



Three new species of terrestrial isopods (Crustacea, Isopoda, Oniscidea) from Brazilian caves

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ABSTRACT

A second amphibian species of terrestrial isopods in the genus *Xangoniscus* Campos-Filho, Araujo & Taiti, 2014 and two new species of *Trichorhina* Budde-Lund, 1908 are described from the Bambuí karst area in the state of Minas Gerais. *Xangoniscus odara* n. sp. and *Trichorhina cipoensis* n. sp. were collected in Lapa do Cipó cave, municipality of Itacarambi, and *Trichorhina pataxosi* n. sp. in Gruta do Sufoco and Gruta do Nei, municipality of Pedro Leopoldo.

KEY WORDS

Styloniscidae, Platyarthridae, Bambuí group, Neotropic.

INTRODUCTION

The Brazilian karst areas have the largest number of caves in the whole South America. Approximately 15,000 caves have been recorded so far (CECAV, 2015), but they represent only about 7% of the estimated total number of caves (ca. 100,000) (Auler, 2002; Sallun Filho and Karmann, 2012). Most of Brazilian caves have a Precambrian origin and are mainly constituted by carbonate rocks (limestone and dolomite) (Auler, 2002). Caves in other lithologies, such as iron ore, sandstone and granite are also frequently reported and have a great potential for troglotibiotic fauna. Nowadays, the Brazilian caves are distributed in 19 groups or formations, mostly located in northeastern and southern regions (Auler, 2002).

Currently, more than 300 species of troglotibiotic terrestrial isopods in 16 families are known, mostly described for caves in the northern hemisphere (Taiti, 2004; Taiti and Gruber, 2008; Taiti and Xue, 2012; Tabacaru and

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Giurginca, 2013; Campos-Filho *et al.*, 2014, 2015; Taiti, 2014; Souza *et al.*, 2015; Taiti and Wynne, 2015). In Brazil, 30 species have been recorded from cave environment, but only nine are troglotitic, i.e., *Iuiuiscus iuiuensis* Souza, Ferreira & Senna, 2015, *Spelunconiscus castroi* Campos-Filho, Araujo & Taiti, 2014, and *Xangoniscus aganju* Campos-Filho, Araujo & Taiti, 2014 (Styloniscidae), *Leonardoscia hassalli* Campos-Filho, Araujo & Taiti, 2014 (Philosciidae), *Amazoniscus eleonora* Souza, Bezerra & Araújo, 2006, *Amazoniscus leistikowi* Campos-Filho, Araujo & Taiti, 2014, *Circoniscus buckupi* Campos-Filho & Araujo, 2011, *Circoniscus carajasensis* Campos-Filho & Araujo, 2011 (Scleropactidae), and *Trichorhina guanophila* Souza-Kury, 1993 (Platyarthridae) (Souza-Kury, 1993; Souza *et al.*, 2006, 2015; Campos-Filho and Araujo, 2011; Campos-Filho *et al.*, 2014).

In the present work three new species of terrestrial isopods from Brazilian caves in the states of Minas Gerais are described. One species represents the fourth case of Oniscidea with an amphibian way of life in Brazil.

MATERIAL AND METHODS

Specimens were stored in 75% ethanol and identifications were based on morphological characters. The species were illustrated with the aid of a camera lucida mounted on Wild M5 and M20 microscopes and with pictures obtained with a JSM 6060 Scanning Electron Microscope. For each new species the material examined, description, etymology and remarks are given. The coordinates of the *noduli laterales* were obtained and figured as in Vandel (1962). The classification of subterranean animals is based mainly on Sket (2008) and Culver and Pipan (2009).

Abbreviations

MZUF: Natural History Museum, Section Zoology 'La Specola', Florence, Italy.

MZUSP: Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil.

PCNP: Peruaçu Caves National Park.

Study Area

Bambuú Group, Peruaçu Caves National Park and Lagoa Santa region, southeastern Brazil: The Bambuú Group represents the largest karstic area in Brazil (ca.

105,000 km²), which corresponds to over half of all karst areas in the country (Auler, 2004; Auler and Piló, 2015) and is located in the states of Bahia, Goiás, Minas Gerais and Tocantins (Dardenne *et al.*, 1986; Auler, 2002, 2004). The Bambuú group comprises a sequence of six carbonate-siliciclastic rock formations dated from Late Proterozoic, 950–600 my (Dardenne *et al.*, 1986), with two of them mainly consisting of carbonates: Lagoa do Jacaré and Sete Lagoas (Auler, 2004). The caves of Oniscidean new species occurrence are located in the karst plateau of San Francisco at 500–700 m of altitude.

Lapa do Cipó cave is located in the Peruaçu Caves National Park at Sete Lagoas Formation (Auler and Piló, 2015), biogeographically inserted in Cerrado (Brazilian Savannah-like vegetation) and Paraná Forest Provinces, Chacoan Subregion (Morrone, 2014). The climate domain (*sensu* Kottek *et al.*, 2006) is Equatorial Savannah Climate with dry winter (Aw) and sclerophyllous vegetation as dominant (Pennington *et al.*, 2006). Lapa do Cipó cave is not touristic and shows an excellent conservation status, including the surrounding vegetation (Fig. 1A, B). This cave has a small drainage inside and terrestrial substrate formed by silt, gravel and organic matter, such as guano and leaf litter. The two caves Gruta do Sufoco and Gruta do Nei are located at Lagoa Santa region and have similar biogeographical, geomorphological and climatological characteristics of Peruaçu karst area. These caves have small extension (ca. 200 m) with rocky and miscellaneous organic substrates (roots, guano and leaf litter) and are impacted by nearby mining projects.

SYSTEMATICS

Styloniscidae Vandel, 1952a

Xangoniscus Campos-Filho, Araujo & Taiti, 2014

Type species. *Xangoniscus aganju* Campos-Filho, Araujo & Taiti, 2014 by original designation and monotypy.

Xangoniscus odara n. sp. (Figs. 2–7, 14)

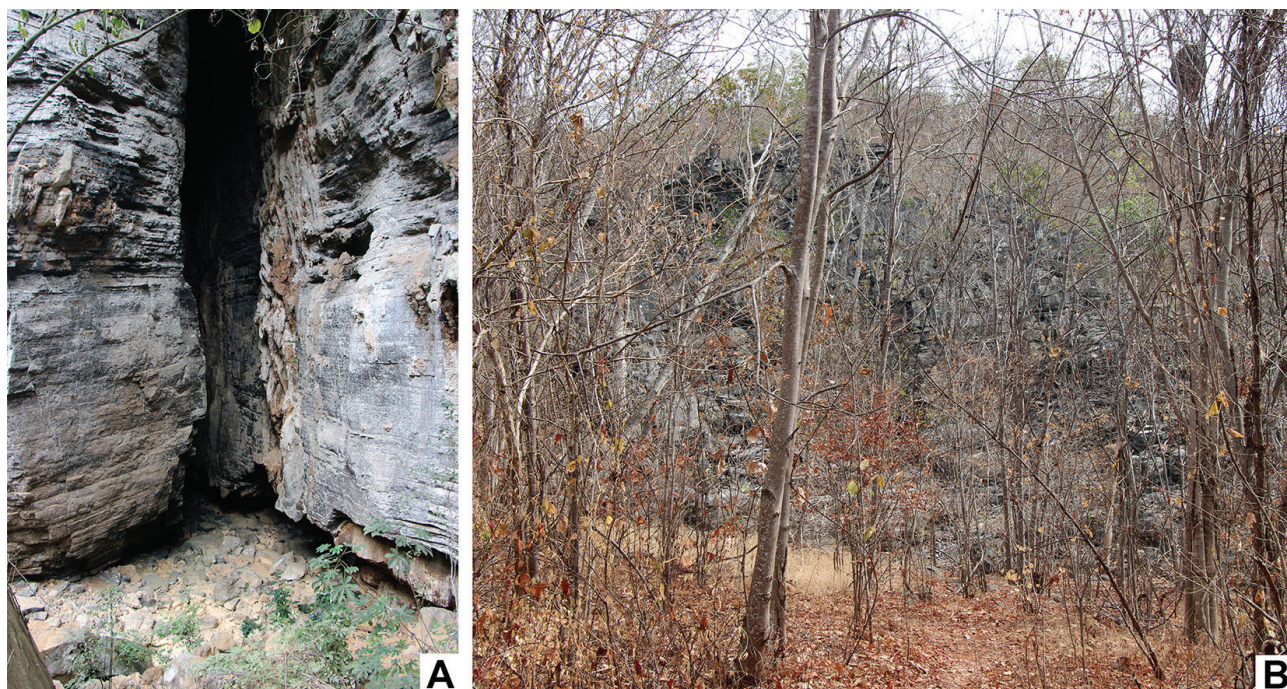


Figure 1. Lapa do Cipó cave, Peruacu Caves National Park, state of Minas Gerais, Brazil. A, cave entrance; B, surrounding area.

Type material. Holotype: 1 ♂ (MZUSP 34104), **Minas Gerais**, Itacarambi, PCNP, Lapa do Cipó cave, 15°03'13"S 44°11'38"W, II.2015, leg. J.E. Gallão, D. von Schimonsky & B.G.O. Monte. Paratypes: 3 ♀♀ (MZUSP 34105), 1 ♂ (part in micropreparations), 2 ♀♀ (MZUF 9615), same data as holotype.

