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Terrestrial isopods (Crustacea: Isopoda: Oniscidea) from Brazilian caves

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To date, six species of terrestrial isopods were known from Brazilian caves, but only four could be classified as troglobites. This article deals with material of Oniscidea collected in many Brazilian karst caves in the states of Pará, Bahia, Minas Gerais, Mato Grosso do Sul, and São Paulo, and deposited in the collections of the Museu de Zoologia, Universidade de São Paulo, the Coleção de Carcinologia do Departamento de Zoologia, Universidade Federal do Rio Grande do Sul, and the collection of the Natural History Museum, Section of Zoology 'La Specola', Florence. Three new genera have been recognized: ***Spelunconiscus*** gen. nov. and ***Xangoniscus*** gen. nov. (Styloniscidae), and ***Leonardoscia*** gen. nov. (Philosciidae). Twenty-two species have been identified, 11 of which in the families Styloniscidae, Philosciidae, Scleropactidae, Plathyartridae, Dubioniscidae, and Armadillidae are new to science: ***Leonardoscia hassalli*** sp. nov., ***Metaprosekia quadriocellata*** **sp. nov.**, ***Metaprosekia caupe*** **sp. nov.**, ***Amazoniscus leistikowi*** **sp. nov.**, ***Novamundoniscus altamiraensis*** **sp. nov.**, ***Trichorhina yiara*** **sp. nov.**, ***Trichorhina curupira*** **sp. nov.**, and ***Ctenorillo ferrarai*** **sp. nov.** from Pará; ***Xangoniscus aganju*** **sp. nov.** from Bahia; and ***Spelunconiscus castroi*** **sp. nov.** and ***Trichorhina anhanguera*** **sp. nov.** from Minas Gerais. Four new species in the families Styloniscidae (***Spelunconiscus castroi*** **sp. nov.** and ***Xangoniscus aganju*** **sp. nov.**), Philosciidae (***Leonardoscia hassalli*** **sp. nov.**), and Scleropactidae (***Amazoniscus leistikowi*** **sp. nov.**) with highly troglomorphic traits can be considered as troglobitic, whereas all the remaining species are either troglophilic or accidentals. Brazilian caves are now under potential threat because of recent legislation, and the knowledge of the subterranean biodiversity of the country is thus of primary importance.

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ADDITIONAL KEYWORDS: cavernicolous fauna – Neotropical – new genera – new species.

INTRODUCTION

Terrestrial isopods (Oniscidea), widespread and abundant soil invertebrates, have great potential for successful colonization of subterranean habitats because of their detritivorous feeding habits and the availability of favourable substrates in caves throughout the world. Indeed, these animals have been recorded in all studied karst areas around the world as troglobites (species constituted by exclusively subterranean source populations), troglophiles (species with source populations in both hypogean and epigean habitats, with

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individuals regularly commuting between these habitats; Sket, 2008; Trajano, 2012), and accidentals (Culver & Pipan, 2009). Until 2004, *c.*300 troglobitic species in 16 families of Oniscidea were recorded worldwide, most of which were from much more intensively investigated caves in the northern hemisphere (Taiti, 2004).

In the last decade, biospeleological surveys have progressed considerably in Australia, Asia, and South America. Taxonomic impediment has been a major problem in regions of mega-biodiversity, such as southeastern Asia and Brazil, because of the paucity of specialists able to describe such diversity, using characters that not only have a strong phylogenetic signal but that may also be used empirically in a straightforward manner, coping with the increasing demand for robust scientific bases for effective conservation policies.

Brazil has a great potential for subterranean habitats, either in karst or in non-karst areas. It has been estimated that *c.*2.8% of the country area (approximately 2 368 000 km^2) is covered by exposed carbonatic rocks (Sallun Filho & Karmann, 2012), where the largest subterranean systems develop. In addition, karstic caves may also form in siliciclastic rocks, and non-karst cavities may occur in ferruginous and other types of rocks and sediments, which occupy large areas in the country. So far, more than 10 000 caves are known in Brazil, with potential for there being more than 100 000 (Sallun Filho & Karmann, 2012), with most of them lying outside of protected areas. Until recently, all Brazilian caves were legally protected (BRASIL, 1990). In 2008, a new decree (BRASIL, 2008) established a classification of caves into degrees of relevance according to criteria based on the presence of attributes of uniqueness. Because those attributes were largely insufficient, were ill defined, and because there was no scientifically valid method to test for presence versus absence, this new regulation may represent a major threat to Brazilian subterranean diversity. The decree is currently sub judice.

Not surprisingly, in view of the extensive collecting efforts carried out by speleobiologists throughout Brazil since the 1980s, dozens of oniscideans have been reported in faunistic publications (e.g. Pinto-da-Rocha, 1995; Souza-Kury, 1997a; Trajano, 2000; Trajano & Bichuette, 2010; Gallão, 2012), but because of the aforementioned taxonomic impediment, only six have been described so far: *Benthana iporangensis* Lima & Serejo, 1993 (Philosciidae), *Amazoniscus eleonorae* Souza, Bezerra & Araujo, 2006, *Circoniscus buckupi* Campos-Filho & Araujo, 2011, *Circoniscus carajasensis* Campos-Filho & Araujo, 2011 (Scleropactidae), *Trichorhina guanophila* Souza-Kury, 1993 (Platyarthridae), and *Gabunillo aridicola* Souza, Senna & Kury, 2010 (Armadillidae) (Lima & Serejo, 1993; Souza-Kury, 1993; Souza, Bezerra & Araújo, 2006; Souza *et al*., 2010; Campos-Filho & Araujo, 2011). Four of these species (*A. eleonorae*, *C. buckupi*, *C. carajasensis*, and *T. guanophila*) present the classical troglomorphisms, such as regression of ocular structures and dark body pigmentation, which are indicative of their troglobitic status.

Strong economic pressures have been pushing for the liberalization of environmental policies in general, allowing for the destruction of huge areas of natural habitats in Brazil. Because conservation policies worldwide are mostly taxon-based, taxononomic studies are urgently needed in Brazil, especially for the relatively poorly known subterranean invertebrates. Recently, we have received a large collection of oniscideans from caves in the states of Pará, Bahia, Minas Gerais, Mato Grosso do Sul, and São Paulo. In addition to the listing of many already known species, the present study describes several new taxa present in this original collection.

MATERIAL AND METHODS

The material in the present article comes from collections of the Museu de Zoologia, Universidade de São Paulo, and the Coleção de Carcinologia do Departamento de Zoologia, Universidade Federal do Rio Grande do Sul.

Specimens have been collected by hand and stored in 75% ethanol, and identifications are based on morphological characters with the use of micropreparations. For each new species, the material examined, description, etymology, and remarks are presented. For the already described species only citations from Brazil are included. The terminology used in species descriptions is mainly based on Vandel (1960, 1962), Leistikow (2001a, 2001b), and Taiti & Argano (2009). Coordinates of the noduli laterales were obtained and illustrated as described in Vandel (1962). The classification of respiratory structures follows Hoese (1982) and Paoli, Ferrara & Taiti (2002). The taxa were illustrated with the aid of a camera lucida mounted on Wild M5 and M20 microscopes.

The material is deposited in the Museu de Zoologia (MZUSP), Universidade de São Paulo, São Paulo, in the Coleção de Carcinologia do Departamento de Zoologia, Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, and in the collection of the Natural History Museum, Section of Zoology 'La Specola', Florence (MZUF).

STUDY AREA

Altamira karst area, central state of Pará, northern Brazil

This region is situated in the Equatorial Amazonian Domain, where the climate is tropical humid (Ab'Saber,

1977; Nimer, 1989; Kottek *et al*., 2006). The caves are located in whitish sandstones of the Maecuru Group, Lontra Member, early to middle Carboniferous (Caputo, Rodrigues & Vasconcelos, 1971). Rocky outcrops form elongated hills, with an average altitude of 150 m a.s.l., and slopes facing south. The caves from Altamira contain very abundant and stable bat populations, which may reach thousands of individuals. Consequently, large quantities of guano are available as a food source for terrestrial and aquatic invertebrates (Trajano & Moreira, 1989).

Serra de Carajás, Canaã dos Carajás, and Parauapebas, state of Pará, northern Brazil

Serra dos Carajás, characterized by a series of discontinuous mountains and hills, is located in the basin between the Itacaiúnas and Parauapebas rivers (5°54′–6°33′S, 49°53′–50°34′W), in the Equatorial Amazonian Domain, at elevations of 600–800 m a.s.l. The climate is wet tropical (Kottek *et al*., 2006). The ancient and extensive surface erosion prevented the development of dense tropical rainforest, contrasting with the surrounding dense forest (Campos & Castilho, 2012; Crescencio & Carmo, 2013). Ferruginous caves are very distinct in formation and structure from the karstic caves, and the structure and functioning of the ecosystems in this kind of habitat are still very poorly understood. To date, the Serra dos Carajás karst area has approximately 1350 caves (CECAV, 2013).

Lajeado de Soledade, Apodi karst system, states of Rio Grande do Norte and Ceará, north-eastern Brazil

Lajeado de Soledade is an area of approximately 3 km^2 located in the south-western portion of the Potiguar watershed, in the Caatinga biome (mesophytic and xeromorphic forests), with a semi-arid climate (Kottek *et al*., 2006). This karst area is formed by Upper Cretaceous carbonatic rocks (Bagnoli, 1994; Porpino, Júnior & Santos, 2009), consisting of calcarenites and dolomites originating during the Albian–Campanian period (113–72 Mya) in a subtidal zone. The caves in this karst area are also characterized by the presence of a large number of rupestrian paintings and well-preserved fossil records (Porpino *et al*., 2009).

Chapada Diamantina Region, central state of Bahia (Itaetê and Iraquara), north-eastern Brazil

With an area of approximately 38 000 km^2, the Chapada Diamantina geographic region is a plateau reaching an altitude of 1700 m a.s.l., formed by exposed limestones of Neoproterozoic age (1000–541 Mya). It belongs to the Una Geological Group, in the Irecê, and the Una–Utinga sedimentary basins that are separated by much older mesoproterozoic exposed rocks of the Chapada Diamantina Group, including sandstone layers, where caves are also formed (Inda & Barbosa, 1978; Karmann & Sánchez, 1979). The climate is tropical dry (i.e. semiarid; Kottek *et al*., 2006), with irregular rain, and with annual precipitation of *c*.640 mm (Instituto Nacional de Meteorologia – INMET), and with annual mean temperatures ranging between 20 °C and 22 °C (Nimer, 1989). Part of the area is protected by law, and the conservation status of the subterranean fauna is relatively good.

Morro do Chapéu karst area, state of Bahia, north-eastern Brazil

This region, situated at the north of Chapada Diamantina in a typical Caatinga area with a tropical dry (i.e. semiarid) climate [Aw type (equatorial savannah with dry winter); Kottek *et al*., 2006], follows the course of the Jacaré River, right tributary of the Middle São Francisco River. Its main karst feature is Brejões Cave, with more than 7 km of mapped conduits. Brejões Cave is situated in a legally protected area, an APA (Environmental Protection Area), which contributes to its preservation.

Serra do Ramalho karst area, southern state of Bahia, north-eastern Brazil

The Serra do Ramalho karst, middle São Francisco River basin, has several important caves, a few with more than 30 km of passageways. Serra do Ramalho is dominated by a plateau formed by limestone rocks of the Bambuí Group (Auler, Rubbioli & Brandi, 2001). This plateau extends for kilometres and forms large cave systems in the region, distributed in two sections: the lower plateau, to the south, and the upper plateau, to the north (Mattox *et al*., 2008). According to the classification by Kottek *et al*. (2006), the climate is tropical dry (i.e. semiarid), Aw type, characterized by a dry winter (from March to October), and with an annual precipitation of *c*.640 mm (Instituto Nacional de Meteorologia, INMET). The native vegetation consists of Caatinga, interspersed with Cerrado (savannah-like) vegetation. The Serra do Ramalho karst area is a spot of high subterranean biodiversity, both aquatic (Bichuette & Trajano, 2005; Mattox *et al*., 2008; Bichuette & Rizzato, 2012; Simone, 2012) and terrestrial (e.g. Baptista & Giupponi, 2002; Trajano & Bichuette, 2010). Nevertheless, it is not legally protected. Presently, the accelerated extraction of the original vegetation for cotton and soybean cultivation represents the main threat for subterranean ecosystems.

São Roque de Minas (Zeferino I) and Presidente Olegário (Vereda da Palha), state of Minas Gerais, south-eastern Brazil

The caves from São Roque de Minas and Presidente Olegário are located, respectively, in the Serra da Canastra (south-western Minas Gerais) and in the Paracatu River basin (north-western Minas Gerais), Upper São Francisco river basin. These limestones belong to Bambuí Group, of Upper Proterozoic age, and the native vegetation is Cerrado (Brazilian savannah) (Ab'Saber, 1977). The climate is tropical and semi-humid, with four to five dry months (Nimer, 1989). Both karst areas are under threat from plantations and/or pasture, with many deforested areas. The area is completely unprotected. Only the limestone outcrops and cave entrances are better preserved because of the difficulties in establishing crops over rock landscapes.

Serra da Bodoquena, Mato Grosso do Sul state, south-western Brazil

Serra da Bodoquena consists of a north-south carbonatic plateau of Neoproterozoic age, Corumbá Group, extending for approximately 200 km, of width varying between 10 and 70 km, that forms an important water divide in the Paraguay Belt, related to the development of the Cenozoic Pantanal Basin, which is still subsiding within the limits of the Paraguay Basin (Almeida, 1965; Boggiani, Fairchild & Coimbra, 1993; Cordeiro, Borghezan & Trajano, 2014). The climate is classified as Aw, tropical, with a wet summer and a dry winter (Justo, 2000). Rains are concentrated during November–February, with a mean average precipitation of about 1300 mm per year and a mean annual temperature of 24 °C. The natural vegetation consists of savanna in contact with semi-deciduous seasonal forest (Scremin-Dias *et al*., 1999; Galati *et al*., 2003; Boggiani *et al*., 2011). Part of the Serra da Bodoquena area is within the limits of the Parque Estadual da Serra da Bodoquena. Threats to subterranean communities include: poor control of activities in the park; habitat destruction from deforestation, causing cave siltation and a decrease of food input; pollution; and direct disturbance by uncontrolled visitor numbers and cave diving.

SYSTEMATIC ACCOUNT

Family Trichoniscidae Sars, 1899

Genus *Miktoniscus* Kesselyák, 1930

Type species: Trichoniscus linearis Patience, 1908 by original designation and monotypy.

Miktoniscus medcofi (Van Name, 1940)

Figures 1–4, 40

Miktoniscus medcofi Lemos de Castro, 1953: 529, fig. I; Lemos de Castro, 1971: 10, fig. 3; Souza-Kury, 1998: 668; Araujo & Bueno, 1998: 186; Leistikow & Wägele, 1999: 7; Schmalfuss, 2003: 166.

Material examined

Brazil, Pará: three ♂ (one in micropreparations), four ♀, two specimens without pleon, Canaã dos Carajás, SB karst area, 6°17′S, 49°59′W, undated, leg. R. Bessi (UFRGS 5374).

Remarks

At present *Miktoniscus* includes 15 species distributed in the USA, Mexico, Brazil, and western Europe (Schmalfuss, 2003). *Miktoniscus medcofi* (Van Name, 1940) was described from specimens collected in glasshouses in Illinois, USA. Four species (*Trichoniscus veracrucensis* Mulaik, 1960; *Miktoniscus humus* Mulaik & Mulaik, 1942; *Miktoniscus alabamensis* Muchmore, 1964, and *Miktoniscus ohioensis* Muchmore, 1964) are considered junior synonyms of *M. medcofi* (see Schultz, 1976). This species has been recorded from several localities in southern and central USA, Vera Cruz in Mexico, and in the Brazilian states of Amapá, Pará, Rio de Janeiro, São Paulo, and Rio Grande do Sul, where it is most probably introduced. The species is fully re-illustrated herein (Figs 1–4) with the material from Canaã dos Carajás to allow for future diagnosis.

Family Styloniscidae Vandel, 1952

Genus ***Spelunconiscus*** Campos-Filho, Araujo & Taiti **gen. nov.**

Type species: **Spelunconiscus castroi** Campos-Filho, Araujo & Taiti **sp. nov**.

Diagnosis

Body slightly convex, unable to roll up into a ball, with pleon slightly narrower than pereon. Cephalon with small antennary lobes and distinct suprantennal line. Pleonites 3–5 with epimera reduced, adpressed, without visible posterior points. Antennule of three articles, with a line of short and thickset aesthetascs on distal article. Antenna with flagellum of several articles, no visible aesthetascs. Right mandible with one penicil; left mandible with two penicils. Maxillule outer branch with 5 + 5 teeth, all entire, and two slender setose stalks; inner branch with three penicils at apex. Maxilla with outer lobe much broader than inner lobe. Maxilliped

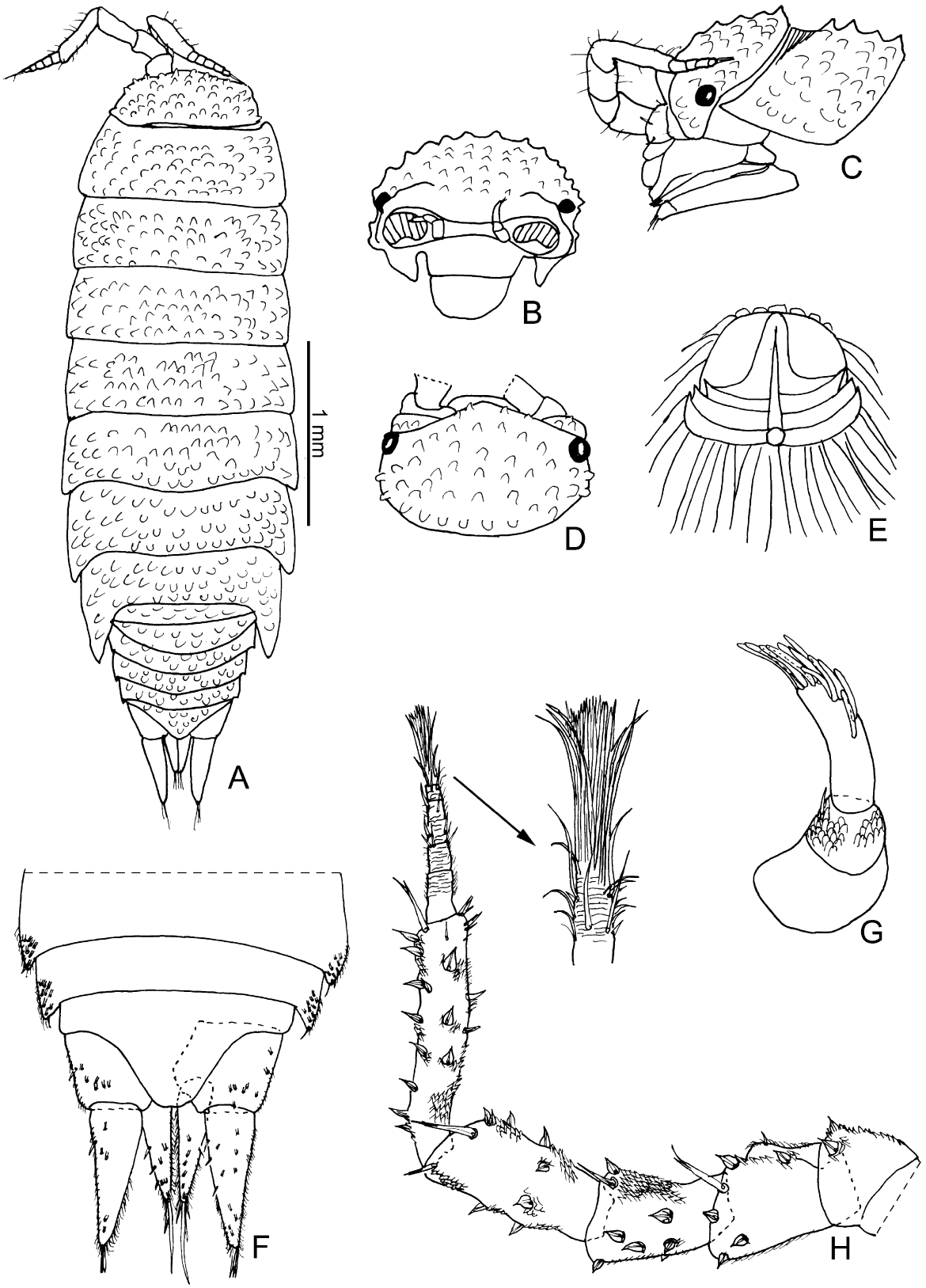

Figure 1. *Miktoniscus medcofi* (Van Name, 1940), ♀: A, habitus, dorsal; B, cephalon, frontal; C, cephalon and pereonite 1, lateral; D, cephalon, dorsal; E, dorsal scale seta; F, pleonites 4 and 5, telson, and uropods; G, antennule; H, antenna.

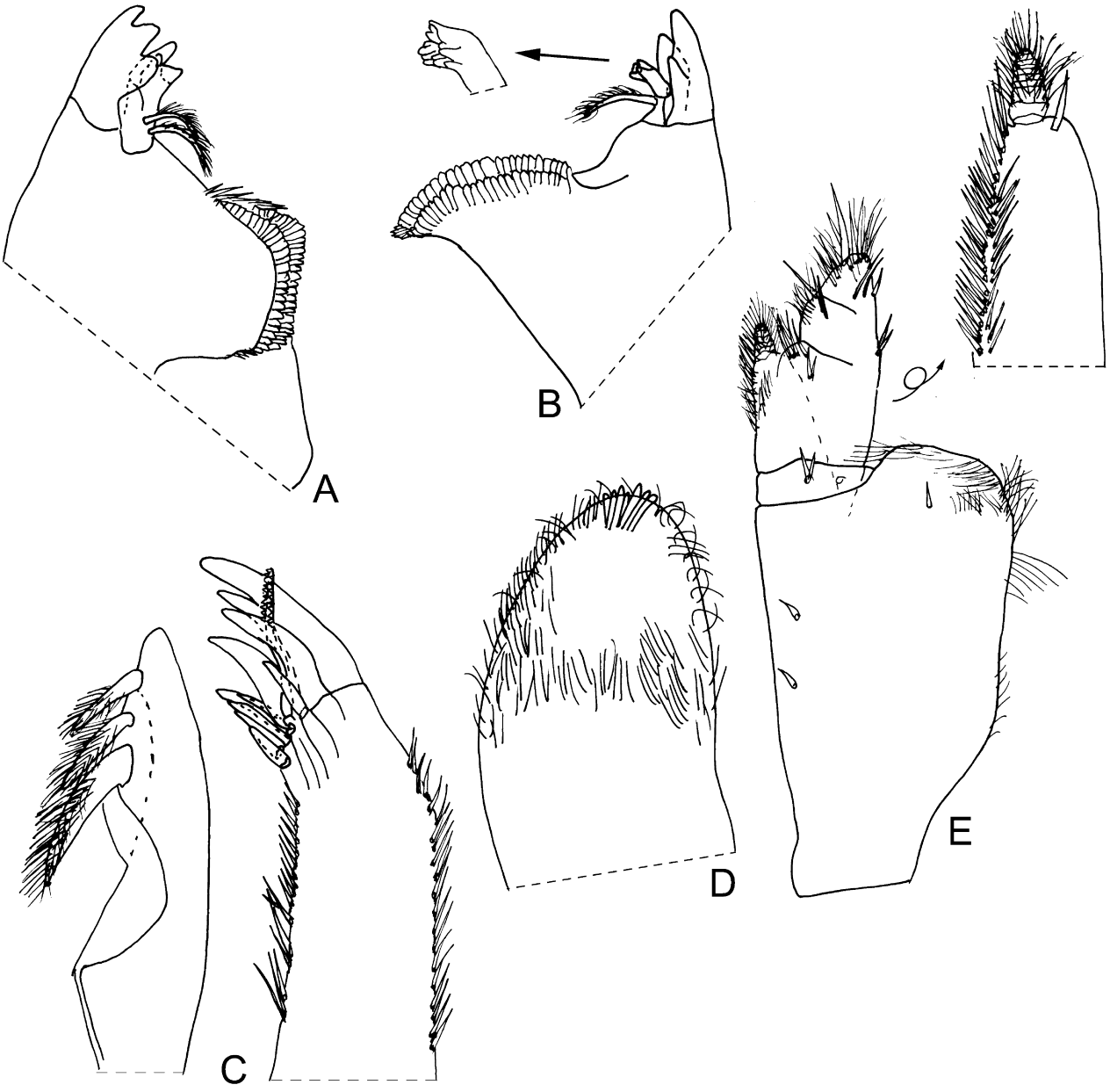

Figure 2. *Miktoniscus medcofi* (Van Name, 1940), ♀: A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped.

with basis enlarged on distal portion; endite narrow bearing a large apical penicil. Pereopods with unbranched and glabrous dactylar setae. Uropod with endopod and exopod inserted at the same level. Pleopod exopods with a fringe of thin setae along margins. Genital papilla lanceolate. Male pleopod 1 exopod longer than endopod, endopod two-jointed with flagelliform distal article. Male pleopod 2 endopod robust, distal portion narrow, triangular.

Etymology

From the Latin *spelunca* = cave + *Oniscus*.

Remarks

At present, Styloniscidae includes with certainty ten genera (Schmalfuss, 2003; Taiti & Xue, 2012): *Clavigeroniscus* Arcangeli, 1930, *Cordioniscus* Graeve, 1914, *Indoniscus* Vandel, 1952a, *Kuscheloniscus* Strouhal, 1961, *Notoniscus* Chilton, 1915, *Paranotoniscus*

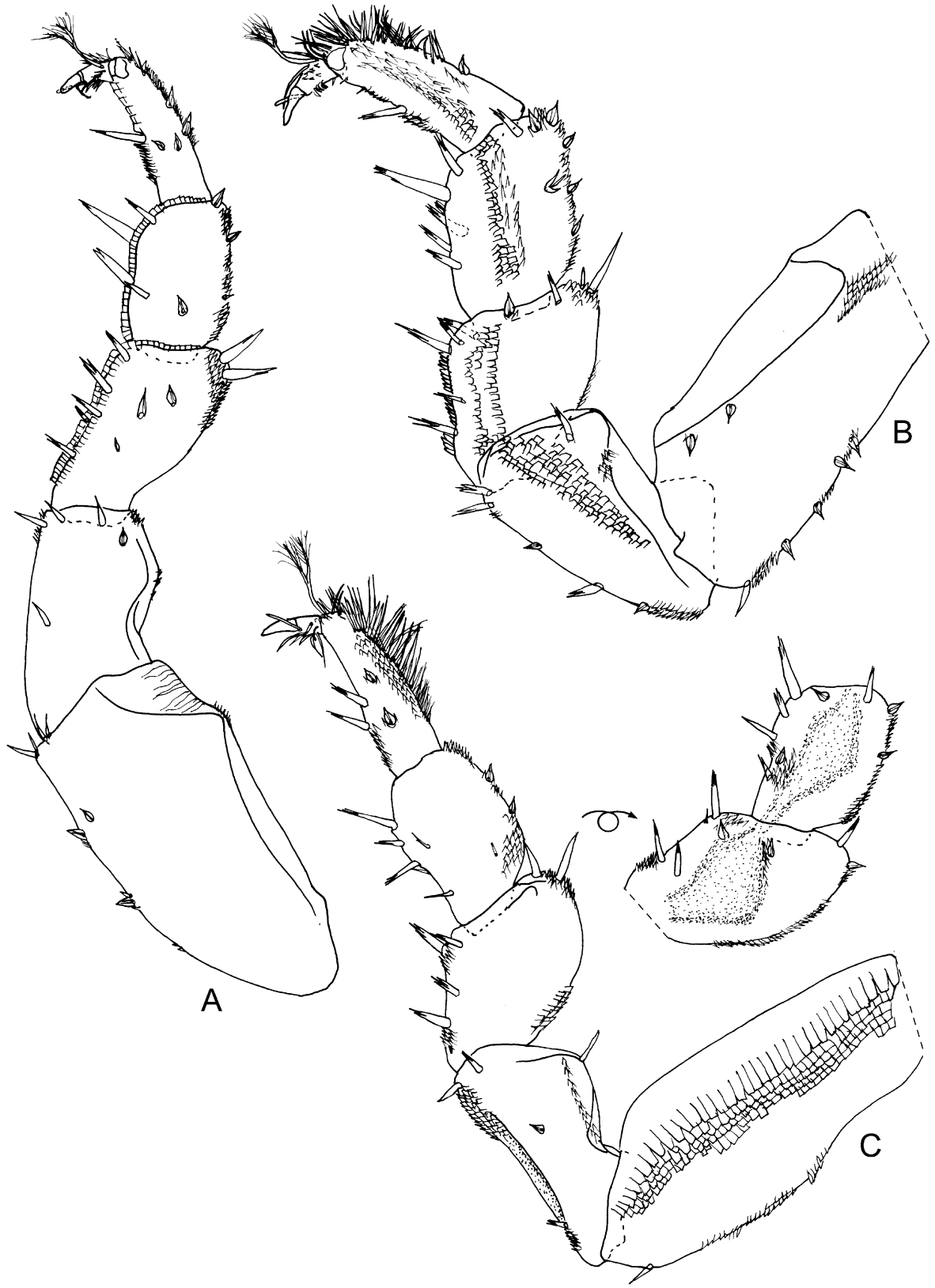

Figure 3. *Miktoniscus medcofi* (Van Name, 1940), ♂: A, pereopod 1; B, pereopod 6; C, pereopod 7.

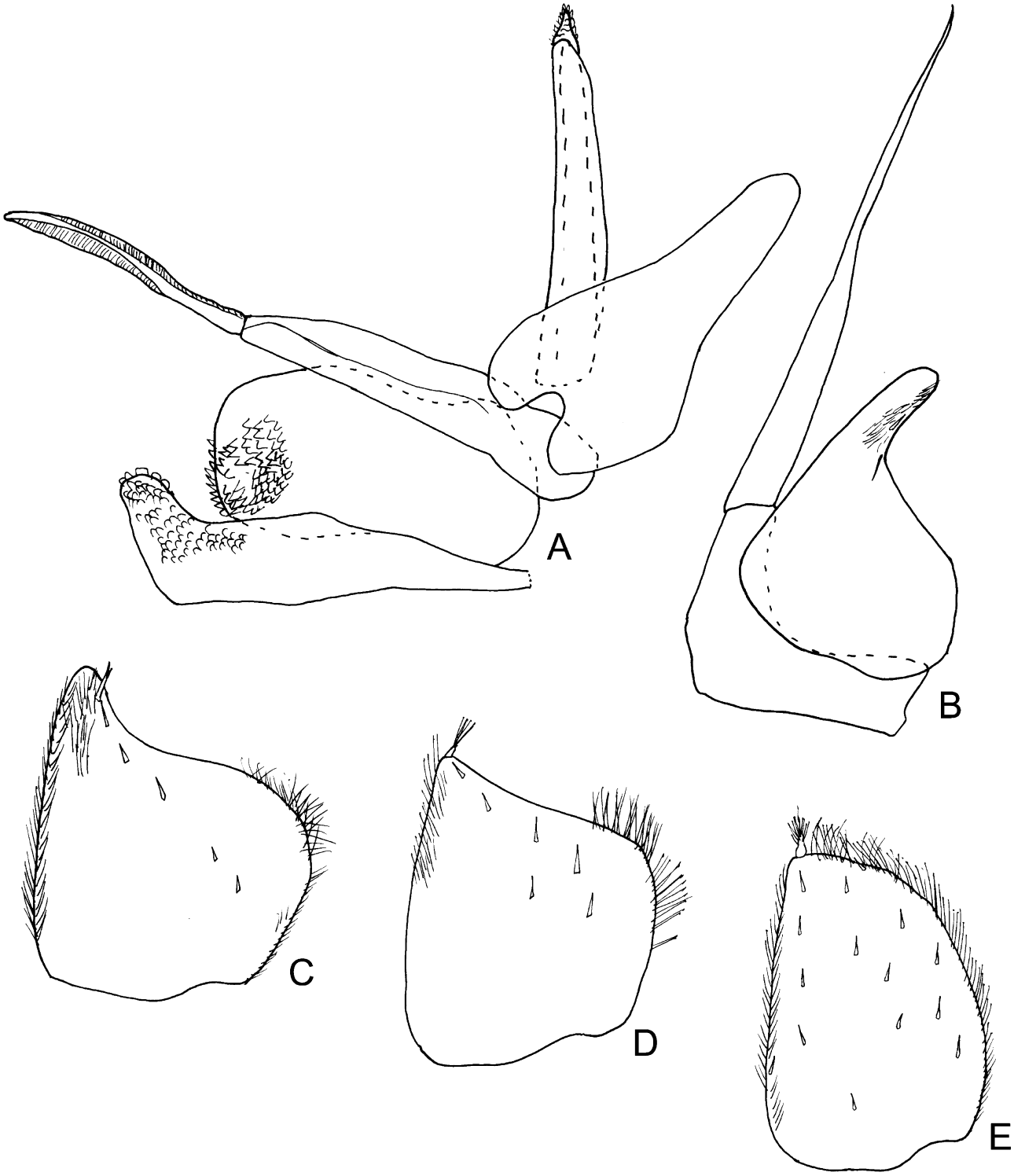

Figure 4. *Miktoniscus medcofi* (Van Name, 1940), ♂: A, genital papilla and pleopod 1; B, pleopod 2; C, pleopod 3 exopod; D, pleopod 4 exopod; E, pleopod 5 exopod.

