 2020a). Both larval and adult members of

this family are aquatic and more diverse in montane areas of tropical and subtropical regions (Jäch & Balke 2008). Knowledge about the family in the Neotropical region has improved in recent years, and currently 51 genera and approximately 500 species are known.

In Brazil, there are about 180 valid species in 26 genera. However, there are several regions in Brazil where specimens of Elmidae have not been sampled (Polizei 2018a). In addition, where sampling has been conducted, the specimens generally have been identified only to the genus level. Thus, it is highly likely that the richness of species of Elmidae within Brazil has been strongly underestimated. Despite this, knowledge has advanced, including the description of new species and the development of taxonomic keys (Fernandes *et al.* 2011; Fernandes & Hamada 2012; Sampaio *et al.* 2012; Barbosa *et al.* 2013; Ferreira-Jr *et al.* 2014; Passos *et al.* 2015; Polizei 2018a, 2018b; Polizei & Barclay 2018, 2019a, 2019b; Linský *et al.* 2019; Almeida *et al.* 2020; Polizei *et al.* 2020a, 2020b; Polizei & Fernandes 2020).

Specimens from Brazil that do not fit into any of the known genera of Elmidae have been examined in this study. Previously, Paul J. Spangler (1924–2010) from the US National Museum of Natural History (USNM) indicated in a label that some specimens from Hinton's collection, that were loaned to him, belonged to a new genus. However, Spangler never published a proposal for a new genus based on these specimens, which were returned to the Natural History Museum of London (NHMUK) some years ago (Max Barclay, personal communication). In the present study, the morphology of these specimens and of new specimens collected in the Atlantic Forest confirmed a new genus, which is described herein.

In addition, *Microcylloepus ochus* Hinton, 1940 is synonymized under *Microcylloepus femoralis* Hinton, 1940, and transferred to the new genus; and two new species, *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov. and *S. timburi* Polizei & Bispo gen. et sp. nov. are described. The type species of the genus (*S. xiririca*) is described and illustrated based on the male and female. Biological notes, scanning electron microscope images and a key for the genus are also presented.

Material and methods

Depositories for the examined material:

MZSP = Museu de Zoologia da Universidade de São Paulo – São Paulo, Brazil (Sônia Casari)
NHMUK = Natural History Museum, London, United Kingdom (Maxwell Barclay)
USN = US National Museum of Natural History, Washington, DC, USA (Maria Lourdes Chamorro).

The following specimens of Elmidae (Coleoptera) were studied: 1) material collected by Fritz Plaumann in the 1930s from Santa Catarina State in southern Brazil and housed in NHMUK and MZSP; 2) material collected by the authors in streams in Atlantic Forest from São Paulo State in southeastern Brazil. For the identification, we used 1) the Neotropical key for genera of Elmidae (Manzo 2005); 2) material included in the reference collection of New World Elmidae species (donated by Dr William D. Shepard – Essig Museum of Entomology, University of California, Berkeley, USA); 3) Elmidae collections housed in NHMUK, MNHN, and MZSP; 4) Elmidae genera described in the literature.

A morphological study of *S. femoralis* gen. et comb. nov. was based on pinned specimens housed in the NHMUK. This material had already been dissected by H.E. Hinton. In the case of the two new species, morphological studies were initially based on wet specimens preserved in 70% ethyl alcohol. For dissection, the aedeagus was detached from the specimen and cleared using 10% KOH heated for approximately 15 minutes (Brown 1972). The genitalia were studied, photographed, and stored in

glycerine. Subsequently, the specimens were pinned, and the genitalia stored in microtubes containing glycerine, which were pinned below each specimen. The specimens were studied using a Leica MS5 and Leica N205A stereoscopic microscopes. Photographs of specimens and morphological structures were taken using a Canon EOS550D camera coupled to a Leica stereo microscope (M205A). For the line drawings, a ZEISS Axioskop microscope with camera lucida was used.

The type species of the genus, *S. xiririca* Polizei & Bispo gen. et sp. nov., was also studied using an electron microscope. The specimens were prepared through an ascending ethanol series, remaining one day in each dilution (70%, 90% and 100%), dried through the critical point, placed on SEM specimen stubs with double-sided tape, and metalized in gold. The scanning electron microscope images were taken with a Carl Zeiss LEO 440 scanning electron microscope in the Laboratório de Microscopia de Varredura at the Museu de Zoologia da Universidade de São Paulo.

The general morphological terminology used follows Kodada *et al.* 2016. All of the photographs and drawings were edited using Adobe Photoshop CC® and Adobe Illustrator CC®. The specimen labels are quoted verbatim. Line changes are indicated by "/" and the labels are separated by "//".

Results

Class Insecta Linnaeus, 1758
Order Coleoptera Linnaeus, 1758
Superfamily Byrrhoidea *sensu* Lawrence & Newton, 1995
Family Elmidae Curtis, 1830
Subfamily Elminae Curtis, 1830

Genus ***Spanglerelmis*** Polizei & Bispo gen. nov.
urn:lsid:zoobank.org:act:C46A6C28-9B3C-448C-A7C4-C6D2C4F051DD
Figs 1–10

Type species

Spanglerelmis xiririca Polizei & Bispo sp. nov., by present designation.

Diagnosis

Spanglerelmis Polizei & Bispo gen. nov. can be distinguished from other elmid genera by the following combination of characters: 1) pronotum covered by punctures, without transverse, longitudinal, or oblique impressions, sulci or gibbosities on disc (Figs 1A, E, 2A, 6A, C, 8B, 9A); 2) sublateral carinae on pronotum sinuous reaching the anterior and posterior margins of pronotum, converging toward apex (Figs 1A, E, 2A, 6A, C, 8B, 9A); 3) elytra with a carina on interval III and two sublateral carinae on intervals V and VI (Figs 1A, E, 2A, 6A, D, 9A); 4) disc of prosternum with a pair of carinae on the posterior half (Figs 1B, F, 2B, 7A, C, 9B); 5) sides of mesoventrite strongly raised (Figs 1B, F, 2B, 7A–C, 9B); 6) femora with an oblique belt of tomentum dorsally (Figs 1B, F, 2B, 7B, 9B) and a transverse belt ventrally (Figs 1A, E, 2A, 6A, B, 9A); and 7) disc of abdominal ventrites 1–4 glabrous, sides densely covered by tomentum (Figs 2B, 7B, 8B, 9B), and ventrite 5 completely and densely covered by tomentum. Morphologically, the new genus resembles *Neoelmis* Musgrave, 1935 (sharing the body shape and the elytral strongly punctate); *Microcylloepus* Hinton, 1935 (sharing the body shape, the elytral carinae pattern, and disc of prosternum with a pair of carinae on the posterior half), and *Elachistelmis* Maier, 2012 (sharing the body elongated and pronotum without any kind of impression). However, these three genera differ from *Spanglerelmis* Polizei & Bispo gen. nov. by the following characteristics: 1) *Neoelmis* has pronotum with a strongly transversal impression and a constricted medially sublateral carinae; elytra with just one sublateral carina; sides of mesoventrite not raised; femora densely covered

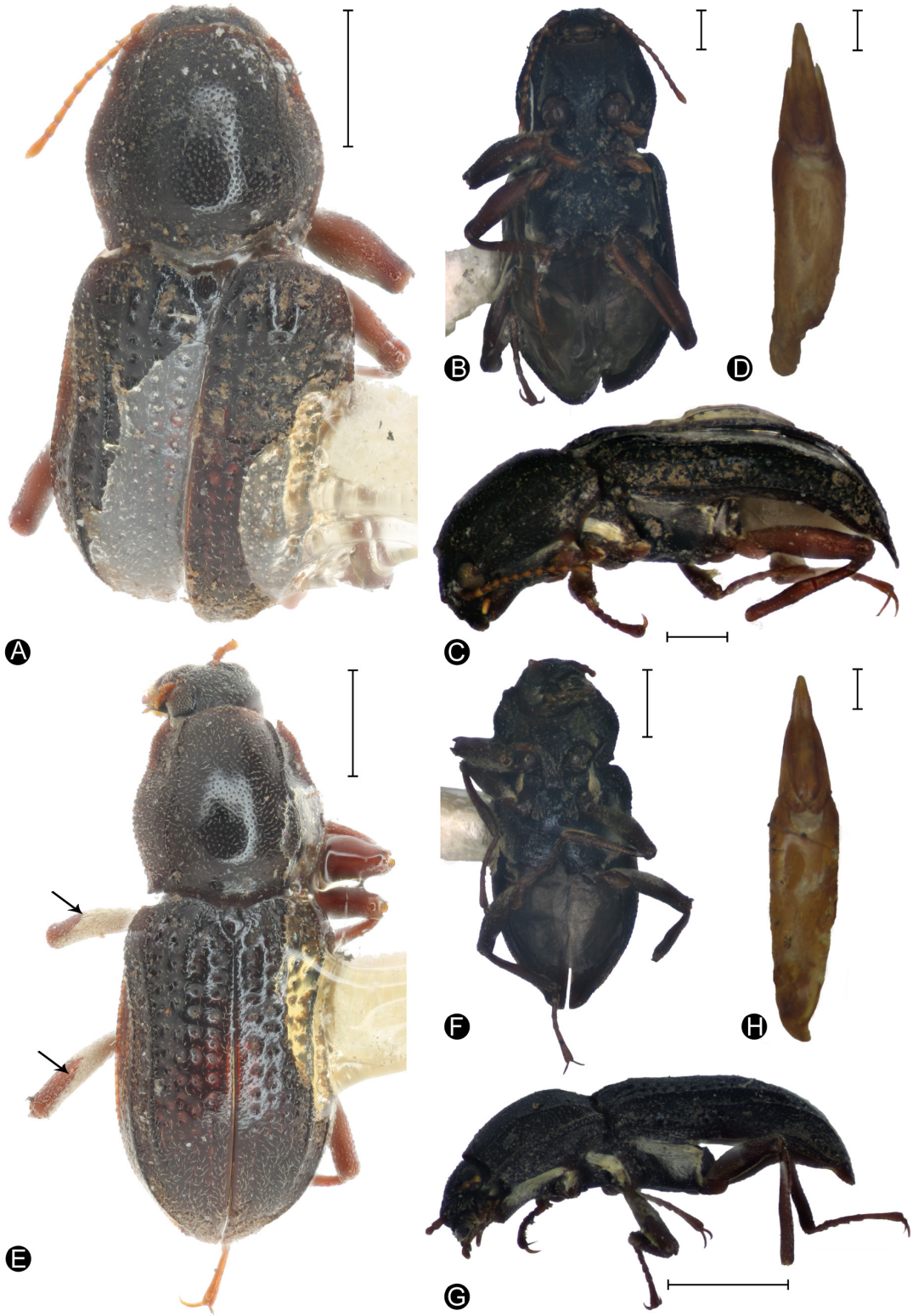

Fig. 1. A–D. *Spanglerelmis femoralis* (Hinton, 1940) gen. et comb. nov., holotype, ♂ (NHMUK 010583892). **A–C**. Habitus. **A**. Dorsal view. **B**. Ventral view. **C**. Lateral view. **D**. Aedeagus in ventral view. **E–H**. *Microcylloepus ochus* Hinton, 1940, holotype, ♂(NHMUK 010583871). **E–G**. Habitus. **E**. Dorsal view (arrows showing the pattern of tomentum on femur). **F**. Ventral view. **G**. Lateral view. **H**. Aedeagus in ventral view. Scale bars: A–C, E–G = 0.5 mm; D, H = 0.1 mm.

by tomentum; and disc of the abdominal ventrites 2–4 covered by tomentum; 2) *Microcylloepus* has the pronotum with transverse impression on the apical third, with a broad median impression, and with two oblique subbasal impressions on disc and sides of mesoventrite not raised; and 3) *Elachistelmis* has sublateral carinae on pronotum straight and divergent in toward apex; elytra with just the sublateral carinae; sides of mesoventrite not raised and femora glabrous.