Description. Body length: ♂ 4.5 mm, ♀ 5.5 mm. Body colorless, elongated with almost parallel sides (Figs. 2A, 7A, B). Dorsal surface smooth with scattered fringed scale setae (Fig. 2B). Eyes absent. Cephalon (Fig. 2C, D) with large quadrangular antennary lobes; profrons with V-shaped suprantennal line. Posterior corners of pereonites 1–4 right-angled, of pereonites 5–7 progressively more acute; pleonites 3–5 with falciform epimera (Fig. 2A, E). Telson (Fig. 2E) with well pronounced concave sides and broadly rounded apex. Antennula (Fig. 2F) with three articles, proximal and distal articles subequal in length, second article shorter with brush of setae on outer margin and long seta on inner margin, distal article with two long apical aesthetascs. Antenna (Fig. 2G) with fifth article of peduncle slightly longer than flagellum; flagellum with four articles, first article longest, second and third articles subequal in length, fourth article shortest. Right mandible with one penicil and *lacinia mobilis* leaf-shaped with pointed apex (Fig. 3A), left mandible

with two penicils (Fig. 3B). Maxillula (Fig. 3C) outer branch with 5 + 5 teeth, apically entire, and two thick plumose stalks; inner branch with three penicils, proximal penicil longer than two apical. Maxilla (Fig. 3D) with setose and bilobate apex, outer lobe smaller. Maxilliped (Fig. 3E) basis enlarged on distal portion; endite rectangular, outer and medial margins setose, apically with two triangular teeth and large rounded penicil. Uropod (Fig. 4A) with endopod slightly longer than exopod, inserted at same level.

Male. Pereopods 1–4 (Fig. 4B–E) merus, carpus and propodus with fringed scales on sternal margin. Pereopods 4–6 (Figs 4E, 5A, B) carpus concave on distal half of sternal margin, more evident on carpus 6. Pereopods 5–7 (Fig. 5A–C) propodus much longer than in previous pereopods. Pereopods 5 and 6 (Fig. 5A, B) merus and proximal part of carpus with rows of scales on sternal margin. Pereopod 7 (Fig. 5C) basis with scales of water conduction system, ischium with straight sternal margin, merus and carpus with no distinct modifications. Genital papilla (Fig. 6A) lanceolate, enlarged on median portion, apical part narrow and pointed. Pleopod 1 (Fig. 6B) exopod subtriangular, fringed with fine setae; endopod longer than exopod, with narrow basal article and flagelliform distal article; basipod with triangular medial part fringed with fine and long setae on outer and distal

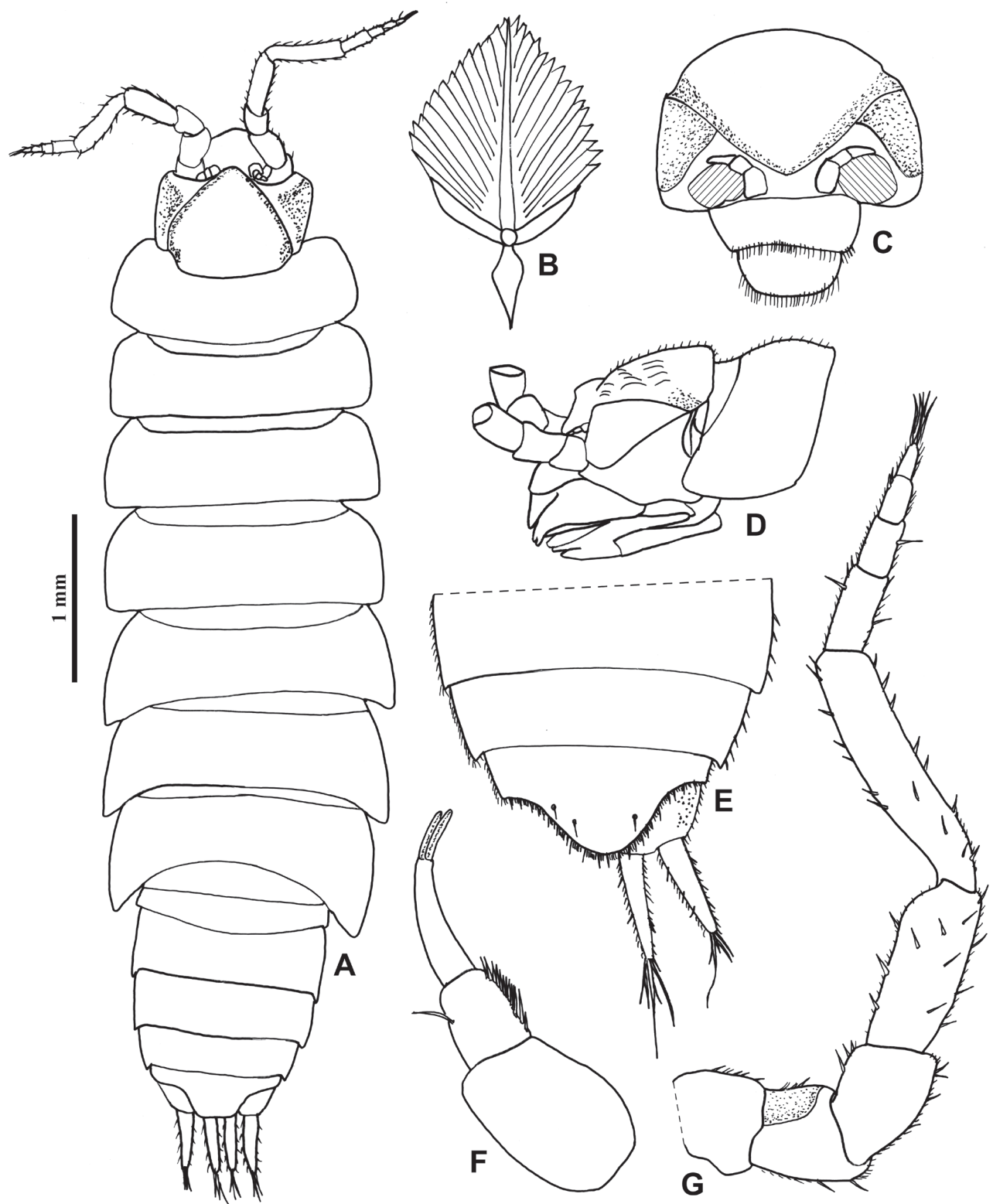


Figure 2. *Xanagoniscus odara* n. sp. (male paratype). A, dorsal habitus; B, dorsal scale-seta; C, cephalon, frontal view; D, cephalon and pereonite 1, lateral view; E, pleonites 4 and 5, telson and uropod; F, antennula; G, antenna.

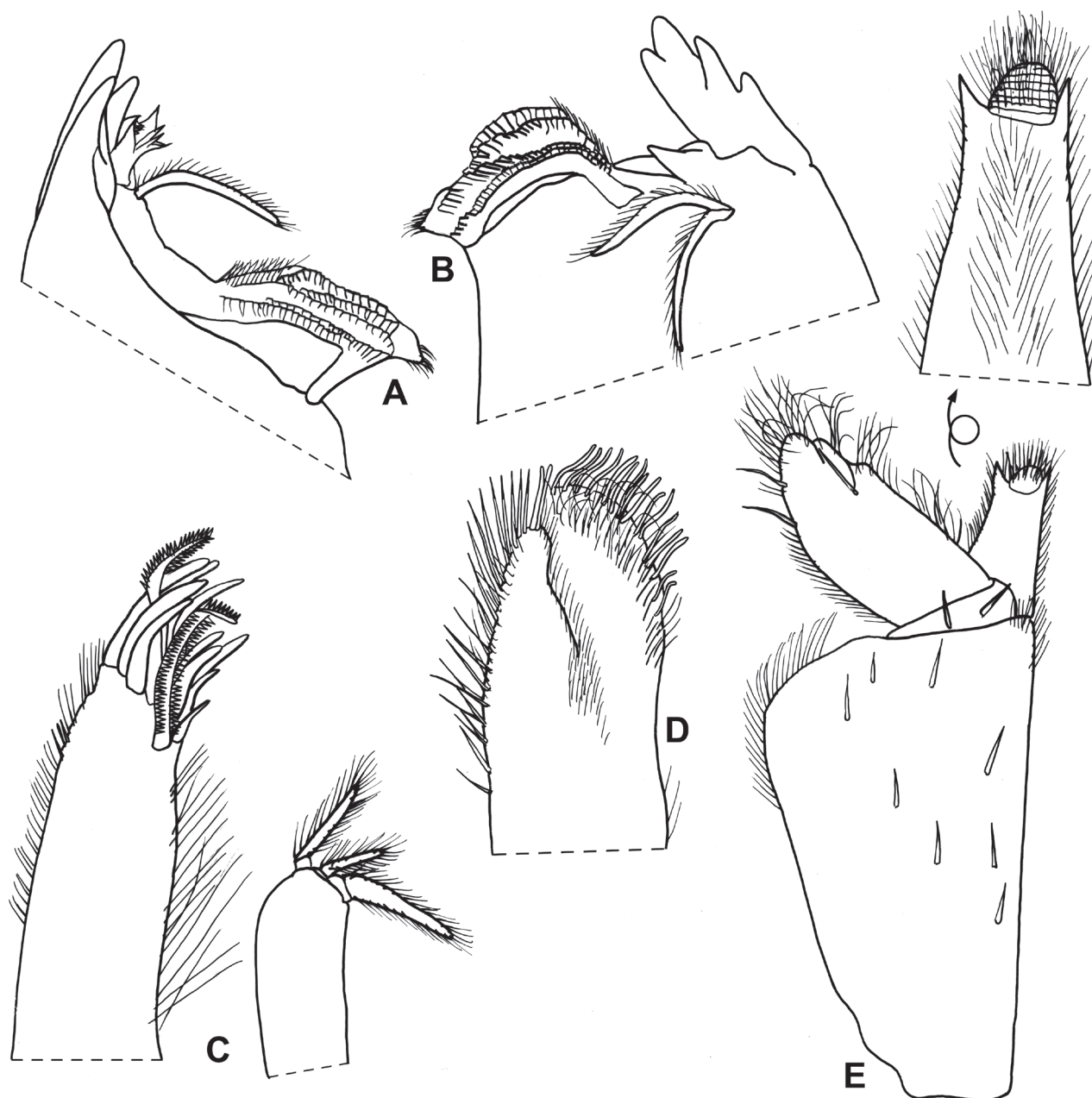


Figure 3. *Xangoniscus odara* n. sp. (male paratype). A, right mandible; B, left mandible; C, maxillula; D, maxilla; E, maxilliped.

margin. Pleopod 2 (Fig. 6C) exopod triangular, distal margin bearing five setae; endopod of two thickset articles, second article about three times as long as first, with complex apical part: distal margin rounded with narrow transverse process and longitudinal ridge on ventral surface. Pleopod 3 exopod (Fig. 6D) triangular, longer than wide, covering pleopods 1 and 2, fringed with short setae. Pleopod 4 and 5 exopods (Fig. 6E, F) trapezoidal, wider than long, with margins bearing several short setae.