Barnard, 1932, *Pectenoniscus* Andersson, 1960, *Styloniscus* Dana, 1853, *Thailandoniscus* Dalens, 1989, and *Trogloniscus* Taiti & Xue, 2012; *Madoniscus* Paulian de Félice, 1950 might also belong to this family (Schmalfuss, 2003). Styloniscidae is divided into three subfamilies: Styloniscinae, Notoniscinae, and Kuscheloniscinae (Strouhal, 1961). The new genus belongs to Styloniscinae, which also includes *Styloniscus*,

Cordioniscus, *Clavigeroniscus*, *Indoniscus*, *Thailandoniscus*, *Trogloniscus*, and probably *Pectenoniscus* (Taiti & Xue, 2012). *Spelunconiscus* gen. nov. is readily distinguishable from all these genera in having the antennule with short and thickset aesthetascs, the dactylar seta unbranched and glabrous, instead of bifid and setose, and the male pleopod 1 exopod longer than endopod. It also differs from *Styloniscus* and *Cordioniscus* in the genital papilla not enlarged distally, from *Trogloniscus* in the antennal flagellum having several articles (only three in *Trogloniscus*), from *Clavigeroniscus* and *Thailandoniscus* by the male pleopod 2 endopod distally triangular, and not truncate.

SPELUNCONISCUS CASTROI CAMPOS-FILHO, ARAUJO & TAITI **SP. NOV.**

FIGURES 5–8, 40

Type material

Holotype: ♂, Brazil, Minas Gerais, Matozinhos, Gruta MOC-32, 19°31′S, 44°03′W, 8–18 February 2011, leg. F. Franco (MZUSP 27521).

Paratypes: Two ♂ (one in micropreparations), same data as holotype (MZUSP 27522).

Etymology

The species is named after Prof. Alceu Lemos de Castro, for his invaluable contribution to the knowledge of terrestrial isopods from Brazil.

Description

Maximum length: 6 mm. Body colourless, elongated, pereon with almost parallel sides (Fig. 5A). Dorsal surface smooth (Fig. 5B), with pointed scale setae (Fig. 5C). Eyes absent. Cephalon (Fig. 5D–F) with small quadrangular antennary lobes; profrons with a small carena and suprantennal line distinctly bent down in the middle. Posterior margin of pereonites 1–3 straight, and of pereonites 4–7 progressively more concave. Pleonites 3–5 epimera reduced, adpressed, with no posterior points visible in dorsal view. Telson (Fig. 5G) with concave sides and broadly rounded apex. Antennule (Fig. 5H) with distal article longer than second and first, conical, and bearing five short and stout aesthetascs. Antenna (Fig. 5I) with fifth article of peduncle shorter than flagellum; flagellum of between five and seven articles, according to animal size. Mandibles with two penicils on the left (Fig. 6A) and one penicil on the right (Fig. 6B). Outer branch of maxillule with 5 + 5 teeth, apically entire, and two slender stalks (Fig. 6C); inner branch with proximal penicil longer than the two apical ones. Maxilla with setose and bilobate apex, inner lobe smaller (Fig. 6D). Maxilliped basis enlarged on distal portion, outer, inner, and distal margins bearing a fringe of thin setae; endite rectangular and narrow, bearing a large apical penicil (Fig. 6E). Uropod (Fig. 7A) with endopod as long as exopod, and inserted at similar level. Pereopod 1 (Fig. 7B) carpus with transverse antennal grooming brush. Pereopod 7 (Fig. 7C) basis with lines of scales for the water conducting system, ischium with sternal margin straight and two setae on tergal margin, merus slightly concave, and carpus longer than merus. Genital papilla (Fig. 8A) with a conical shape and narrow and elongated apical part. Pleopod 1 (Fig. 8B) exopod triangular, elongated, outer margin concave, distal margin rounded, a fringe of thin setae along inner, distal, and outer margins; endopod narrow, with almost parallel sides, slightly shorter than exopod, basal part enlarged, distal part flagelliform. Pleopod 2 (Fig. 8C) exopod subretangular, with median portion narrower, distal margin slightly sinuous, and bearing four setae; endopod of two articles, about five times longer than exopod, second segment enlarged, more than twice as long as first, distal part narrow, triangular, bearing a subapical spine. Pleopod 3 exopod (Fig. 8D) trapezoidal, bearing six strong setae and with a fringe of thin setae along the margins. Pleopods 4 and 5 exopods (Fig. 8E,F) rhomboidal, bearing three and four strong setae, respectively, and covered with thin setae on the medial part.

Remarks

These specimens were collected in water, but other specimens have also been observed out of the water (M.E.B., pers. observ.), so the species should be considered as amphibian rather than aquatic. Other aquatic or amphibian species in the family Styloniscidae are known from Thailand (*Thailandoniscus annae* Dalens, 1989) and southern China (*Trogloniscus clarkei* Taiti & Xue, 2012 and *Trogloniscus trilobatus* Taiti & Xue, 2012).

GENUS *XANGONISCUS* CAMPOS-FILHO, ARAUJO & TAITI **GEN. NOV.**

Type species: **Xangoniscus aganju** Campos-Filho, Araujo & Taiti **sp. nov**.

Diagnosis

Body slightly convex, unable to roll up into a ball, with pleon narrower than pereon. Cephalon with large antennary lobes, distinct suprantennal line, and a transversal groove on the anterior part of vertex. Pleonites 3–5 with epimera well developed, with visible posterior points. Antennule of three articles with two long apical aesthetascs. Antenna with flagellum of three clearly distinct articles and a short apical organ. Right mandible with one penicil; left mandible with two penicils. Maxillule outer branch with 5 + 5 teeth entire and two long and thick setose stalks; inner branch with

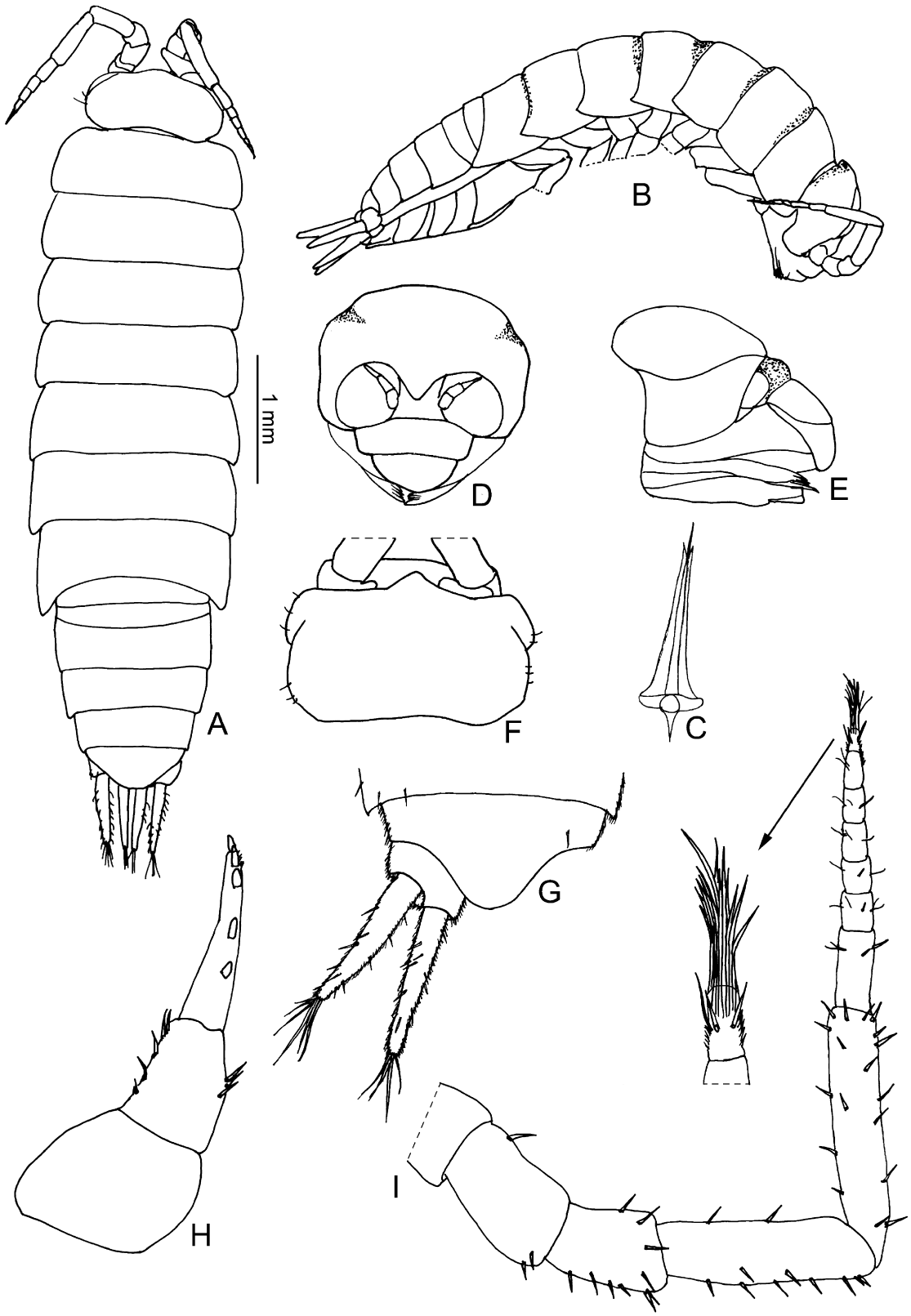

Figure 5. ***Spelunconiscus castroi*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, habitus, dorsal; B, adult specimen, lateral; C, dorsal scale seta; D, cephalon, frontal; E, cephalon, lateral; F, cephalon, dorsal; G, pleonite 5, telson and uropod; H, antennule; I, antenna.

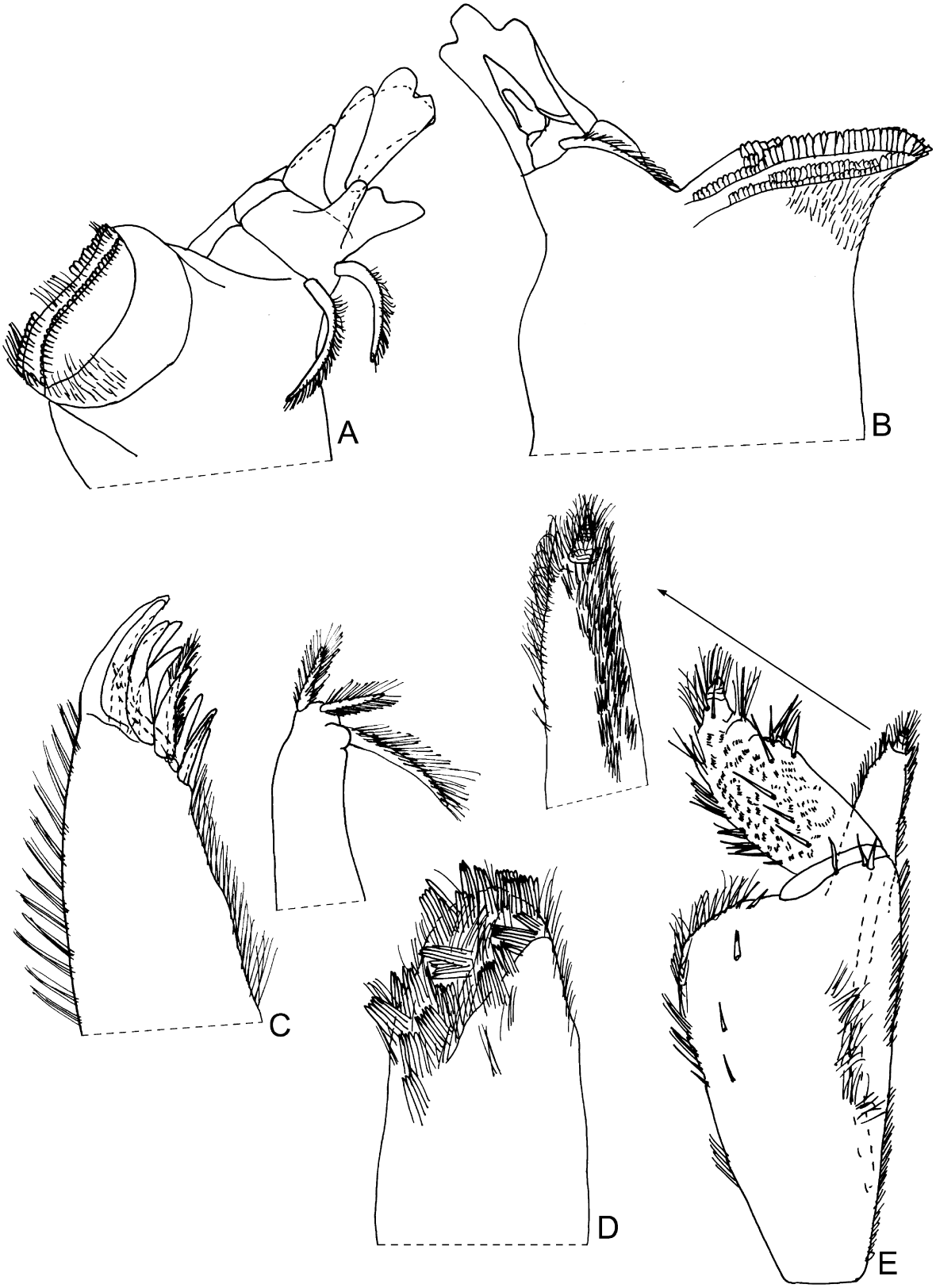

Figure 6. ***Spelunconiscus castroi*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped.

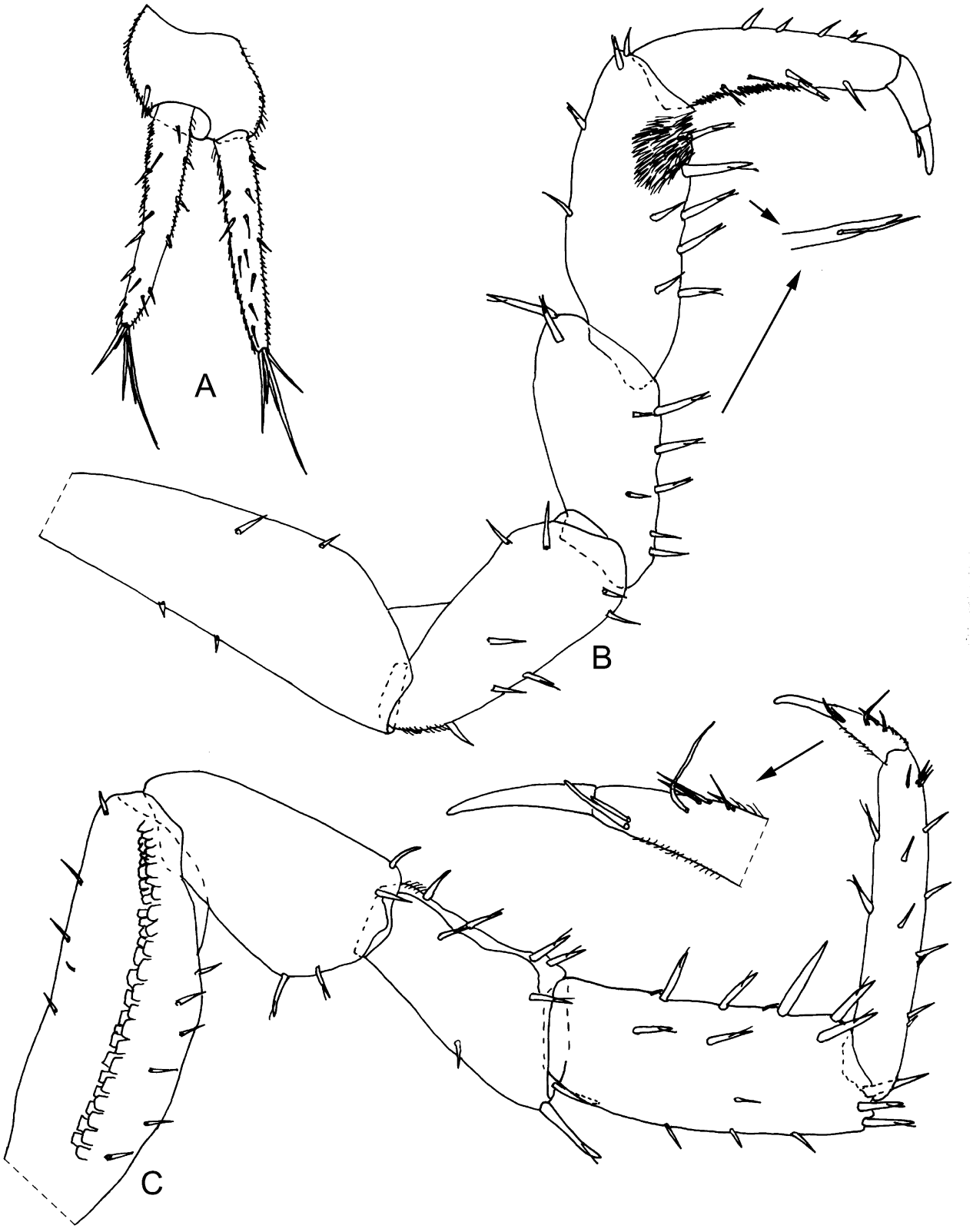

Figure 7. ***Spelunconiscus castroi*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, uropod; B, pereopod 1; C, pereopod 7.

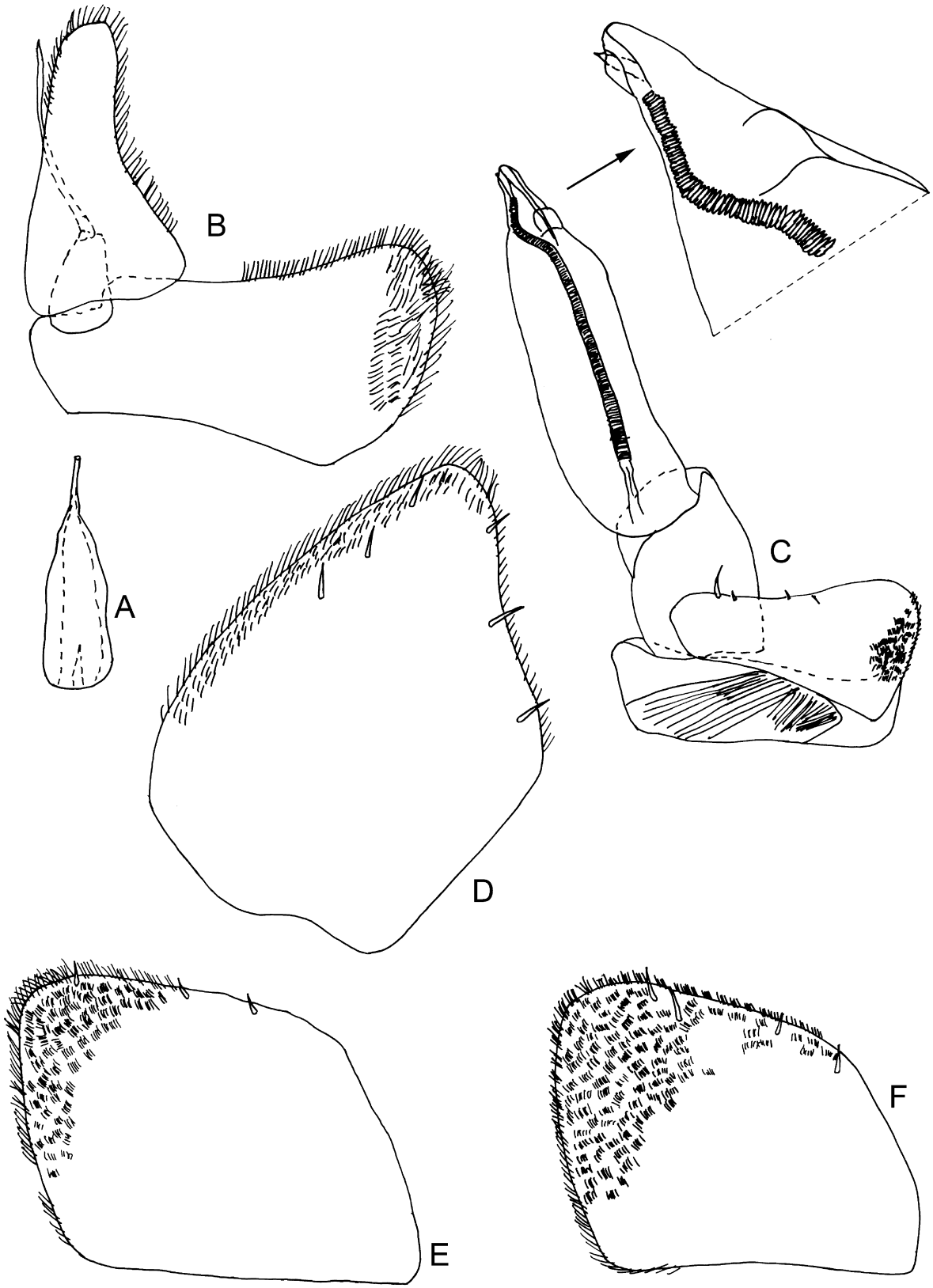

Figure 8. ***Spelunconiscus castroi*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, genital papilla; B, pleopod 1; C, pleopod 2; D, pleopod 3 exopod; E, pleopod 4 exopod; F, pleopod 5 exopod.

three penicils at apex. Maxilla with outer lobe much broader than inner lobe. Maxilliped basis triangular, with enlarged distal portion; endite narrow, bearing a large apical penicil. Pereopods with unbranched and glabrous dactylar setae, and a fringe of large scales on distal margins of segments. Uropod with endopod and exopod inserted at the same level. Pleopod exopods with a fringe of thin setae along margins. Genital papilla lanceolate. Male pleopod 1 exopod shorter than endopod, endopod two-jointed, with flagelliform distal article. Male pleopod 2 endopod stout with distal article truncate, bearing a wrench-like apex.

Etymology

The new genus is named after Xangô Orisha, the Afro-Brazilian divinity of fire, thunderbolt, and justice, known as the only Orisha that has power over the dead, and with strong connections to trees and nature.

Remarks

In having the distal article of the second male pleopod 2 endopod with truncate and complex apex, *Xangoniscus* gen. nov. resembles *Clavigeroniscus* and *Thailandoniscus*. It is readily distinguished from both genera in having a transversal groove on vertex along the frontal margin, in lacking the penicil on the molar process of the right mandible, and in the more complex apex of the male pleopod 2 endopod; it is distinguished from *Clavigeroniscus* by the unbranched dactylar seta of the pereopods, and also from *Thailandoniscus* in the genital papilla distally not enlarged. In the stout endopod of the male pleopod 2, *Xangoniscus* gen. nov. is also similar to *Spelunconiscus* gen. nov., from which it differs by the well-developed epimera of pleonites 3–5, the antennule with long apical aesthetascs, the antennal flagellum with three distinct articles, the lines of scales on pereopods, male pleopod 1 exopod shorter than endopod, and the complex apical part of the male pleopod 2 endopod.

XANGONISCUS AGANJU CAMPOS-FILHO, ARAUJO & TAITI **SP. NOV.**

FIGURES 9–13, 40

Type material

Holotype: ♂, Brazil, Bahia, Cariranha, Gruna do Mandiaçu, 13°50′S, 44°14′W, 11 September 2008, leg. M.E. Bichuette (MZUSP 27523).

Paratypes: Two ♂, one ♀, same data as holotype (MZUSP 27524).

Etymology

The new species is named after Aganju, an Afro-Brazilian divinity representative of the subterranean environment.

Description

Maximum length: ♂, 6 mm; ♀, 7 mm. Colourless body, pereon with almost parallel sides (Fig. 9A). Dorsal surface smooth with pointed scale setae, which are fringed on the posterior margins of the pereonites and pleonites (Fig. 9B,C). Eyes absent. Cephalon (Fig. 9D,E) with large quadrangular antennary lobes; profrons with a small carena and V-shaped suprantennal line; vertex with rounded frontal groove and slightly depressed at sides. Posterior corners of pereonite 1 right-angled, of pereonites 2–7 progressively more acute. Pleonites 3–5 (Fig. 9F) with falciform epimera. Telson (Fig. 9F,G) with slightly concave sides and broadly rounded apex. Antennule (Fig. 9H) of three articles similar in length, and bearing two long apical aesthetascs. Antenna (Fig. 9I) with fifth article of peduncle longer than flagellum; flagellum of three distinct articles, first and second articles subequal in length, third article much shorter. Mandibles with two penicils in the left (Fig. 10A) and one penicil in the right (Fig. 10B); lacinia mobilis leaf-shaped. Outer branch of maxillule with 5 + 5 teeth, apically entire, and two thick plumose stalks (Fig. 10C); inner branch with proximal penicil longer than the two apical ones. Maxilla with setose and bilobate apex, inner lobe smaller (Fig. 10D). Maxilliped basis enlarged on distal portion, outer, inner, and distal margins bearing a fringe of thin and long setae; endite with a very large rounded apical penicil (Fig. 10E). Uropod (Fig. 11A) with exopod distinctly longer than endopod, and inserted at the same level.

Male: Pereopod 1 (Fig. 11B) with fringed scales on sternal and distal margin of merus, on almost whole surface of carpus, and on sternal margin of propodus. Pereopods 2–4 (Fig. 11C) with fringed scales on sternal and distal margin of merus, carpus, and on sternal margin of propodus. Pereopod 5 (Fig. 11D) with fringed scales on sternal and distal margin of merus and carpus; carpus with a depression on distal half of sternal margin and a distal rounded lobe. Pereopod 6 (Fig. 12A) basis, ischium, and merus with rows of scales on distal margin, ischium enlarged with a flattened sternal part, carpus with distal part narrower than basal one, propodus with rounded flat lobe on basal part. Pereopod 7 (Fig. 12B) with no distinct modifications; ischium with straight sternal margin. Genital papilla (Fig. 13A) lanceolate, enlarged on median portion, and apical part narrow and pointed. Pleopod 1 (Fig. 13B) exopod subtriangular, about two-thirds as long as endopod; endopod with narrow basal article and flagelliform distal article; basis with a triangular medial part fringed with fine and

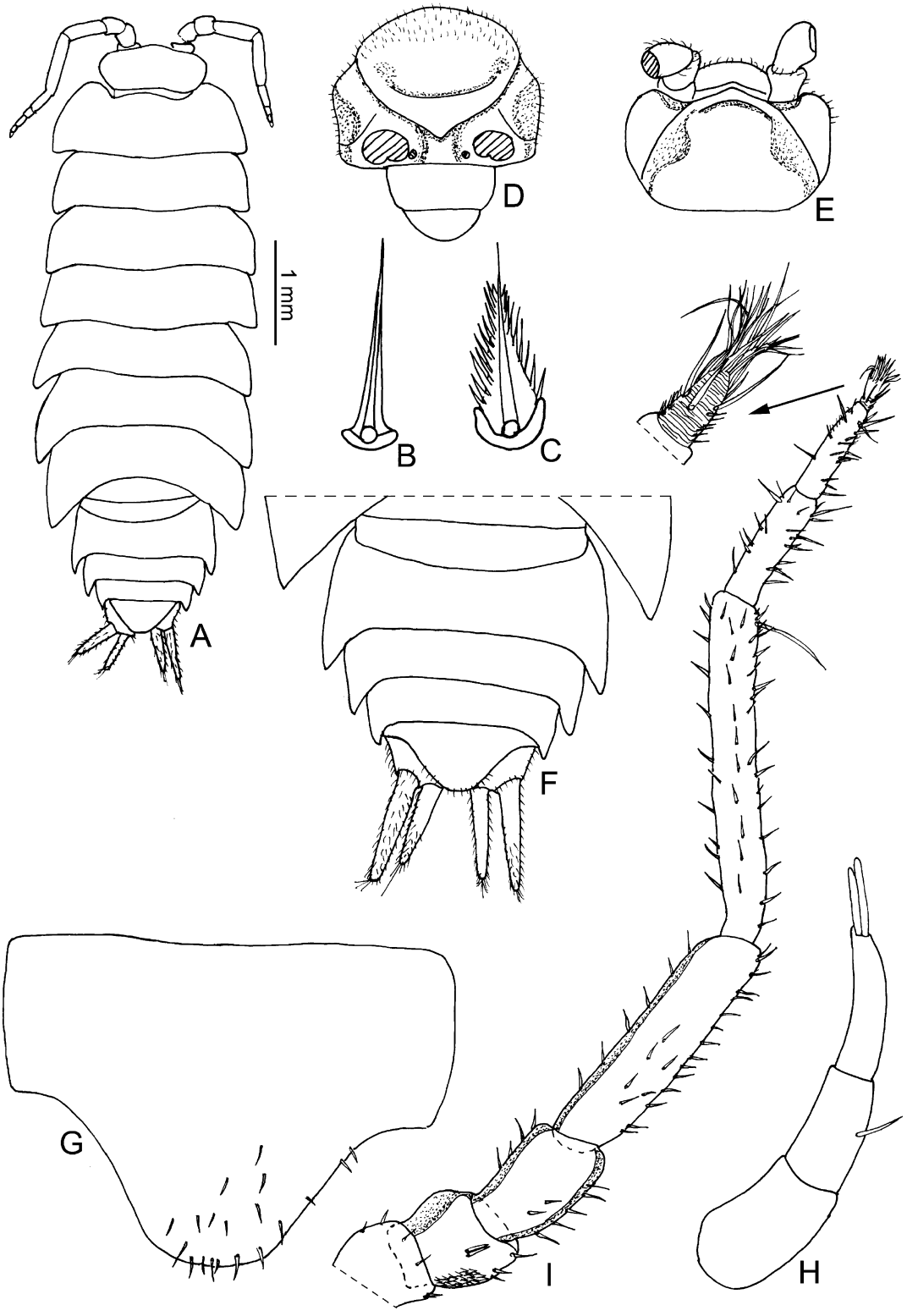

Figure 9. ***Xangoniscus aganju*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, habitus, dorsal; B, pointed dorsal scale seta; C, fringed dorsal scale seta; D, cephalon, frontal; E, cephalon, dorsal; F, pereonite 7, pleonites 1–5, telson and uropods; G, telson; H, antennule; I, antenna.