Etymology

The name is a combination of *Spangler* (in honour of Dr Paul J. Spangler 1924–2010, a pioneer of studies of Neotropical aquatic beetles, who initially indicated it could be a new genus) plus *elmis,* the nominate genus of the family Elmidae. Gender feminine.

Description

Head (Figs 1A–C, E–G, 2–3, 6A, 7A, C, 8–9). Partially retractable (Figs 1A–C, E–G, 8B, 9B); dorsal surface punctate and covered by setae, without impressions; eyes protruding laterally; antennae filiform with 11 antennomeres, each one covered by few, very short and thin setae at apex (Figs 2, 6A, 7A, C, 8A, 9); clypeus broad, ornamented as the other parts of head.

Fig. 2. *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov., holotype, ♂ (MZSP31444). Habitus. **A**. Dorsal view (arrow showing the pattern of tomentum on femur). **B**. Ventral view. Scale bar = 0.5 mm.

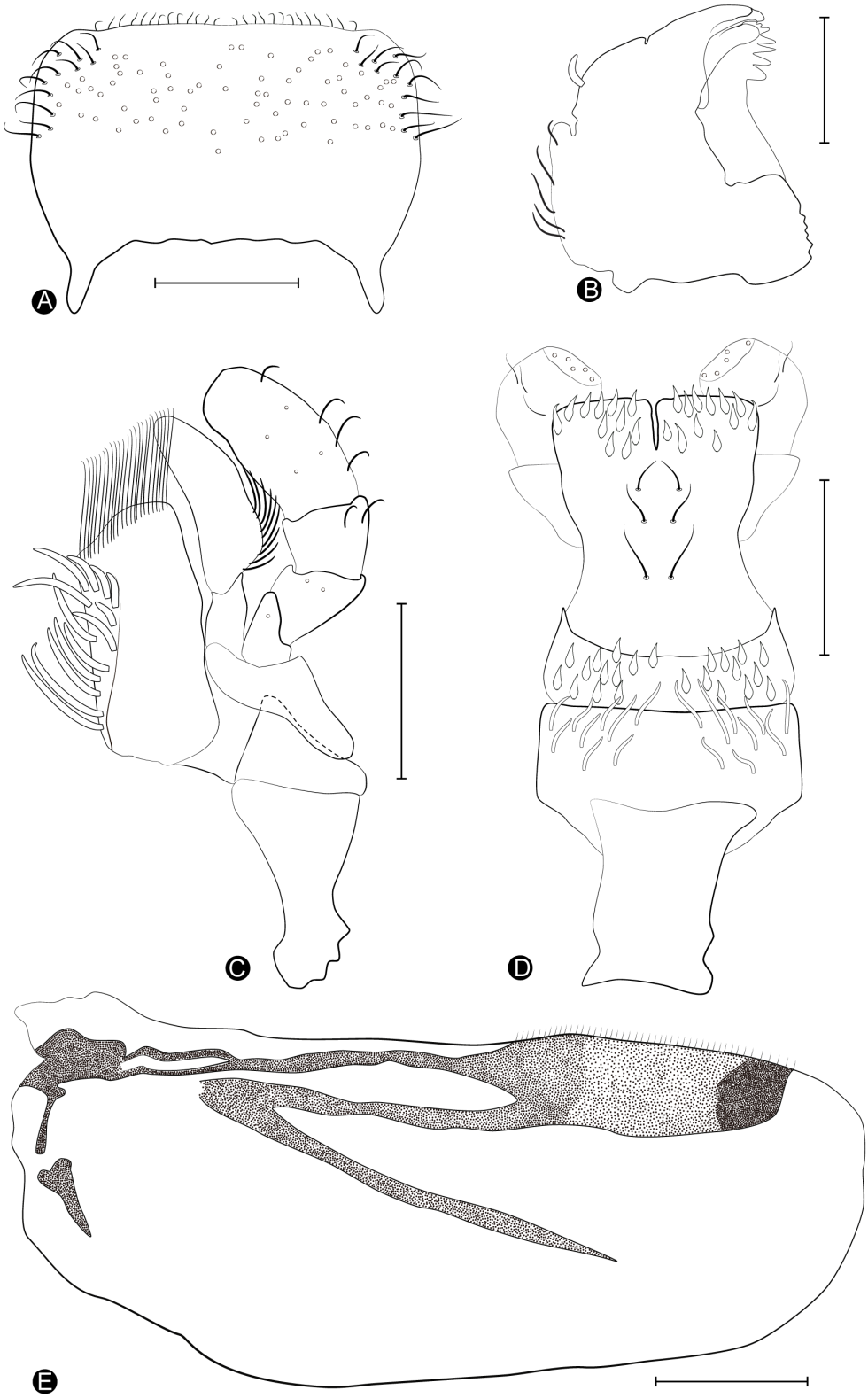

Fig. 3. *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov. (MZSP31453). Dorsal view. **A**–**D**. Mouthparts. **A**. Labrum (setae are represented by punctures). **B**. Left mandible. **C**. Right maxilla. **D**. Labium. **E**. Metathorax wing (micropterous). Scale bars = 0.1 mm.

Thorax (Figs 1A–C, E–G, 2, 6, 7–8B, 9A–B). Pronotum (Figs 1A, E, 2A, 6A, C, 8B, 9A) as long as wide; anterior margin slightly arcuate; lateral margin arcuate and slightly crenulated; posterior and anterior angles acute; posterior margin smooth with two prescutellar fovea; disc surface punctured, without transverse, longitudinal, or oblique impressions, sulci or gibbosities (Figs 1A, E, 2A, 6A, C, 9A); sublateral carinae strongly sinuous, reaching anterior and posterior margins of pronotum, converging toward apex (Fig. 6C). Elytra (Figs 1A, E, 2A, 6A, D, 9A) longer than wide; moderately convex dorsally; lateral margins moderately explanate; apices rounded; humeri rounded; elytral surface strongly striate-punctate, with a row of setae between the punctures (Figs 1A, E, 2A, 6A, D, 9A); carinae on intervals III, V and VI. Epipleura narrow, anteriorly wider; glabrous, without tomentum or row of granules (Figs 1B–C, F–G, 2B, 7, 8B, 9B); at least partly concealed posteriorly by produced lateral margins of the abdominal ventrites. Prosternum (Figs 1B–C, F–G, 2B, 7A, C, 8B, 9B) declined anteriorly and concealing the head in repose; lateral margins with a belt of tomentum (Fig. 1G); disc with a pair of carinae longitudinal reaching the

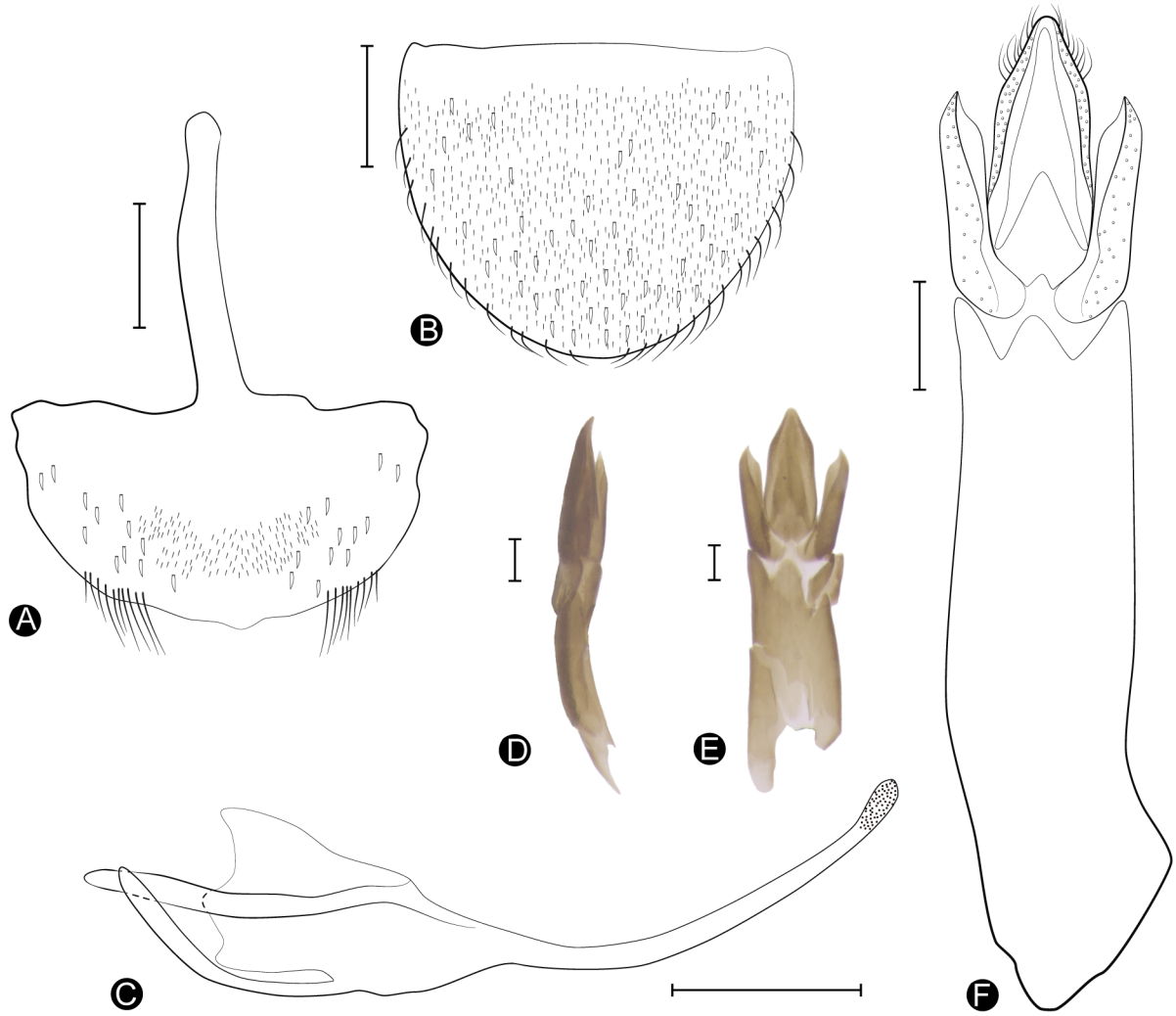

Fig. 4. *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov. ♂. **A**. Sternite VIII. **B**. Tergite VIII. **C**. Segment IX (MZSP31453). **D**. Aedeagus in lateral view. **E**–**F**. Aedeagus in ventral view (MZSP31444). Scale bars = 0.1 mm.