Etymology. The new species is named after Odara, a

word of Hindu origin meaning peace and tranquility, commonly used in the Afro-Brazilian religions of Candomblé and Umbanda.

Remarks. The genus *Xangoniscus* was erected by Campos-Filho *et al.* (2014) to include the amphibious species *X. aganju* from a cave at Caririnha, Bahia. The genus is mainly characterized by the male pleopod 2 endopod thickset with distal portion presenting a complex structure. In *X. odara* n. sp. the male specimens have the pleopods 1 and 2 not visible in ventral view since they are covered by the pleopod 3 exopod (Fig.

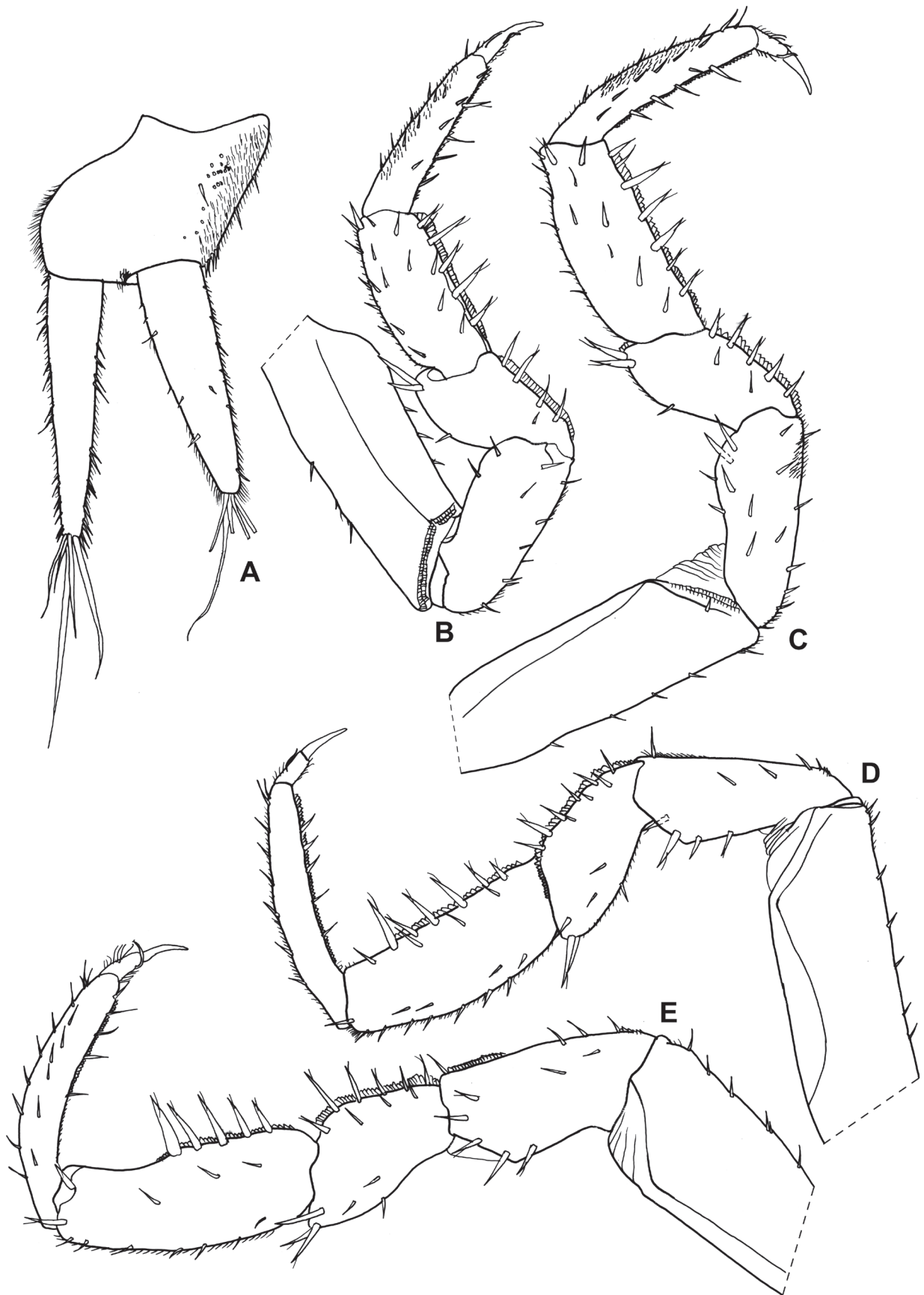


Figure 4. *Xangoniscus odara* n. sp. (male paratype). A, uropod; B, pereopod 1; C, pereopod 2; D, pereopod 3; E, pereopod 4.

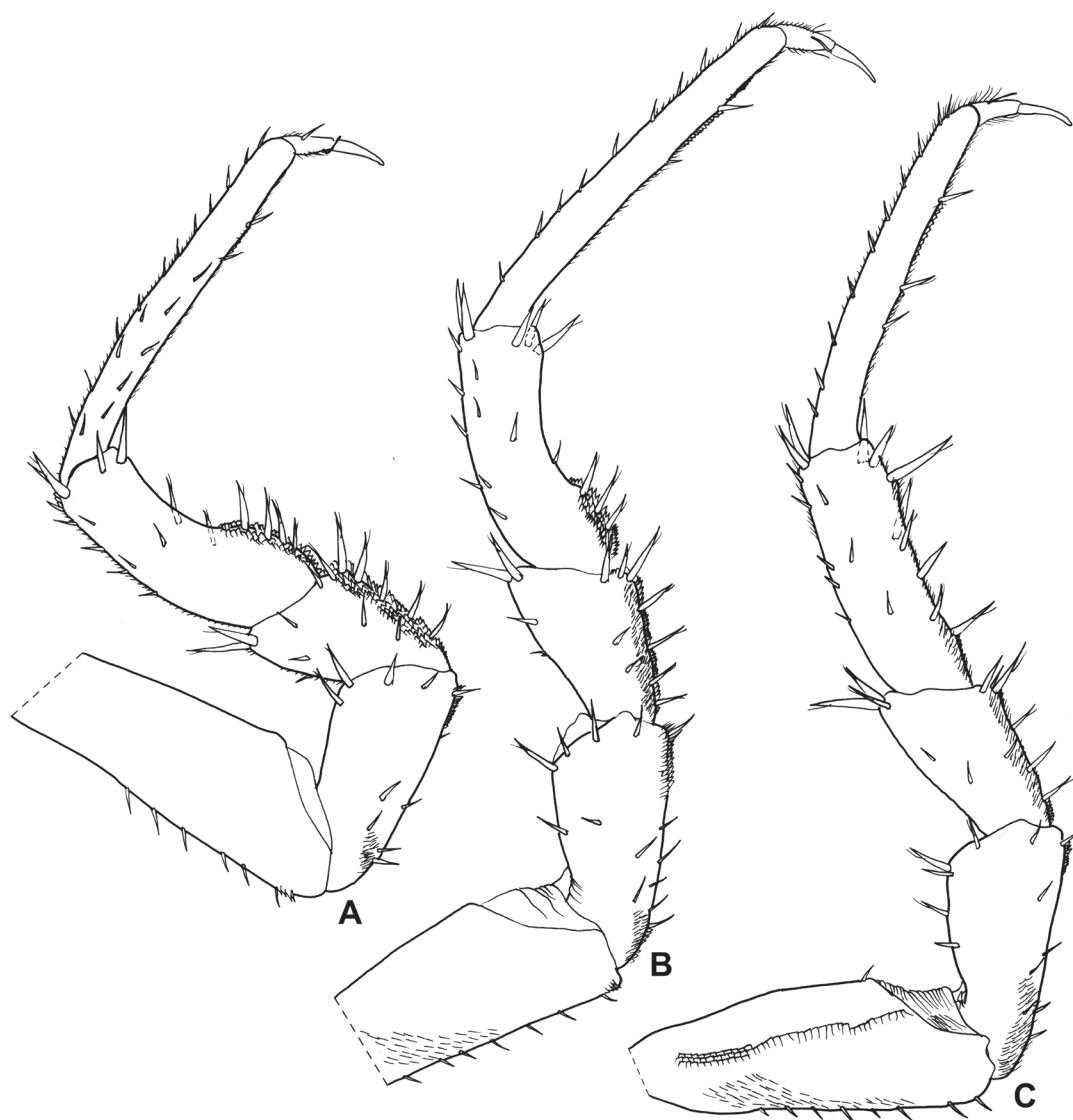


Figure 5. *Xangoniscus odara* n. sp. (male paratype). A, pereopod 5; B, pereopod 6; C, pereopod 7.

7B), probably to protect the complex structure of pleopod 2 endopod. This peculiar arrangement of the pleopods is present also in *X. aganju*, and is probably typical of the genus.