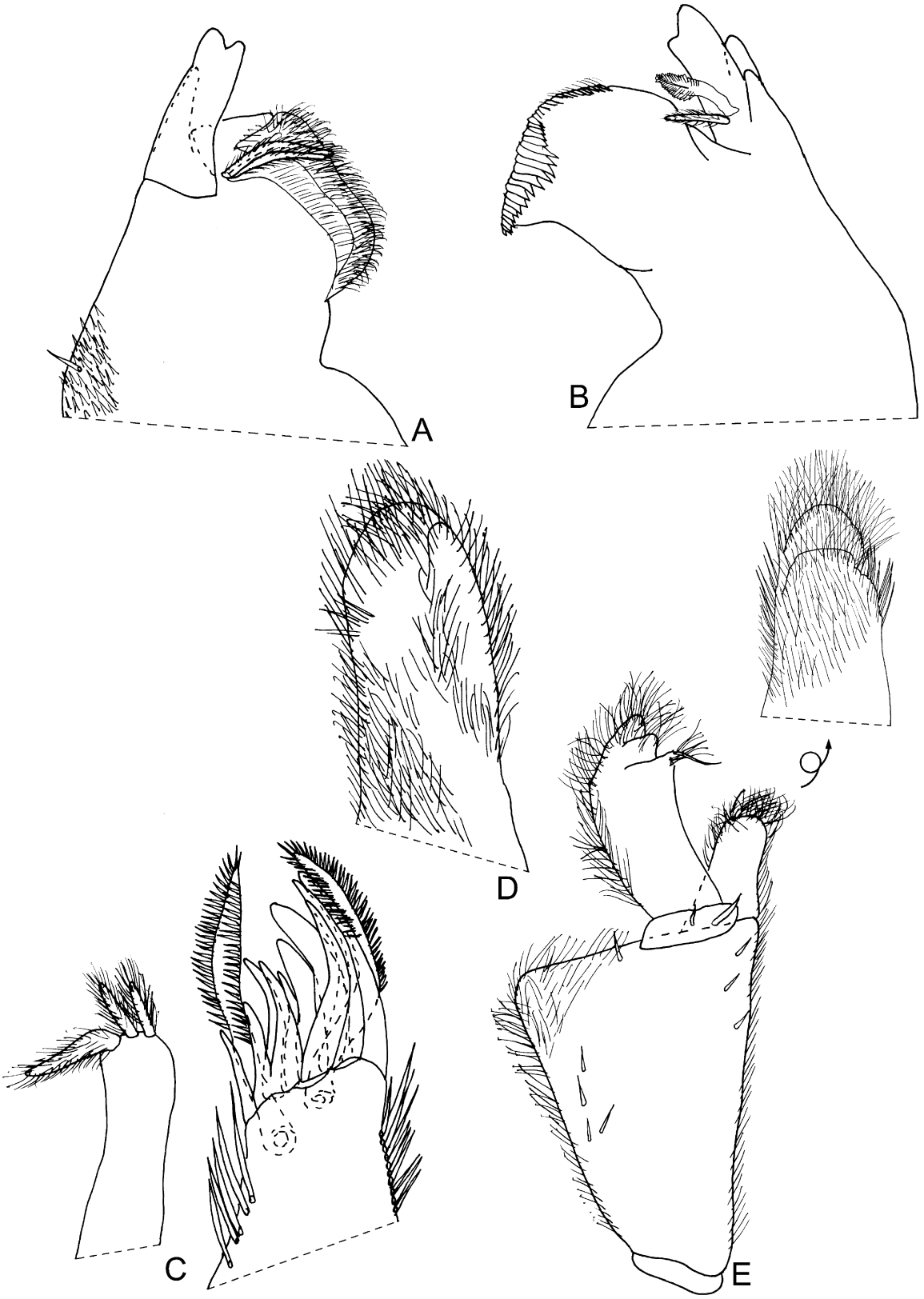

Figure 10. ***Xangoniscus aganju*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped.

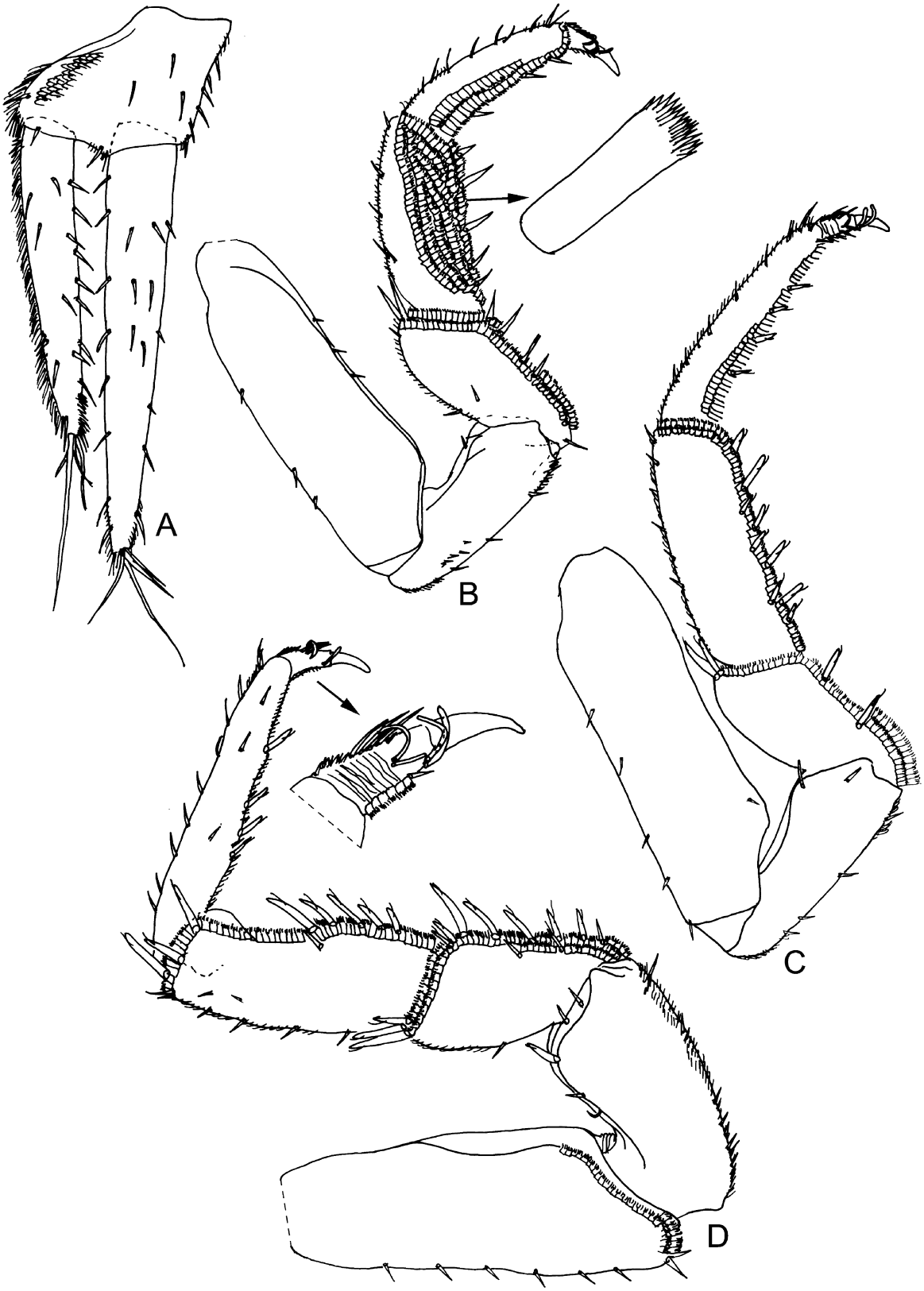

Figure 11. ***Xangoniscus aganju*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, uropod; B, pereopod 1; C, pereopod 2; D, pereopod 5.

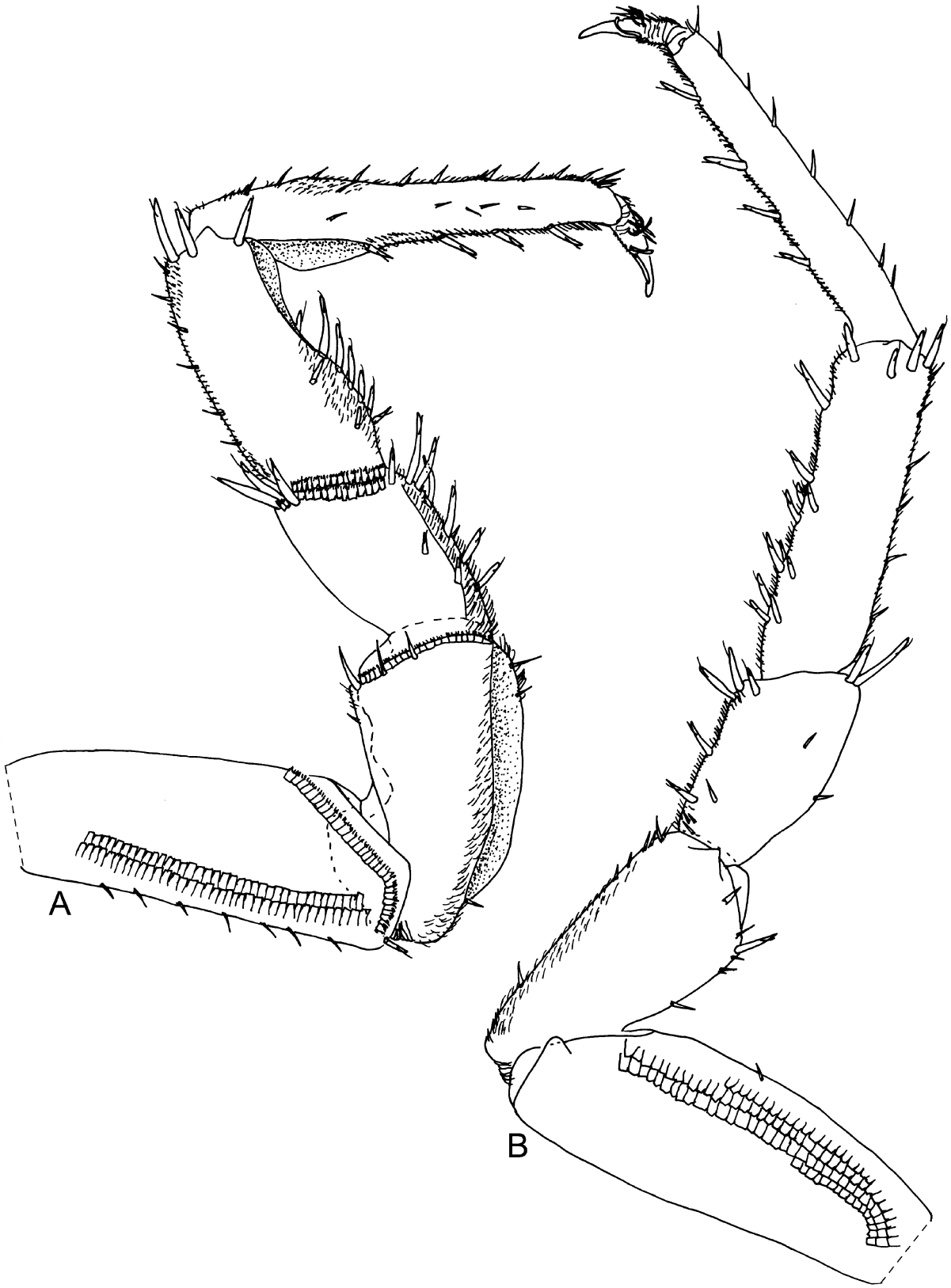

Figure 12. ***Xangoniscus aganju*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 6; B, pereopod 7.

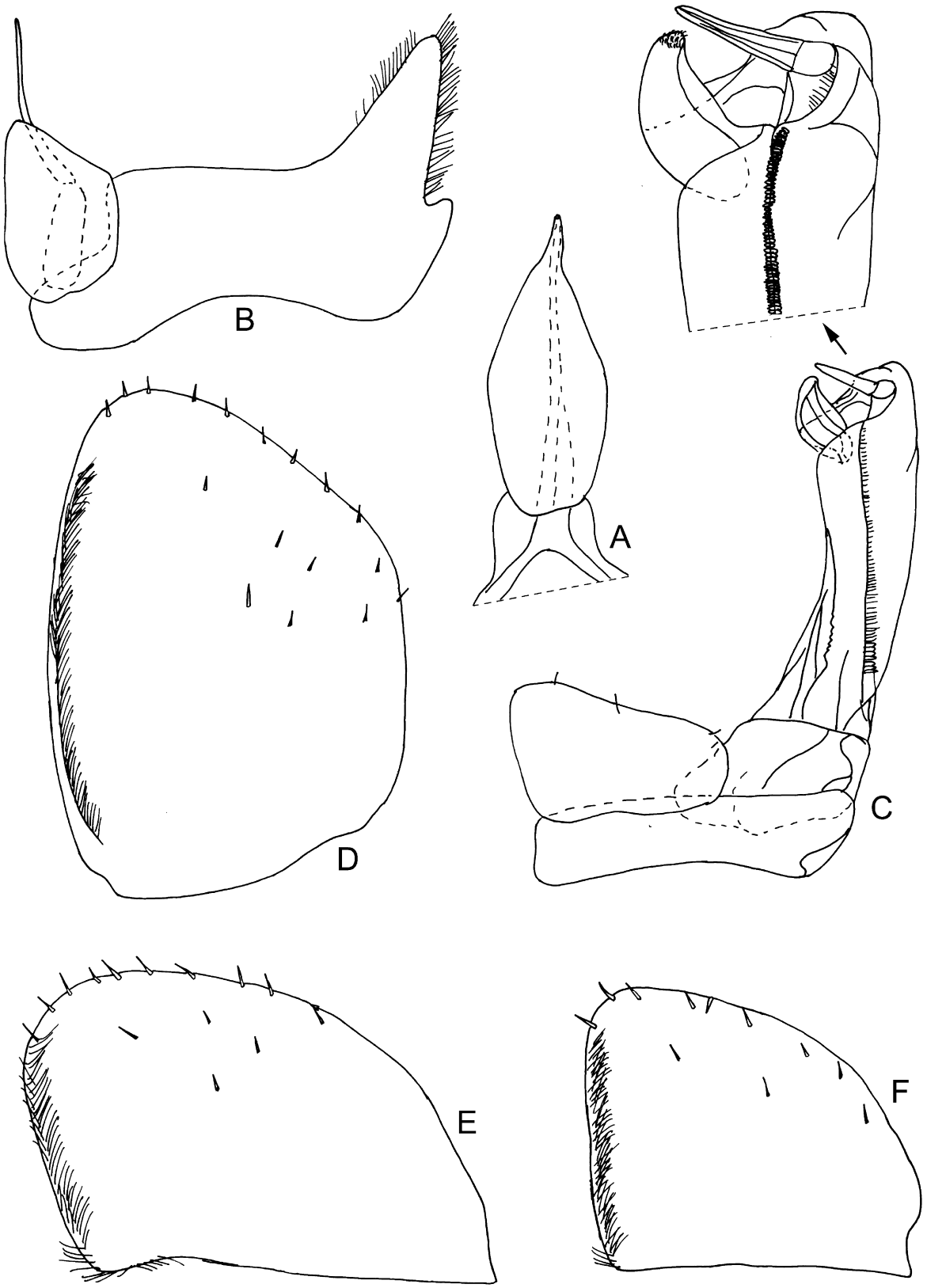

Figure 13. ***Xangoniscus aganju*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, genital papilla; B, pleopod 1; C, pleopod 2; D, pleopod 3 exopod; E, pleopod 4 exopod; F, pleopod 5 exopod.

long setae. Pleopod 2 (Fig. 13C) exopod trapezoidal, with longer outer part, distal margin bearing three setae; endopod of two articles, thickset, second segment about three times longer than first, distal part wrench-like, with a medial triangular lobe and transverse point. Pleopod 3 exopod (Fig. 13D) very large, trapezoidal, longer than wide, with distal margin bearing several short setae. Pleopods 4 and 5 exopods (Fig. 13E,F) rhomboidal, wider than long, with distal margin rounded and bearing several short setae.

Remarks

These specimens have been collected in water and on the ground, so this species must also be considered as amphibian.

Family Philosciidae Kinahan, 1857

Genus *Leonardoscia* Campos-Filho, Araujo & Taiti **gen. nov.**

Type species: **Leonardoscia hassalli** Campos-Filho, Araujo & Taiti **sp. nov**.

Diagnosis

Body ovoidal, with pleon slightly narrower than pereon. Pereonites with fan-shaped scale setae; one series of noduli laterales per side inserted more or less on the same line, at a certain distance from the lateral margin of the pereonites; no visible gland pores. Cephalon with suprantennal line and without frontal line. Epimera of pleonites 3–5 reduced, but with small posterior points visible in dorsal view. Antennule with short and thickset third segment bearing two apical aesthetascs and a tuft of aesthetascs on medial margin. Antennal flagellum with apical seta as long as third segment. Molar penicil of mandible dichotomized. Maxillule outer ramus with 4 + 5 (four apically cleft) teeth, plus an accessory tooth; inner branch with a small posterior point. Maxilliped endite without penicil. Pereopods with flagellar dactylar and ungual seta. Pleopodal exopods without respiratory structures. Uropodal protopod with outer margin grooved in the distal part, insertion of endopod slightly proximal to that of exopod. Male pleopod 2 endopod long and thin, bearing some triangular teeth in the distal part. Male pleopod 5 exopod with a groove near medial margin.

Etymology

The new genus is named after Leonardo da Vinci, who also gives the name to the cave where the type species was collected.

Remarks

In the shape of the antennula with a medial tuft and two apical aesthetascs, the new genus shows affinities with *Prosekia* Leistikow, 2001 and related genera (tribe Prosekiini, according to Leistikow, 2001a,c), from which it is readily distinguishable in having fan-shaped instead of pointed dorsal scale setae. For this last character *Leonardoscia* gen. nov. also resembles *Caraiboscia* Vandel, 1968 and *Colombophiloscia* Leistikow, 2001 (see Leistikow, 2001e), which do not belong to the Prosekiini, however. It differs from both in lacking the penicil on the maxilliped endite, from *Caraiboscia* in having the outer teeth of the maxillule apically cleft, and from *Colombophiloscia* in having a dichothomized instead of simple molar penicil of the mandible. Within the Prosekiini the noduli laterales more or less at the same distance from the lateral margins of the pereonites are present only in the new genus and in *Metaprosekia* Leistikow, 2000 (see below), whereas in all the other genera (*Prosekia*, *Xiphoniscus* Vandel, 1968, *Andenoniscus* Verhoeff, 1941, *Androdeloscia* Leistikow, 1999, and *Erophiloscia* Vandel, 1972) the nudulus lateralis on pereonite 4 is inserted more medially.

Leonardoscia hassalli Campos-Filho, Araujo & Taiti **sp. nov.**

Figures 14–16, 40

Type material

Holotype: ♂, Brazil, Pará, Altamira, Caverna Leonardo da Vinci, 3°09′02″S, 52°04′10″W, 17 December 2010, leg. M.E. Bichuette and J.E. Gallão (MZUSP 27525).

Paratypes: One ♂, eight ♀, same data as holotype (MZUSP 27526); two ♂, same locality as holotype, 14 April 2009, leg. M.E. Bichuette (MZUSP 27527).

Etymology

The new species is named after Prof. Mark Hassall, for his contribution to the knowledge on the biology of Oniscidea.

Description

Maximum length: ♂ and ♀, 2.5 mm. Body outline as in Figure 14A. Body colourless. Dorsum covered with semicircular scales and numerous fan-shaped scale setae (Fig. 14G); noduli laterales with b/c and d/c coordinates as in Figure 14B; gland pores not visible. Cephalon (Fig. 14C–E) with suprantennal line bent down in the middle; eyes reduced, consisting of four ommatidia. Telson with distal part triangular, with straight sides and obtuse apex (Fig. 14F). Antennule (Fig. 14H) with first and third articles subequal in length, second article shorter; third article with two long apical aesthetascs and a tuft of six aesthetascs on medial margin. Antenna (Fig. 14I) reaching back middle pereonite 2; fifth article of peduncle swollen; flagellum as long as fifth article

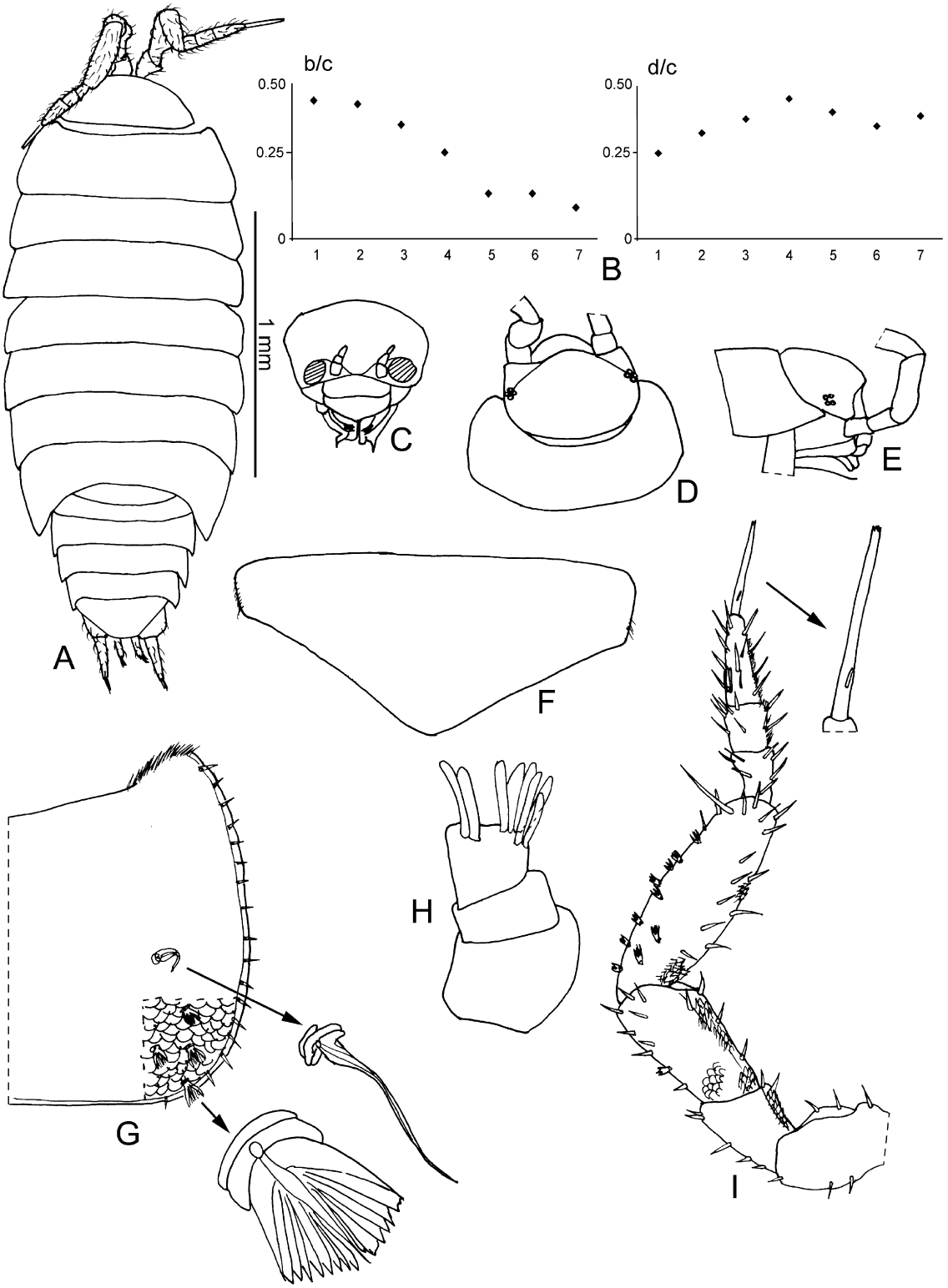

Figure 14. ***Leonardoscia hassalli*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♀: A, habitus, dorsal; B, noduli laterales b/c and d/c coordinates (b = distance of the nodulus lateralis from the posterior margin of the pereonite; c = length of the pereonite; d = distance of the nodulus lateralis from the lateral margin of the pereonite); C, cephalon, frontal; D, cephalon and pereonite 1, dorsal; E, cephalon and pereonite 1, lateral; F, telson; G, pereonite 1, nodulus lateralis, and dorsal scale seta; H, antennule; I, antenna.

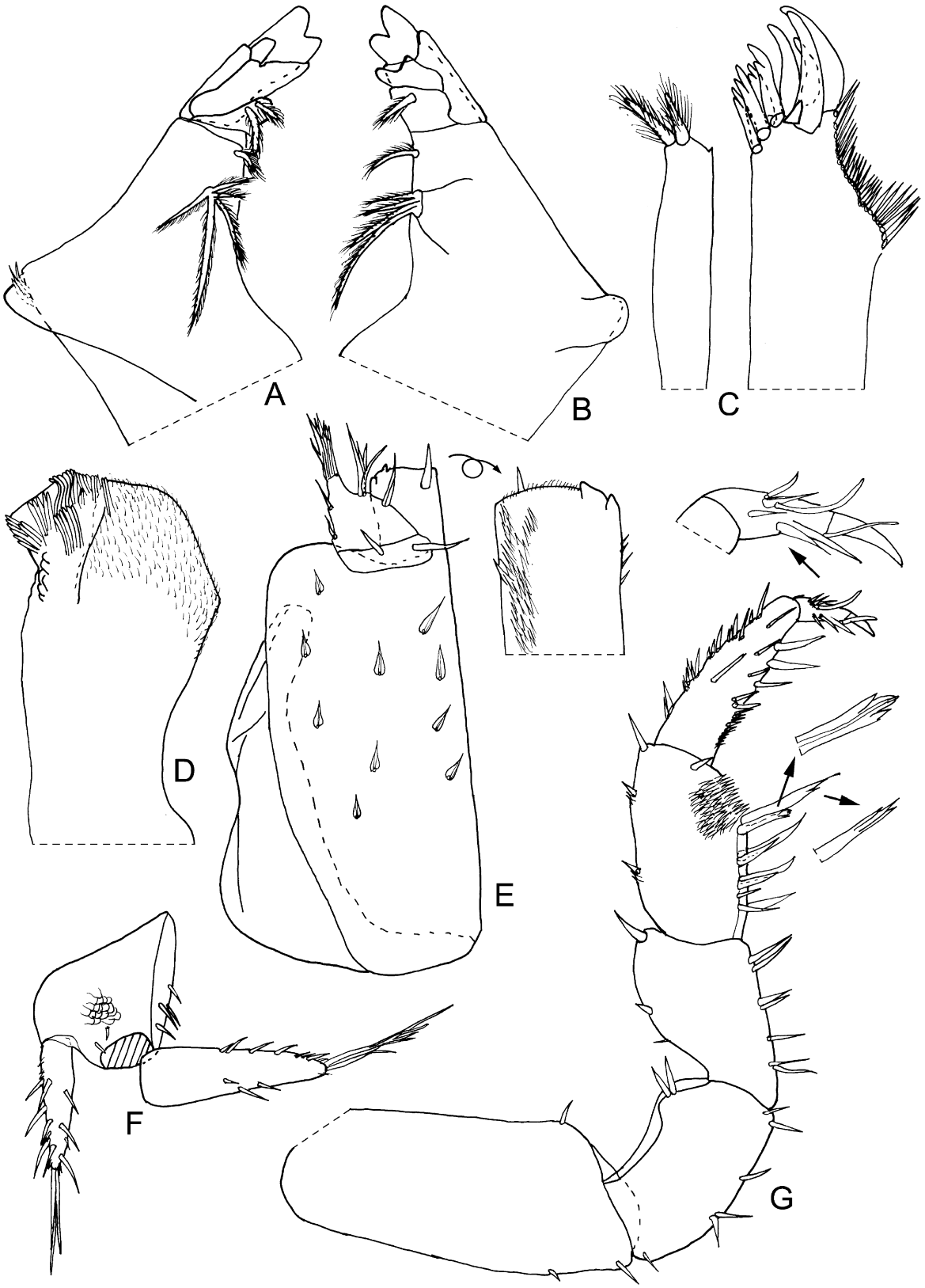

Figure 15. ***Leonardoscia hassalli*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♀: A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped; ♂: F, uropod; G, pereopod 1.

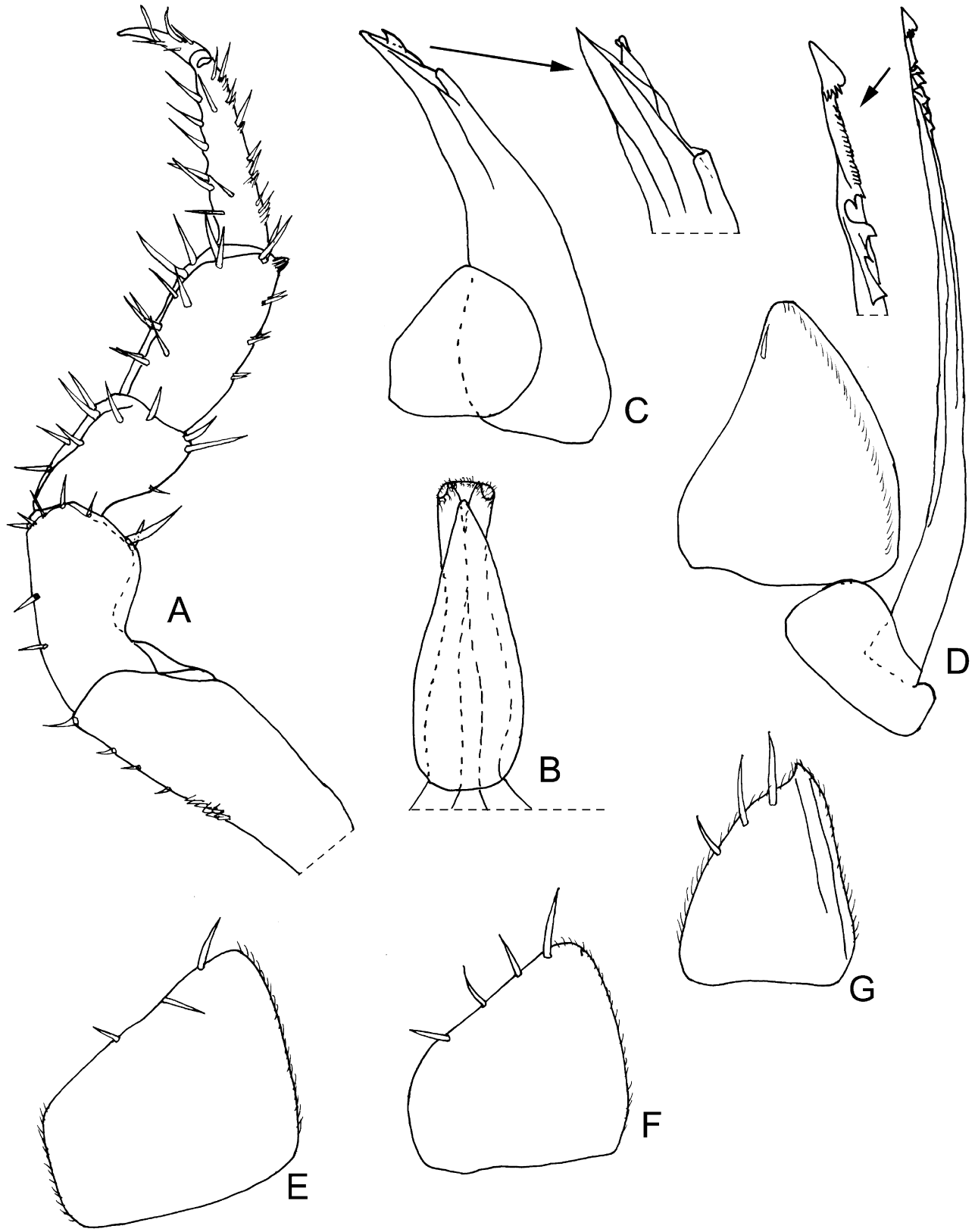

Figure 16. ***Leonardoscia hassalli*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 7; B, genital papilla; C, pleopod 1; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

of peduncle, distal flagellar article longer than first and second, and bearing two aesthetascs, apical organ as long as distal article of flagellum, showing sensory hairs enclosed by a common tube-like sheath, free sensilla short and inserted at one-quarter of the length of the apical organ. Mandibles (Fig. 15A,B) with molar penicil consisting of five branches, 2 + 1 free penicils on the left and 1 + 1 on the right mandible. Maxillule (Fig. 15C) outer branch with 4 + 5 teeth (four cleft); inner branch with two long narrow penicils at apex. Maxilla (Fig. 15D) with setose and bilobate apex; outer lobe about twice as wide as inner lobe, and with distal margin rounded. Maxilliped (Fig. 15E) basis rectangular, with sparse triangular scale setae; endite with short setae and two triangular teeth at apex. Pereopods dactylus with long inner claw, ungual and dactylar setae flagelliform, with simple apex. Pereopod 1 (Fig. 15G) with transverse antennal grooming brush and one seta with hand-like apex. Uropod (15F) with exopod distinctly longer than endopod.