posterior half (Figs 1B, F, 2B, 7A, C, 9B). Prosternal process (Figs 2B, 7A, C, 9B) slightly narrow, lateral margins converging posteriorly, apex rounded. Proepimeron and proepisternon covered by tomentum. Mesoventrite with a mesoventral cavity to receive the prosternal process; sides strongly raised (Figs 1B, F, 2B, 7A–C, 9B); mesoepimeron covered by tomentum. Metaventrite (Figs 1B, F, 2B, 7B, D, 8B, 9B) longer than mesoventrite, with discrimen strongly depressed (male) (Figs 1B, F, 8B, 9B), and with the lateral region covered by tomentum. Legs (Figs 1A–C, E–G, 2, 6A–B, 7, 8B, 9A–B). Legs with pro and mesocoxae rounded, and metacoxae transverse. Trochanter as long as wide. Femora narrowed distally; with an oblique belt of tomentum dorsally (Figs 1B, F, 2B, 7B, 9B) and a transverse belt ventrally (Figs 1A, E, 2A, 6A–B, 9A). Tibiae thin, each with two fringes of tomentum on pro and mesotibiae and a single fringe on metatibia; and with a row of spines on protibia. Tarsal formula 5–5–5. Tarsus (Figs 1C, G, 2B, 6A–B, 7–8B, 9B) elongated, with short setae on ventral surface. Claws simple and large.

Abdomen. Five ventrites (Figs 2B, 4, 7A–B, D, 8B, 9B); strongly convex in cross section; disc of ventrites 1–4 glabrous, punctured, bearing scattered setae, and laterally densely covered by tomentum (Figs 2B, 7B, 8B, 9B); ventrite 5 completely and densely covered by tomentum, laterally emarginate, and posteriorly rounded.

Male genitalia (Figs 1D, H, 4D–F, 9C–E). Symmetrical, robust, and very sclerotized. Phallobase tubular. Parameres with sensorial pores. Penis with fibula and corona absent.

Larvae. Unknown.

Spanglerelmis femoralis (Hinton, 1940) gen. et comb. nov.
Figs 1, 10A, F

Microcylloepus femoralis – Hinton, 1940: 241, figs 3, 6.
Microcylloepus ochus – Hinton, 1940: 245, figs 4, 5. **Syn. nov.**

Diagnosis

Body dark brown in colour, antennae, mouthparts and legs red-brown. *Spanglerelmis femoralis* gen. et comb. nov. morphologically resembles *S. timburi* Polizei & Bispo gen. et sp. nov. by the profemora swollen, hypomeron without tomentum near the suture; and disc of the abdominal ventrite 1 without carina. However, it can be differentiated by a curved spur on metatibia. Furthermore, the male genitalia can be differentiated by the phallobase 2× as long as the penis, approximately 4× as long as wide; and penis 3× as long as wide. While in *Spanglerelmis timburi,* the spur is lacking on the metatibia and the male genitalia has phallobase 1.5× as long as penis, approximately 2.5× as long as wide, and penis 4× as long as wide.

Material examined

Holotype

BRAZIL • ♂; "N. Teutonia / 1936 Braz. // Type // Microcylloepus / femoralis / Hinton / Type // NHMUK010583892 //"; NHMUK010583892.

Others specimens

BRAZIL • 2 ♂, 2 ♀; "N. Teutonia / 1936 Braz. // Microcylloepus / femoralis / Hinton / Paratype // H. E. Hinton / collection. / B. M. 1977–566"; NHMUK • ♂; "Type // N. Teutonia / 1936 Braz. // Microcylloepus / ochus / Hinton / Type // Brit. Mus. / 1942 // NHMUK010583871 //"; NHMUK • 1 ♂, 3 ♀; "N. Teutonia / 1936 Braz. // Microcylloepus / ochus / Hinton / P-type // H. E. Hinton / collection. / B. M. 1977-566"; NHMUK • "Nova Teutônia / SC, Brasil / V-66 / F.Plaumann col. // MZSP 36559"; MZSP36559.

Size

Holotype: total length: 2.60 mm; maximum width: 1.04 mm.

Comments

Hinton (1940) described *Microcylloepus femoralis* (Fig. 1A–D) and *M. ochus* (Fig. 1E–H) as the only species of *Microcylloepus* without a longitudinal impression on the disc of pronotum and with shallow oblique impressions entirely confined to the side near the sublateral carina. Hinton (1940) considered the two species very similar, presenting a complete description for *M. femoralis*, and a note pointing the differences for *M. ochus*. Hinton detached the aedeagus of both species, preserving them glued to a card pinned with the specimens. However, for an unknown reason, he did not describe or illustrate these genitalia. Studying the morphological structures of these two species in detail, mainly the male genitalia (Fig. 1D, H), we concluded that *Microcylloepus ochus* is a junior synonym of *Microcylloepus femoralis*. In both species, the head is without distinct impressions; the pronotum without oblique impressions (Fig. 1A, E); elytra twice as long as pronotum; humeri feebly gibbous, and the same pattern

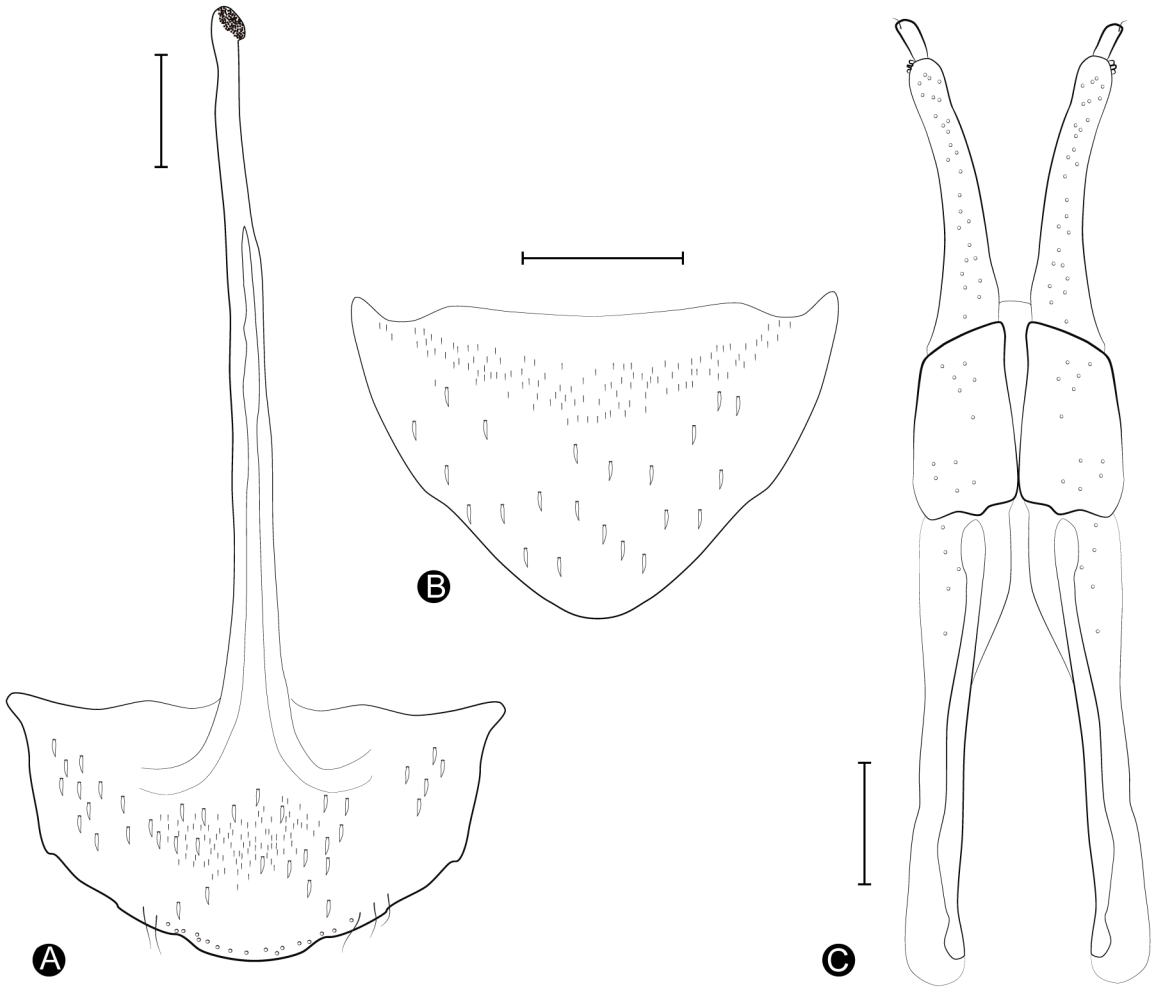

Fig. 5. *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov. ♀ (MZSP31454). **A**. Sternite VIII. **B**. Tergite VIII. **C**. Genitalia. Scale bars = 0.1 mm.

of sexual dimorphism. For example, in both species, the males have: 1) mesoventrite strongly raised; 2) metaventrite and disc of abdominal ventrite 1 strongly depressed (slightly depressed on females); and 3) metatibia with a curved spur (straight on females).