Xangoniscus odara n. sp. is distinguished from *X. aganju* by the cephalon without frontal carena, shape of dorsal scale-setae, antennal flagellum of four articles (three in *X. aganju*), uropod with exopod shorter than endopod (viceversa in *X. aganju*), male pereopod 6 ischium without flattened sternal part, male pleopod 2 exopod triangular (trapezoidal in *X. aganju*), and distal portion of male pleopod 2 endopod with rounded, instead of concave, distal margin and lacking a triangular outer lobe.

This species has amphibian habits like *X. aganju*, and

it was collected in pools inside the cave (Supplementar Online Material), with bottom formed by silt and gravels (Fig. 7C, D).

Platyarthridae Verhoeff, 1949

***Trichorhina* Budde-Lund, 1908**

Type species. Bathytropa thermophila Dollfus, 1896 [= *Trichorhina tomentosa* (Budde-Lund, 1893)] by original designation.

***Trichorhina cipoensis* n. sp.**

(Figs. 8–10, 14)

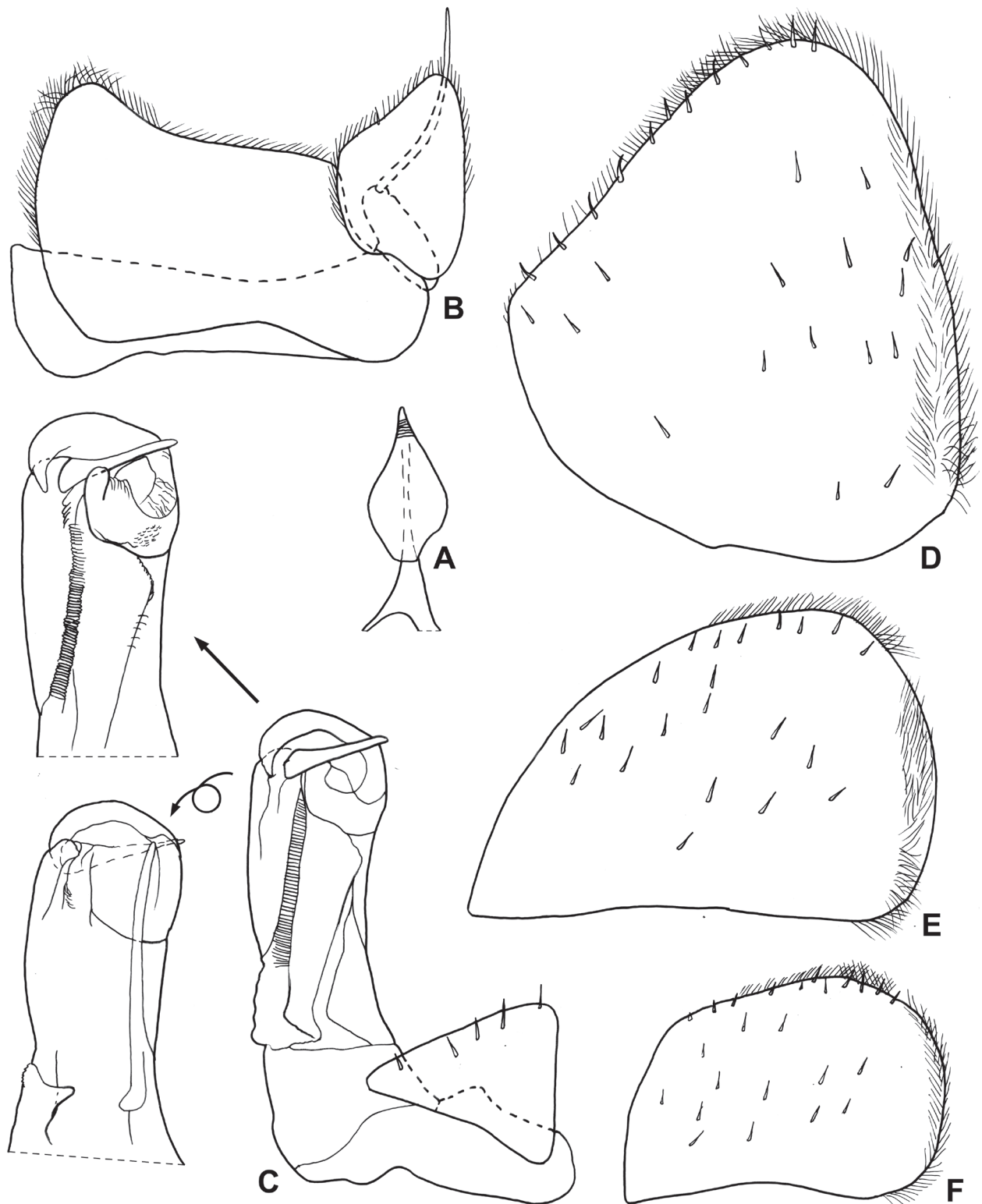


Figure 6. *Xangoniscus odara* n. sp. (male paratype). A, genital papilla; B, pleopod 1; C, pleopod 2; D, pleopod 3 exopod; E, pleopod 4 exopod; F, pleopod 5 exopod.

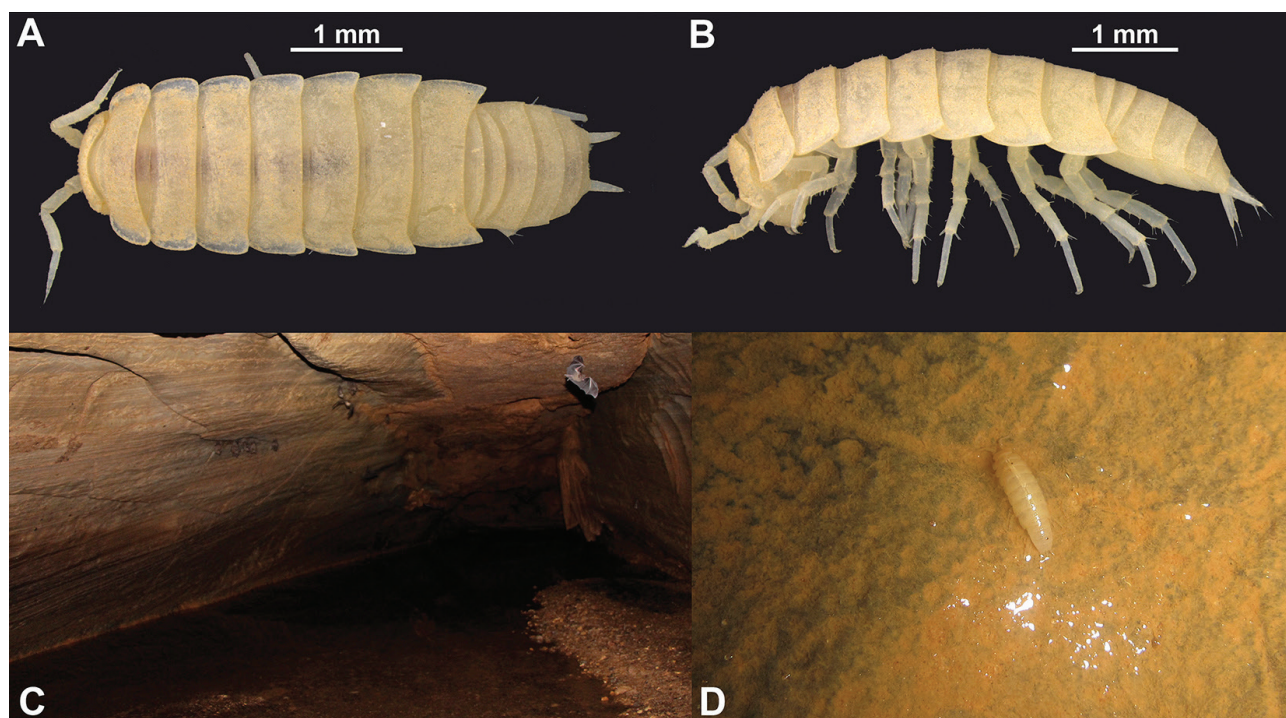


Figure 7. *Xangoniscus odara* n. sp. (male paratype). A, habitus, dorsal view; B, habitus, lateral view; C, Lapa do Cipó cave, collecting site; D, specimen in pool.

Type material. *Holotype*: 1 ♂ (MZUSP 34106), Minas Gerais, PCNP, Lapa do Cipó cave, 15°3'13"S 44°11'38"W, 5.VI.2014, leg. J.E. Gallão, D. von Schimonsky & B.G.O. Monte. *Paratypes*: 2 ♂♂ (one in micropreparations), 1 ♀ (MZUF 9616), 1 ♂, 4 ♀♀ (MZUSP 34107), same data as holotype.

Description. Body length: ♂ 4.5 mm, ♀ 5 mm. Body colorless, slightly convex (Fig. 8A). Dorsal surface covered with fan-shaped scale-setae (Fig. 8B); pereon epimera with glandular pores; small *noduli laterales* (Fig. 8E) inserted on one line close to posterior margins and more or less at same distance from lateral margins of pereonites, d/c and b/c coordinates as in Fig. 9A, B, respectively. Cephalon (Fig. 8C, D) with lateral lobes triangular, slightly protruding frontwards; suprantennal line, frontal line and eyes absent; vertex with no scale-setae at sides. Pleon (Fig. 8A, F) with outline continuous with that of pereon; epimera of pleonites 3–5 falciform, directed backwards. Telson (Fig. 8F) triangular, lateral margins slightly concave and apex narrowly rounded. Antennula (Fig. 8G) with three articles, distal article longest with several aesthetascs inserted apically and sub-apically. Antenna (Fig. 8H) when extended posteriorly surpassing posterior

margin of pereonite 1; flagellum with two articles, second article about three times as long as first, bearing two rows of two aesthetascs each, apical organ short with long free sensilla. Mandibles (Fig. 9C, D) with molar penicil simple, left mandible with 2+1 penicils, right mandible with 1+1 penicils. Maxillula (Fig. 9E) inner branch with two subequal penicils, distal portion bearing lateral tip; outer branch with 3+4 teeth, outer set with accessory tooth, inner set with two cleft teeth. Maxilla (Fig. 9F) with setose and bilobate apex; outer lobe about three times as wide as inner lobe, distal margin rounded. Maxilliped (Fig. 9G) basis rectangular bearing sparse scale-setae; endite subrectangular, medial seta surpassing distal margin. Uropod (Fig. 8I) protopod grooved on outer margin, exopod slightly longer than endopod, endopod inserted proximally. Pereopod sternal setae with cleft apex; pereopod 1 with antennal grooming brush reaching median margin of carpus; dactylus with long inner claw, unguis and dactylar seta with simple apex.