Male: Pereopod 7 (Fig. 16A) ischium with sternal margin slightly convex and bearing two long setae. Genital papilla (Fig. 16B) with a triangular ventral shield and two apical orifices. Pleopod 1 (Fig. 16C) exopod triangular, about as wide as long, with medial and outer margins rounded; endopod with distal portion bearing a subapical triangular lobe on medial margin, acute apex. Pleopod 2 (Fig. 16D) exopod triangular, outer margin slightly concave and bearing one seta; endopod with short basal article, narrow distal article about twice as long as exopod, with distal portion equipped with some triangular teeth and an arrow-like apex. Pleopods 3 and 4 exopods (Fig. 16E,F) subquadrangular, bearing three and four setae, respectively. Pleopod 5 exopod (Fig. 16G) triangular, outer margin convex, bearing three long setae, acute apex.

GENUS *METAPROSEKIA* LEISTIKOW, 2000

Type species: Metaprosekia nodilinearis Leistikow, 2000 by original designation and monotypy.

Diagnosis
See Leistikow (2000).

METAPROSEKIA QUADRIOCELLATA CAMPOS-FILHO, ARAUJO & TAITI **SP. NOV.**

FIGURES 17–19, 40

Type material
Holotype: ♂, Brazil, Pará, Altamira, Caverna Leonardo da Vinci, 3°09′48″S, 52°05′09″W, 14 April 2009, leg. M.E. Bichuette (MZUSP 27528).

Paratypes: Brazil, Pará, Altamira, one ♂, same data as holotype (MZUSP 27529); one ♀, 3°15′11″S, 52°11′08″W, 8 July 2009, leg. M.E. Bichuette (MZUSP 27530), one ♂, two ♀ (part of one in micropreparations), 11 April 2009, leg. M.E. Bichuette (MZUSP 27531); one ♂ (part in micropreparations), one ♀, Abrigo do Sismógrafo, 3°17′18″S, 52°13′28″W, 9 April 2009, leg. M.E. Bichuette (MZUSP 27532); one ♂, one ♀, Abrigos Assurini, 3°15′04″S, 52°10′45″W, 15 December 2010, leg. M.E. Bichuette and J.E. Gallão (MZUF 7698).

Etymology
Latin: *quadri* = four + *ocellatus* = having eyes. The name refers to the small eye of the species, consisting of only four ommatidia.

Description
Maximum length: ♂, 3.6 mm; ♀, 4 mm. Body elongated, outline as in Figure 17A. Colour yellowish brown, antenna and uropods completely pigmented, cephalon with irregular pale spots, pereonites 1–7 with the usual muscle pale spots, pereonites 4–7 with a longitudinal medial pale spot, pleon completely pigmented, telson displaying four small pale spots. Dorsum covered with sparse pointed scale setae (Fig. 17C); one line of noduli laterales per side, inserted more or less at the same distance from the lateral margin of pereonites, b/c and d/c coordinates as in Figure 17B; gland pores not visible. Cephalon (Fig. 17D,E) lacking frontal line, suprantennal line slightly sinuous; eyes reduced, with four ommatidia. Pleon narrower than pereon; pleonites 3–5 reduced, adpressed, with no visible posterior points (Fig. 17A). Telson (Fig. 17F) with distal part triangular, with slightly concave sides and obtuse apex. Antennule (Fig. 17G) of three articles, first article longer than second and third, third article with apical aesthetascs and a tuft of five aesthetascs on medial margin. Antenna (Fig. 17H) reaching rear margin of pereonite 3; flagellum as long as fifth article of peduncle, third flagellar article longer than first and second, and bearing one row of two aesthetascs, apical organ as long as distal article of flagellum, showing sensory hairs enclosed by a common tube-like sheath, free sensilla short and inserted at one-quarter of the length of the apical organ. Mandibles (Fig. 17I,J) with molar penicil consisting of five or six branches, 2 + 1 free penicils on the left and 1 + 1 on the right mandible. Maxillule (Fig. 18A) outer branch with 4 + 5 (four cleft) teeth and one slender seta; inner branch with two short penicils and a short triangular point. Maxilla (Fig. 18B) with setose and bilobate apex; outer lobe about twice as broad as inner lobe, with distal margin rounded. Maxilliped (Fig. 18C) basis rectangular; endite setose on the medial and distal margins, one seta overpassing distal margin, and one

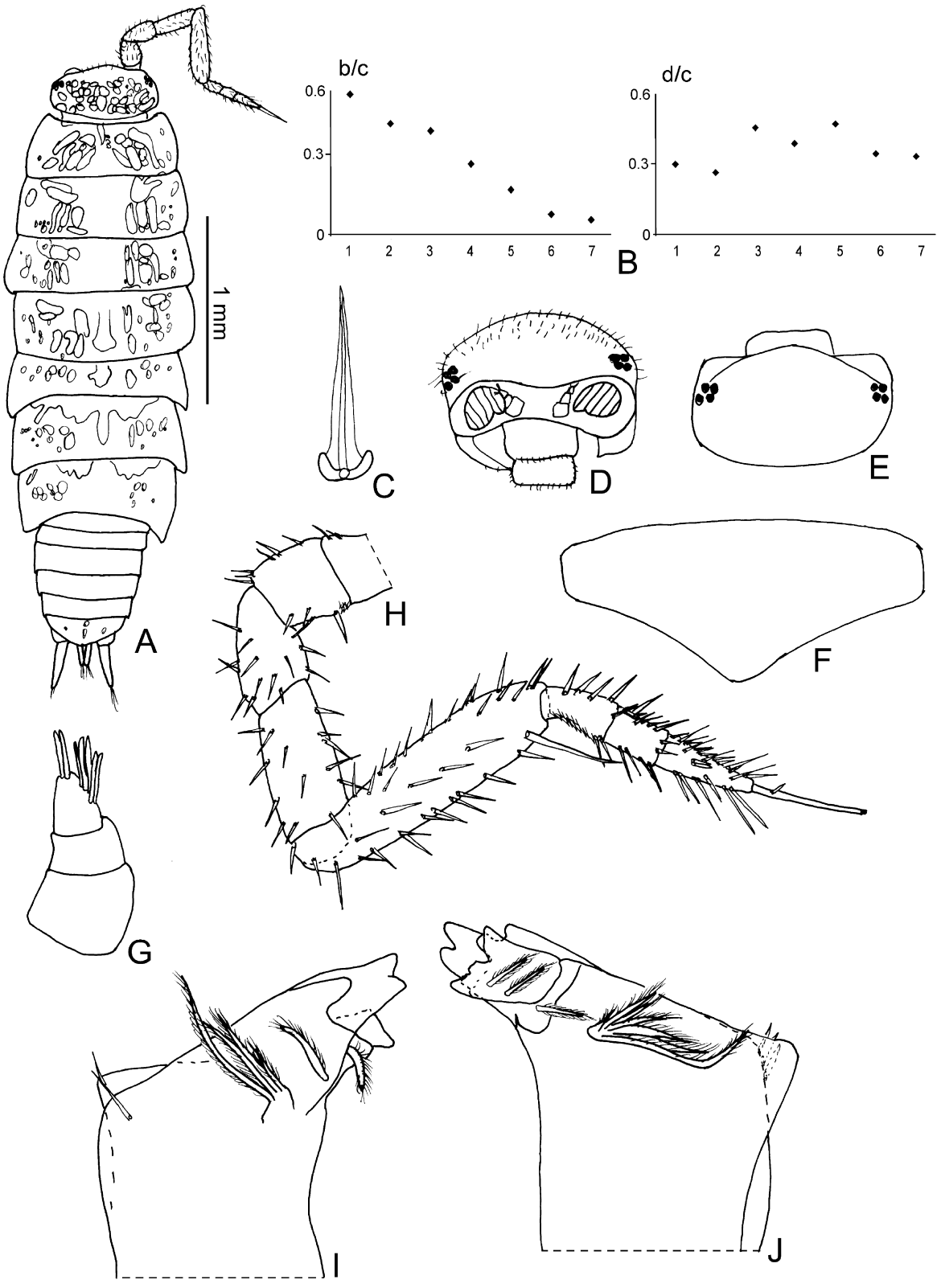

Figure 17. ***Metaprosekia quadriocellata*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, habitus, dorsal; B, noduli laterales b/c and d/c coordinates; C, dorsal scale seta; D, cephalon, frontal; E, cephalon, dorsal; F, telson; G, antennule; H, antenna; I, left mandible; J, right mandible.

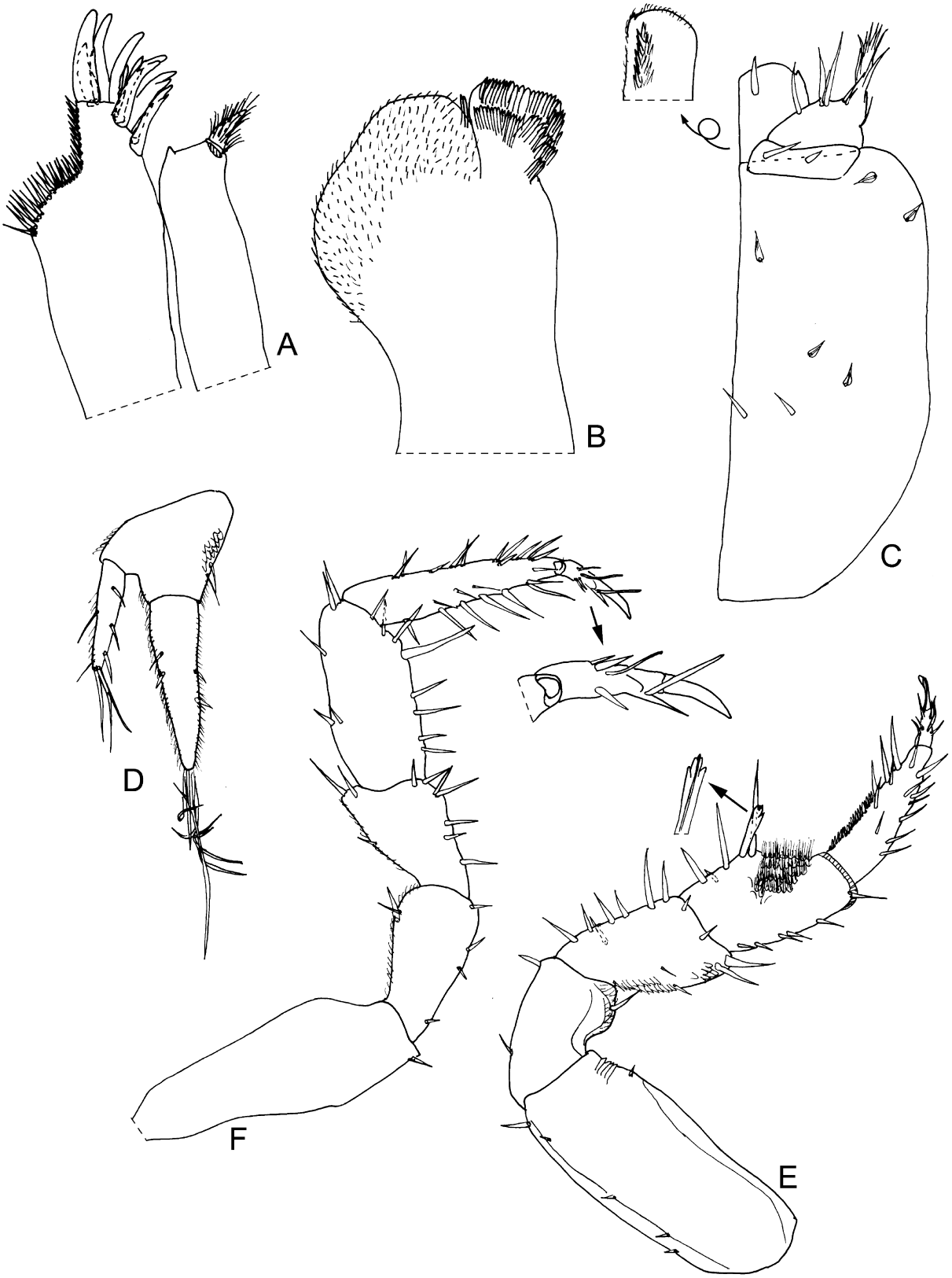

Figure 18. ***Metaprosekia quadriocellata*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, maxillule; B, maxilla; C, maxilliped; D, uropod; E, pereopod 1; F, pereopod 7.

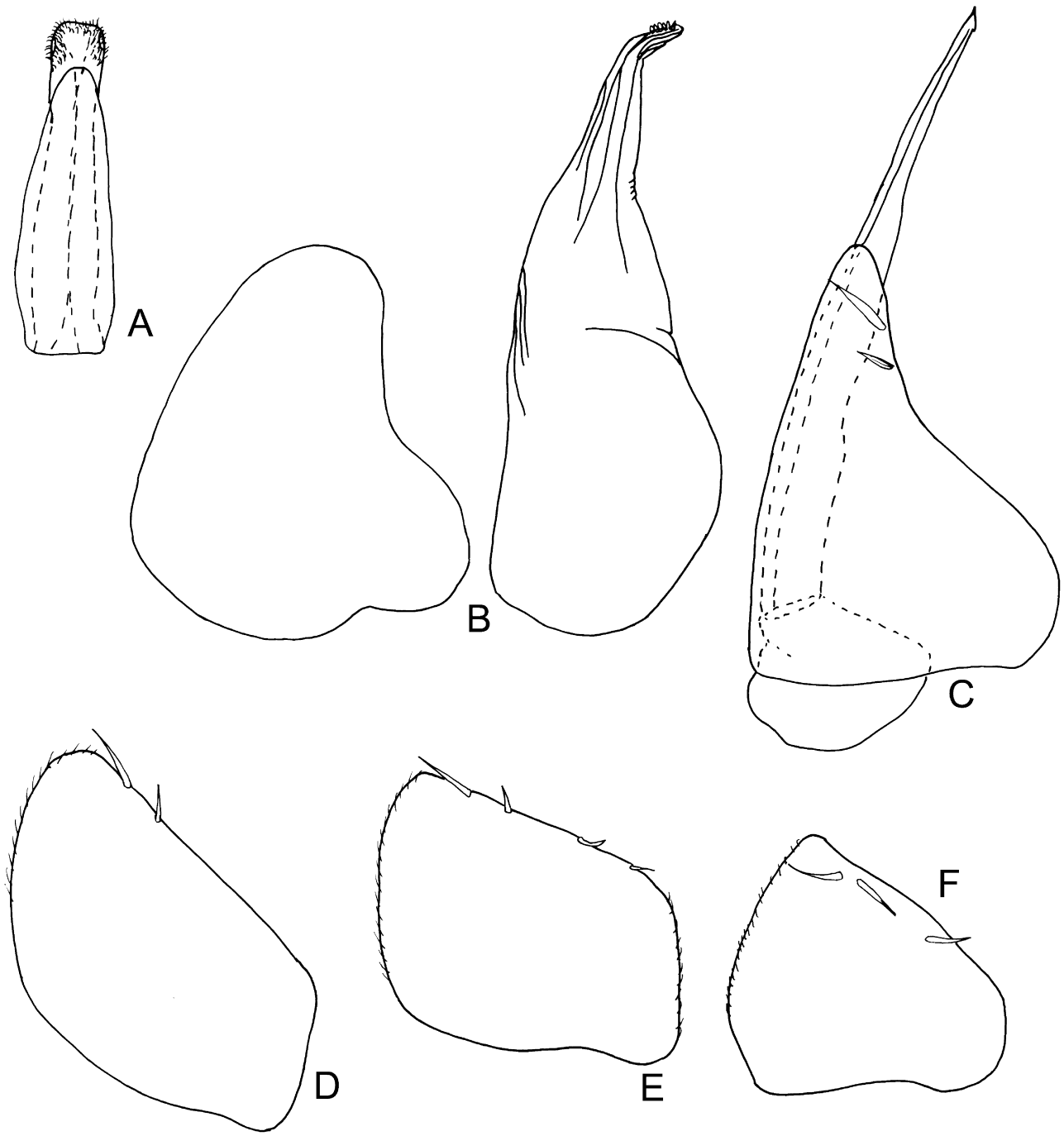

Figure 19. ***Metaprosekia quadriocellata*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, genital papilla; B, pleopod 1; C, pleopod 2; D, pleopod 3 exopod; E, pleopod 4 exopod; F, pleopod 5 exopod.

triangular point on outer corner. Pereopod dactylus with ungual seta simple, apex reaching tip of outer claw, dactylar seta short, reaching base of inner claw. Uropod (Fig. 18D) protopod grooved on the distal half of the outer margin; exopod longer than endopod; insertion of endopod proximal to that of exopod.

Male: Pereopod 1 (Fig. 18E) and pereopod 7 (Fig. 18F) with no distinct sexual differentiation. Genital papilla (Fig. 19A) with a triangular ventral shield and two subapical orifices. Pleopod 1 (Fig. 19B) exopod cordiform, with distal margin broadly rounded, and outer margin concave; endopod with distal portion narrow, bearing

minute setae, and bent outwards. Pleopod 2 (Fig. 19C) exopod triangular, outer margin concave, bearing two setae; endopod distinctly longer than exopod. Pleopods 3 and 4 exopods (Fig. 19D,E) rhomboidal, with distal margins bearing two and four setae, respectively. Pleopod 5 exopod (Fig. 19F) triangular, outer margin sinuous, bearing three long setae.

Remarks

Leistikow (2000) established *Metaprosekia* for the new species *M. nodilinearis* from the Venezuelan Cordilleras, and included the genus in the Prosekiini. Leistikow (2001a) considers the small eye with three ommatidia and the position of noduli laterales in a line at the same distance from the lateral margins of the pereonites as possible autoapomorphies of the genus. The new species here described shows all the characters of the genus except for the eye with four ommatidia. In general, eye size cannot be considered as a good generic character as it is linked to the ecology of the species. *Metaprosekia qudriocellata* sp. nov. is readily distinguished from *M. nodilinearis* by the eye with four instead of three ommatidia, seven instead of 12 aesthetascs on the antennule, shorter dactylar organ on pereopods, male pleopod 1 exopod with wider and more broadly rounded distal part, and different shape of the male pleopods 1–5 exopods.

METAPROSEKIA CAUPE CAMPOS-FILHO, ARAUJO & TAITI **SP. NOV.**

FIGURES 20–22, 40

Type material

Holotype: ♂, Brazil, Pará, Caverna Sugiro, 3°17′54″S, 52°14′06″W, 13 December 2010, leg. M.E. Bichuette and J.E. Gallão (MZUSP 27550).

Paratypes: Two ♂, three ♀, same data as holotype (MZUSP 27551), one ♂, one ♀, same data as holotype (MZUF 7699).

Etymology

The new species is named after Caupé, the Tupí-Guaraní divinity of beauty.

Description

Maximum length: ♂, 2.7 mm; ♀, 3 mm. Body outline as in Figure 20A. Colour yellowish brown. Dorsum covered with sparse lanceolate scale setae (Fig. 20B). Noduli laterales inserted more or less at the same distance from the lateral margin of pereonites; b/c and d/c coordinates as in Fig 20C; gland pores not visible. Cephalon (Fig. 20D, E) with suprantennal line straight; eye with four ommatidia. Pleonites 3–5 with epimera reduced, adpressed, with no posterior points (Fig. 20A). Telson with distal part triangular with slightly concave sides and obtuse apex (Fig. 20F). Antennule (Fig. 20G) of three articles similar in length, third article with two apical aesthetascs and one tuft of six aesthetascs on medial margin. Antenna (Fig. 20H) reaching mid pereonite 3; flagellum slightly shorter than fifth article of peduncle, third article longer than second and third, third article bearing one row of two aesthetascs, apical organ as long as distal article of flagellum, showing sensory hairs enclosed by a common tube-like sheath, free sensilla short and inserted at one quarter of the length of the apical organ. Buccal pieces (Figs 20I,J, 21A–C) similar to those of the preceding species. Pereopod (Figs 21E, 22A) dactylus with ungual and dactylar setae having simple apex and reaching tip of outer claw. Uropod (Fig. 21D) protopod grooved on the distal half of the outer margin; exopod longer than endopod; insertion of endopod proximal to that of exopod.

Male: Pereopod 1 (Fig. 21E) and pereopod 7 (Fig. 22A) with no distinct sexual modifications. Genital papilla (Fig. 22B) with a triangular ventral shield and two subapical orificies. Pleopod 1 (Fig. 22C,D) exopod triangular, with outer margin concave and medial margin convex; endopod about twice longer than exopod, distally pointed and bent outwards, with a line of short setae near medial margin. Pleopod 2 (Fig. 22E) exopod triangular, outer margin slightly concave, bearing three setae; endopod distinctly longer than exopod. Pleopods 3–5 exopods (Fig. 22F–H) subquadrangular, with distal margins slightly concave and bearing two, four, and three setae, respectively.

Remarks

Metaprosekia caupe sp. nov. can be distinguished from *M. nodilinearis* by the eye with four instead of three ommatidia, the smaller number of aesthetascs on the antennule (eight instead of 12), and the male pleopod 1 exopod with shorter distal point and more concave outer margin. It is very similar to *M. quadriocellata* sp. nov., from which it differs mainly in the shape of the male pleopod 1 exopod, with a smaller distal point, and endopod, with the apical part less bent outwards.

GENUS *BENTHANA* BUDDE-LUND, 1908

Type species: Philoscia picta Brandt, 1833 by subsequent designation (Van Name, 1936).

Diagnosis

See LEMOS DE CASTRO (1958), Araujo & Leistikow (1999), and Leistikow (2001a).

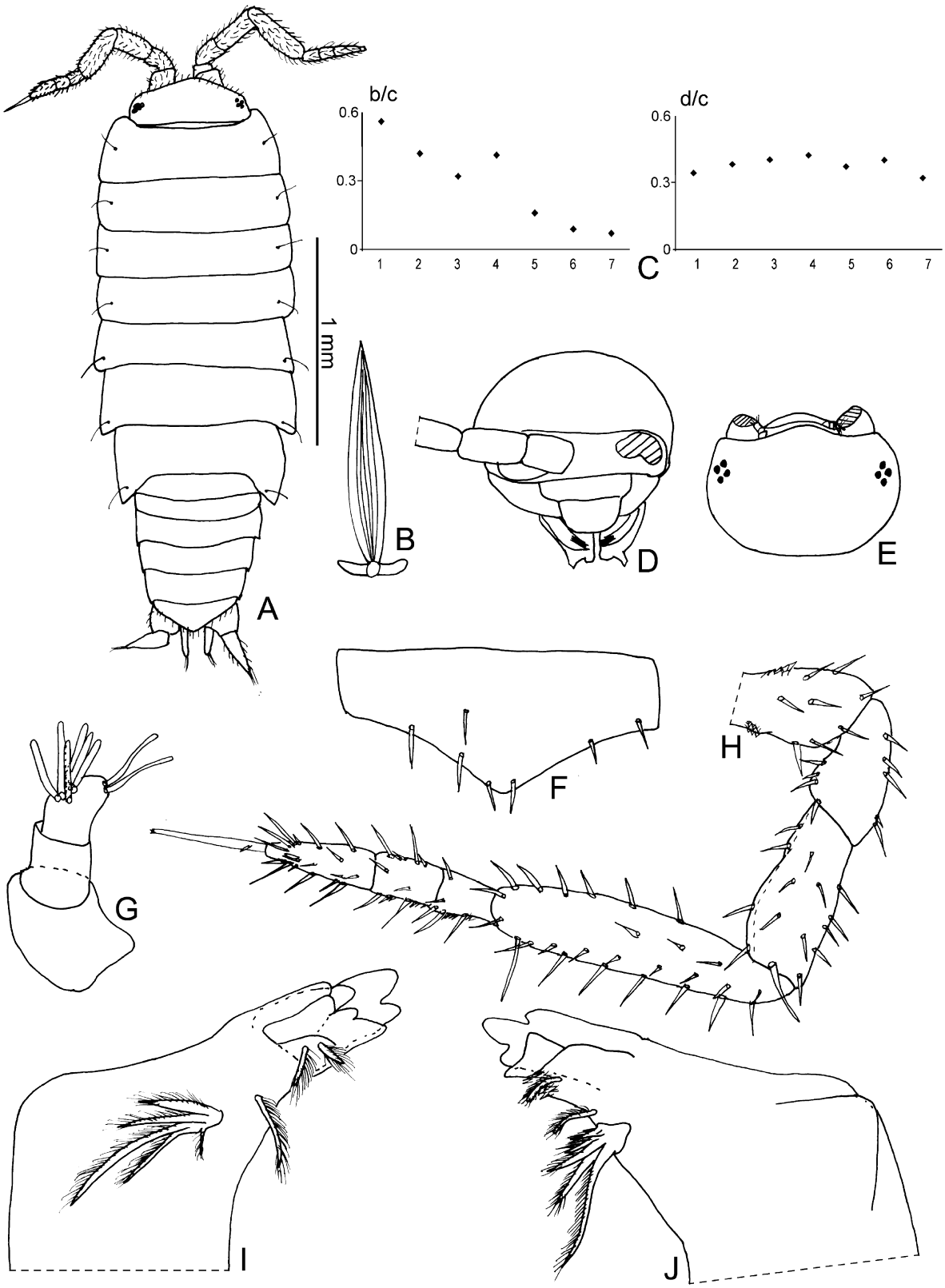

Figure 20. ***Metaprosekia caupe*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, habitus, dorsal; B, dorsal scale seta; C, noduli laterales b/c and d/c coordinates; D, cephalon, frontal; E, cephalon, dorsal; F, telson; G, antennule; H, antenna; I, left mandible; J, right mandible.

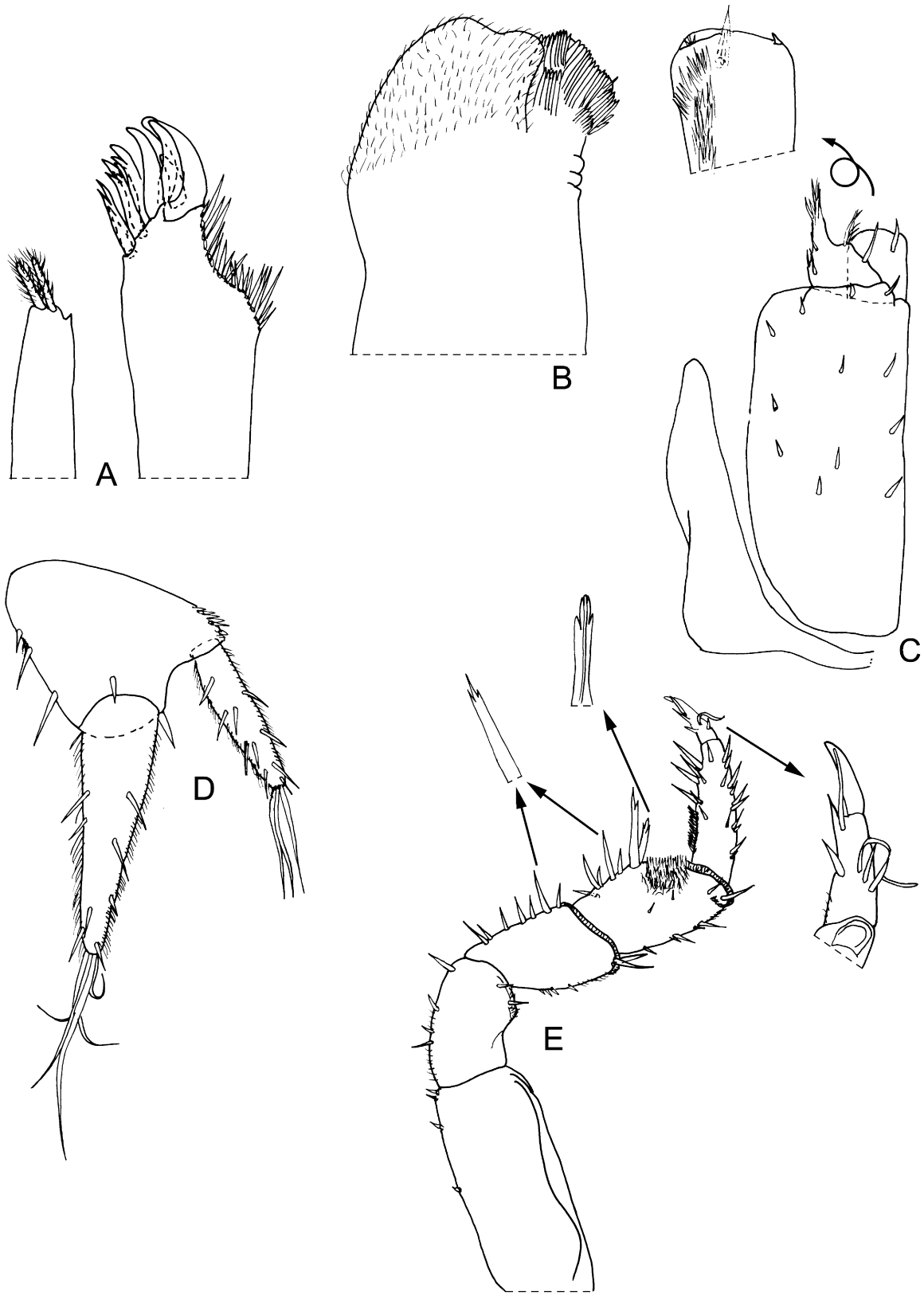

Figure 21. ***Metaprosekia caupe*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, maxillule; B, maxilla; C, maxilliped; D, uropod; E, pereopod 1.

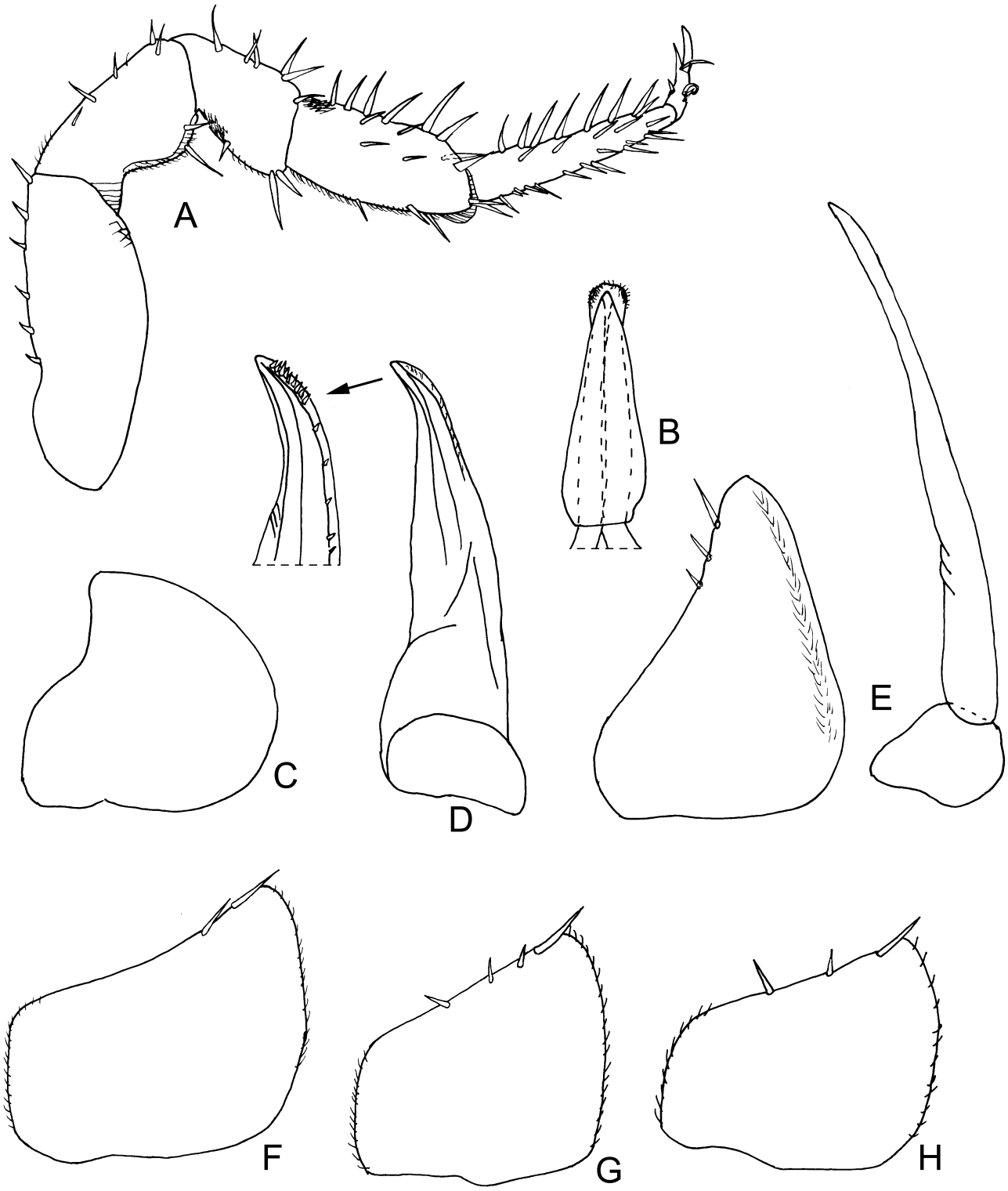

Figure 22. ***Metaprosekia caupe*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 7; B, genital papilla; C, pleopod 1 exopod; D, pleopod 1 endopod; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

BENTHANA IPORANGENSIS LIMA & SEREJO, 1993

FIGURE 40

Benthana iporangensis Lima & Serejo, 1993: 490, figs 1–4; Souza-Kury, 1998: 659; Leistikow & Wägele, 1999: 14; Schmalfuss, 2003: 53.