Here, it is important to note that the impressions in the pronotum mentioned by Hinton (1940) and slightly represented in the illustration of Bug (1973), in fact, are not present in the types. The types of the two species are housed on NHMUK (Fig. 1) and the morphological analysis revealed no kind of impression on pronotum. Despite this, Hinton (1940) informed a pronotum with an "oblique impression shallow" and "without a trace of a median longitudinal impression". On the other hand, the illustration of *M. femoralis* by Bug (1973: 125, fig. 3) also revealed a pronotum with a slightly median longitudinal impression, but different to Hinton (1940), included a pair of shallow oblique impressions. In view of the inconsistencies between our morphological data and the studies of Hinton (1940) and Bug (1973), our conclusions about *M. femoralis* were based only on our analysis of the types. These analyses revealed that there is no impression on the pronotum. It is also important to note that both Hinton (1940) and Bug (1973) agreed that *M. femoralis* do not fit into the "typical" species of *Microcylloepus*.

Here, *Microcylloepus femoralis* is transferred to *Spanglerelmis* Polizei & Bispo gen. nov. by the following characters: pronotum without transverse, longitudinal, or oblique impressions, sulci, or gibbosities on the disc, and sublateral carinae sinuous reaching the anterior and posterior margins of pronotum, converging toward apex; elytra with three carinae, on intervals III, V and VI; a disc of prosternum with a pair of carinae reaching the posterior half region; sides of mesoventrite strongly raised; femora with an oblique belt of tomentum dorsally and a transverse belt ventrally. This combination of characters fits that of *Spanglerelmis* and differs from the other genera of Elmidae.

Spanglerelmis xiririca Polizei & Bispo gen. et sp. nov.
urn:lsid:zoobank.org:act:44BD1453-3EE8-4626-87D8-06FAD617050D
Figs 2–8, 10A–D

Diagnosis

Body dark-brown, antennae, mouthparts and legs red-brown. *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov. can be easily differentiated from *S. timburi* Polizei & Bispo gen. et sp. nov. and *S. femoralis* by the profemora not swollen; hypomeron with a belt of tomentum near the suture; disc of abdominal ventrite 1 with a pair of carinae. While in *S. timburi* and *S. femoralis* the profemora is swollen; there is no tomentum on the suture on hypomeron; and absence of carina on disc of the abdominal ventrite 1. Moreover, the male genitalia can be differentiated by the phallobase 2.5× as long as penis (1.5× in *S. timburi* and 2× in *S. femoralis*) and the penis with long setae on apex.

Etymology

The specific epithet *xiririca* refers to the oldest name for Eldorado county, the region where specimens of the new species were collected; it is an indigenous word (Tupi origin) meaning "running water".

Type locality

Eldorado, São Paulo State, Brazil.

Type material

Holotype (male)
BRAZIL • "São Paulo. Eldorado. / Parque Estadual Caverna do / Diabo. 12.VII.2013 559m. / 24°38′00.7″ S 048°24′32.7″ W / Thiago Polizei & Lucas Costa leg. // MZSP31444"; MZSP31444.

Fig. 6. *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov. under scanning electron microscope, ♀ (MZSP31480). Dorsal view. **A**. Habitus. **B**. Middle leg (arrows showing the pattern of tomentum on femur). **C**. Pronotum. **D**. Elytra. Scale bars: A = 0.2 mm; B–D = 0.1 mm.

Paratypes

BRAZIL • 7 specs; "São Paulo. Eldorado. / Parque Estadual Caverna do / Diabo. 12.VII.2013 559m. / 24°38′00.7″ S 048°24′32.7″ W / Thiago Polizei & Lucas Costa leg. (5 in MZSP, 1 in USNM, 1 in NHMUK)"; MZSP 31445–31449 • 4 specs; "São Paulo. Eldorado. / Parque Estadual Caverna do / Diabo. 13.VII.2013 452m. / 24°38'22.9″ S 048°24'01.3″ W / Thiago Polizei & Lucas Costa leg. (2 in MZSP, 1 in USNM, 1 in NHMUK), (MZSP 31450–31451)" • 1 spec.; "São Paulo. Echaporã / Área de Proteção Ambiental – APA. / 28.VIII.2013. 565m. / 22º25′06.9″ S 050º12′0.9″ W / Thiago Polizei & Lucas Costa leg. //"; MZSP31452 • 12 specs; "São Paulo. Ribeirão Grande. / Parque Estadual Intervales. Ribeirão / Água Comprida. 16.X.1999 / 24°17′38″ S 048°25′04″ W / Pitágoras C. Bispo leg. (12 in MZSP)"; MZSP 31453–31464 • 11 specs; "São Paulo. Ribeirão Grande. / Parque Estadual Intervales. Ribeirão / Mirante. 27.VI.1999. 820m. / 24°16′34″ S 048°25′02″ W / Pitágoras C. Bispo leg. (11 in MZSP)"; MZSP 31469–31479 • 9 specs; "São Paulo. Ribeirão Grande. / Parque Estadual Intervales. Ribeirão / Bocaína. 20.V.2000. 760m. / 24°16′13″ S 048°27′09″ W / Pitágoras C. Bispo leg. (9 in MZSP) (3 used under SEM)"; MZSP 31480–31488 • 51 specs; "São Paulo. Ribeirão Grande. / Parque Estadual Intervales. Ribeirão / Roda d'Água. 16.VII.1999. 760m. / 24°16′16″ S 048°25′31″ W / Pitágoras C. Bispo leg. (31 in MZSP, 10 in USNM, 10 in NHMUK)"; MZSP 31489–31519 • 1 spec. "SP:Ribeirão / Grande-Faz.Intervales / G.C. Froehlich & C.M. / Polegatto col. // Córrego Roda / d'Água 16.II.1993 / C.G.F. & C.M.P. //"; MZSP 36563 • 1 spec.;"SP:Rib.Grande / Faz. Intervales - Rib. / Água Comprida / 09.XI.1983 Froehlich / & Paprocki col. // MZSP 36561"; MZSP 36561 • 6 specs; "São Paulo. Campos do / Jordão. Parque Estadual Campos / do Jordão. Riacho Galharada. / 16.V.2005. 1912m. M.Segura leg. / 22°43′07″ S 45°27′26″ W // Coleção Laboratório de Entomologia / Aquática – UFSCar. / Doado do MZSP em X.2008 pela Profª / Dra. Lívia Fusari. (6 in MZSP)"; MZSP 41691–41696 • 1 spec.; "São Paulo. Campos do / Jordão. Parque Estadual Campos / do Jordão. Riacho Campo do / Meio. 18.V.2005. M.Segura leg. / 1580m. 22°41′53″ S 45°29′02″ W // Coleção Laboratório de Entomologia / Aquática – UFSCar. / Doado do MZSP em X.2008 pela Profª / Dra. Lívia Fusari. // MZSP 43718"; MZSP 43718.

Description

Head (Figs 6A, 7A, C, 8). Partially retractable (Figs 8B, 9B); dorsal surface with punctures distanced from each other by the equivalent of their own diameters and covered by setae, without impressions. Eyes protruding laterally (Fig. 8A). Antennae with each antennomere with few, very short and thin setae on apex (Fig. 8A). Frontoclypeal suture arcuate. Clypeus broad; ornamented as the other parts of head; anterolateral corners rounded, with long setae; anterior margin convex. Labrum (Figs 3A, 8A) subrectangular, covered by long and thin setae; anterolateral margin rounded; anterior margin almost straight. Mandibles (Fig. 3B) symmetrical, subtriangular; apex gradually curved mesad, with three apical teeth; posterolateral lobe visible in dorsal view; mandible with a lateroventral stout seta and a row of thin and long setae below the posterolateral lobe; molar region with several transverse carinae; prostheca membranous, forming several lobes on apex and with thin setae on middle. Maxillary (Figs 3C, 8A) cardo elongate; stipes subtriangular and divided; palpifer present, subtriangular; maxillary palpus four segmented, palpomeres I–III covered by few setae on apex; apical palpomere subequal in length to the three preceding combined, with a circular row of setae on middle (Fig. 8A), truncate apically, with apical sensory field; galea palpiform, 2 segmented, apical segment 2× as long as the basal, with a row of long setae on posterolateral margin; lacinia subrectangular, with mesal stout setae and a fringe of long and thin setae on apex. Labial (Figs 3D, 8A) mentum flat, slightly transverse, anterior margin straight, with stout setae, especially on anterolateral margin; submentum arcuate, converging anteriorly, anterior angles strongly acute and protruding; labial palpus 3 segmented (Fig. 8A); palpomere II with few setae on apex, apical palpomere subequal in length to the two preceding combined, with a circular row of setae on middle, apex with sensorial peg-like setae; ligula (Figs 3D, 8A) slightly sclerotized, almost as long as wide, subdivided apically, with stout cone-like setae and few long, thin setae on disc. Gena covered by tomentum.