Male. Pereopod 1–3 (Fig. 10A) merus and carpus with brush of setae on sternal margin. Pereopod 7 (Fig. 7J) ischium with sternal margin slightly convex. Genital papilla as in Fig. 10B. Pleopod 1 (Fig. 10C) exopod subtriangular, twice as broad as long, rounded apex; endopod three times as long as exopod, distal part

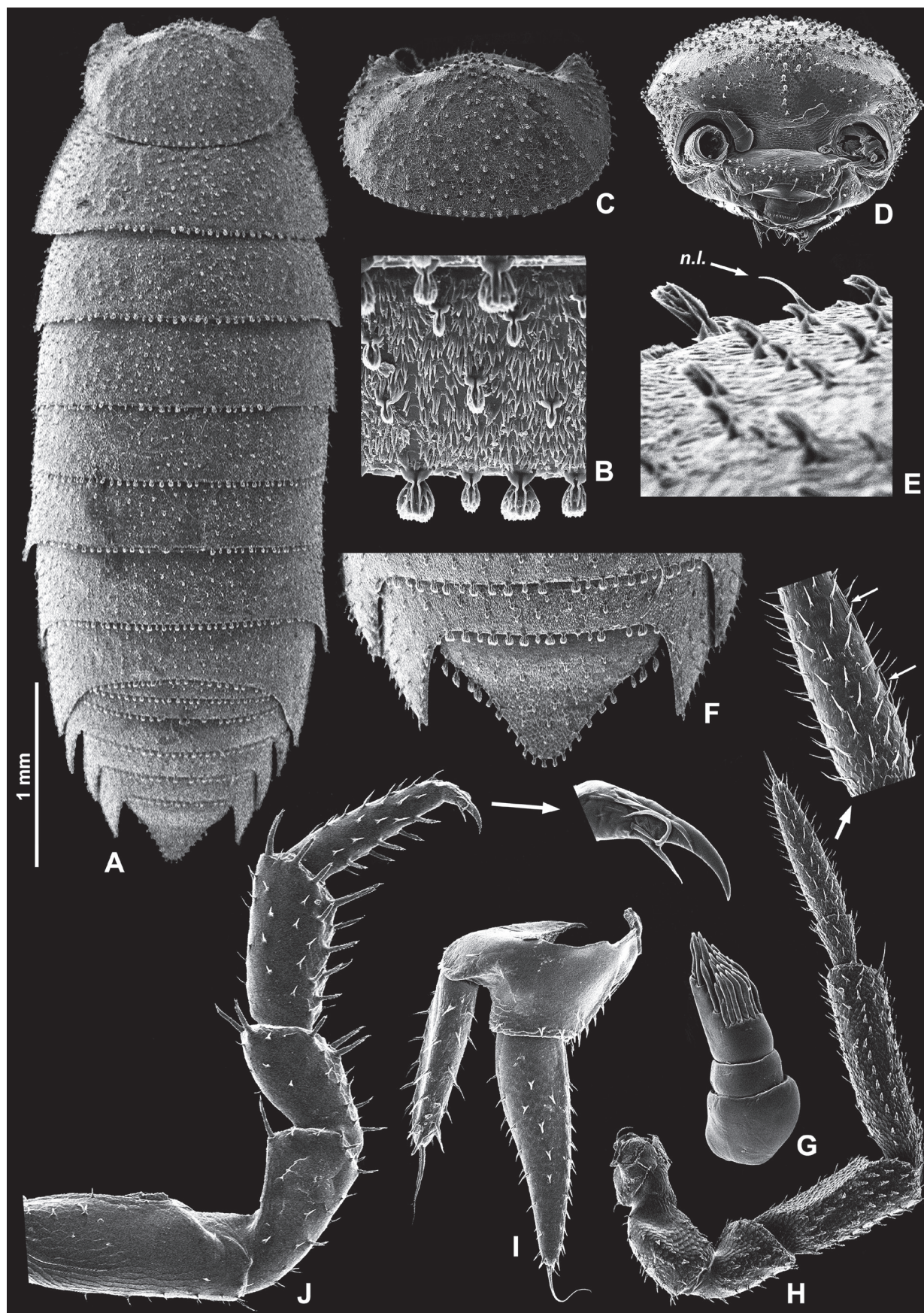


Figure 8. *Trichorhina cipoensis* n. sp. (male paratype). A, habitus, dorsal view; B, dorsum and scale-setae; C, cephalon, dorsal view; D, cephalon, frontal view; E, dorsum surface, scale-setae and *nodulus lateralis*; F, pleonites 4 and 5, and telson; G, antennula; H, antenna; I, uropod; J, pereopod 7.

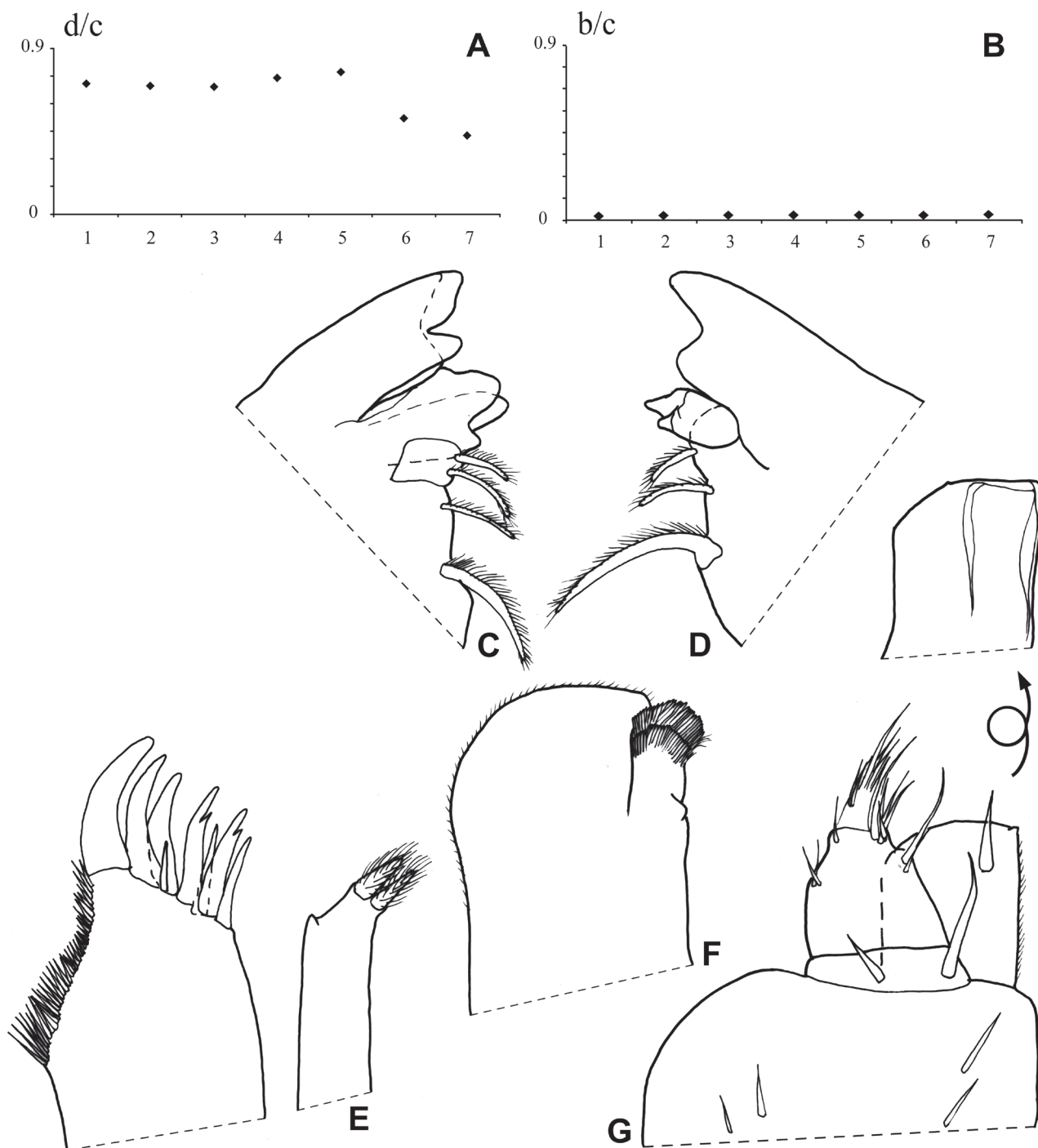


Figure 9. *Trichorhina cipoensis* n. sp. (male paratype). A, d/c coordinates of *noduli laterales*; B, b/c coordinates of *noduli laterales*; C, left mandible; D, right mandible; E, maxillula; F, maxilla; G, maxilliped.

acute. Pleopod 2 (Fig. 10D) exopod triangular, outer margin concave bearing six setae; endopod slightly longer than exopod. Pleopod 3 and 4 exopods as in Fig. 10E, F. Pleopod 5 exopod (Fig. 10G) triangular, outer margin convex bearing seven setae.