Remarks

To date, *Benthana* includes two subgenera: *Benthana s.s.* with 21 species and *Benthanoscia* Lemos de Castro, 1958 with four species. The genus is distributed in south-eastern and southern Brazil; two species, *Benthana angustata* (Nicolet, 1849) and *Benthana bilineata* (Nicolet, 1849), are recorded from Chile, but their position in this genus is doubtful. *Benthana iporangensis* was described from material collected in three caves from São Paulo state: Águas Quentes, Areias de Cima, and Areias de Baixo caves (Fig. 40). *Benthana iporangensis* was the second cavernicolous oniscidean described from Brazil.

Distribution

Brazil: São Paulo.

BENTHANA TAENIATA ARAUJO & BUCKUP, 1994

FIGURE 40

Benthana taeniata Araujo & Buckup, 1994: 269, figs 1–13, 28; Souza-Kury, 1998: 660; Leistikow & Wägele, 1999: 14; Araujo & Lopes, 2003: 2438; Schmalfuss, 2003: 62; Leistikow & Araujo, 2006: 244, figs 1–5.

Material examined

Brazil, Minas Gerais: one ♀, Serra da Canastra, São Roque de Minas, Gruta Zeferino I, 20°06′03″S, 46°25′09″W, 7 April 2009, leg. M.E. Bichuette (UFGRS 5375).

Remarks

Despite *Benthana* species being recognized mainly by the shape of the male pleopod 1 exopod, female specimens can be identified by other characteristics found in the antennule, maxillule, maxilliped endite, uropods and telson. The female specimen examined here is identified as *Benthana taeniata* on the basis of these characters. Moreover, also the distinct colour pattern of the antenna is characteristic of this species (see Araujo & Buckup, 1994). *Benthana taeniata* was also collected out of caves in the state of Minas Gerais (I.S.C.-F., pers. observ.).

Benthana taeniata was previously known from the Brazilian states of Rio de Janeiro, Santa Catarina, and Rio Grande do Sul. The present record, the first north of south-eastern Brazil, indicates a wide distribution for this species.

GENUS *ISCHIOSCIA* VERHOEFF, 1928

Type species: Ischioscia lobifera Verhoeff, 1928 [= *Ischioscia variegata* (Dollfus, 1893a)], by monotypy.

Diagnosis

See Vandel (1968), Schmalfuss (1980), Leistikow (1999, 2001a, 2001d), and Leistikow & Schmidt (2002).

ISCHIOSCIA AMAZONICA LEMOS DE CASTRO, 1955

FIGURE 40

Ischioscia amazonica Lemos de Castro, 1955: 51, figs 1–8; 1967: 318; Schmalfuss, 1980: 131; Souza-Kury, 1998: 661; Leistikow & Wägele, 1999: 16; Leistikow & Schmidt, 2002: 152, figs 17–21.

Proischioscia amazonica; Vandel, 1968: 78, figs 12, 13.

Material examined

Brazil, Pará: One ♂, Canaã dos Parauapebas, Gruta Cav 18 S11, 06°26′08″S, 50°17′43″W, 22–28 September 2010, leg. R. Andrade (UFRGS 4754); one ♀, Parauapebas, Gruta Cav 28 S11, 06°24′23″S, 50°14′56″W, 22–28 September 2010, leg. R. Andrade (UFRGS 4775).

Distribution

Brazil: Amazonia and Pará.

FAMILY SCLEROPACTIDAE VERHOEFF, 1938

GENUS *AMAZONISCUS* LEMOS DE CASTRO, 1967

Type species: Amazoniscus arlei Lemos de Castro, 1967, by original designation and monotypy.

Diagnosis

See Lemos de Castro (1967, 1969) and Schmidt (2007).

AMAZONISCUS LEISTIKOWI CAMPOS-FILHO, ARAUJO & TAITI **SP. NOV.**

FIGURES 23–25, 40

Type material

Holotype: ♂, Brazil, Pará, Altamira, Abrigo do Sismógrafo, 3°17′18″S, 52°13′30″W, 9 April 2009, leg. M.E. Bichuette (MZUSP 27534).

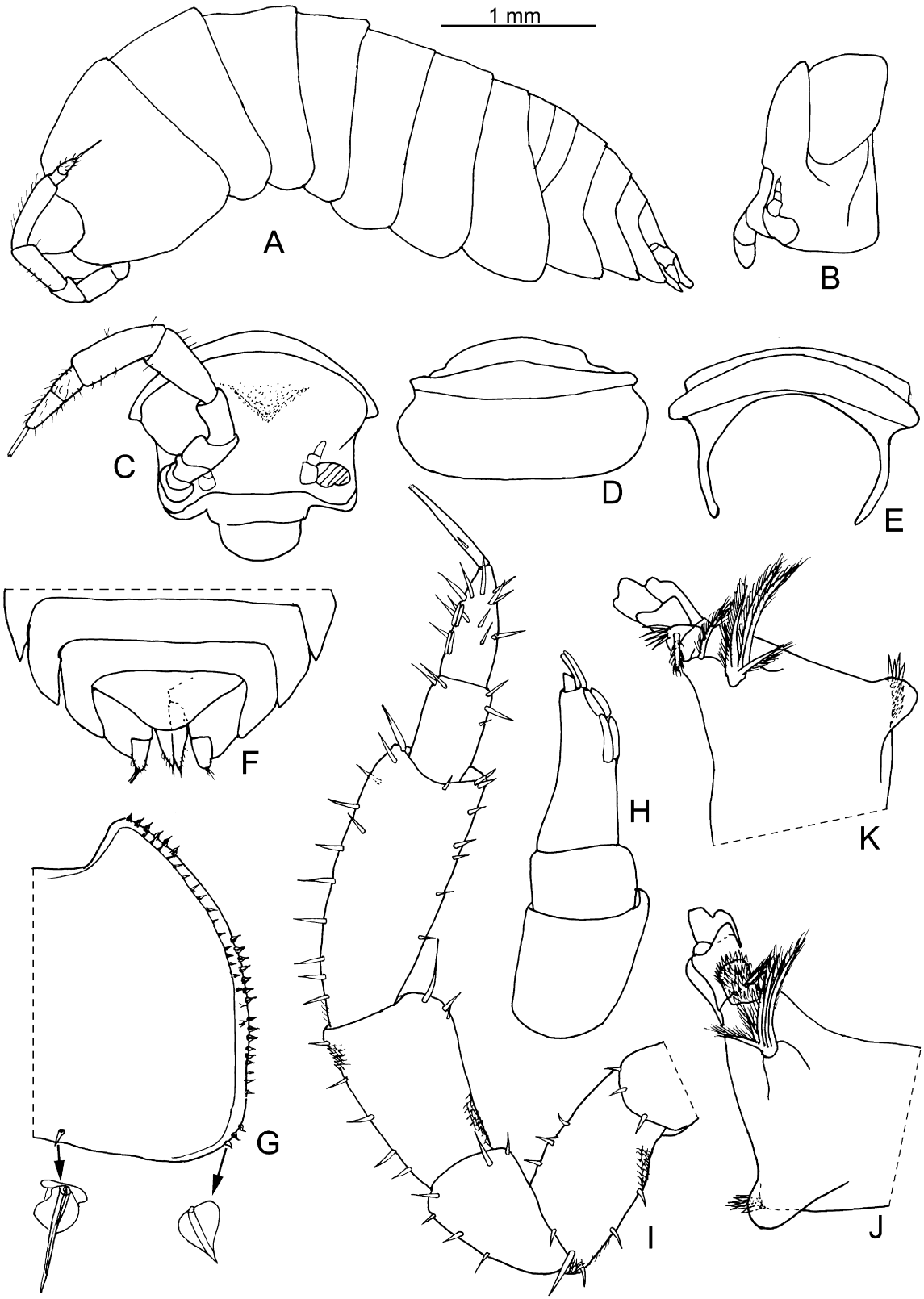

Figure 23. ***Amazoniscus leistikowi*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, habitus, lateral; B, cephalon, lateral; C, cephalon, frontal; D, cephalon, dorsal; E, cephalon, caudal; F, pleonites 3–5, telson, and uropods; G, pereonite 1, nodulus lateralis, and dorsal scale seta; H, antennule; I, antenna; J, left mandible; K, right mandible.

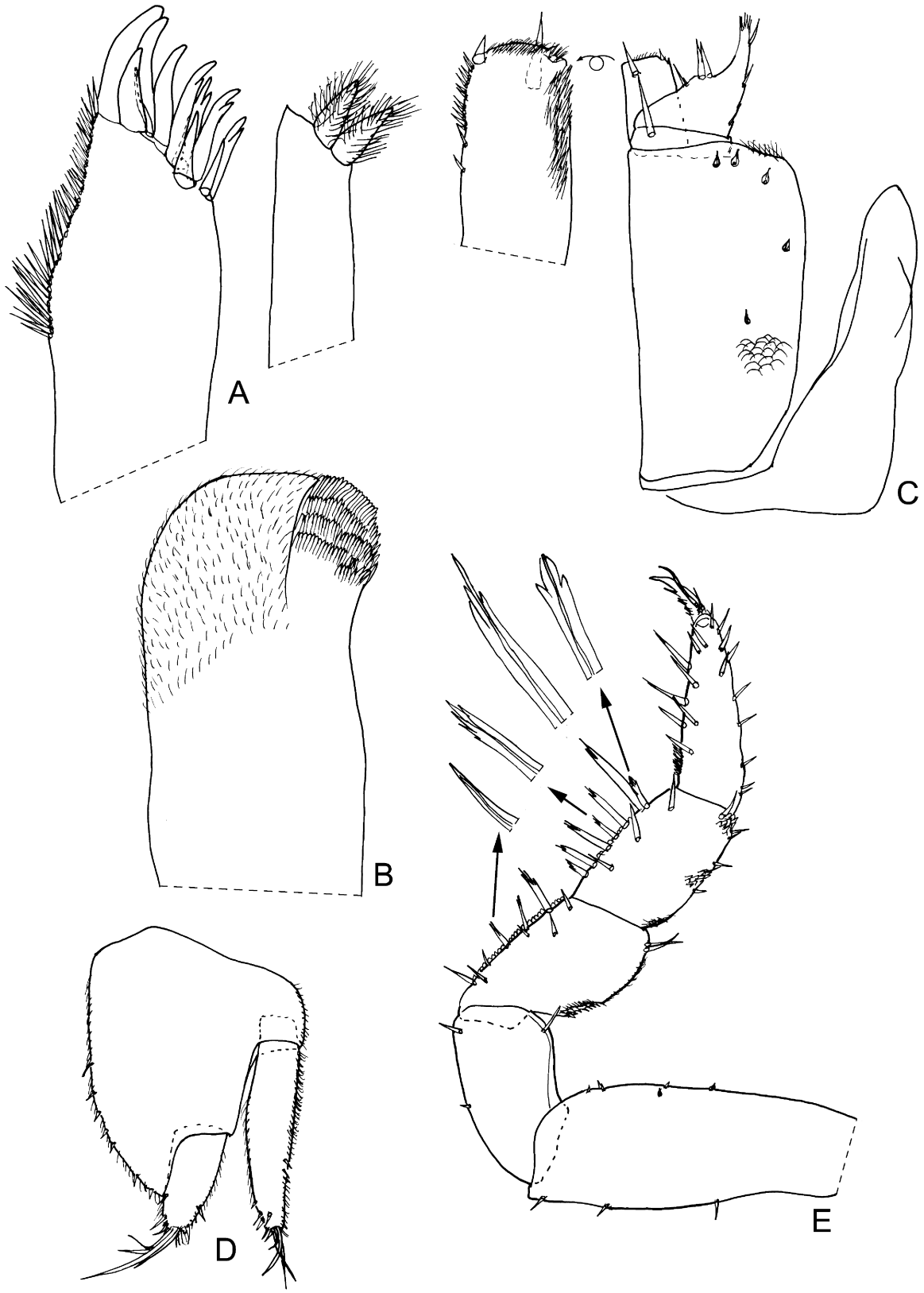

Figure 24. ***Amazoniscus leistikowi*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, maxillule; B, maxilla; C, maxilliped; D, uropod; E, pereopod 1.

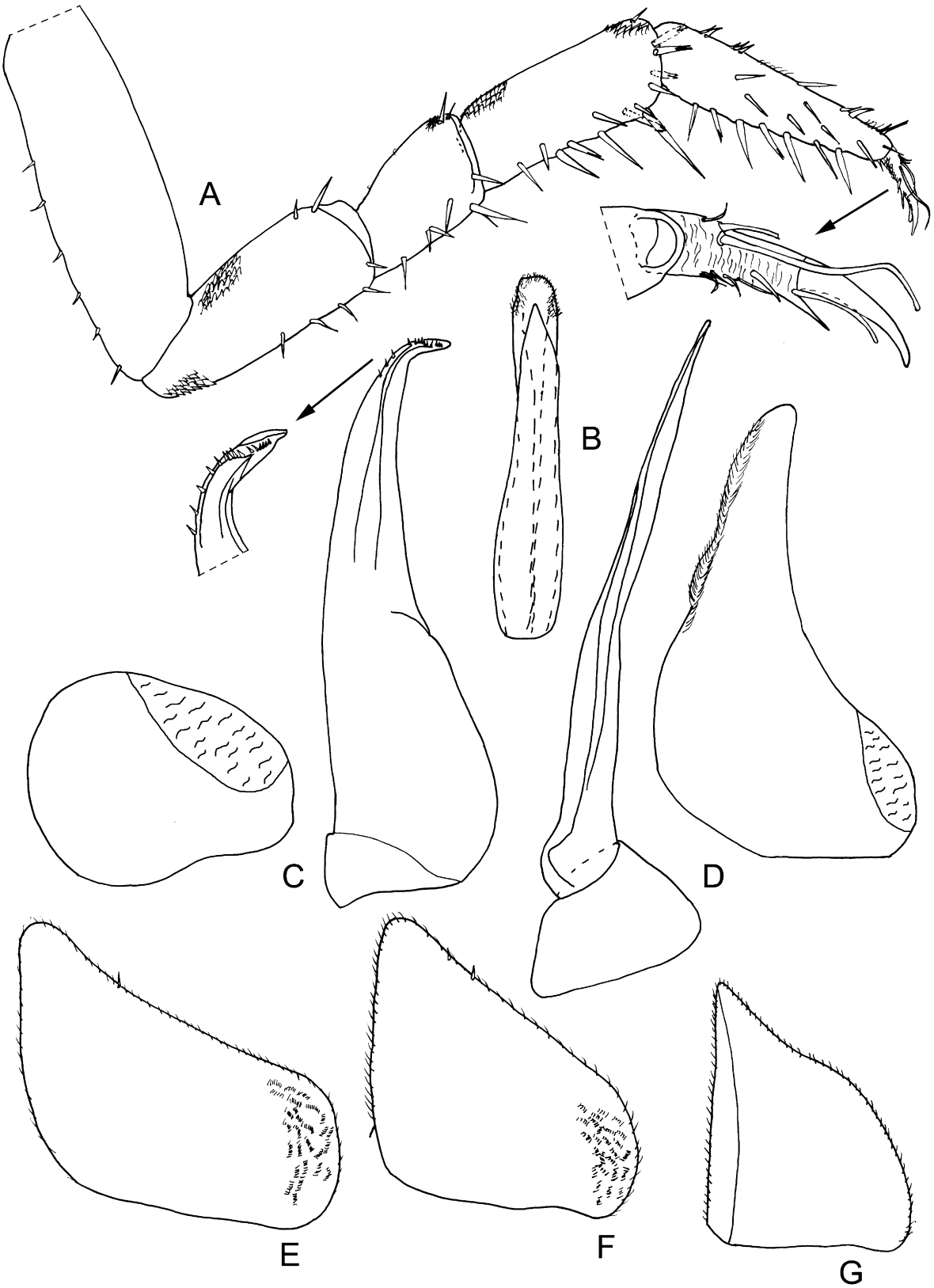

Figure 25. ***Amazoniscus leistikowi*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 7; B, genital papilla; C, pleopod 1; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

Paratypes: One ♂ (in micropreparation), two ♀, same data as holotype (MZUSP 27535).

Etymology

The new species is named after Dr Andreas Leistikow, for his contribution to the knowledge of Neotropical Oniscidea.

Description

Maximum length: ♂, 4 mm; ♀, 4.4 mm. Colourless body. Body convex, endoantennal conglobation (Fig. 23A). Dorsum smooth, with some scattered triangular scale setae; one line of noduli laterales per side, more or less at the same distance from the lateral margins and close to the posterior margins of the pereonites; no visible gland pores (Fig. 23G). Cephalon (Fig. 23B–E) with frontal shield protruding upwards, frontal margin broadly rounded, no suprantennal line; eyes absent. Pereonites 1 and 2 with no schisma or ventral lobes; pereonites 1–5 with posterior margin straight; pereonites 6 and 7 with posterior margin slightly sinuous at sides. Pleon (Fig. 23F) continuous with pereon, epimera 3–5 well developed, directed backwards. Telson (Fig. 23F) short, more than twice as broad as long, with slight concave sides and rounded apex. Antennule (Fig. 23H) of three articles, third article about twice as long as second, bearing three rows of two aesthetascs each and an apical triangular point. Antenna (Fig. 23I) short and stout, reaching posterior margin of first pereonite when extended back, fifth article of peduncle slightly longer than flagellum, flagellum with two subequal articles, distal article with two rows of two aesthetascs each, apical organ as long as second article of flagellum, and with simple and short free sensilla. Mandibles (Fig. 23J,K) with molar penicil consisting of five setae, left mandible with two penicils, and right mandible with one penicil. Maxillule (Fig. 24A) with inner branch bearing two short penicils, inserted transversely, and a distal triangular point; outer branch with 4 + 6 (four cleft) teeth and a slender seta. Maxilla (Fig. 24B) with outer lobe about twice as broad as medial lobe, distal margin rounded, and covered with trichiform setae; medial lobe rounded, and covered with thick setae. Maxilliped (Fig. 24C) with rectangular basis, sparse scale setae, distal margin with fringe of thin setae; endite rectangular with distal margin rounded with a short penicil and one hook; palp with three tufts of setae, proximal article with one long inner seta. Pereopods with short inner claw, ungual seta long and simple, long dactylar seta simple, and reaching tip of outer claw. Pleopods 1 and 2 with respiratory areas. Uropod (Fig. 24D) with insertion of endopod and exopod at different levels, protopod flattened and enlarged, endopod twice as long as exopod.

Male: Pereopod 1 (Fig. 24E) with merus and carpus with sternal margin covered with short scales. Pereopod 7 (Fig. 25A) ischium elongated with almost parallel sides, carpus twice as long as merus. Genital papilla (Fig. 25B) with narrow ventral shield and subapical orifices. Pleopod 1 (Fig. 25C) exopod rounded; endopod with narrow distal part bent outwards and bearing small triangular setae. Pleopod 2 (Fig. 25D) exopod triangular, with concave outer margin; endopod distinctly longer than exopod. Pleopod 3 (Fig. 25E) exopod subquadrangular, with slightly concave outer margin, bearing one robust seta, inner and outer margins fringed with thin setae. Pleopod 4 (Fig. 25F) exopod triangular, straight outer margin with two robust setae, inner and outer margins fringed with thin setae. Pleopod 5 exopod (Fig. 25G) triangular, with distal part narrower and acute, inner and outer margins fringed with thin setae.

Remarks

To date, *Amazoniscus* includes two Brazilian species: *Amazoniscus arlei* Lemos de Castro, 1967, from the states of Amapá, Pará, and Tocantins (Lemos de Castro, 1967; Schmidt, 2007), and *Amazoniscus eleonorae* Souza, Bezerra & Araujo, 2006, from caves in the state of Pará (Souza *et al*., 2006). *Amazoniscus leistikowi* sp. nov. is readily distinguishable from *A. arlei* by the lack of eyes, the more broadly rounded telson, the male pereopod 7 ischium with sternal margin straight instead of concave, the male pleopod 1 exopod without a narrow posterior point, and endopod distinctly bent outwards. The new species is morphologically similar to *A. eleonorae*, the other cavernicolous species in the genus, from which it differs in having the antenna with stouter articles of the peduncle, the molar penicil of the mandible with five instead of 11 setae, and the male pleopod 1 endopod distinctly bent outwards in the distal part.

Amazoniscus eleonorae Souza, Bezerra & Araujo, 2006

Figure 40

Amazoniscus eleonorae Souza, Bezerra & Araujo, 2006: 37, figs 1–20.

Remarks

Amazoniscus eleonorae was the first Brazilian Scleropactidae species described from a hypogean environment, with material from three localities in the state of Pará – Pedra da Cahoeira, Planaltina, and Limoeiro caves – all located in the Altamira karst area (Fig 40).

GENUS *CIRCONISCUS* PEARSE, 1917

Type species: Circoniscus gaigei Pearse, 1917, by monotypy.

Diagnosis

See Souza & Lemos de Castro (1991) and Schmidt (2007).

Remarks

Schmidt (2007) revised the Neotropical Scleropactidae and redefined *Circoniscus*, considering the schisma on pereonite 1 as the autapomorphic character of the genus, as assumed by Souza & Lemos de Castro (1991). The genus *Amazoniscus* was included in the same clade and considered as the sister group of *Circoniscus*. Recently, Campos-Filho & Araujo (2011) described two cavernicolous species of *Circoniscus* from Pará, Brazil, and recorded the presence of a schisma in young individuals of *C. buckupi*, but lacking in adults, interpreted as a secondary loss. At present, *Circoniscus* includes seven species from French Guiana, Guyana, Brazil, Peru, and Paraguay (Schmidt, 2007).

CIRCONISCUS BEZZII ARCANGELI, 1931

FIGURE 40

Circoniscus bezzii Arcangeli, 1931: 115, plate II; Van Name, 1936: 311, fig. 184; Vilela *et al*., 1971: 185; Souza & Lemos de Castro, 1991: 50, figs 23–44; Schultz, 1995: 417, fig. 12J–M; Souza-Kury, 1998: 666; Leistikow & Wägele, 1999: 38; Schmalfuss, 2003: 81; Schmidt, 2007: 72, figs 224–229.

Material examined

Brazil, Minas Gerais: one ♂, one ♀, Presidente Olegário, Caverna Vereda da Palha, near the entrance of the cave, 18°18′15″S, 46°07′33″W, 1 March 2011, leg. P.B. Araujo, UFRGS 4824.

Distribution

Brazil (Pará, Minas Gerais and São Paulo) and Paraguay.

CIRCONISCUS BUCKUPI CAMPOS-FILHO & ARAUJO, 2011

FIGURE 40

Circoniscus buckupi Campos-Filho & Araujo, 2011: 28, figs 1–3, 7.

Distribution

Brazil: Pará.

CIRCONISCUS CARAJASENSIS CAMPOS-FILHO & ARAUJO, 2011

FIGURE 40

Circoniscus carajasensis Campos-Filho & Araujo, 2011: 34, figs 4–7.

Distribution

Brazil: Pará.

CIRCONISCUS INTERMEDIUS SOUZA & LEMOS DE CASTRO, 1991

FIGURE 40

Circoniscus intermedius Souza & Lemos de Castro, 1991: 53, figs 45–68; Souza-Kury, 1998: 666; Leistikow & Wägele, 1999: 38; Schmalfuss, 2003: 82; Schmidt, 2007: 70, fig. 217.

Material examined

Brazil, Pará: one ♀, Altamira, Abrigo do Sismógrafo, 3°17′12″S, 52°13′09″W, 7 July 2009, leg. M.E. Bichuette (UFRGS 5376). Mato Grosso do Sul: one ♂, one ♀, Bodoquena, Gruta Dente de Cão, Parque Nacional Serra da Bodoquena, 20°44′49″S, 56°47′06″W, 15 June 2006, leg. L.M. Cordeiro (UFRGS 4868).

Distribution

Brazil (Pará, Mato Grosso and Mato Grosso do Sul).

Remarks

Circoniscus intermedius was described by Souza & Lemos de Castro (1991) from the Brazilian states of Mato Grosso and Pará. Schmidt (2007) redescribed the species, and stated that the paratypes from Pará might belong to a distinct species. The specimens examined by us correspond in all details to the description and figures provided by Souza & Lemos de Castro (1991) on the holotype from Mato Grosso, and are identified as *C. intermedius*.

CIRCONISCUS INCISUS SOUZA & LEMOS DE CASTRO, 1991

FIGURE 40

Circoniscus incisus Souza & Lemos de Castro, 1991: 56, figs 69–90; Souza-Kury, 1998: 666; Leistikow & Wägele, 1999: 38; Schmalfuss, 2003: 82; Schmidt, 2007: 71, figs 218–223.

Circoniscus gracilidens Souza & Lemos de Castro, 1991: 56; Souza-Kury, 1998: 666; Leistikow & Wägele,

1999: 38; Schmidt & Wägele, 2001: 317, fig. 5a, b; Schmalfuss, 2003: 81; Schmidt, 2007: 85.

Material examined
Brazil, Pará: one ♂, one ♀, Canaã dos Carajás, Gruta S11D-12, 06°23′45″S, 50°21′34″W, 01–14 August 2010, leg. R. Andrade (UFRGS 4751); one ♂, one ♀, Canaã dos Parauapebas, Gruta S11D-69, 06°23′33″S, 50°19′07″W, 03–19 August 2010, leg. R. Andrade (UFRGS 4752); one ♂, Parauapebas, Gruta N4E66, 06°01′53″S, 50°09′04″W, 29 February–4 March 2010, leg. R. Andrade (UFRGS 5623).

Remarks
Circoniscus incisus was previously known from the Brazilian state of Rio de Janeiro. The present record, from northern Brazil, indicates a wide distribution for this species.

Family Dubioniscidae Schultz, 1995

Genus *Novamundoniscus* Schultz, 1995

Type species: Phalloniscus vandeli Lemos de Castro, 1960, by original designation.

Diagnosis
See Schultz (1995).

Remarks
Schultz (1995) established *Novamundoniscus* to allocate the species of *Phalloniscus* from the New World. The genus includes seven species from Venezuela and Brazil (Schmalfuss, 2003).

Novamundoniscus altamiraensis Campos-Filho, Araujo & Taiti **sp. nov.**

Figures 26–28, 40

Type material
Holotype: ♂, Brazil, Pará, Altamira, Abrigos Assurini, 3°15′02″S, 52°12′31″W, 15 December 2010, leg. M.E. Bichuette and J.E. Gallão (MZUSP 27536).

Paratypes: One ♂ (in micropreparations), one ♀, same data as holotype (MZUSP 27537); one ♂, Canaã dos Parauapebas, FLONA Carajás, 06°04′51″S, 50°09′31″W, 14 March–4 April 2010, leg. R. Andrade (UFRGS 5607P).

Etymology
The new species is named after the locality where the specimens were collected: Altamira, Pará.

Description
Maximum length: ♂, 2.4 mm; ♀, 2.6 mm. Body outline as in Figure 26A. Colour brown, antennae and uropods completely pigmented, cephalon with irregular pale muscle spots, pereonites with a median pale area, more evident on pereonites 1–4, pleon pigmented, pleonite 2 with pale spots on lateral portions. One line of noduli laterales inserted more or less at the same distance from the lateral margins of pereonites, b/c and d/c coordinates as in Figure 26B; dorsum covered with fan-shaped scale setae (Fig. 26F); gland pores not visible. Cephalon (Fig. 26C,D) with short frontal lobes and lacking frontal line, suprantennal line slightly sinuous; eye with 11 ommatidia. Pleonites 3–5 with well-developed epimera, directed backwards. Telson (Fig. 26E) more than twice as wide as long, with triangular distal part, concave sides and rounded apex. Antennule (Fig. 26G) of three articles, third article with two rows of two and three aesthetascs each, and an apical pair. Antenna (Fig. 26H) reaching rear margin of pereonite 3; flagellum about as long as fifth article of peduncle; flagellum of three articles with distal article longer than first and second articles, second article bearing one row of two aesthetascs and third article bearing two rows of two aesthetascs, apical organ short, free sensilla as long as apical organ. Mandibles (Fig. 27A,B) with molar penicil consisting of five or six setae, and 2 + 1 free penicils on the left mandible and 1 + 1 on right mandible. Maxillule (Fig. 27C) outer branch with 4 + 5 (four cleft) teeth; inner branch with two short penicils inserted transversely and distal margin rounded. Maxilla (Fig. 27D) with setose and bilobate apex; outer lobe about twice as wide as medial lobe, with distal margin rounded. Maxilliped (Fig. 27E) basis rectangular, with sparse scale setae; endite with distal margin curved, one stout seta, and no penicil. Pereopods with inner claw of dactylus as long as outer claw, ungual seta reaching tip of outer claw, and simple apex, and dactylar seta reaching median portion of outer claw and simple apex (Fig. 27G). Uropod (Fig. 27F) protopod grooved on outer margin; exopod distinctly longer than endopod; insertion of endopod proximal to that of exopod.

Male: Pereopod 7 (Fig. 28A) with fringe of hyaline scales on distal margins of ischium and merus, ischium with sternal margin straight. Genital papilla as in Figure 28B. Pleopod 1 (Fig. 28C) exopod subrectangular, with distal margin straight; endopod with tapering distal part slightly swollen subapically, and bearing minute setae. Pleopod 2 (Fig. 28D) exopod triangular, outer margin concave, bearing three strong setae; endopod slightly longer than exopod. Pleopods 3–5 as in Figure 28E–G.