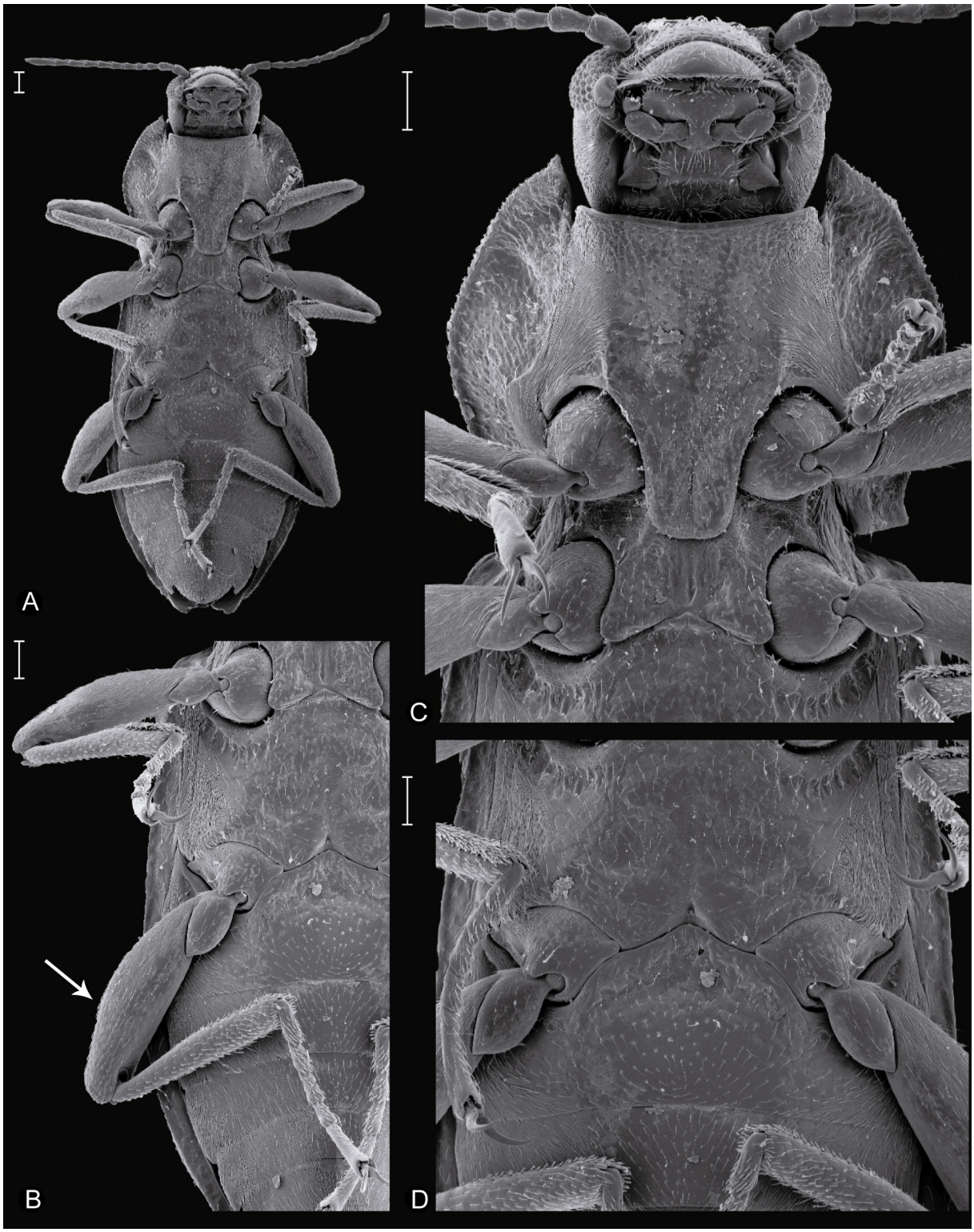

Fig. 7. *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov. under scanning electron microscope, ♀ (MZSP31481). Ventral view. **A**. Habitus. **B**. Hind leg (arrow showing the pattern of tomentum on femur). **C**. Prosternum and mesoventrite. **D**. Metaventrite and abdominal ventrites I–II. Scale bars = 0.1 mm.

Thorax (Figs 2, 6–8B). Pronotum (Figs 2A, 6A, C, 8B) as long as wide; anterior margin slightly arcuate; lateral margins arcuate and slightly crenulated; posterior and anterior angles acute; posterior margin smooth with two prescutellar fovea; surface with punctures distanced from each other by the equivalent of one or two times their own diameter, without transverse, longitudinal or oblique impressions, sulci or gibbosities (Fig. 6C); sublateral carinae sinuous, reaching the anterior and posterior margin, converging toward the apex. Scutellum rounded, covered by few setae. Elytra (Figs 2A, 6A, D) longer than wide; almost as wide as pronotum; moderately convex dorsally (Fig. 8B); anterior margins smooth; lateral margins moderately explanate; apices rounded (Fig. 6D); humeri rounded; elytra strongly striate-punctate and with rows of thin setae between the punctures (Figs 2A, 6A, D); carinae on intervals III, V and VI, extending ⅕ of the elytral length on the third interval, ¾ of the elytral length on the fifth interval, and ⅘ of the elytral length on the sixth interval (Fig. 6A, D). Epipleura narrow, anteriorly wider; glabrous, without tomentum or row of granules (Figs 2B, 7–8B); posteriorly at least partly concealed by produced lateral margins of the abdominal ventrites (Fig. 7A). Metathoracic wings (Fig. 3E) micropterous, costal and subcostal veins fused near the sclerites, radial cell incomplete, median vein not reaching the margin, anal region with a single vein; apical region with two distinctly pigmented stripes; apical margin with a row of short and thin setae. Hypomeron narrow, posteriorly wider than anteriorly; with a belt of tomentum near the suture (Fig. 7C). Prosternal disc with a pair of carinae reaching the posterior half (Figs 2B, 7A, C). Prosternal process (Figs 2B, 7A, C, 9B) slightly narrow, lateral margins converging posteriorly, apex rounded. Proepimeron and proepisternon are covered by tomentum. Mesoventrite with a mesoventral cavity to receive the prosternal process; sides strongly raised (Figs 2B, 7A, C); mesoepimeron covered by tomentum. Metaventrite (Figs 2B, 7B, D, 8B) longer than mesoventrite, with strong longitudinal medial depression (Fig. 8B); discrimen conspicuous, reaching the anterior and posterior margins (Fig. 2B), with lateral region covered by tomentum. Legs (Figs 2, 6A–B, 7, 8B) red-brown. Femora narrowed at the distal margin, 4× as long as wide; proximal half ventrally covered by tomentum (Figs 2B, 7B), dorsally covered by an oblique belt of tomentum (Figs 2A, 6A–B). Tibiae thin, 6× as long as wide; with two fringes of tomentum on distal ⅔ of pro and mesotibiae and a single fringe on metatibia; with a row of spines on distal half of protibia. Tarsus (Figs 2B, 6A–B, 7–8B) elongated; with short setae on ventral surface of each tarsomere; apical tarsomere as long as the four-preceding combined. Claws simple and large.

Abdomen. Five ventrites (Figs 2B, 4, 7A–B, D, 8B); strongly convex in cross-section, with punctures separated by 3× their own diameters, scattered setae in the lateral region; ventrite 1 with a complete pair of carinae on disc; disc of ventrites 1–4 glabrous, punctured, with scattered setae, laterally densely covered by tomentum (Figs 2B, 7B, 8B, 9B); ventrite 5 completely and densely covered by tomentum, strongly emarginate laterally and rounded posteriorly. Sternite VIII (Fig. 4A) widely rounded; anterior margin slightly sinuous and with a basal projection moderately longer than the remainder of sternite; posterolateral margins with long setae; surface with some setae on lateral region and short, thin spines on the disc. Tergite VIII (Fig. 4B) almost as long as wide; widely rounded posteriorly; anterior margin slightly arcuate; surface with setae and short, thin spines; posterior margin with long setae. Segment IX (Fig. 4C) forming an asymmetrical genital capsule surrounding the aedeagus; anterior portion forming a median, long strut; distal portion semitubular, punctured on apex.

Male genitalia (Fig. 4D–F). Symmetrical, robust, very sclerotized. Phallobase tubular, very long, 2.5× as long as penis; slightly curved in lateral view (Fig. 4D); approximately 4× as long as wide. Parameres narrowed towards the apex and covering ¾ of penis; 5× as long as wide; with sensorial pores. Penis 1.2× as long as parameres, 3× as long as wide at the base, slightly narrowed towards the apex, with a deep median depression near the apex; apex with long thin setae (Fig. 4F); fibula approximately the length of the penis.

Fig. 8. *Spanglerelmis xiririca* Polizei & Bispo gen. et sp. nov. under scanning electron microscope, ♂. **A**. Head in ventral view (MZSP31481). **B**. Habitus in lateral view (MZSP31482). Scale bars: A = 0.02 mm; B = 0.1 mm.

Female (Figs 5–7). External morphology similar to male, excepted for the absence of a row of spines on the distal half of protibiae; metaventrite with a slight longitudinal medial depression, discrimen barely visible in optical microscopy (Fig. 7D). Sternite VIII (Fig. 5A) almost 2× as wide as long; anterior margins sinuous; basal projection approximately 3× as long as remainder of sternite; posterolateral margins slightly emarginate; posterior margin sinuous and with setae; disc surface covered with short setae and spines. Tergite VIII (Fig. 5B) subtriangular; anterolateral margin emarginate and posterior margin arcuate; surface with setae on ⅔ posterior and spines on ⅓ anterior.

Female genitalia (Fig. 5C). Ovipositor symmetrical. Valvifer membranous, approximately as long as coxites, parallel; baculus sclerotized, bar-like. Coxites wider at base, narrowed at apex, divergent, divided by a transverse line; apical coxite 1.5× as long as basal; apex with stout setae; surface with micropunctures, without setae. Styli slightly curved and divergent; apical portion rounded, with a seta.

Intraspecific variation

This species varies slightly in size, from 2.30–2.34 mm long, maximum width 0.86–0.88 mm (n = 10).

Spanglerelmis timburi Polizei & Bispo gen. et sp. nov.
urn:lsid:zoobank.org:act:14D0A49C-EBE9-4FB1-9AB5-087E46548EF4
Figs 9–10A, E

Diagnosis

Body dark-brown, antennae, mouthparts and legs red-brown. *Spanglerelmis timburi* resembles *S. femoralis* by the profemora swollen but can be differentiated by the elytral interval IV with first puncture bigger and deeper than any others; metatibia without spur; and male genitalia with phallobase 1.5× as long as the penis, approximately 2.5× as long as wide; and penis 4× as long as wide. While in *S. femoralis*, the first elytral puncture on interval IV is not bigger and deeper than any others; metatibia with a spur; male genitalia with phallobase 2× as long as the penis, approximately 4× as long as wide; and penis 3× as long as wide.

Etymology

The specific epithet *timburi* refers to the Timburi county (São Paulo State, Brazil) where the holotype was collected. Timburi is the name of a very common tree (*Enterolobium timbouva* Mart.) in the region. It is an indigenous word (Tupi origin) meaning ‘nose or snout’.

Type locality

Timburi, São Paulo State, Brazil.

Type material

Holotype

BRASIL• ♂; “São Paulo. Timburi / Área de Proteção Ambiental - / APA. 19.X.2013 633m. / 23°11'01.6" S 049°37'49.2" W / Thiago Polizei & Lucas Costa leg. // MZSP31520”; MZSP 31520.

Description

Measurements. Male: holotype. Total length: 2.37 mm; maximum width: 0.82 mm.

Head (Fig. 9B). Partially retractable; dorsal surface with punctures distanced from each other by the equivalent of their own diameters, without setae or impressions. Eyes protruding laterally.