Etymology. This new species is named after the locality where specimens were collected: Lapa do Cipó cave, Peruaçu caves National Park, Minas Gerais.

Remarks. The genus *Trichorhina* comprises about

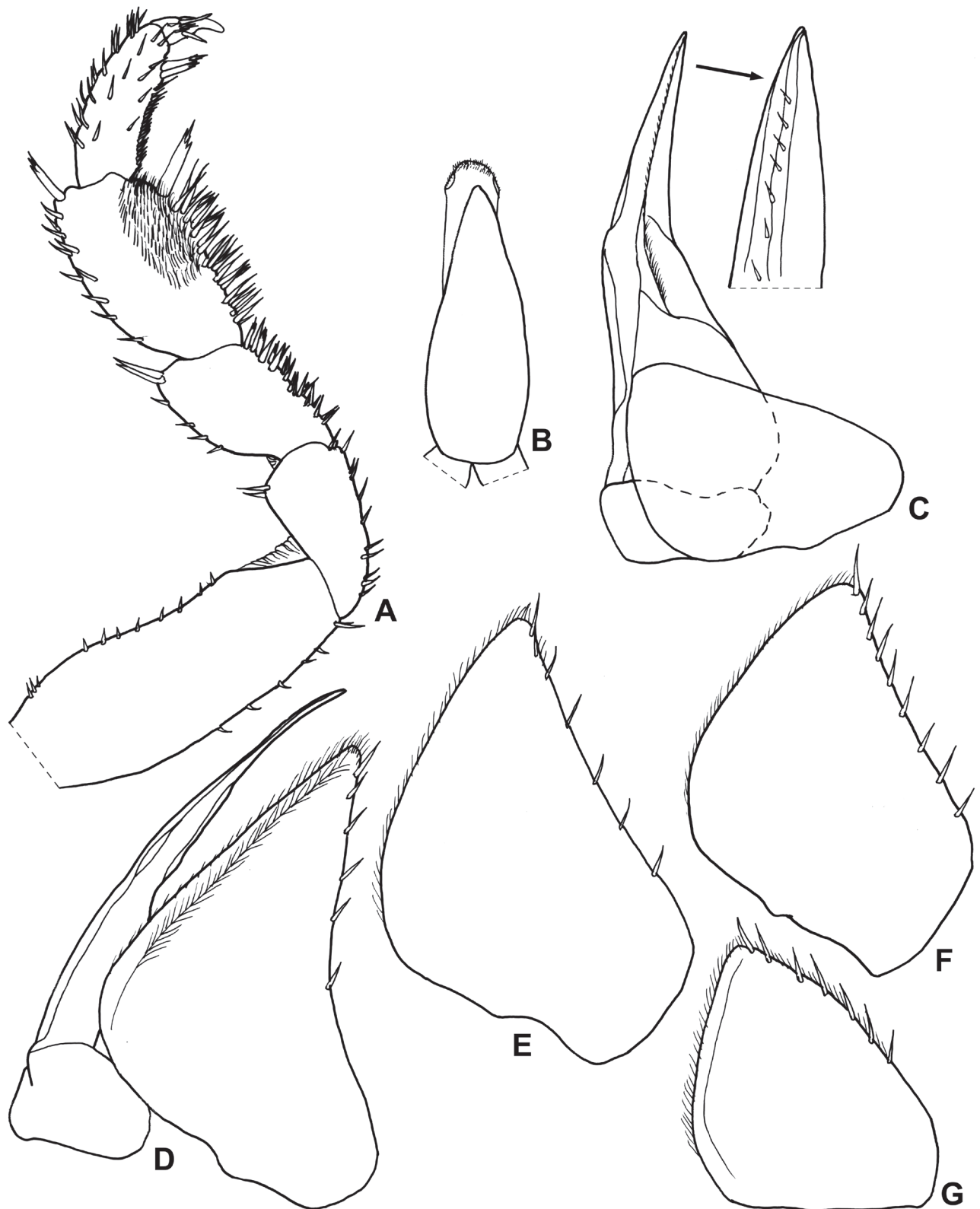


Figure 10. *Trichorhina cipoensis* n. sp. (male paratype). A, pereopod 1; B, genital papilla; C, pleopod 1; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

70 described species widely distributed in tropical and subtropical areas (Schmalfuss, 2003; Souza *et al.*, 2011; Campos-Filho *et al.*, 2014). In Brazil, the genus includes 23 species, five of which occurring in caves: *Trichorhina anhanguera* Campos-Filho, Araujo & Taiti, 2014, *Trichorhina curupira* Campos-Filho, Araujo & Taiti, 2014, *Trichorhina guanophila* Souza-Kury, 1993, *Trichorhina kaingangi* Campos-Filho, 2015, and *Trichorhina yiara* Campos-Filho, Araujo & Taiti, 2014 (Souza-Kury, 1993; Campos-Filho *et al.*, 2014, 2015).

In the absence of eyes *Trichorhina cipoensis* n. sp. is similar to *T. anhanguera*, *Trichorhina anophthalma* Arcangeli, 1936, *Trichorhina boneti* Rioja, 1956, *Trichorhina brasiliensis* Andersson, 1960, *Trichorhina buchnerorum* (Verhoeff, 1942), *Trichorhina caeca* Vandel 1952b, *T. guanophila*, *T. kaingangi*, *Trichorhina paolae* Caruso, 1978, *Trichorhina sicula* Vandel, 1969, *Trichorhina simoni* (Dollfus, 1893), *Trichorhina xoltunae* Mulaik, 1960, and *Trichorhina zimpanensis* Mulaik, 1960. It is distinguished from all these species by the different shape of the male pleopod 1 exopod; from *T. anhanguera* in having more developed pleon epimera, telson with narrowly rounded apex, maxillula outer branch with two cleft teeth (*vs.* all entire); from *T. anophthalma* in the cephalon with triangular instead of quadrangular frontal lateral lobes and male pereopod 7 ischium with convex instead of slightly concave sternal margin (see Reboleira *et al.*, 2015); from *T. brasiliensis* in the cephalon with shorter lateral lobes, mandibles with molar penicil simple (*vs.* dichotomized); from *T. buchnerorum*, *T. caeca*, *T. paolae*, *T. sicula* and *T. simoni* in having narrowly rounded apex (*vs.* obtuse or broadly rounded apex); from *T. guanophila*, *T. xoltunae* and *T. zimpanensis* in having the antennula with many aesthetascs subapically and apically inserted (*vs.* few aesthetascs inserted apically), mandibles with simple molar penicil (*vs.* dichotomized); and from *T. kaingangi* in having narrower body shape, mandibles with simple molar penicil (*vs.* dichotomized), maxillula outer branch with two cleft teeth.

This species occurs in the same cave of *Xan goniscus odara* n. sp. It was collected from organic matter substrate, such as guano and leaf litter.

***Trichorhina pataxosi* n. sp.**

(Figs. 11–14)

Type material. Holotype: 1 ♂ (MZUSP 34108), Minas Gerais, Pedro Leopoldo, Gruta do Sufoco, 19°25'53"S 44°2'8"W, 12–15.I.2009, leg. F.P. Franco. *Paratypes:* many ♂♂ and ♀♀ (MZUSP 34109), 4 ♂♂ (one in micropreparations), 4 ♀♀ (MZUF 9617), same data as holotype; 1 ♂ (MZUSP 34110), same locality and collector as holotype, 5–6.X.2009, 1 ♀ (MZUSP 34111), Pedro Leopoldo, Gruta do Nei, 19°37'45"S 44°0'30"W, 5–6.X.2009, leg. F.P. Franco, 1 ♂, 3 ♀♀, 1 manca (MZUSP 34112) same locality, 12–15.I.2009, leg. F.P. Franco.

Description. Body length: ♂ 3.5 mm, ♀ 4.5 mm. Body (Fig. 11A) colorless, slightly convex, outline of pleon continuous with that of pereon. Dorsal surface covered with fan-shaped scale-setae (Fig. 11B); one line of *noduli laterales* inserted close to the posterior margins and more or less at same distance from lateral margins of pereonites, d/c and b/c coordinates as in Fig. 11F, G, respectively. Cephalon with lateral lobes triangular, slightly protruding frontwards, suprantennal line, frontal line and eyes absent (Fig. 11C, D). Pereonites 1 and 2 epimera with posterior corners right-angled, pereonites 3–7 gradually directed backwards. Pleon (Fig. 11A, E) with epimera falciform, directed backwards. Telson (Fig. 11E) triangular, lateral margins concave with narrowly rounded apex. Antennula (Fig. 11H) with three articles, distal article with tuft of aesthetascs subapically and apically inserted. Antenna (Fig. 11I) when extended posteriorly surpassing posterior margin of pereonite 1; flagellum with two articles, second article about three times as long as first, bearing two aesthetascs, apical organ short with long free sensilla. Mandibles (Fig. 12A, B) with molar penicil simple, left mandible with 2+1 penicils, and right mandible with 1+1 penicils. Maxillula (Fig. 12C) inner branch with two subequal penicils, distal portion bearing lateral tip; outer branch with 3+5 teeth. Maxilla (Fig. 12D) with setose and bilobate apex; outer lobe about three times as wide as inner lobe, distal margin rounded. Maxilliped (Fig. 11E) basis rectangular bearing sparse setae; endite subrectangular, medial seta surpassing distal margin, distal margin rounded bearing one hook-like short spine. Pereopod 1 with antennal grooming brush transverse reaching median part of carpus; dactylus with inner claw reaching median portion of outer claw, dactylar and unguar setae with simple apices. Uropod