Remarks
Novamundoniscus altamiraensis sp. nov. is readily distinguishable from the other Brazilian species *Novamundoniscus dissimilis* (Lemos de Castro, 1960), *Novamundoniscus macrophthalmus* (Lemos de Castro,

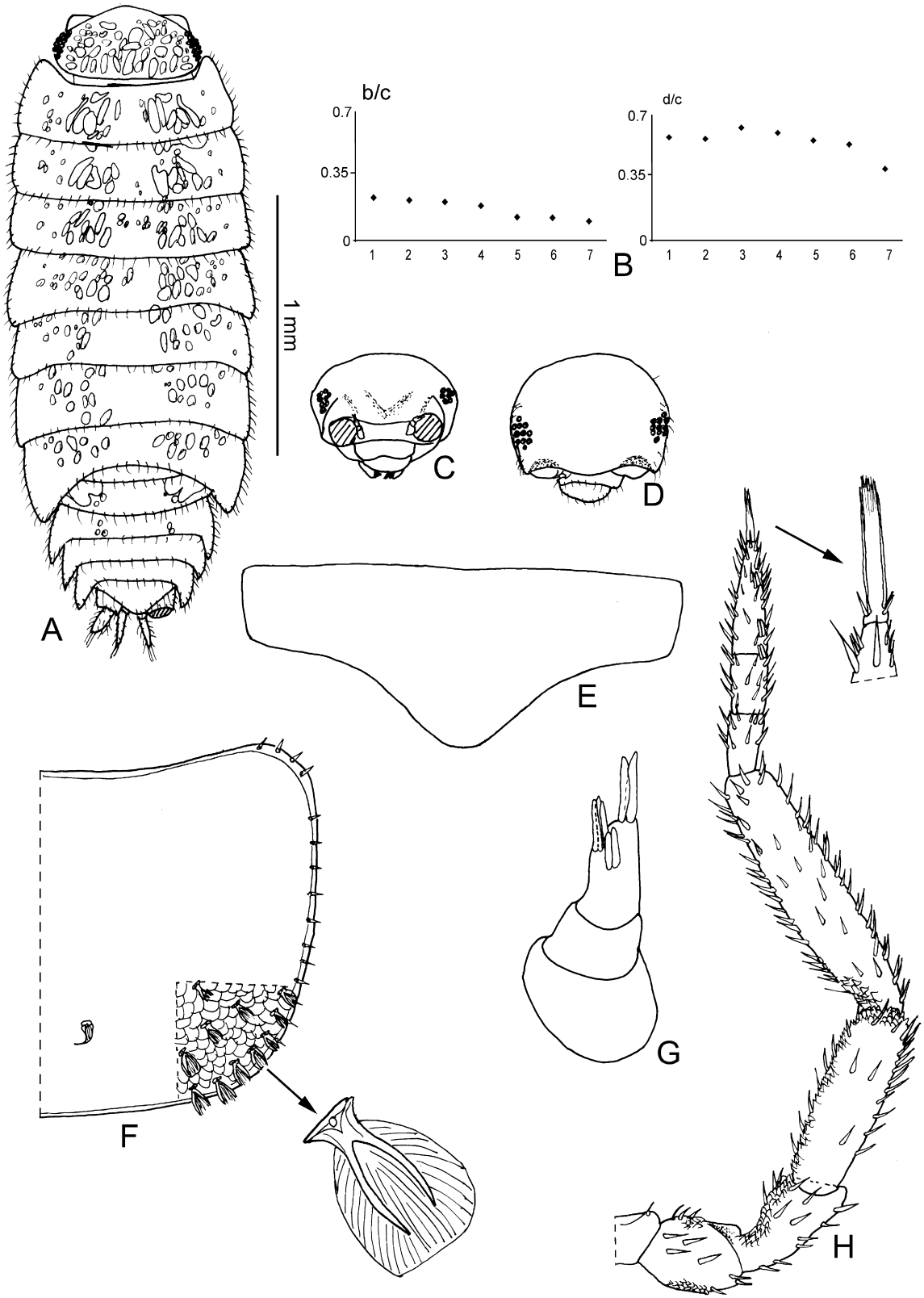

Figure 26. ***Novamundoniscus altamiraensis*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, habitus, dorsal; B, noduli laterales b/c and d/c coordinates; C, cephalon, frontal; D, cephalon, dorsal; E, telson; F, pereonite 1, nodulus lateralis, and dorsal scale seta; G, antennule; H, antenna.

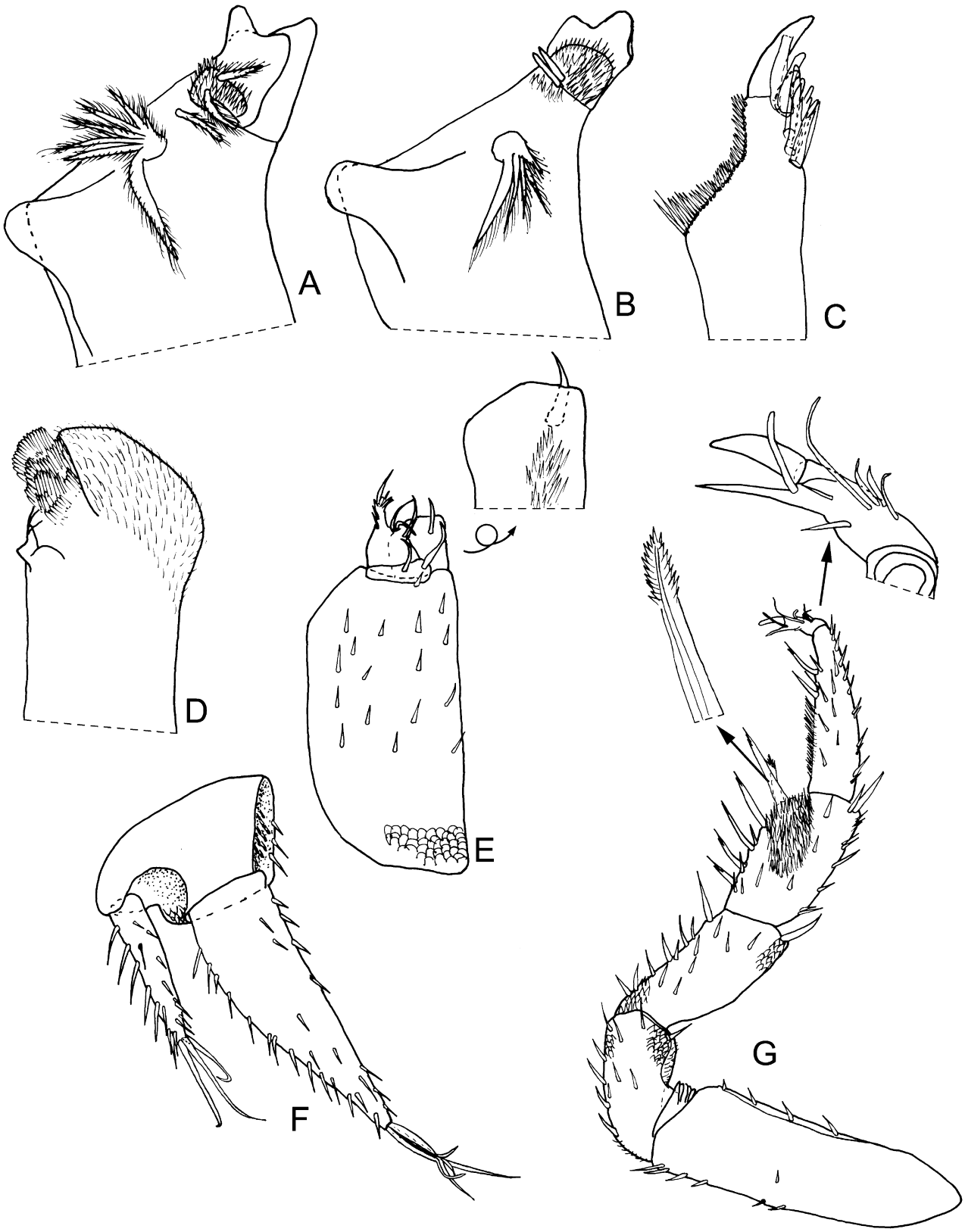

Figure 27. ***Novamundoniscus altamiraensis*** Campos-Filho, Araujo & Taiti sp. nov., ♂:, A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped; (F) uropod; G, pereopod 1.

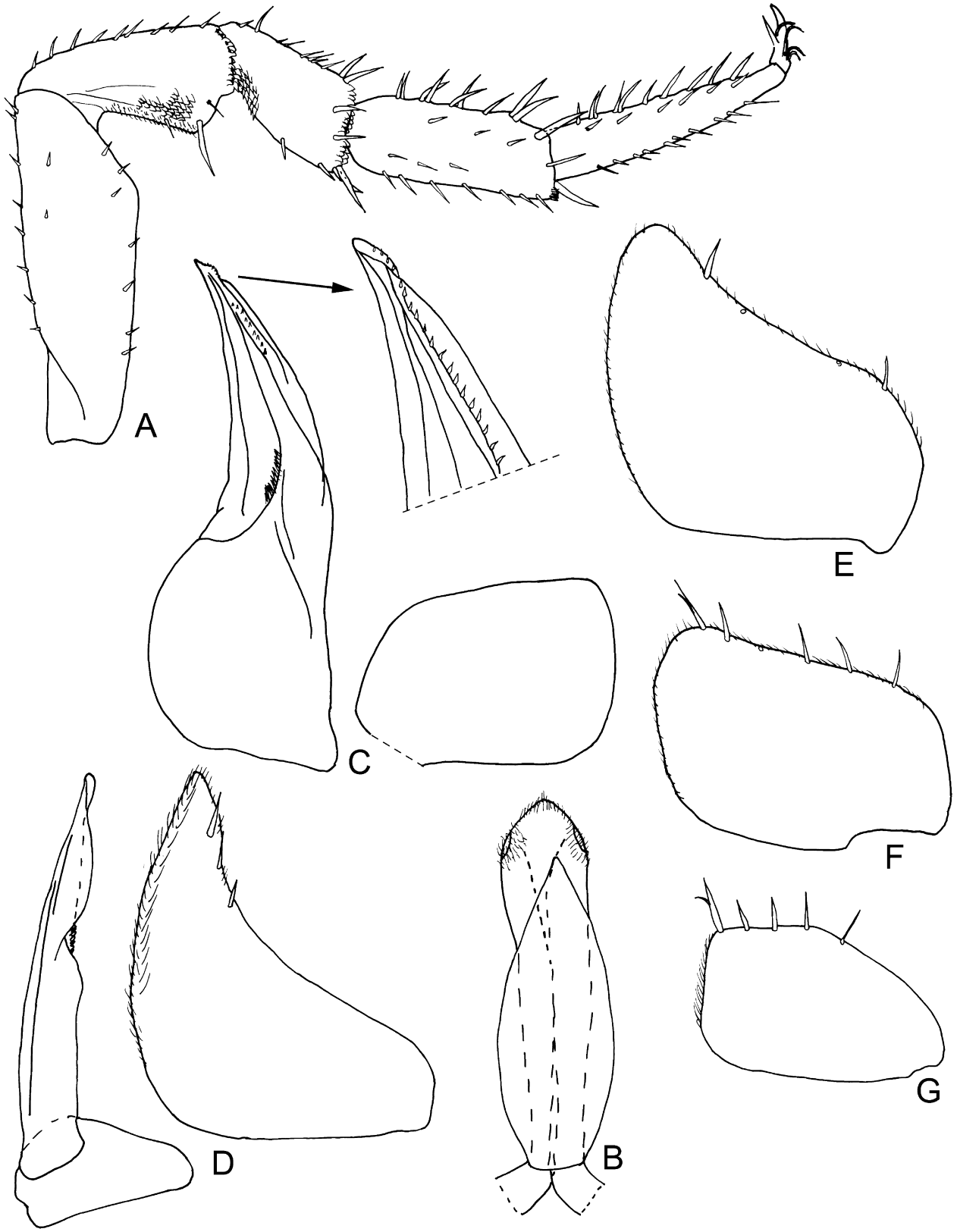

Figure 28. *Novamundoniscus altamiraensis* Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 7; B, genital papilla; C, pleopod 1; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

1960), *Novamundoniscus singularis* (Lemos de Castro, 1967), *Novamundoniscus vandeli* (Lemos de Castro, 1960), and *Novamundoniscus gracilis* Lopes & Araujo, 2003, by the shape of male pleopod 1 and pleopod 2 endopod. It also differs from *N. dissimilis*, *N. singularis*, *N. vandeli*, and *N. gracilis* in the number of ommatidia (*N. dissimilis* = 7; *N. singularis* and *N. gracilis* = 15; *N. vandeli* = 8; *N. altamiraensis* Campos-Filho, Araujo & Taiti sp. nov. = 11). The new species differs from the Venezuelan species *Novamundoniscus marcuzzii* (Vandel, 1952b) and *Novamundoniscus persimilis* (Vandel, 1952b) in the telson with rounded instead of pointed apex.

Genus *Dubioniscus* Vandel, 1963

Type species: Dubioniscus delamarei Vandel, 1963, by monotypy.

Diagnosis
See Lemos de Castro (1970) and Schultz (1995).

Remarks
Vandel (1963) established *Dubioniscus* mainly on the peculiar shape of the cephalon. At present it includes four species from Cuba, Brazil, Paraguay, and Argentina (Schmalfuss, 2003).

Dubioniscus goeldii (Lemos de Castro, 1967)

Figure 40

Hileioniscus goeldii Lemos de Castro, 1967: 318.

Calycuoniscus goeldii; Lemos de Castro, 1968: 408, figs 1–7; Souza-Kury, 1998: 656.

Dubioniscus goeldii; Schultz, 1995: 401; Leistikow & Wägele, 1999: 24; Schmalfuss, 2003: 106.

Material examined
Brazil, Pará, Altamira: one ♀, Abrigo do Paratizão, 3°15′03″S, 52°01′57″W, 12 November 2009, leg. M.E. Bichuette (UFRGS 5377); one ♀, Abrigos Assurini, 3°15′02″S, 52°12′31″W, 15 December 2010, leg. M.E. Bichuette and J.E. Gallão (UFRGS 5378); one ♀, Canaã dos Carajás, Gruta S11-07, 06°27′20″S, 50°14′29″W, 3–19 August 2010, leg. R. Andrade (UFRGS 4778); one ♂, one ♀, Parauapebas, Gruta Cav 24 S11, 06°25′21″S, 50°18′24″W, 22–28 September 2010, leg. R. Andrade (UFRGS 4753); one ♂, one ♀, Parauapebas, Gruta Cav 34 S11, 06°24′40″S, 50°20′35″W, 22–28 April 2010, leg. R. Andrade (UFRGS 4774); one ♂, one ♀, Altamira, Abrigo do Sismógrafo, 03°17′18″S, 52°13′30″W, 12 November 2009, leg. M.E. Bichuette (UFRGS 4752).

Distribution
Brazil: Pará.

Dubioniscus marmoratus Lemos de Castro, 1970

Figure 40

Dubioniscus marmoratus Lemos de Castro, 1970: 3, figs 1–3; Schultz, 1995: 401; Souza-Kury, 1998: 656; Leistikow & Wägele, 1999: 25; Schmalfuss, 2003: 106.

Material examined
Brazil, São Paulo: one ♂, Itu, Caverna do Riacho Subterrâneo, 23°16′10″S, 47°13′52″W, undated, leg. M.E. Bichuette (UFRGS 5379).

Distribution
Brazil: Rio de Janeiro and São Paulo.

Family Platyarthridae Verhoeff, 1949

Genus *Trichorhina* Budde-Lund, 1908

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

Diagnosis
See Schmidt (2002) and Souza, Araújo & Campos-Filho (2011).

Trichorhina yiara Campos-Filho, Araujo & Taiti **sp. nov.**

Figures 29–31, 40

Type material
Holotype: ♂, Brazil, Pará, Altamira, Abrigo do Sismógrafo, 3°17′17″S, 52°13′29″W, 9 April 2009, leg. M.E. Bichuette (MZUSP 27538).

Paratypes: One ♀, same data as holotype (MZUSP 27539), one ♂ (in micropreparations), one ♀, same data as holotype (MZUSP 27540); two ♀, Pará, Altamira, Abrigo do Abutre, 3°15′12″S, 52°11′01″W, 11 April 2009, leg. M.E. Bichuette (MZUSP 27552).

Etymology
The name of the new species refers to the Amazonian myth of Yiara, known in Tupi language as the Mother of Waters that lives in the River Amazon. In Amazonian legends she is a beautiful siren who, using her voice, is capable of making all fishermen fall in love with her.

Description
Maximum length: ♂, 2.6 mm; ♀, 3 mm. Body outline as in Figure 29A. Colour light brown; cephalon with irregular unpigmented spots; pereon with the usual pale muscle spots and a central unpigmented spot on pereonites 3–7, larger on pereonite 3; antennae, uropods,

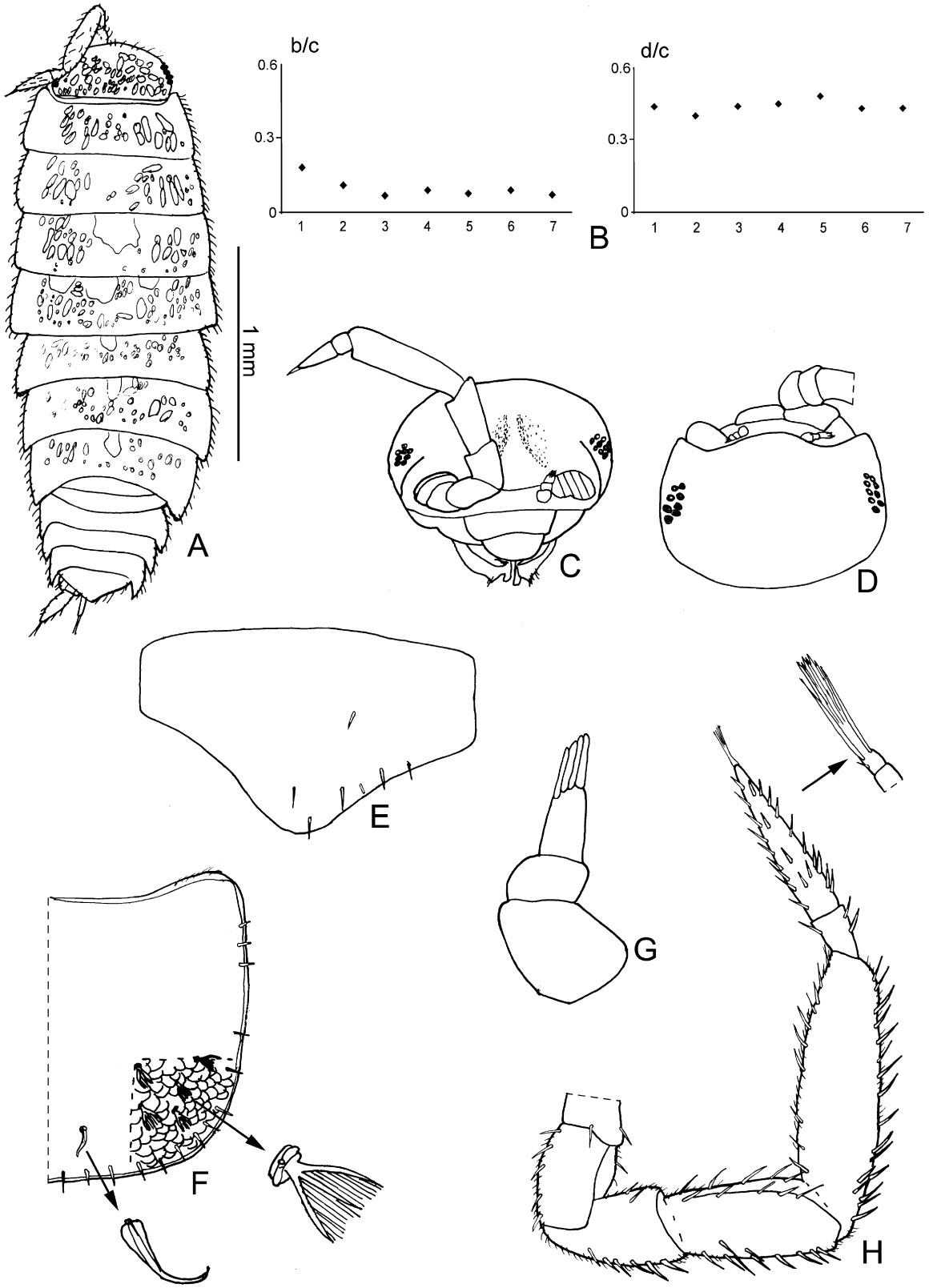

Figure 29. ***Trichorhina yiara*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♀: A, habitus, dorsal; B, noduli laterales b/c and d/c coordinates; C, cephalon, frontal; D, cephalon, dorsal; E, telson; F, pereonite 1, nodulus lateralis, and dorsal scale seta; G, antennule; H, antenna.

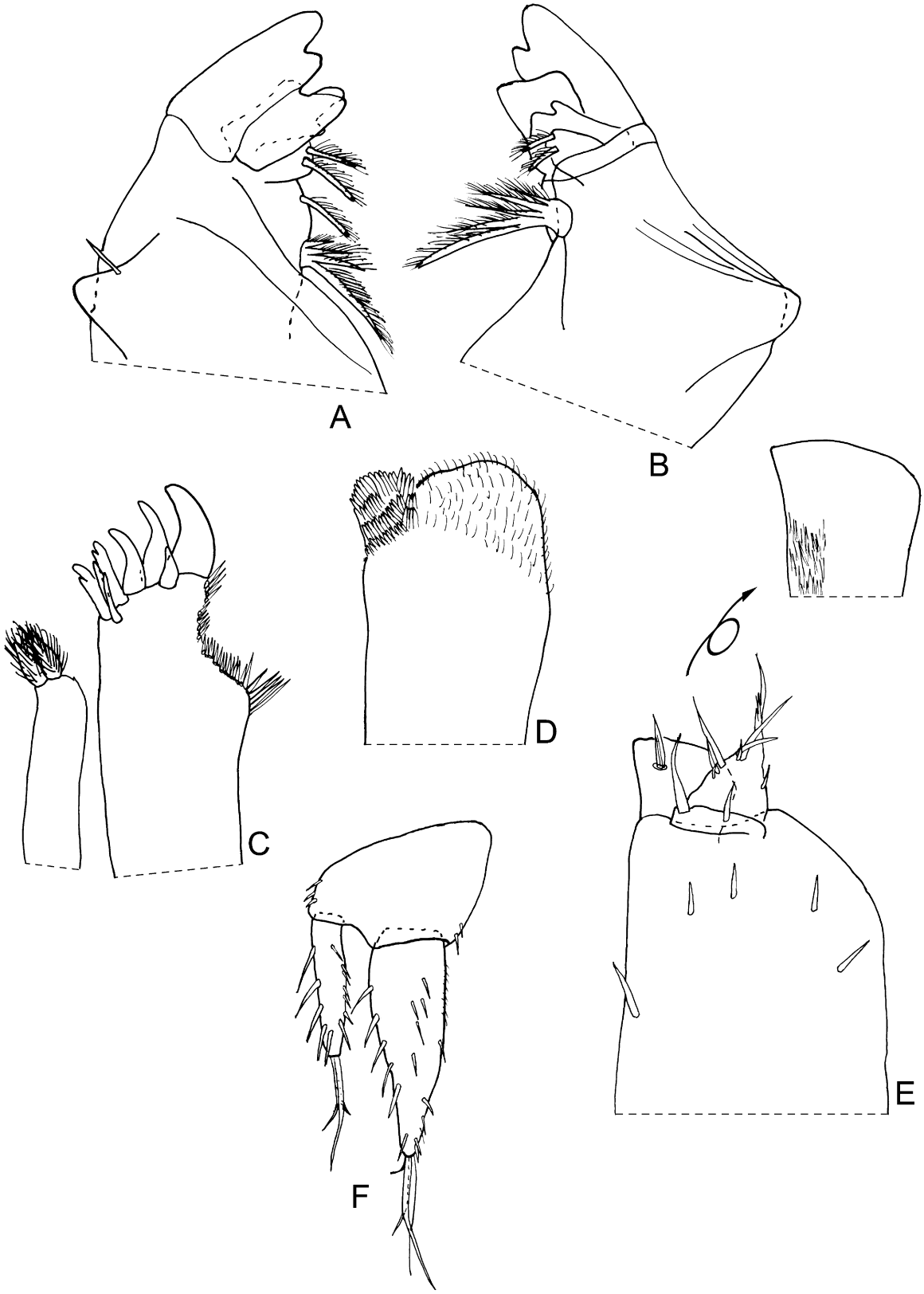

Figure 30. ***Trichorhina yiara*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♀: A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped; F, uropod.

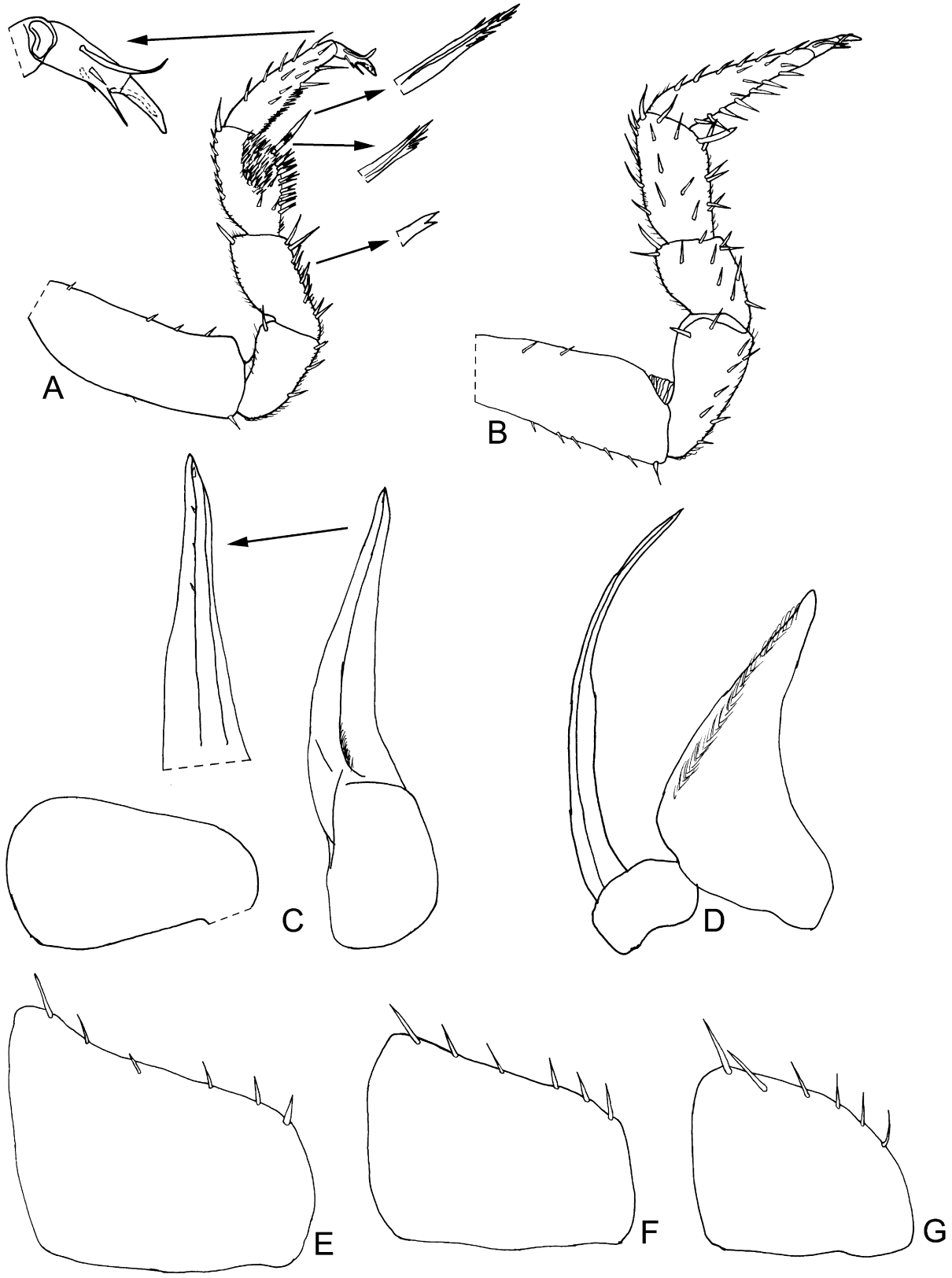

Figure 31. ***Trichorhina yiara*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 1; B, pereopod 7; C, pleopod 1; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

pleon, and telson completely pigmented. Dorsum covered with fan-shaped scale setae (Fig. 29F); one line of noduli laterales per side inserted close to the posterior margin, and far from the lateral margin of the pereonites, b/c and d/c coordinates as in Figure 29B. Cephalon (Fig. 29C,D) with short lateral lobes, no frontal line, suprantennal line slightly sinuous; eye dark, with ten ommatidia. Pleon (Fig. 29A) slightly narrower than pereon, epimera of pleonites 3–5 well developed, falciform. Telson (Fig. 29E) triangular, concave sides and rounded apex. Antennule (Fig. 29G) of three articles, second article shorter than first and third, third article with four apical aesthetascs. Antenna (Fig. 29H) with fifth article of peduncle slightly swollen; flagellum as long as fifth article of peduncle, second flagellar article about three times as long as first, apical organ short, with free sensilla as long as apical organ. Mandibles (Fig. 30A,B) with molar penicil consisting of at least five setae, left mandible with 2 + 1 penicils and right mandible with 1 + 1 penicils. Maxillule (Fig. 30C) outer branch with 4 + 4 (two cleft) teeth. Maxilla (Fig. 30D) with setose and bilobate apex; outer lobe about twice as broad as inner lobe, with rounded distal margin. Maxilliped (Fig. 30E) basis rectangular, with sparse scale setae; endite with one seta overpassing distal margin, no penicil. Pereopod dactylus with short inner claw, ungual seta and dactylar seta almost reaching tip of outer claw, and simple apex (Fig. 31A). Uropod (Fig. 30F) exopod distinctly longer than endopod; insertion of endopod proximal to that of exopod.

Male: Pereopods 1–3 with brush of setae on sternal margin of carpus (Fig. 31A). Pereopod 7 (Fig. 31B) without distinct sexual dimorphism; ischium with sternal margin slightly convex. Pleopod 1 (Fig. 31C) exopod about twice as broad as long, with rounded distal part; endopod slightly bent outwards, with distal part triangular, acute, bearing few minute setae. Pleopod 2 (Fig. 31D) exopod triangular, with concave outer margin; endopod slightly longer than exopod. Pleopods 3–5 exopods as in Figure 31E–G.

Remarks

To date, *Trichorhina* includes 63 species, of which 19 are recorded from Brazil (Schmalfuss, 2003; Souza *et al.*, 2011). The monophyly of the genus is questionable and in need of revision. In the number of ommatidia *T. yiara* sp. nov. resembles *Trichorhina amazonica* Souza-Kury, 1997b, from which it is readily distinguishable by the shape of the male pleopod 1 exopod, with shorter posterior lobe and endopod much thinner. In the presence of two cleft teeth on the outer branch of the maxillule, the new species is similar to *Trichorhina argentina* Vandel, 1963, *Trichorhina brasilensis* Andersson, 1960, *Trichorhina crassisetae* Souza, Araujo & Campos-Filho, 2011, and *Trichorhina paraensis* Souza-Kury, 1997b, from which it differs in the fan-like dorsal scale setae, the number of aesthetascs on antennule, and the shape of the male pleopod 1.

TRICHORHINA CURUPIRA CAMPOS-FILHO, ARAUJO & TAITI **SP. NOV.**

FIGURES 32, 33, 40

Type material

Holotype: ♂, Brazil, Pará, Altamira, Caverna Pedra da Cachoeira, 3°19′13″S, 52°19′22″W, 15 December 2010, leg. M.E. Bichuette (MZUSP 27541).

Paratypes: Five ♂ (one in micropreparations) and three ♀, same data as holotype (MZUSP 27542).

Etymology

The new species is named after Curupira, a mythological creature of Brazilian folklore. In Tupi language *kuru´pir* means covered with blisters, and the character is known as the protector of forests and animals.

Description

Maximum length: ♂ and ♀, 3 mm. Body outline as in Figure 32A. Colour pale yellow. Dorsum covered with fan-shaped scale setae (Fig. 32F); one line of noduli laterales inserted more or less at the same distance from the lateral margin of pereonites; b/c and d/c coordinates as in Figure 32B. Cephalon (Fig. 32C,D) with small lobes, no frontal line, supranatennal line straight; eye reduced, with three ommatidia. Pleon (Fig. 32A) slightly narrower than pereon, epimera of pleonites 3–5 well developed, falciform. Telson (Fig. 32E) with triangular distal part, concave sides, and rounded apex. Antennule (Fig. 32G) of three articles, distal joint with nine apical aesthetascs. Antenna (Fig. 32H) short and stout, with flagellum as long as fifth article of peduncle, second flagellar article about three times as long as first, apical organ short. Mouth parts as in *T. yiara* sp. nov. Pereopod dactylus with short inner claw; ungual and dactylar seta, with simple distal part reaching tip and middle of outer claw, respectively (Fig. 33A). Uropod (Fig. 32I) protopod grooved on outer margin; exopod stout and longer than endopod; insertions of endopod and exopod almost at the same level.