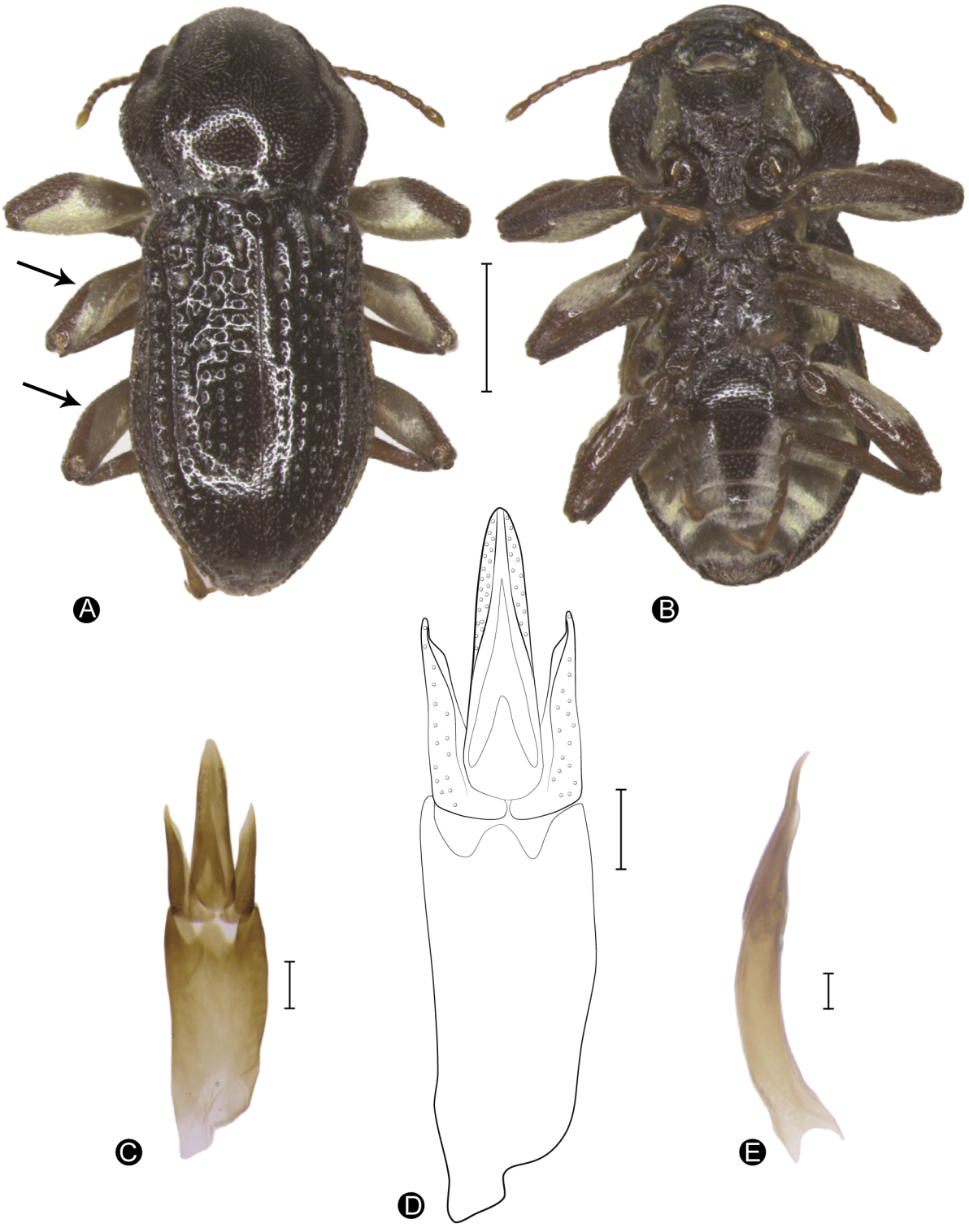

Fig. 9. *Spanglerelmis timburi* Polizei & Bispo gen. et sp. nov. holotype, ♂ (MZSP31520). **A**–**B**. Habitus. **A**. Dorsal view (arrows showing the pattern of tomentum on femur). **B**. Ventral view. **C**–**D**. Aedeagus in ventral view. **E**. Aedeagus in lateral view. Scale bars: A–B = 0.5 mm; C–E = 0.1 mm.

Antennae with each one antennomere covered by few, very short, and thin setae on apex (Fig. 9A–B). Frontoclypeal suture sinuous. Clypeus broad; ornamented as the other parts of head; anterolateral corners rounded with short golden setae; anterior margin convex. Labrum subrectangular covered by short and thin setae; anterolateral margin rounded and covered by long golden setae; anterior margin sinuous.

Thorax (Fig. 9A–B). Pronotum (Fig. 9A) as long as wide; anterior margin slightly arcuate; lateral margins arcuate and slightly crenulated; posterior and anterior angles acute; posterior margin smooth with two prescutellar fovea; surface with punctures distanced from each other by the equivalent from one to two times their own diameter, without transverse, longitudinal or oblique impressions, sulci or gibbosities (Fig. 9A); sublateral carinae sinuous, reaching the anterior and posterior margin, converging toward apex. Scutellum rounded, covered by micropunctures, without setae. Elytra (Fig. 9A) longer than wide; almost as wide as pronotum; slightly convex dorsally; anterior margins smooth; lateral margins moderately arcuate and explanate; apices rounded; humeri rounded; elytra strongly striate-punctate with rows of short thin setae between the punctures (Fig. 9A); first puncture on interval IV bigger and deeper than any others; carinae on intervals III, V and VI extending ⅙ of the elytral length on the third interval, ¾ of the elytral length on the fifth interval, and ⅘ of the elytral length on the sixth interval (Fig. 9A). Epipleura slightly wide, but very narrow anteriorly; glabrous, without tomentum or row of granules; posteriorly at least partly concealed by produced lateral margins of the abdominal ventrites (Fig. 9B). Hypomeron narrow, posteriorly wider than anteriorly; without tomentum near the suture (Fig. 9B). Prosternum disc with a pair of carinae reaching the posterior half (Fig. 9B). Prosternal process (Fig. 9B) slightly narrow, lateral margins converging posteriorly, apex rounded. Proepimeron and proepisternon covered by tomentum. Mesoventrite with a mesoventral cavity to receive the prosternal process; sides strongly raised (Fig. 9B); mesoepimeron covered by tomentum. Metaventrite (Fig. 9B) longer than mesoventrite, with strong longitudinal medial depression; discrimen conspicuous, reaching the anterior and posterior margins (Fig. 9B), lateral region covered by tomentum. Legs (Fig. 9A–B) red-brown. Femora slightly narrowed at the distal margin; profemur swollen, 2× as long as wide, meso and metafemur 4× as long as wide; proximal ⅔ ventrally covered by tomentum (Fig. 9B), dorsal surface covered by an oblique belt of tomentum (Fig. 9A). Tibiae thin; protibia 3× as long as wide, meso and metatibia 6× as long as wide; with two fringes of tomentum on distal half of pro and mesotibiae and a single fringe on metatibia; with a row of spines on distal half of protibia; protibial apex 3× as wide as base. Tarsus elongated; ventral surface of tarsomeres covered by short setae; apical tarsomere shorter than the four-preceding combined. Claws simple and large.

Abdomen. Five ventrites (Fig. 9B); strongly convex in cross-section, with punctures separated by 3× their own diameters, and with scattered setae in the lateral region; ventrite 1 without carinae on disc; disc of ventrites 1–4 glabrous, with micropunctures, and laterally densely covered by tomentum (Fig. 9B); ventrite 5 completely and densely covered by tomentum, moderately emarginate laterally and rounded posteriorly.

Male genitalia (Fig. 9C–E). Symmetrical, robust, and very sclerotized. Phallobase tubular, long, 1.5× as long as penis; strongly curved in lateral view (Fig. 9E); approximately 2.5× as long as wide. Parameres narrowed towards the apex and covering ⅔ of the penis; 4× as long as wide; with sensorial pores. Penis 1.5× as long as parameres (Fig. 9C–D), 4× as long as wide, narrowed towards the apex, with a deep median depression near the apex; sinuous in lateral view (Fig. 9E); fibula approximately half the length of the penis.

Female. Unknown.