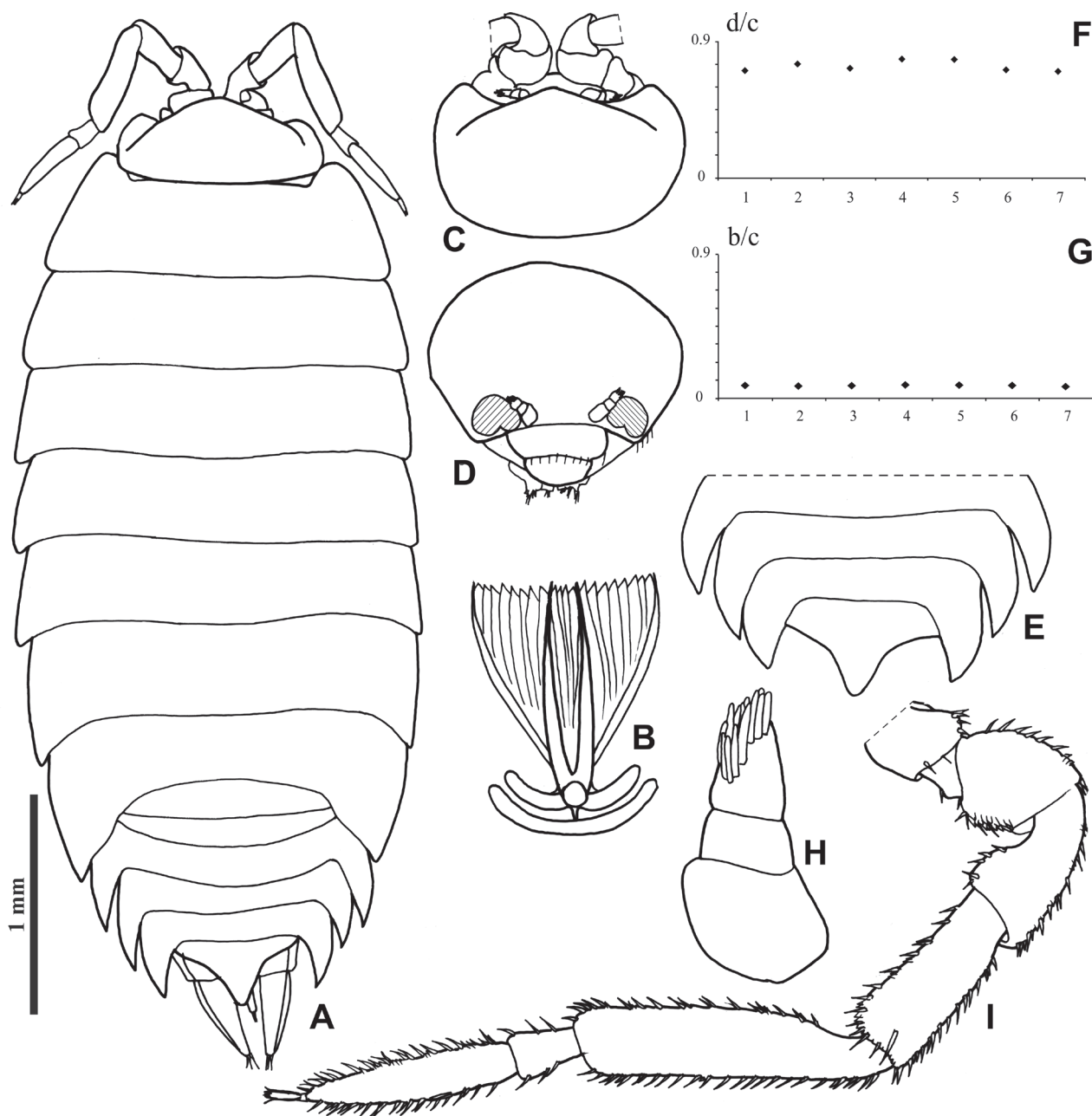


Figure 11. *Trichorhina pataxosi* n. sp. (male paratype). A, dorsal habitus; B, dorsal scale-seta; C, cephalon, dorsal view; D, cephalon, frontal view; E, pleonites 3–5 and telson; F, d/c coordinates of *noduli laterales*; G, b/c coordinates of *noduli laterales*; H, antennula; I, antenna.

(Fig. 13A) protopod grooved on outer margin bearing glandular fields, exopod slightly longer than endopod, endopod inserted proximally.

Male. Pereopod 1–7 (Fig. 13B, C) merus and carpus with brush of long setae on sternal margin; ischium 7 triangular, sternal margin straight and distal margin bearing three large setae. Pleopod 1 (Fig. 13D) exopod subtriangular, slightly wider than long with broadly rounded apical part; endopod tapering, twice as long as exopod, medial margin bearing minute setae. Pleopod

2 (Fig. 13E) exopod triangular, outer margin slightly concave bearing nine setae; endopod as long as exopod. Pleopod 3 and 4 exopods as in Fig. 13F, G. Pleopod 5 exopod (Fig. 13H) triangular, outer margin slightly convex bearing 10 setae.

Etymology. The new species is named after the native people Pataxós who originally inhabited the Brazilian states of Bahia and Minas Gerais.

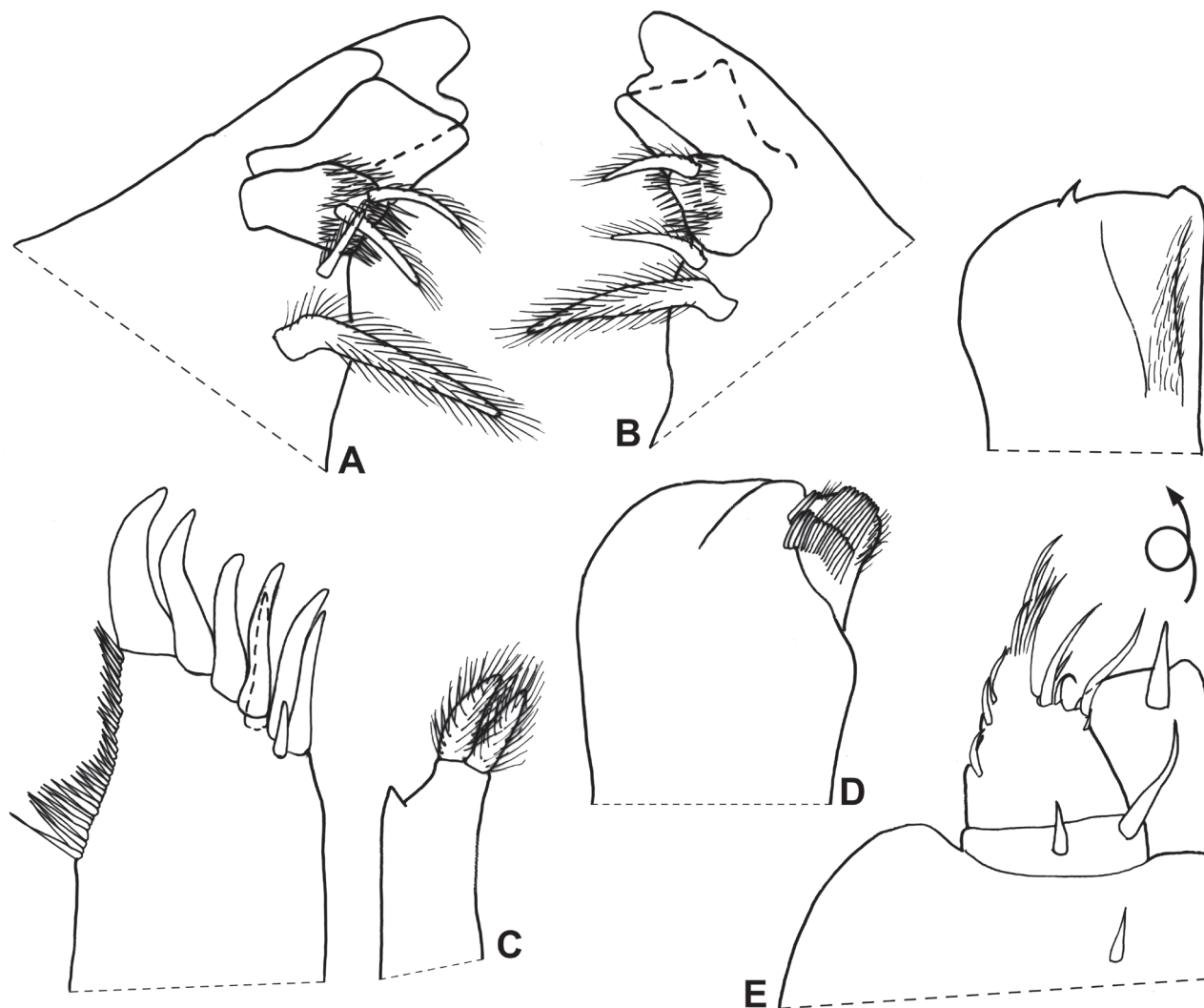


Figure 12. *Trichorhina pataxosi* n. sp. (male paratype). A, left mandible; B, right mandible; C, maxillula; D, maxillula; E, maxilliped.

Remarks. *Trichorhina pataxosi* n. sp. can be distinguished from *Trichorhina cipoensis* n. sp. by the different shape of dorsal scale-setae, the maxillula outer branch with inner teeth simple, maxilliped endite with hook-like distal spine, more acute distal part of telson, and male pereopods 1–7 merus and carpus densely setose. This species was collected in guano and leaf litter in two caves of Lagoa Santa region, which are under severe threat by mining.