Male: Pereopod 1 (Fig. 33A) carpus and, to a lesser extent, merus with a line of long setae on sternal margin. Pereopod 7 (Fig. 33B) with no peculiar modifications; ischium with sternal margin straight. Pleopod 1 (Fig. 33C) exopod ovoid; endopod with distal part bearing a few setae near medial margin. Pleopod 2 (Fig. 33D)

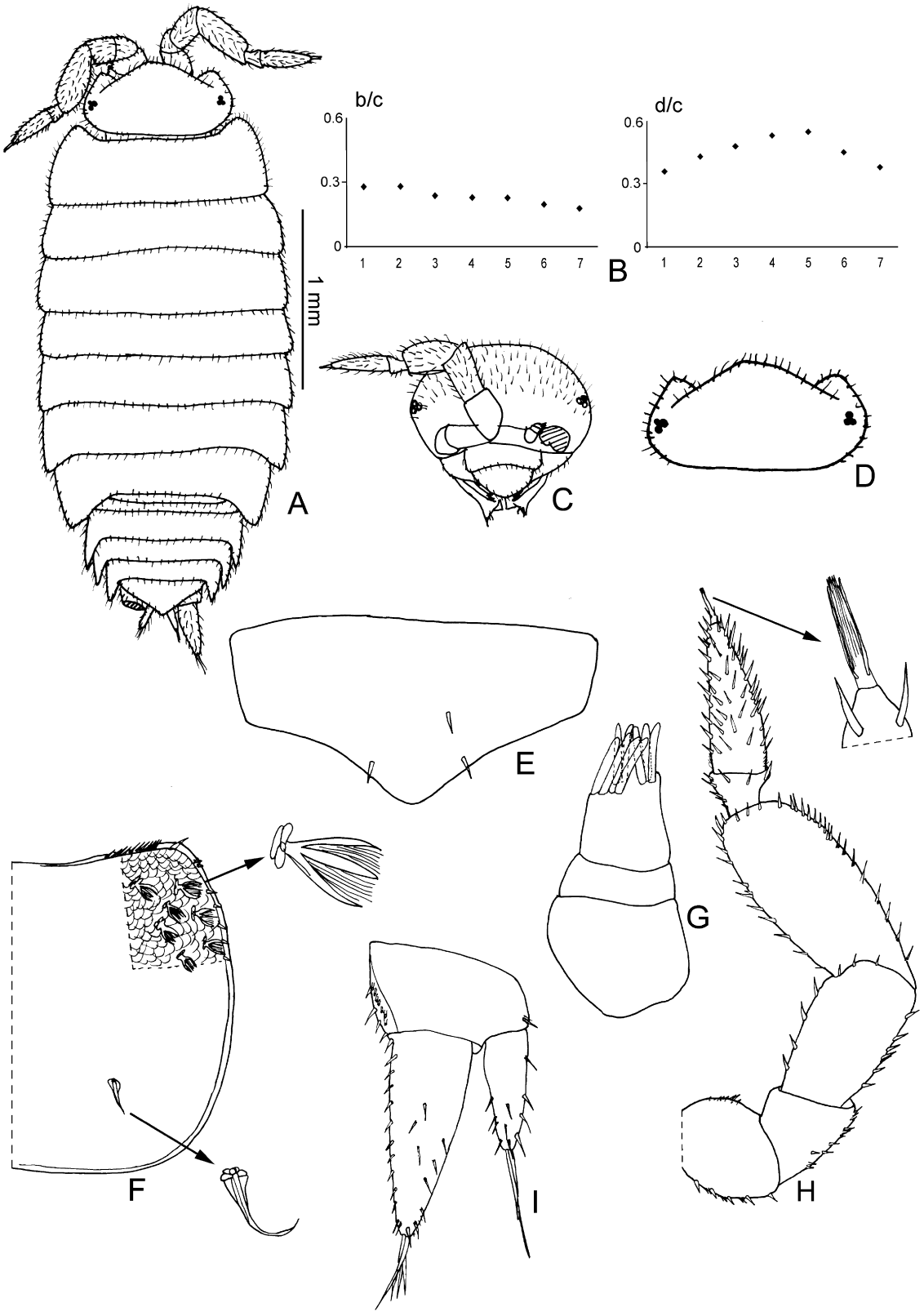

Figure 32. ***Trichorhina curupira*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♀: A, habitus, dorsal; B, noduli laterales b/c and d/c coordinates; C, cephalon, frontal; D, cephalon, dorsal; E, telson; F, pereonite 1, nodulus lateralis, and dorsal scale seta; G, antennule; H, antenna; I, uropod.

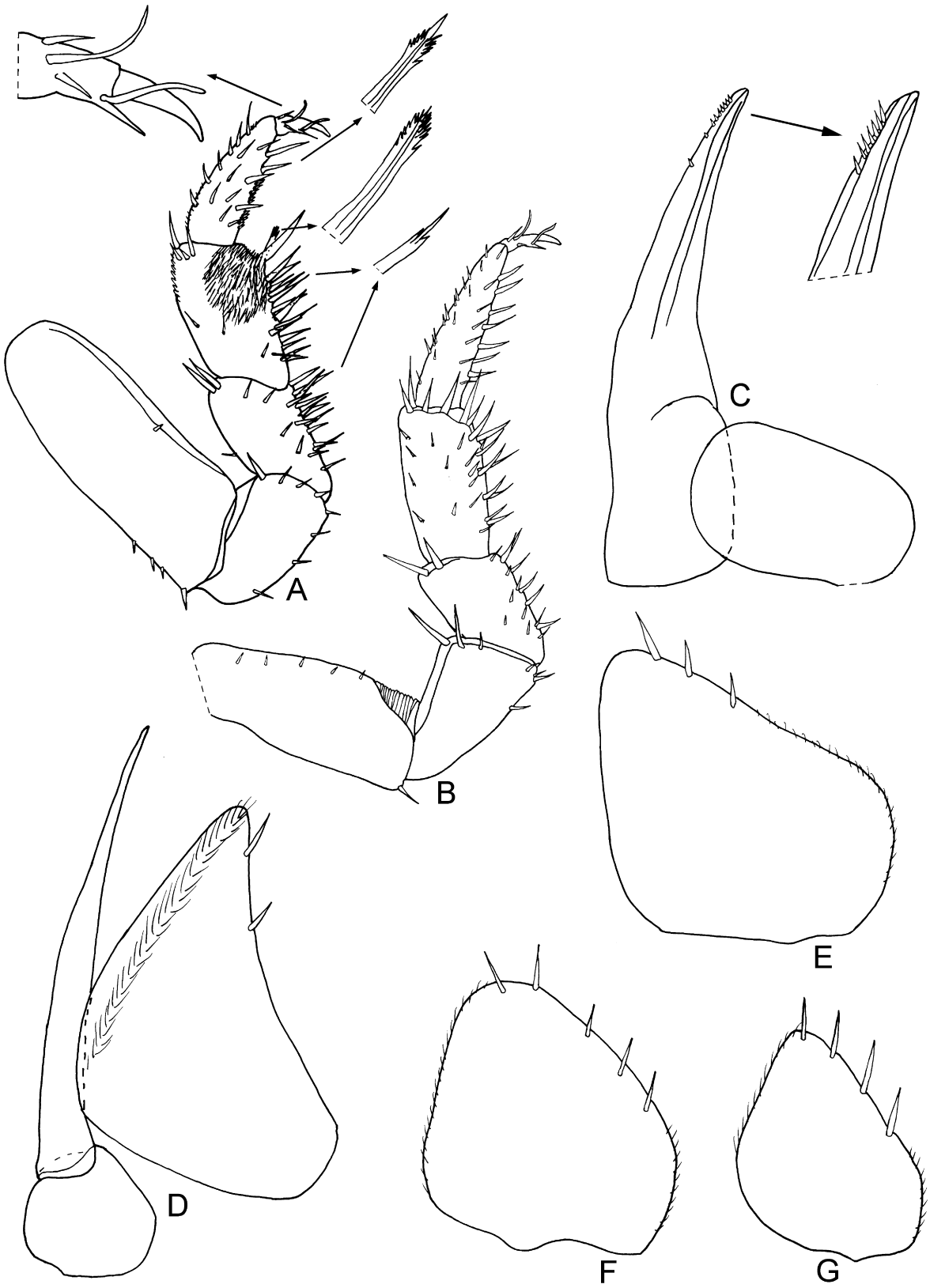

Figure 33. ***Trichorhina curupira*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 1; B, pereopod 7; C, pleopod 1; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

exopod triangular, outer margin slightly concave; endopod longer than exopod. Pleopods 3–5 exopods as in Figure 33E–G.

Remarks

In the eye with three ommatidia, *T. curupira* sp. nov. resembles *Trichorhina mulaiki* Schmalfuss, 2003 from Mexico and *Trichorhina triocellata* Ferrara & Taiti, 1985 from Aldabra Island. It differs from *T. mulaiki* in the pale colour, the presence of cephalic lobes, and the telson with rounded instead of pointed apex; it differs from *T. triocellata* in the less wide body shape, different shape of dorsal scale setae, and lack of tuft of setae on pereopod dactylus. In Brazil, other species of *Trichorhina* have a reduced number of eyes, e.g. *Trichorhina acuta* Araujo & Buckup, 1994, *Trichorhina heterophthalma* Lemos de Castro, 1964, and *Trichorhina sexdens* Souza, Araujo & Campos-Filho, 2011. The new species is readily distinguishable from those species by the different shape of the dorsal scale setae, by the different shape of the endite of the maxilliped, and by the different shape of the male pleopod 1.

TRICHORHINA ANHANGUERA CAMPOS-FILHO, ARAUJO & TAITI **SP. NOV.**

FIGURES 34–36, 40

Type material

Holotype: ♂, Brazil, Minas Gerais, Morro do Pilar, Gruta MP-10, 20°15′54″S, 43°53′13″W, 13–17 February 2012, leg. R. Bessi (MZUSP 27543).

Paratypes: Two ♂, same data as holotype (MZUSP 27544); one ♂, one ♀, same locality and collector, 28 February 2012 (MZUSP 27545); one ♂, two ♀, same data (MZUSP 27546).

Etymology

The new species is named after the Tupi myth of Anhanguera, which means 'old devil', protector of animals against hunters.

Description

Maximum length: ♂, 4 mm; ♀, 4.5 mm. Body outline as in Figure 34A. Colourless body. Dorsum covered with fan-shaped scale setae (Fig. 34E). One line of noduli laterales inserted more or less at the same distance from the lateral margin of pereonites; b/c and d/c coordinates as in Figure 34B. Cephalon (Fig. 34C,D) with no lateral lobes; no frontal line, suprantennal line straight; eyes absent. Pleon (Fig. 34A) slightly narrower than pereon, epimera of pleonites 3–5 well developed, falciform. Telson (Fig. 34F) with distal part triangular, concave sides and rounded apex. Antennule (Fig. 34G) of three articles, distal article with about ten apical aesthetascs. Antenna (Fig. 34H) with flagellum as long as fifth article of peduncle, second flagellar article about three times as long as first, apical organ short. Mandibles (Fig. 35A,B) with molar penicil consisting of a single unbranched seta, left mandible with 2 + 1 penicils and right mandible with 1 + 1 penicils. Maxillule (Fig. 35C) outer branch with 4 + 5 teeth, all simple; inner branch with two short penicils and a short point on outer margin. Maxilla (Fig. 35D) with setose and bilobate apex; outer lobe about four times as wide as inner lobe, subquadrate with distal margin straight. Maxilliped (Fig. 35E) basis rectangular, with sparse triangular scale setae; endite with one seta overpassing distal margin, and distal margin straight, bearing two hooks. Uropod (Fig. 35F) exopod distinctly longer than endopod; insertion of endopod slightly proximal to that of exopod. Pereopod dactylus with long inner claw, ungual and dactylar seta with simple apex reaching tip and middle of outer claw, respectively (Fig. 35G).

Male: Pereopods 1–3 carpus and merus with a brush of piliform setae on sternal margin. Pereopod 7 (Fig. 36A) ischium with sternal margin slightly concave. Genital papilla as in Figure 36B. Pleopod 1 (Fig. 36C) exopod ovoidal; endopod tapering, with no peculiar modification at apex. Pleopod 2 (Fig. 36D) exopod triangular, outer margin concave and bearing two setae; endopod longer than exopod, with almost parallel sides, and acute apex. Pleopods 3–5 exopods as in Figure 36E–G.

Remarks

Among the 19 species of *Trichorhina* presently known from Brazil (Souza *et al*., 2011), only two species are known to be blind and colourless: *Trichorhina pittieri* (Pearse, 1921) and *T. brasilensis*. *Trichorhina anhanguera* sp. nov. is readily distinguishable by the shape of the male pleopod 1 exopod, ovoidal without any posterior lobe. In having the molar penicil of the mandible consisting of a single unbranched seta, the new species resembles *Trichorhina lenkoi* Souza, Araújo & Campos-Filho, 2011, *Trichorhina macrops* Souza-Kury, 1993, *Trichorhina myrmecophila* Souza, Araújo & Campos-Filho, 2011, *Trichorhina orensis* Souza, Araújo & Campos-Filho, 2011, *Trichorhina paraensis* Souza-Kury, 1997b, and *Trichorhina sexdens* Souza, Araújo & Campos-Filho, 2011. It differs from these species in the lack of eyes, number of aesthetascs of the antennule, and shape of male pleopod 1.

TRICHORHINA GUANOPHILA SOUZA-KURY, 1993

FIGURE 40

Trichorhina guanophila Souza-Kury, 1993: 198, figs 11–27.

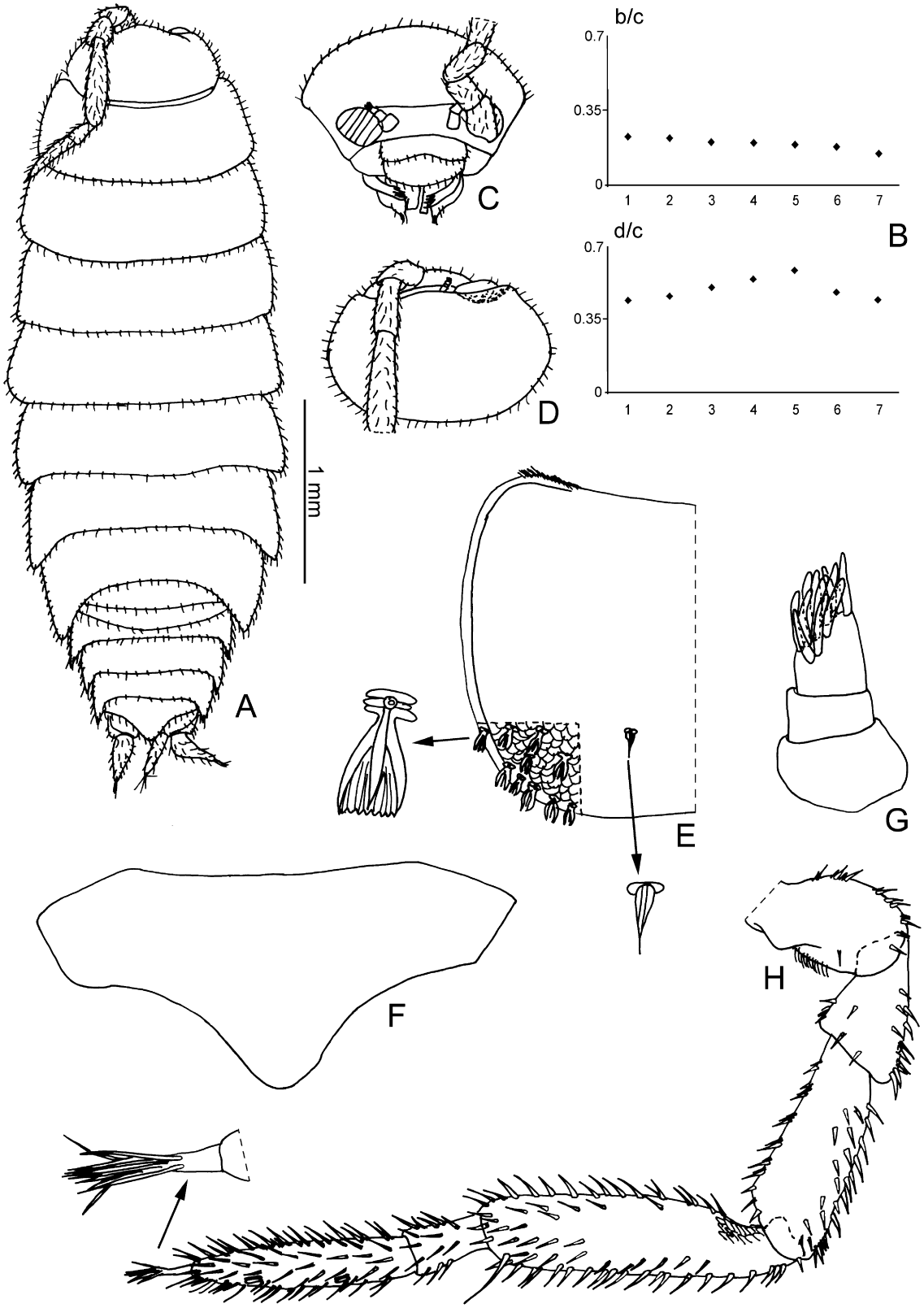

Figure 34. ***Trichorhina anhanguera*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♀: A, habitus, dorsal; B, noduli laterales b/c and d/c coordinates; C, cephalon, frontal; D, cephalon, dorsal; E, pereonite 1, nodulus lateralis, and dorsal scale seta; F, telson; G, antennule; H, antenna.

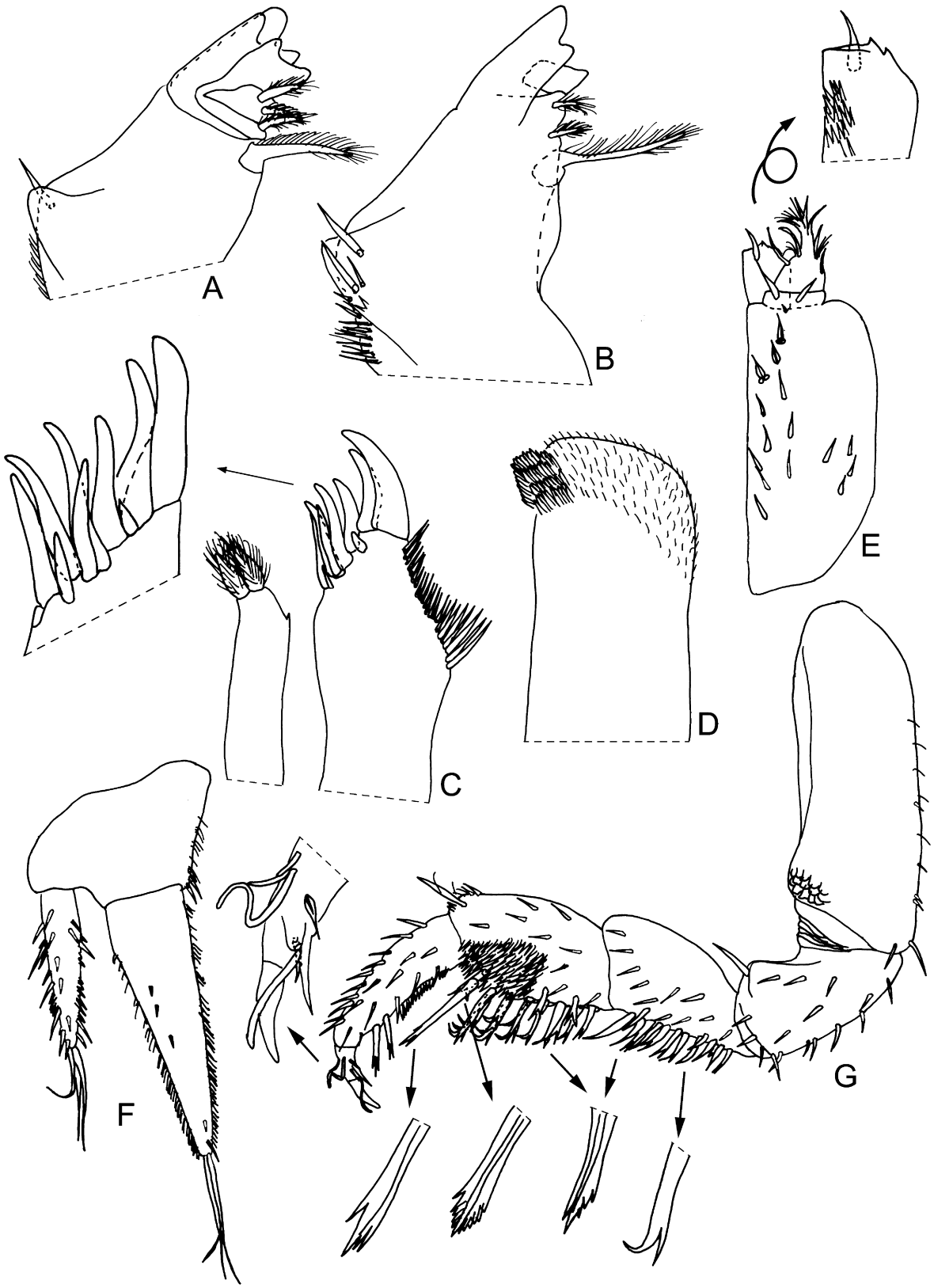

Figure 35. ***Trichorhina anhanguera*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♀: A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped; F, uropod; ♂: G, pereopod 1.

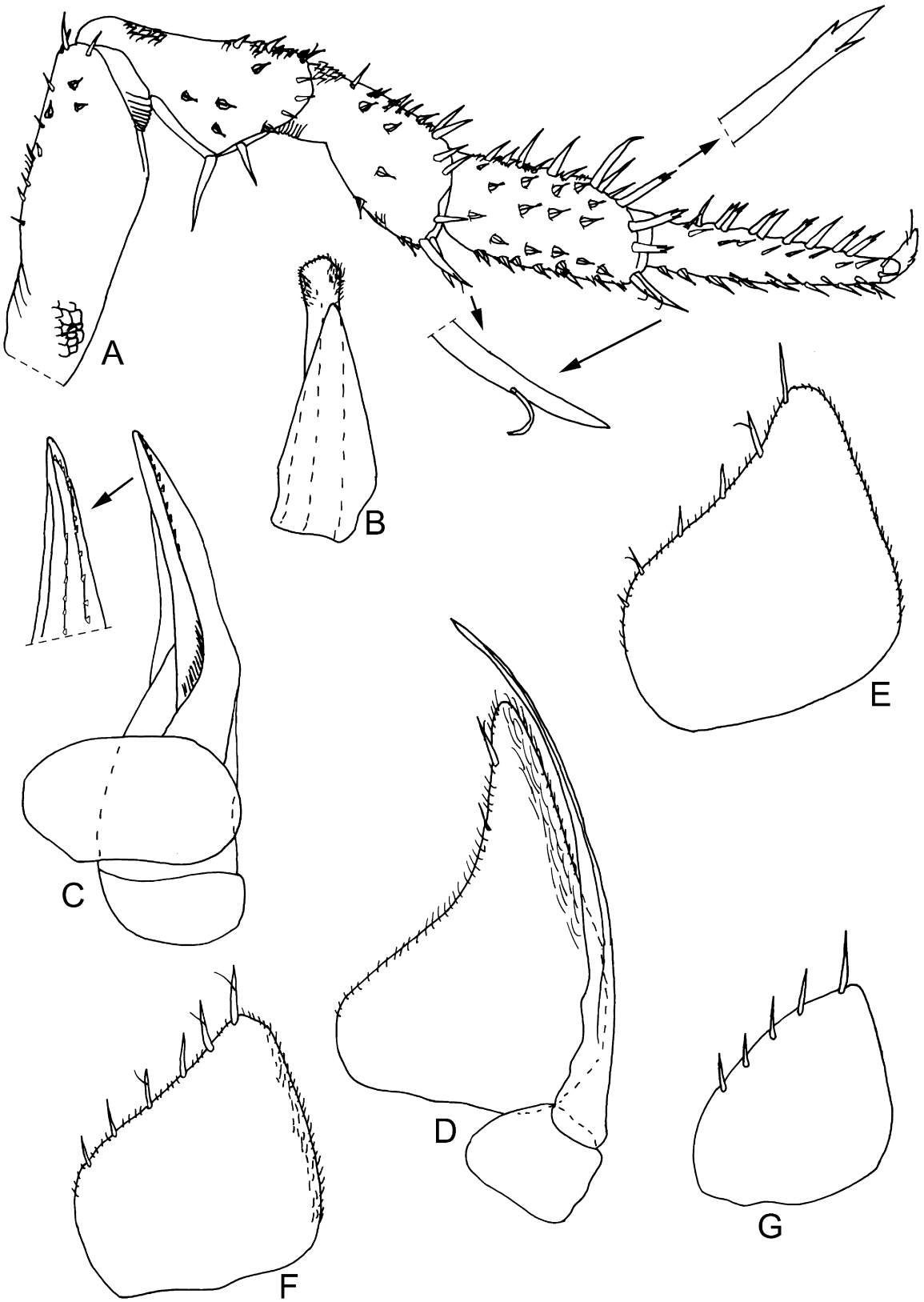

Figure 36. ***Trichorhina anhanguera*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 7; B, genital papilla; C, pleopod 1; D, pleopod 2; E, pleopod 3 exopod; F, pleopod 4 exopod; G, pleopod 5 exopod.

Distribution
Brazil: Bahia.

FAMILY PORCELLIONIDAE BRANDT, 1831

GENUS *PORCELLIONIDES* MIERS, 1877

Type species: Porcellio (Porcellionides) jelskii Miers, 1877 [= *Porcellionides pruinosus* (Brandt, 1833)], by subsequent designation (Schmalfuss & Ferrara, 1978*)*.

Diagnosis
See Vandel (1962), Gruner (1966), and Schmalfuss & Ferrara (1978).

PORCELLIONIDES PRUINOSUS (BRANDT, 1833)

FIGURE 40

Metoponorthus pruinosus; Andersson, 1960: 564; Lemos de Castro, 1967: 323; Lemos de Castro, 1971: 4, fig. 9.

Porcellionides pruinosus; Souza-Kury, 1998: 664; Leistikow & Wägele, 1999: 35; Araujo *et al*., 1996: 129, figs 46–47; Araujo, 1999: 255, fig. 28; Schmalfuss, 2003: 212; Appel *et al*., 2011: 125.

Material examined
Brazil, Bahia: one ♂, Iraquara, Gruta Alto da Cruz, 24 February 2007, leg. M.E. Bichuette (UFRGS 5382); one ♂, one ♀, one manca, Itaetê, Lapa de Bode, 6 July 2004, leg. M.E. Bichuette (UFRGS 5383).

Distribution
Cosmopolitan species of Mediderranean origin.

FAMILY ARMADILLIDIIDAE BRANDT, 1833

GENUS *ARMADILLIDIUM* BRANDT, 1831

Type species: Armadillidium commutatum Brandt, 1831 [= *Armadillidium vulgare* (Latreille, 1804)], by subsequent designation (Fowler, 1912*)*.

Diagnosis
See Schmalfuss (1981, 1982, 1985).

ARMADILLIDIUM VULGARE (LATREILLE, 1804)

FIGURE 40

Armadillidium vulgare; Lemos de Castro, 1971: 4, fig 14; Lenko, 1971: 8; Souza-Kury, 1998: 654; Araujo *et al*., 1996: 133, figs 54–58, 68; Araujo, 1999: 252, fig. 23; Schmalfuss, 2003: 38; Appel *et al*., 2011: 124, figs 1B, 2D–F.

Material examined
Brazil, Minas Gerais: one ♀, Serra da Canastra, São Roque de Minas, Gruta Zeferino I, 20°06′50″S, 46°25′25″W, 7 September 2009, leg. M.E. Bichuette (UFRGS 5380).

Distribution
Species of Mediterranean origin introduced to many parts of the world.

ARMADILLIDAE BRANDT, 1831

GENUS *CTENORILLO* VERHOEFF, 1942

Type species: Ctenorillo buddelundi Verhoeff, 1942 [= *Ctenorillo regulus* (Van Name, 1920)], by monotypy.

Diagnosis
See Schmalfuss & Ferrara (1983).

Remarks
Verhoeff (1942) established *Ctenorillo* to allocate the new species *C. buddelundi* from Uganda. Taiti, Paoli & Ferrara (1998) synonymized *Tuberdillo* Schmalfuss & Ferrara, 1983 and *Vandelillo* Arcangeli, 1957 with *Ctenorillo*. At present the genus has mainly an African distribution, with only one species, *C. mineri* (Van Name, 1936), recorded from Venezuela and Guyana (Schmalfuss, 2003).

CTENORILLO FERRARAI CAMPOS-FILHO, ARAUJO & TAITI **SP. NOV.**

FIGURES 37–40

Type material
Holotype: ♂, Brazil, Pará, Canaã dos Carajás, FLONA Carajás (FLONA – National forest), Gruta N5S 07, 6°06′20″S, 50°07′09″W, 3–13 May 2005, leg. R. Andrade and Arnoni (MZUSP 27547).

Paratypes: One ♂, five ♀, same data as holotype (MZUSP 24244, 24245, 24246, 24247, 24248, 24249); one ♀, Pará, Canaã dos Carajás, Gruta Cris 11, 6°26′29″S 49°40′51″W, 29 June–6 July 2008, leg. R. Andrade (MZUSP 24256).

Etymology
The new species is named after Dr Franco Ferrara, Florence, Italy, for his invaluable contribution to the knowledge of terrestrial isopods.