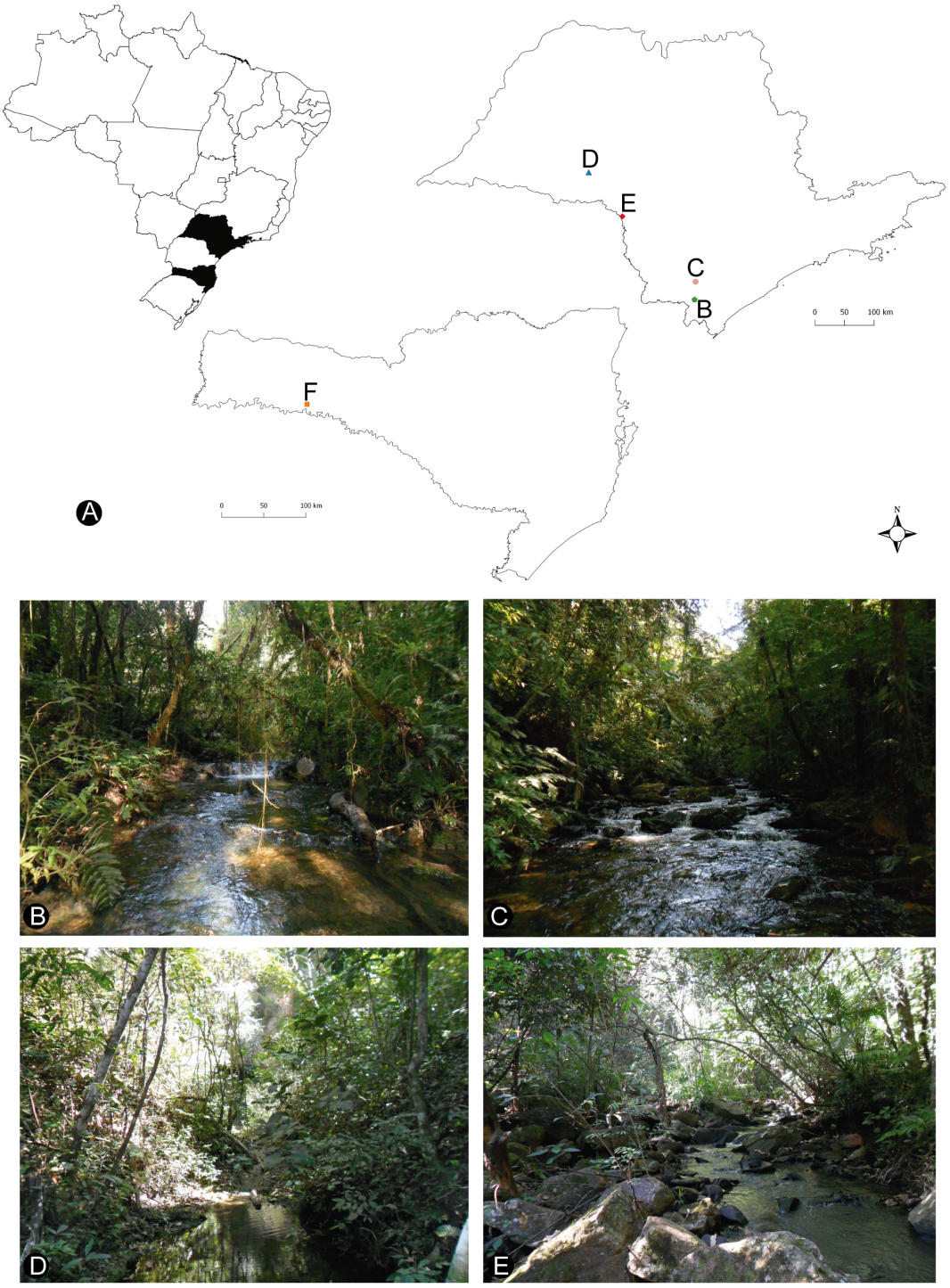

Fig. 10. Distribution records for *Spanglerelmis* Polizei & Bispo gen. nov. **A**. Map of Brazil highlighting the São Paulo and Santa Catarina States, showing the localities of *Spanglerelmis* gen. nov. **B**–**D**. Locality of *Spanglerelmis xiririca* gen. et sp. nov. **B**. Parque Estadual Caverna do Diabo, Eldorado, São Paulo State, Brazil (type locality) (24°38′00.7″ S, 048°24′32.7″ W). **C**. Parque Estadual de Intervales, Ribeirão Grande, São Paulo State, Brazil (24°16′16″ S, 048°25′31″ W). **D**. Echaporã, São Paulo State, Brazil (22°25′06.9″ S, 050°12′0.9″ W). **E**. Type locality of *Spanglerelmis timburi* gen. et sp. nov. Timburi, São Paulo State, Brazil (23°11′01.6″ S, 049°37′49.2″ W). **F**. Type locality of *Spanglerelmis femoralis* gen. et comb. nov. Nova Teutônia (currently county of Seara), Santa Catarina State, Brazil (27°09′42.5″ S, 052°25′28.5″ W).

Key to the species of *Spanglerelmis* Polizei & Bispo gen. nov.

1. Protibia not swollen (Fig. 2); hypomeron with a belt of tomentum near the suture (Fig. 7C); apical tarsomere as long as the four-preceding combined; abdominal ventrite 1 with a pair of carinae, ventrite 5 strongly emarginate laterally (Fig. 2B)..... .....***Spanglerelmis xiririca*** Polizei & Bispo gen. et sp. nov.
– Protibia swollen (Figs 1B, F, 9A–B); hypomeron without a belt of tomentum near the suture (Figs 1B, F, 9B); apical tarsomere shorter than the four-preceding combined; abdominal ventrite 1 without carinae, ventrite 5 moderately emarginate laterally (Fig. 9B) 2

2. Elytron with first puncture on interval IV bigger and deeper than any others (Fig. 9A); setae of the protarsomeres no longer than on the other legs (males); metatibia without spur; phallobase 1.5× as long as penis, approximately 2.5× as long as wide; penis 4× as long as wide (9C–D) .....***Spanglerelmis timburi*** Polizei & Bispo gen. et sp. nov.
– Elytron with first puncture on interval IV not bigger and deeper than any others (Fig. 1A, E); setae of the protarsomeres longer than on the other legs (males); metatibia with a curved spur (males); phallobase 2× as long as penis, approximately 4× as long as wide; penis 3× as long as wide .....***Spanglerelmis femoralis*** (Hinton, 1940) gen. et comb. nov.

Biological notes

Spanglerelmis is only recorded from the Atlantic rainforest (Fig. 10). Most of the material was collected by the authors during expeditions to unimpacted streams in the São Paulo State, Brazil, in the years 1999 to 2000 and 2013, where a high diversity of aquatic beetles, mostly of the family Elmidae, was collected. Samples containing the two new species were collected from streams with high oxygen concentrations and rocky bottoms (Fig. 10B–E) in Parque Estadual Caverna do Diabo (Eldorado) (Fig. 10B); Parque Estadual Intervales (Ribeirão Grande) (Fig. 10C); the region of Echaporã (Fig. 10D); and the region of Timburi (Fig. 10E). These streams are in basins with undisturbed vegetation and in elevations that range from 452 m to 820 m. In general, the specimens were collected in riffles at a depth of 0.1 m to 0.5 m, in streams with different slopes and with alternating pools and riffles (Fig. 10B–E).

Discussion

The knowledge of Neotropical Elmidae has increased in recent years with the description of several new species (Polizei & Barclay 2018, 2019a, 2019b; Linský *et al.* 2019, 2021; Polizei *et al*. 2020a, 2020b; Čiampor *et al.* 2021), and two new genera: *Amazonopsis* Barr, 2018 from Peru, Venezuela, and French Guiana; and *Ictelmis* Čiampor, Linský & Čiamporová-Zaťovičová reported from Ecuador. In Brazil, although new species have been regularly described in recent years (Polizei 2018a, 2018b; Almeida *et al.* 2020; Polizei *et al.* 2020b; Polizei & Fernandes 2020; Polizei & Hamada 2021), the last genera, *Tolmerelmis* Hinton, 1972 and *Tyletelmis* (Hinton, 1972), were described approximately 50 years ago.

A phylogeny hypothesis has never been proposed for Elmidae, hindering any hypothesis of the relationship between *Spanglerelmis* Polizei & Bispo gen. nov. and other genera of the family. However, this genus morphologically resembles *Microcylloepus*, *Neoelmis*, and *Elachistelmis*, but it can easily be differentiated from these genera by the combination of characters, mainly by the pronotum without transverse, longitudinal, or oblique impressions, sulci, or gibbosities on disc; elytra with two sublateral carinae on intervals V and VI; mesoventrite with sides strongly raised; and femora with an oblique belt of tomentum dorsally and a transverse belt ventrally.

Spanglerelmis femoralis gen. et comb. nov. and the junior synonym *Microcylloepus ochus* were described in *Microcylloepus* by Hinton (1940). However, in the original description, Hinton admitted that he made some changes to the generic diagnosis of *Microcylloepus* in order to include the variations of this species,

since this is very different from all other species of *Microcylloepus*. The same was observed by Bug (1973), who assumed in its embracing study of the genus *Microcylloepus* that *M. femoralis* do not fit into the typical species of the genus. Years later, when studying specimens of *Microcylloepus femoralis*, Spangler indicated that this could be a new genus, but, for an unknown reason, he did not publish it. Some neotropical genera, as *Microcylloepus*, are very speciose and include several morphological variations. As demonstrated by the molecular data, these more speciose genera are probably represented by different lineages, which need to be better defined from a taxonomic point of view (Čiampor *et al.* 2019). As highlighted by Čiampor *et al.* (2019), our knowledge about elmids is still incipient.

With the description of *Spanglerelmis* Polizei & Bispo gen. nov. the Brazilian fauna now totals 27 genera of Elmidae. Brazil occupies a large area of South America, contains different biomes, and has several regions where aquatic insects have been poorly sampled. In addition, the small number of taxonomic experts and the lack of taxonomic revisions have made identifying species difficult. Therefore, the current richness of Elmidae in Brazil is likely underestimated. Fortunately, in recent years the sampling effort in different Brazilian regions has increased, resulting in both ecological (Segura *et al.* 2012; Braun *et al.* 2014, 2018a) and taxonomic studies (Polizei 2018a; Almeida *et al.* 2020; Polizei *et al.* 2020a, 2020b; Polizei & Fernandes 2020; Polizei & Hamada 2021), which have expanded knowledge about Elmidae.

Spanglerelmis Polizei & Bispo gen. nov. was found in riffles of unimpacted streams in the Atlantic Forest. Fast and well-oxygenated waters in undisturbed areas are the preferred habitats of Elmidae in Brazil (Couceiro *et al.* 2007). Elmids can be a vulnerable group, since several studies have revealed that changes in the integrity of the habitat can affect these insects (Braun *et al.* 2018a, 2018b). Fortunately, most of the specimens of the two new species, *S. xiririca* Polizei & Bispo gen. et sp. nov. and *S. timburi* Polizei & Bispo gen. et sp. nov., were collected in protected areas. On the other hand, *S. femoralis* gen. et comb. nov. was collected in southern Brazil in the 1930s. After that, the region where this species was collected has changed a lot by anthropic action, and no other specimens of *S. femoralis* gen. et comb. nov. have been collected since. These findings and those of other studies (Braun *et al.* 2018a, 2018b) suggest that the conservation of sensitive species of Elmidae includes the challenge of preserving the integrity of the lotic environments where these organisms live.

Acknowledgments

We thank Maxwell V. L. Barclay (NHMUK), Dr Thierry Deuve, and Azadeh Taghavian (MNHN), and Dr Sônia Casari (MZSP) for providing access to laboratory facilities and assistance during this study. Dr Talita Roell (MZSP) and M.Sc. André Fernandes (Universidade Federal do Tocantins) are warmly thanked for their support and suggestion on this paper. We are grateful to M.Sc. Keita Matsumoto (NHMUK) for the holotype photographs. We also thank FAPESP (São Paulo Research Foundation, grants 2009/53233-7, 2012/21196-8, 2015/17064-7, 2016/21184-0, and 2019/22833-0), CNPq (National Council for Scientific and Technological Development, grant 303260/2018-1) and CAPES (Coordination for the Improvement of Higher Education Personnel) for financial support and scholarships. We are grateful to two anonymous reviewers for the useful suggestions.

References

Almeida M.L.S., Fernandes A.S. & Boldrini R. 2020. A new species of *Macrelmis* Motschulsky, 1859 (Coleoptera: Elmidae) and new records of Elmidae from Roraima State, northern Brazil. *Zootaxa* 4718 (2): 277–284. https://doi.org/10.11646/zootaxa.4718.2.9

Barbosa F.F., Fernandes A.S. & Oliveira. L.G. 2013. Three new species of *Macrelmis* Motschulsky, 1859 (Coleoptera: Elmidae: Elminae) from the Brazilian Cerrado Biome with updated key for the *Macrelmis* of Brazil. *Zootaxa* 3736 (2): 128–142. https://doi.org/10.11646/zootaxa.3736.2.2

Barr C.B. 2018. *Amazonopsis*, an unusual new genus of riffle beetle from South America with two new species (Coleoptera, Elmidae, Elminae). *ZooKeys* 803: 71–92. https://doi.org/10.3897/zookeys.803.28124

Braun B.M., Salvarrey A.V.B., Kotzian C.B., Spies M.R. & Pires M.M. 2014. Diversity and distribution of riffle beetle assemblages (Coleoptera, Elmidae) in montane rivers of Southern Brazil. *Biota Neotrop* 14 (2): 1–11. https://doi.org/10.1590/1676-060320140615183046

Braun B.M., Bertaso T.R.N., Pires M.M., Spies M.R. & Kotzian C.B. 2018a. Responses of riffle beetle assemblages to deforestation in a semi-deciduous Atlantic Forest remnant. *Anais da Academia Brasileira de Ciências* 90 (2): 2189–2201. https://doi.org/10.1590/0001-3765201820160853

Braun B.M., Pires M.M., Stenert C.M. & Kotzian C.B. 2018b. Effects of riparian vegetation width and substrate type on riffle beetle community structure. *Entomological Sciences* 21: 66–75. https://doi.org/10.1111/ens.12283

Brown H.P. 1972. Aquatic dryopoid beetles (Coleoptera) of United States. Biota of Freshwater ecosystem, identification manual no 6. Ohio, U.S. Environmental Protection Agency. https://doi.org/10.5962/bhl.title.4106

Bug K. 1973. Zur Genitalmorphologie und Systematik der neotropischen Spezies des Elminthidae - Genus *Microcylloepus* Hinton, 1935 (Coleoptera: Dryopoidea). *Beiträge zur Entomologie, Contributions to Entomology* 23 (1–4): 99–130.