DISCUSSION

According to the faunistic subterranean classification adopted here, *Xangoniscus odara* n. sp. can be considered as a stygobiont. As mentioned by Campos-Filho *et al.* (2014), the troglotrophic condition of the new species of *Trichorhina* is not certain, since many species in this

genus have an endogean way of life, showing similar morphological adaptations to troglotrophic forms. More extensive collections in endogean habitats outside caves are needed in order to determine whether they are troglotrophic or rather troglotrophic.

In the last years, biospeleological surveys have been conducted throughout Brazil and many unidentified terrestrial isopods have been reported (e.g. Trajano and Bichuette, 2010; Gallão, 2012; Silva and Ferreira, 2015) but the taxonomic impediment has prevented to describe the numerous subterranean taxa encountered. The Brazilian laws (BRASIL, 1990, 2008) guarantee cave preservation when rare or endemic troglotrophic or stygobiotic species are present (e.g. Campos-Filho *et al.*, 2014; Cardoso *et al.*, 2014). Delay in taxonomic research in subterranean environments may lead to

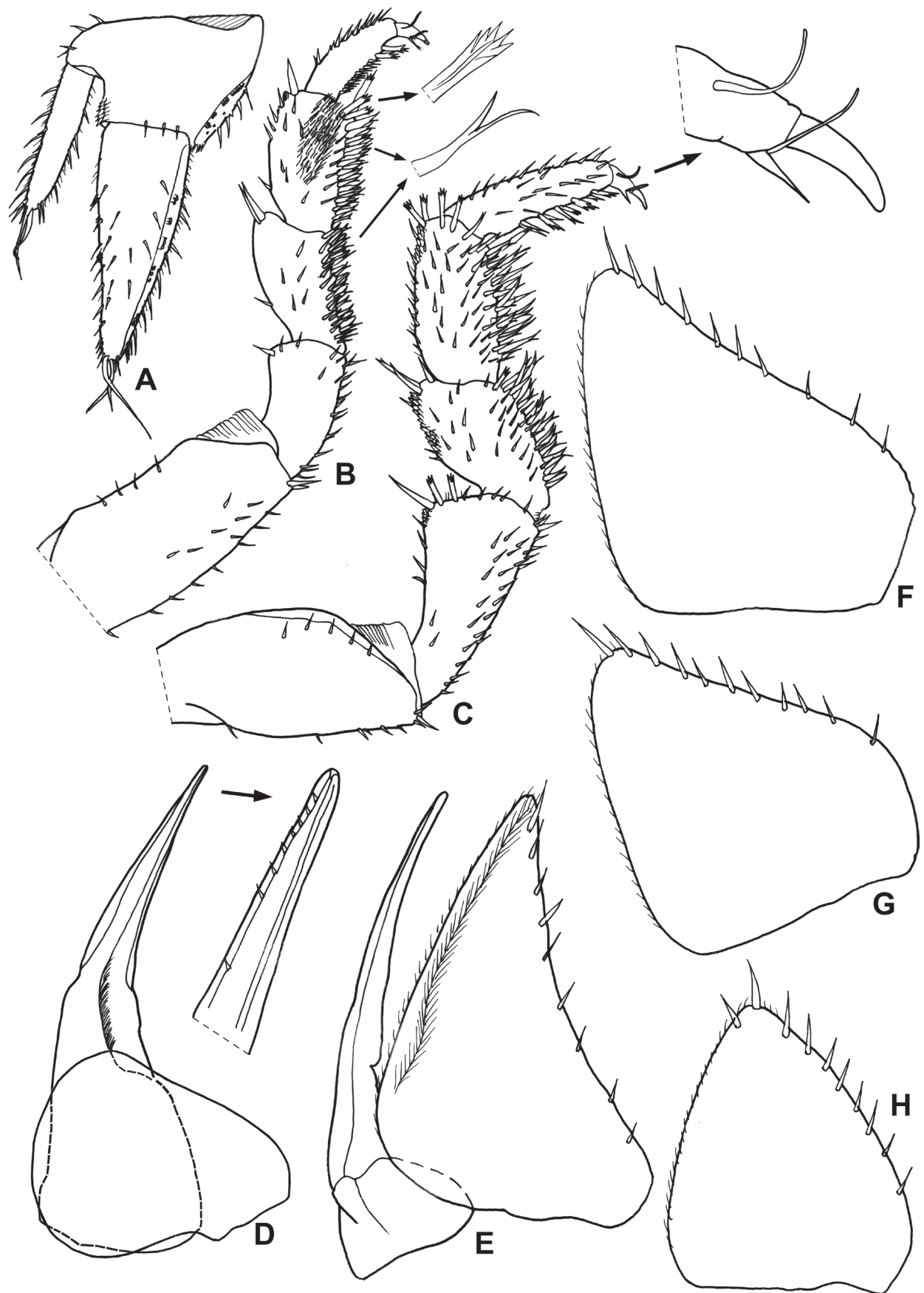


Figure 13. *Trichorhina pataxosi* n. sp. (male paratype). A, uropod; B, pereopod 1; C, pereopod 7; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

loss of biodiversity in caves, even before the species are discovered and described (e.g. Bichuette and Trajano, 2005; Campos-Filho *et al.*, 2014, 2015). The troglobiotic *Xangoniscus odara* n. sp. and *Trichorhina cipoensis* n. sp. coexist in the Lapa do Cipó cave, located in limits of PCNP and protected by environmental laws (Fig. 14). *Trichorhina pataxoensis* n. sp. from Lagoa Santa region (Fig. 14), is threatened by nearby mining activities which may lead to loss or reduction of the habitat. This karst area should therefore be considered to be of high priority for conservation.

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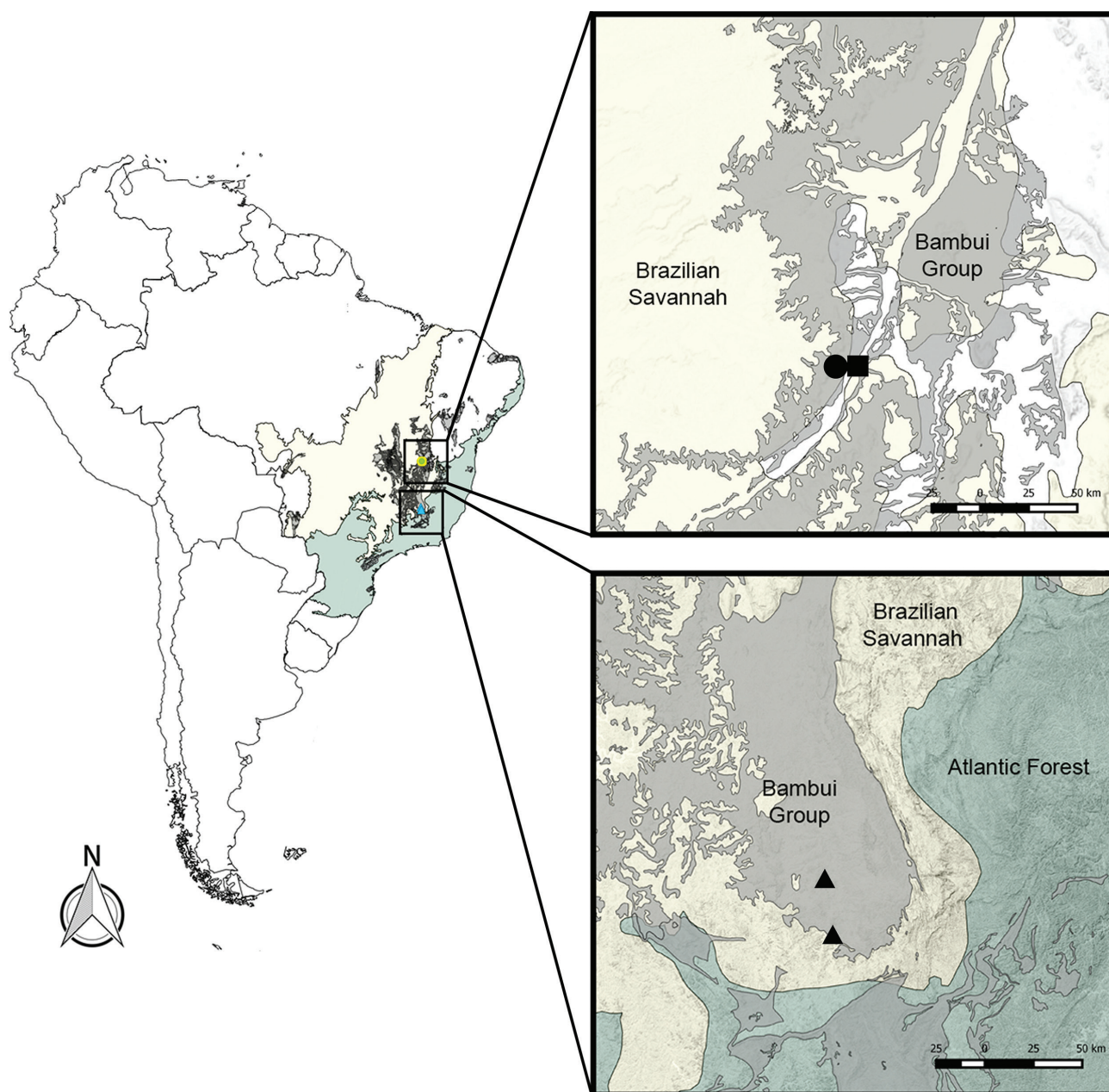


Figure 14. Map of distribution. ●, *Xangoniscus odara* n. sp.; ■, *Trichorhina cipoensis* n. sp.; ▲, *Trichorhina pataxosi* n. sp..

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SUPPLEMENTARY ONLINE MATERIAL

Video on BenchFly. Available at: <http://www.benchfly.com/video/3208/new-amphibian-species-of-the-genus-xangoniscu/>

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