Čiampor F., Kodada J., Bozánová J. & Čiamporová-Zaťovičová Z. 2021. *Disersus otongachi* a new species of Larainae riffle beetles from Ecuador (Coleoptera: Elmidae). *Zootaxa* 4963 (1): 193–199. https://doi.org/10.11646/zootaxa.4963.1.12

Čiampor F., Linský M. & Čiamporová-Zaťovičová Z. 2019. *Ictelmis*, a new riffle beetle genus from Ecuador (Coleoptera: Elmidae). *Zootaxa* 4695 (5): 483–491. https://doi.org/10.11646/zootaxa.4695.5.5

Couceiro S.R.M., Hamada N., Luz S.L.B., Forsberg B. & Pimentel T.P. 2007. Deforestation and sewage effects on aquatic macroinvertebrates in urban streams in Manaus, Amazonas, Brazil. *Hydrobiologia* 575: 271–284. https://doi.org/10.1007/s10750-006-0373-z

Fernandes A.S. & Hamada N. 2012. Description and notes on the bionomics of a new species of *Potamophilops* Grouvelle, 1896 (Coleoptera: Elmidae: Larainae), from the Cerrado biome in Brazil. *Journal of Natural History* 46 (11–12): 717–727. https://doi.org/10.1080/00222933.2011.651643

Fernandes A.S., Passos M.I.S. & Hamada N. 2011. *Stegoelmis* Hinton, 1939 (Coleoptera: Elmidae: Elminae) in Brazil: two new species and a key to the Brazilian species. *Zootaxa* 2921: 56–64. https://doi.org/10.11646/zootaxa.2921.1.6

Ferreira-Jr N., Sampaio B.H.L., Fernandes A.S., Clarkson B., Braga R.B., Passos M.I.S. & Santos A.D. 2014. Ordem Coleoptera. *In:* Hamada N., Nessimian J.L. & Querino R.B. (eds) *Insetos aquáticos na Amazônia brasileira: taxonomia, biologia e ecologia*: 349–376. Editora INPA, Manaus.

Hinton H.E. 1935. Notes on the Dryopoidea (Col.). *Proceedings of the Royal Entomological Society of London. Series B, Taxonomy* 4 (8): 169–179. https://doi.org/10.1111/j.1365-3113.1935.tb00660.x

Hinton H.E. 1940. XIX – On some new Brazilian *Microcylloepus*, with a key to the species (Coleoptera, Elmidæ). *The Annals and Magazine of Natural History* 11 (32): 236–247. https://doi.org/10.1080/03745481.1940.9723672

Hinton H.E. 1972. Two new genera of South American Elmidae (Coleoptera). *The Coleopterists Bulletin* 26 (2): 37–41.

Jäch M.A. & Balke M. 2008. Global diversity of water beetles (Coleoptera) in freshwater. *Hydrobiologia* 595: 419–442. https://doi.org/10.1007/s10750-007-9117-y

Jäch M.A., Kodada J., Brojer M., Shepard W. & Čiampor-Jr F. 2016. *Coleoptera: Elmidae, Protelmidae. World Catalogue of Insects.* Koninklijke Brill. Leiden. https://doi.org/10.1163/9789004291775_002

Kodada J., Jäch M.A. & Čiampor-Jr F. 2016. 19.2. Elmidae Curtis, 1830. *In:* Beutel R.G. & Leschen R.A.B. (eds) *Handbook of Zoology, Volume IV (Part 38), Coleoptera, Beetles, Volume 1: Morphology and Systematics (Archostemata, Adephaga, Myxophaga, Polyphaga partim)*: 561–589. Walter de Gruyter, Berlin.

Linský M., Čiamporová-Zaťovičová Z. & Čiampor-Jr F. 2019. Four new species of *Hexanchorus* Sharp from Ecuador (Coleoptera, Elmidae) with DNA barcoding and notes on the distribution of the genus. *ZooKeys* 838: 85–109. https://doi.org/10.3897/zookeys.838.33086

Linský M., Čiamporová-Zaťovičová Z. & Čiampor-Jr F. 2021. A revision of *Onychelmis* Hinton, 1941 (Coleoptera: Elmidae), with description of new species, DNA barcoding and notes on the geography of the genus. *European Journal of Taxonomy* 739: 1–35. https://doi.org/10.5852/ejt.2021.739.1263

Maier C.A. 2012. *Elachistelmis* gen. n. (Coleoptera: Elmidae: Elminae) from Suriname, with description of two new species. *Zootaxa* 3500: 61–69. https://doi.org/10.11646/zootaxa.3500.1.4

Manzo V. 2005. Key to the South America genera of Elmidae (Insecta: Coleoptera) with distributional data. *Studies on Neotropical Fauna and Environment* 40 (3): 201–208. https://doi.org/10.1080/01650520500140619

Musgrave P.N. 1935. Two new Elmidae from Puerto Rico with description of new genus (Coleoptera). *Proceedings of the Entomological Society of Washington* 37 (2): 32–35.

Passos M.I.S., Miranda G.S. & Nessimian J.L. 2015. Three new species of *Macrelmis* Motschulsky (Coleoptera: Elmidae: Elminae) from Southeastern Brazil with new definition of species groups to the genus. *Zootaxa* 4058 (2): 195–210. https://doi.org/10.11646/zootaxa.4058.2.3

Polizei T.T.S. 2018a. *Microcylloepus loebli*, a new species of riffle beetle (Coleoptera, Elmidae). *In:* Schmidt J., Huber C., Klausnitzer B. & Barclay M.V.L (eds) Wonderful Diversity Contributions to the Taxonomy and Faunistics of Beetles, Papers celebrating the 80th birthday of Dr Ivan Löbl. *Entomologische Blätter und Coleoptera* 114: 323–327.

Polizei T.T.S. 2018b. A new species and a key for the Brazilian species of the genus *Heterelmis* Sharp, 1882 (Coleoptera: Elmidae, Elminae). *Papéis Avulsos de Zoologia* 58: 1–4. https://doi.org/10.11606/1807-0205/2018.58.20

Polizei T.T.S. & Barclay M.V.L. 2018. The genus *Hintonelmis* (Coleoptera: Elmidae: Elminae), new species and records. *Journal of Natural History* 52 (45–46): 2949–2959. https://doi.org/10.1080/00222933.2018.1560512

Polizei T.T.S. & Barclay M.V.L. 2019a. The genus *Cylloepus* Erichson, 1847 (Coleoptera: Elmidae: Elminae) new species and combinations. *Zootaxa* 4652 (1): 93–100. https://doi.org/10.11646/zootaxa.4652.1.3

Polizei T.T.S. & Barclay M.V.L. 2019b. First records of the genera *Neocylloepus* and *Pilielmis* (Coleoptera: Elmidae: Elminae) from Venezuela, with the description of *Pilielmis shepardi* sp. nov. *Zootaxa* 4688 (2): 282–288. https://doi.org/10.11646/zootaxa.4688.2.8

Polizei T.T.S. & Casari S.A. 2019. *Macrelmis pubescens* (Grouvelle, 1889) – redescription of the species, designation of a lectotype and description of its larva (Coleoptera: Elmidae). *Annales de la Société entomologique de France* 55 (4): 327–338. https://doi.org/10.1080/00379271.2019.1610669

Polizei T.T.S., Barclay M.V.L. & Bispo P.C. 2020a. *Hexacylloepus* Hinton, 1940 rises again; 18 new species of a neglected genus (Coleoptera: Byrrhoidea: Elmidae). *Zootaxa* 4819 (1): 6–48. https://doi.org/10.11646/zootaxa.4819.1.2

Polizei T.T.S., Costa L.S.M. & Bispo P.C. 2020b. *Austrolimnius cleidecostae*, a new species of riffle beetle (Coleoptera: Elmidae) from Brazil with habitat notes and updated key of the Brazilian species of the genus. *In:* Casari S.A. & Biffi G. (eds) Systematics, bionomy, and metamorphosis of Coleoptera (Insecta): Papers celebrating the 80th birthday of Cleide Costa. *Papéis Avulsos de Zoologia*. 60: 1–10. https://doi.org/10.11606/1807-0205/2020.60.special-issue.12

Polizei T.T.S. & Fernandes A.S. 2020. The Neotropical genus *Portelmis* Sanderson, 1953 (Coleoptera: Elmidae): three new species, new records and updated key. *Zootaxa* 4810 (3): 452–467. https://doi.org/10.11646/zootaxa.4810.3.3

Polizei T.T.S. & Hamada N. 2021. A new minute riffle beetle (Coleoptera: Elmidae: *Pagelmis*) from the Brazilian Amazon. *Zootaxa* 5061 (2): 369–376. https://doi.org/10.11646/zootaxa.5061.2.9

Sampaio B.H.L., Passos M.I.S. & Ferreira–Jr N. 2012. Two new species of *Macrelmis* Motschulsky (Coleoptera: Elmidae) and a new record of *Macrelmis isis* (Hinton) from Southeastern Brazil. *Zootaxa* 3478: 164–168. https://doi.org/10.11646/zootaxa.3478.1.18

Segura M.O., Fonseca-Gessner A.A., Spies M.R. & Siegloch A.E. 2012. Water beetles in mountainous regions in southeastern Brazil. *Brazilian Journal of Biology* 72: 311–321. https://doi.org/10.1590/S1519-69842012000200012

Manuscript received: 28 June 2020
Manuscript accepted: 6 December 2021
Published on: 12 April 2022
Topic editor: Nesrine Akkari
Section editor: Max Barclay
Desk editor: Marianne Salaün