Description
Maximum length: ♂ and ♀, 5 mm. Colour brown. Dorsum covered with large tubercles, arranged as follows

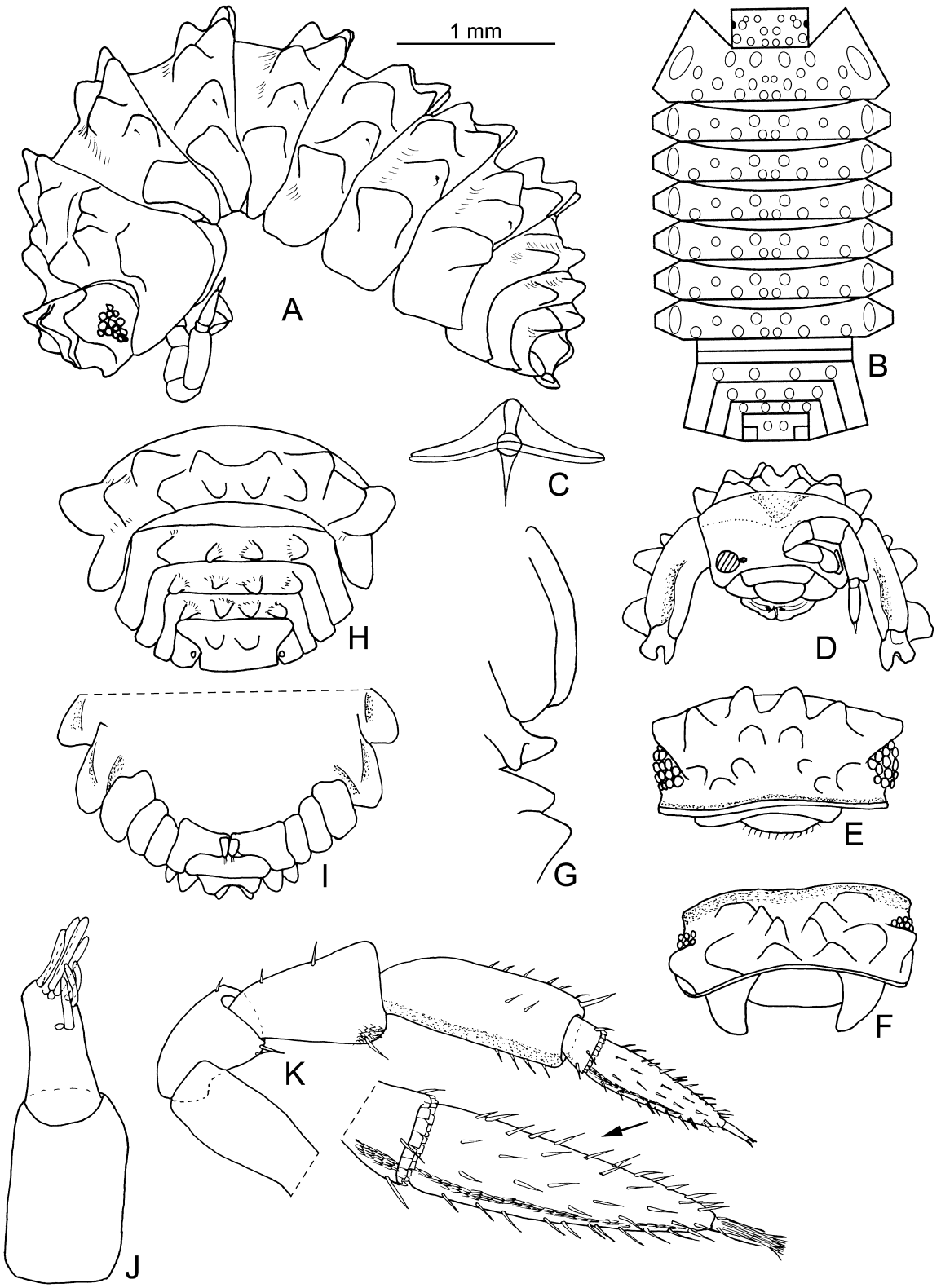

Figure 37. ***Ctenorillo ferrarai*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, habitus, lateral; B, disposition of dorsal tubercles; C, dorsal scale seta; D, cephalon and pereonites 1 and 2, frontal; E, cephalon, dorsal; F, cephalon, caudal; G, epimera of pereonites 1–4, ventral; H, pereonite 7, pleon, telson and uropods, frontal; I, pereonite 7, pleon, telson, and uropods, ventral; J, antennule; K, antenna. Scale bar: 1 mm.

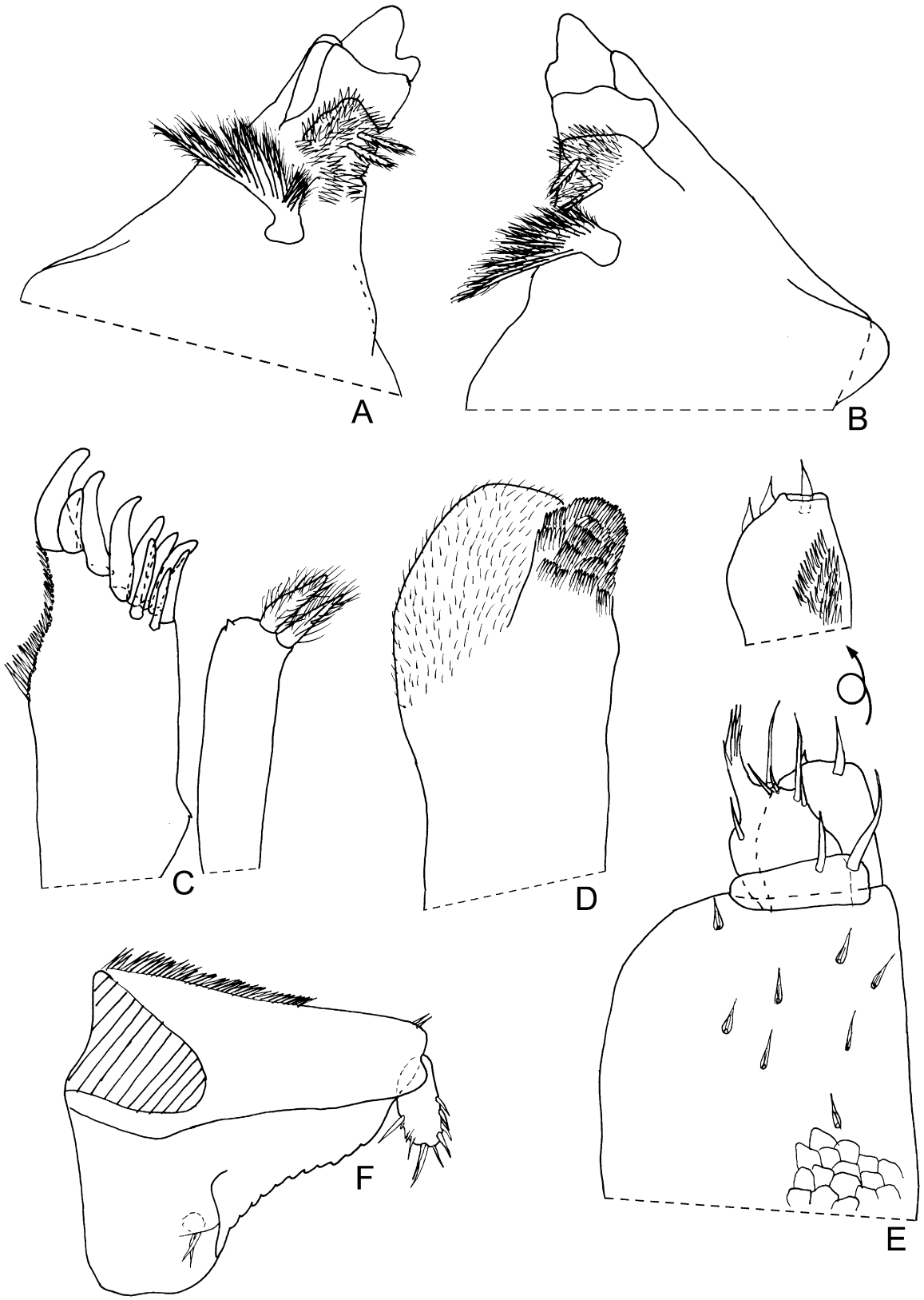

Figure 38. ***Ctenorillo ferrarai*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, left mandible; B, right mandible; C, maxillule; D, maxilla; E, maxilliped; F, uropod.

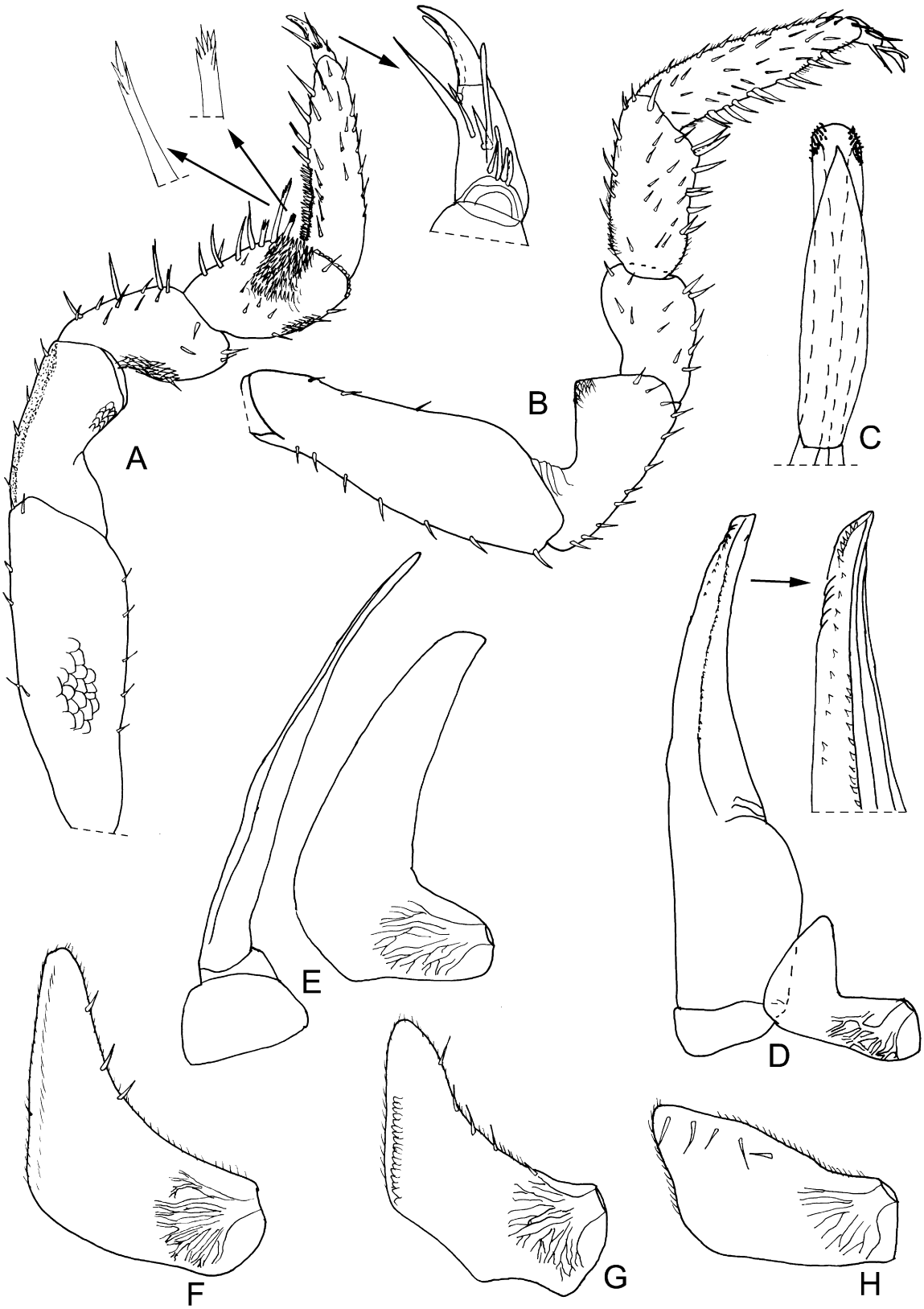

Figure 39. ***Ctenorillo ferrarai*** Campos-Filho, Araujo & Taiti **sp. nov.**, ♂: A, pereopod 1; B, pereopod 7; C, genital papilla; D, pleopod 1; E, pleopod 2; F, pleopod 3 exopod; G, pleopod 4 exopod; H, pleopod 5 exopod.

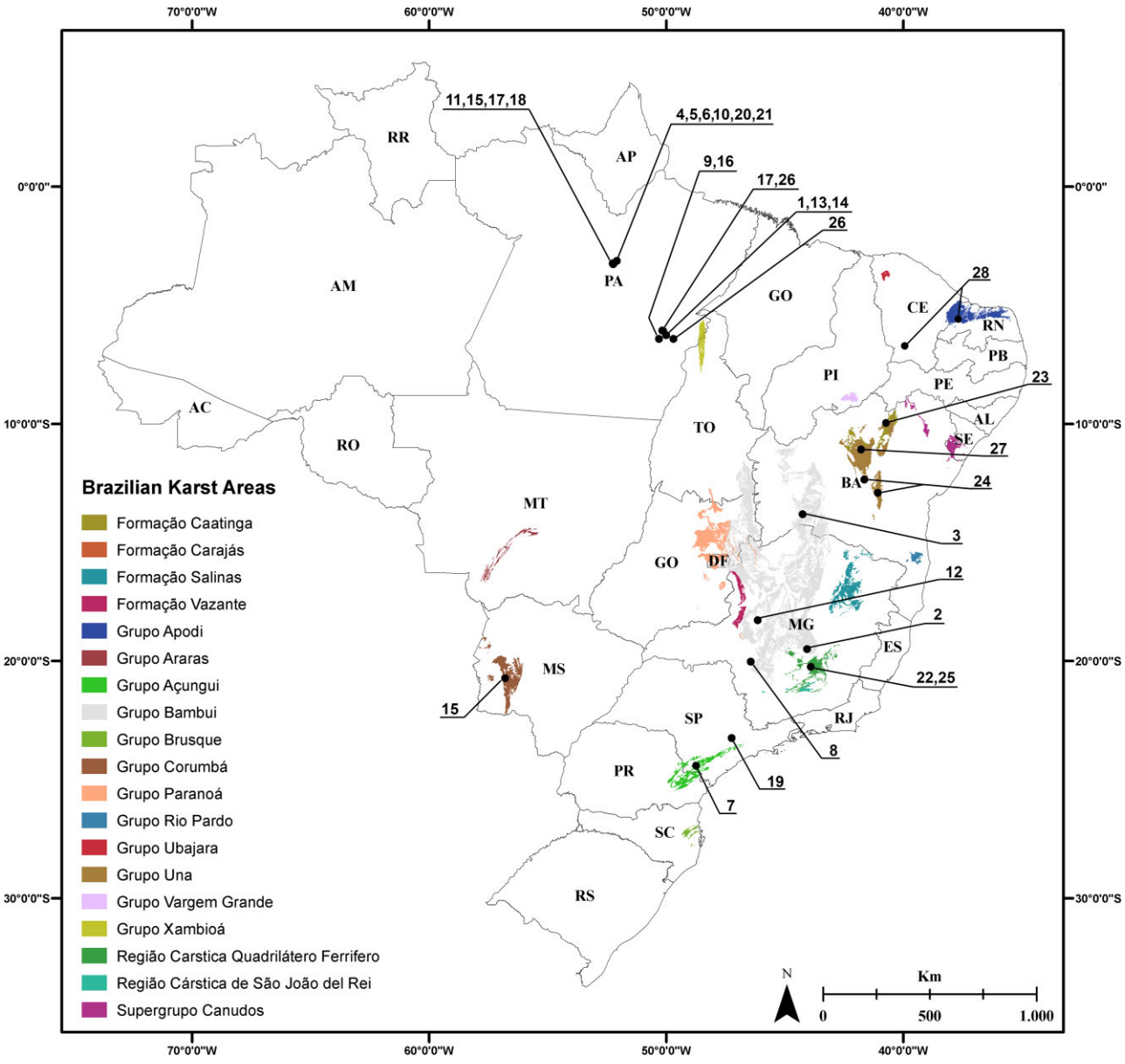

Figure 40. Distribution map of terrestrial isopods in Brazilian karst areas: 1, *Miktoniscus medcofi*; 2, ***Spelunconiscus castroi* sp. nov.**; 3, ***Xangoniscus aganju* sp. nov.**; 4, ***Leonardoscia hassalli* sp. nov.**; 5, ***Metaprosekia quadriocellata* sp. nov.**; 6, ***Metaprosekia caupe* sp. nov.**; 7, *Benthana iporangensis*; 8, *Benthana taeniata*; 9, *Ischioscia amazonica*; 10, ***Amazoniscus leistikowi* sp. nov.**; 11, *Amazoniscus eleonorae*; 12, *Circoniscus bezzi*, 13, *Circoniscus buckupi*; 14, *Circoniscus carajasensis*; 15, *Circoniscus intermedius*; 16, *Circoniscus incisus*; 17, ***Novamundoniscus altamiraensis* sp. nov.**; 18, *Dubioniscus goeldii*; 19, *Dubioniscus marmoratus*; 20, ***Trichorhina yiara* sp. nov.**; 21, ***Trichorhina curupira* sp. nov.**; 22, ***Trichorhina anhanguera*** sp. nov.; 23, *Trichorhina guanophila*; 24, *Porcellionides pruinosus*; 25, *Armadillidium vulgare*; 26, ***Ctenorillo ferrarai* sp. nov.**; 27, *Cubaris murina*; 28, *Gabunillo aridicola*. Abbreviations: AC, Acre; AL, Alagoas; AP, Amapá; AM, Amazonas; BA, Bahia; CE, Ceará; DF, Distrito Federal; ES, Espírito Santo; GO, Goiás; MA, Maranhão; MT, Mato Grosso; MS, Mato Grosso do Sul; MG, Minas Gerais; PA, Pará; PR, Paraíba; PR, Paraná; PE, Pernambuco; PI, Piauí; RJ, Rio de Janeiro; RN, Rio Grande do Norte; RS, Rio Grande do Sul; RO, Rondônia; RR, Roraima; SC, Santa Catarina; SP, São Paulo; SE, Sergipe; TO, Tocantins.

(Fig. 37A,B): vertex of cephalon with three rows, an anterior row of six tubercles, a middle row of two tubercles, and a posterior row of six tubercles; pereonite 1 with an anterior row of four tubercles, a middle row of 12 tubercles, and a posterior row of eight tubercles; pereonites 2–7 with two rows of six tubercles; pleonites 3–5 with one row of four tubercles; telson with two paramedian tubercles. Dorsal surface with short triangular scale setae (Fig. 37C). Pereonites 1–7 with one nodulus lateralis per side inserted on the lateral surface of the second outer tubercle (Fig. 37A). Cephalon (Fig. 37D–F) with frontal shield slightly protruding above vertex and concave in the middle; eye consisting of 14 ommatidia. Pereonite 1 grooved on lateral margin for about two-thirds of its length, inner lobe of schisma rounded, distinctly extending beyond posterior margin of outer lobe (Fig. 37G). Pereonites 2–4 with triangular epimera, pereonites 5–7 with quadrangular epimera (Fig. 37A). Pereonite 2 with a subtriangular ventral lobe distinctly extending beyond posterior margin of the epimeron (Fig. 37G). Pereonites 6 and 7 (Fig. 37I) grooved on ventral portion of epimerae. Telson (Fig. 37H) hourglass-shaped, proximal part broader than distal part, and straight distal margin. Antennule (Fig. 37J) of three articles with six long apical and two subapical aesthetascs. Antenna (Fig. 37K) short and stout, slightly surpassing rear margin of cephalon; flagellum with second article about three times as long as the first. Mandibles (Fig. 38A,B) with molar penicil consisting of several plumose setae; left mandibles with 2 + 1 and right mandible with 1 + 1 free penicils. Maxillule (Fig. 38C) with outer branch bearing 4 + 6 simple teeth; inner branch with two long penicils and a small posterior point. Maxilla (Fig. 38D) bilobate, with inner lobe distinctly narrower than outer lobe. Maxilliped (Fig. 38E) endite with a subapical large seta overpassing the distal margin, and two triangular setae distally; palp with two setae on the basal article. Pleopods 1–5 with monospiracular respiratory structures (Fig. 39D–H). Uropod (Fig. 38F) protopod flattened and enlarged on basal part, distal part trapezoidal, with medial margin slightly concave; exopod very short, inserted dorsally near the medial margin of the protopod.

Male: Pereopod 1 and 7 (Fig. 39A,B) with no particular modifications. Genital papilla as in Figure 39C. Pleopod 1 (Fig. 39D) exopod small, wider than long, with a triangular distal lobe and strongly concave distal margin; endopod with triangular distal part slightly bent outwards, bearing one row of small setae on the caudal surface near distal margin. Pleopod 2 (Fig. 39E) exopod triangular, L-shaped, with outer margin strongly concave; endopod longer than exopod. Pleopods 3–5 as in Figure 39F–H.

Remarks

At present *Ctenorillo* includes 12 species (Schmalfuss, 2003): *Ctenorillo ausseli* Dollfus, 1893b), from the Canary Islands; *Ctenorillo bananae* (Van Name, 1920), from Cameroon, Congo, and Angola; *Ctenorillo buddelundi* Verhoeff, 1942, from Uganda and Kenya; *Ctenorillo fagei* (Paulian de Félice, 1941), from Ivory Coast; *Ctenorillo gabunensis* (Schmalfuss & Ferrara, 1983), from Gabon; *Ctenorillo guinensis* (Schmalfuss & Ferrara, 1983), from Guinea; *Ctenorillo kenyensis* Schmölzer, 1974, from Uganda and Tanzania; *Ctenorillo legai* (Arcangeli, 1941), from Ethiopia; *Ctenorillo parituberculatus* (Taiti & Ferrara, 1987), from Malawi; *Ctenorillo regulus* (Van Name, 1920), from Zaire and Somalia; *Ctenorillo strinatii* (Schmalfuss & Ferrara, 1983), from Congo; and *Ctenorillo mineri* (Van Name, 1936), from Venezuela and Guyana. The best character to distinguish the species of *Ctenorillo* is the number and arrangement of dorsal tubercles. In having four tubercles on pleonites 3–5 and two on telson, *C. ferrarai* sp. nov. resembles *C. fagei*, *C. gabunensis*, *C. guinensis*, and *C. mineri*, from which it differs in the number and disposition of tubercles on the cephalon and pereon. In particular, it is recognized from the only other Neotropical species, *C. mineri*, by having 3 + 3 tubercles in the anterior and 3 + 3 tubercles in the posterior row on pereonites 2–7, instead of 5 + 5 tubercles in the anterior and 4 + 1 + 4 in the posterior row, and by the shape of the male pleopod 1 (compare Figure 39D with figure 97A in Vandel, 1952b, for *C. mineri*).

GENUS *CUBARIS* BRANDT, 1833

Type species: Cubaris murina Brandt, 1833, by subsequent designation (Barnard, 1932).

Diagnosis

Vandel (1952b).

CUBARIS MURINA BRANDT, 1833

FIGURE 40

Cubaris murina; Lemos de Castro 1967: 328; 1971: 12, fig. 13; Souza-Kury 1998: 653; Araujo *et al*. 1996: 129, figs 46–47; Leistikow & Wägele 1999: 44; Schmalfuss, 2003: 81; Appel *et al*. 2011: 124, fig. 2B, C.

Material examined

Brazil, Bahia: one ♂, two ♀, Morro do Chapéu, Guta dos Brejões, 11°06′07″S, 41°46′11″W, 14 May 2009, leg. M.E. Bichuette (UFRGS 5381).

Distribution

Species with a wide distribution along the tropics.

GENUS *GABUNILLO* SCHMALFUSS & FERRARA, 1983

Type species: Gabunillo coecus Schmalfuss & Ferrara, 1983, by original designation and monotypy.

Diagnosis

See Schmalfuss & Ferrara (1983).

GABUNILLO ARIDICOLA SOUZA, SENNA & KURY, 2010

FIGURE 40

Gabunillo aridicola Souza, Senna & Kury, 2010: 2, figs 1–7.

Distribution

Brazil: Ceará.

GENERAL REMARKS

Twenty-two species of terrestrial isopods in nine families and 16 genera have been collected and identified from 35 caves in the states of Bahia, Minas Gerais, Mato Grosso do Sul, Pará, and São Paulo (Table 1). With the six species previosly recorded, the number of oniscidean species confirmed for Brazilian caves is now 28. If we consider that the total number of terrestrial isopod species known from Brazil is 161, this number is not very high. We have to point out that only a limited number of caves in Brazil have been investigated as far as invertebrates are concerned, and the number of cave-dwelling terrestrial isopods will certainly increase as soon as more caves are sampled.

Nevertheless, these data show some biogeographic patterns. The species recognized herein occur in three different biogeographic units, *sensu* Morrone (2006, 2013): (1) the Amazonian subregion, specifically the province Tapajós-Xingu, with 17 species, 12 of which, mostly Philosciidae and Scleropactidae, are endemic to this subregion, in particular to Altamira and Carajás karst areas, state of Pará; (2) the Chacoan subregion, with nine species, three of which, belonging to the families Styloniscidae, Plathyarthridae and Armadillidae, are endemic to Apodi, Una, Bambuí, and Corumbá karst areas, states of Ceará, Rio Grande do Norte, Bahia, Minas Gerais, and Mato Grosso do Sul; and (3) Paraná subregion, with four species, three of which, in the families Philosciidae, Dubioniscidae, and Plathyarthridae, are endemic to Quadrilátero Ferrifero and Açungui karst areas, states of Minas Gerais and São Paulo (Fig. 40). Two species occur in the Amazonian and Chacoan subregions: *Circoniscus bezzi* from the states of Pará, Minas Gerais, and São Paulo, and *Circoniscus intermedius* from the states of Pará and Mato Grosso do Sul (Table 2).

The genus *Benthana* is endemic to South America, and is distributed in the Atlantic forest areas of the Paraná subregion (Campos-Filho, Costa & Araujo, 2013; Morrone, 2013).

The genera of the family Armadillidae have a Gondwanan distribution: *Ctenorillo* from the Amazonian subregion and the Afrotropical region (see Schmalfuss, 2003), and *Gabunillo* from Caatinga province of the Chacoan subregion, with only one species from Gabon, Africa.

The family Scleropactidae with the genera *Amazoniscus* and *Circoniscus* occurs in the Amazonian and Paraná subregions (see Schmidt, 2007), indicating some historical connections between both these subregions (see also Nihei & Carvalho, 2007; Ferrari *et al*., 2010). The family Styloniscidae has mainly a Gondwanan distribution; however, the affinities of the two new genera *Spelunconiscus* gen. nov. and *Xangoniscus* gen. nov., both collected from the Chacoan subregion, still need to be detected. It is interesting to notice that the two styloniscids, *Spelunconiscus castroi* sp. nov. and *Xangoniscus aganju* sp. nov., are amphibian species secondarily adapted to live in water, as demonstrated by the presence of a water-conducting system on pereopod 7 (for a discussion on the origin of aquatic Oniscidea, see Tabacaru, 1999; Taiti & Xue, 2012).

Among the new species described herein, four may be considered troglobitic because of the absence or low number of ommatidia and reduction of pigment (colourless or pale body) and absence in epigean habitats (Trajano, 2012): *Spelunconiscus castroi* sp. nov., *Xangoniscus aganju* sp. nov., *Leonardoscia hassalli* sp. nov., and *Amazoniscus leistikowi* sp. nov. The case with *Trichorhina* is more complicated because there is a great deal of variation concerning the condition of eyes and body colour, and there is evidence for highly convergent or parallel phenotypic evolution, with epigean species showing some troglomorphic traits, common among animals living in deep soil, and these can obscure taxonomic relationships among cave-adapted species and among closely related cave and surface species (see Wilkens & Strecker, 2003; Porter, 2007; Bendik *et al*., 2013). Therefore, the troglobitic status for the two troglomorphic species *Trichorhina curupira* sp. nov. and *Trichorhina anhanguera* is doubtful. Collections in contiguous epigean habitats, which are not usually performed properly in biospeleological surveys, may also show their occurrence outside caves, indicating a troglophilic rather than a troglobitic condition.

All the other species are not troglomorphic, and are either troglophilic or accidental in Brazilian caves, but their status is difficult to establish as we have no or only scatterd data on species that occur outside of caves.

Table 1. List of terrestrial isopods from Brazilian caves

Species	Locality
Trichoniscidae	
1. *Miktoniscus medcofi*	PA, Canaã dos Carajás
Styloniscidae	
2. ***Spelunconiscus castroi* sp. nov.**	MG, Matozinhos, Gruta MOC-32
3. ***Xangoniscus aganju* sp. nov.**	BA, Cariranha, Gruna do Mandiaçu
Philosciidae	
4. ***Leonardoscia hassalli* sp. nov.**	PA, Altamira, Caverna Leonardo da Vinci
5. ***Metaprosekia quadriocellata* sp. nov.**	PA, Altamira, Caverna Leonardo da Vinci
	PA, Altamira, Abrigo do Abutre
	PA, Abrigo do Sismógrafo
	PA, Abrigos Assurini
6. ***Metaprosekia caupe* sp. nov.**	PA, Altamira, Caverna Sugiro
7. *Benthana iporangensis*	SP, Iporanga, Águas Quentes
	SP, Iporanga, Areias de Cima
	SP, Iporanga, Areias de Baixo
8. *Benthana taeniata*	MG, São Roque de Minas, Gruta Zeferino I
	PA, Canaã dos Parauapebas, Gruta Cav 18 S11
9. *Ischioscia amazonica*	PA, Parauapebas, Gruta Cav 28 S11
Scleropactidae	
10. ***Amazoniscus leistikowi* sp. nov.**	PA, Altamira, Abrigo do Sismógrafo
11. *Amazoniscus eleonorae*	PA, Altamira, Pedra da Cachoeira
	PA, Altamira, Caverna Planaltina
	PA, Medicilândia, Gruta do Limoeiro
12. *Circoniscus bezzi*	MG, Presidente Olegário, Caverna Vereda da Palha
	PA, Parauapebas, FLONA Carajás, N4E karst system
13. *Circoniscus buckupi*	PA, Parauapebas, FLONA Carajás, N4WS karst system
	PA, Parauapebas, FLONA Carajás, N5S karst system
	PA, Canaã dos Parauapebas, S11 karst system
14. *Circoniscus carajasensis*	PA, Altamira, Abrigo do Sismográfo
15. *Circoniscus intermedius*	MS, Bodoquena, Gruta Dente de Cão, Parque Nacional Serra da Bodoquena
	PA, Canaã dos Carajás, Gruta S11D-12
	PA, Canaã dos Parauapebas, Gruta S11D-69
16. *Circoniscus incisus*	PA, Parauapebas, Gruta N4E66
Dubioniscidae	
17. ***Novamundoniscus altamiraensis* sp. nov.**	PA, Altamira, Abrigos Assurini
	PA, Canaã dos Parauapebas, FLONA Carajás
18. *Dubioniscus goeldii*	PA, Altamira, Abrigo do Paratizão
	PA, Canaã dos Carajás, Gruta S11-07
	PA, Parauapebas, Gruta Cav 24 S11
	PA, Parauapebas, Gruta Cav 34 S11
	PA, Altamira, Abrigo do Sismógrafo
19. *Dubioniscus marmoratus*	SP, Itu, Caverna do Riacho Subterrâneo
Platyarthridae	
20. ***Trichorhina yiara* sp. nov.**	PA, Altamira, Abrigo do Sismográfo
	PA, Altamira, Abrigo do Abutre
21. ***Trichorhina curupira* sp. nov.**	PA, Altamira, Caverna Pedra da Cachoeira
22. ***Trichorhina anhanguera* sp. nov.**	MG, Morro do Pilar, Gruta MP-10
23. *Trichorhina guanophila*	BA, Campo Formoso, Lapa do Convento
Porcellionidae	
24. *Porcellionides pruinosus*	BA, Iraquara, Gruta Alto da Cruz
	BA, Itaetê, Lapa de Bode
Armadillidiidae	
25. *Armadillidium vulgare*	MG, São Roque de Minas, Gruta Zeferino I
Armadillidae	
26. ***Ctenorillo ferrarai* sp. nov.**	PA, Canaã dos Carajás, FLONA Carajás, Gruta N5S 07
	PA, Canaã dos Carajás, Gruta Cris 11
27. *Cubaris murina*	BA, Morro do Chapéu, Gruta dos Brejões
	CE, Aiuaba, Gruta do Sobradinho
28. *Gabunillo aridicola*	RN, Apodi, Lajeado da Soledade

Abbreviations: BA, Bahia; MG, Minas Gerais; MS, Mato Grosso do Sul; PA, Pará; SP, São Paulo.

Table 2. List of cave-dwelling terrestrial isopods according to Brazilian biogeographic subregions

	Biogegraphic subregions		
	Amazonian	Chacoan	Parana
Trichoniscidae			
1. *Miktoniscus medcofi*	×		
Styloniscidae			
2. ***Spelunconiscus castroi* sp. nov.**		×	
3. ***Xangoniscus aganju* sp. nov.**		×	
Philosciidae			
4. ***Leonardoscia hassalli* sp. nov.**	×		
5. ***Metaprosekia quadriocellata* sp. nov.**	×		
6. ***Metaprosekia caupe* sp. nov.**	×		
7. *Benthana iporangensis*			×
8. *Benthana taeniata*		×	
9. *Ischioscia amazonica*	×		
Scleropactidae			
10. ***Amazoniscus leistikowi* sp. nov.**	×		
11. *Amazoniscus eleonorae*	×		
12. *Circoniscus bezzi*	×	×	
13. *Circoniscus buckupi*	×		
14. *Circoniscus carajasensis*	×		
15. *Circoniscus intermedius*	×	×	
16. *Circoniscus incisus*	×		
Dubioniscidae			
17. ***Novamundoniscus altamiraensis* sp. nov.**	×		
18. *Dubioniscus goeldii*	×		
19. *Dubioniscus marmoratus*			×
Platyarthridae			
20. ***Trichorhina yiara* sp. nov.**	×		
21. ***Trichorhina curupira* sp. nov.**	×		
22. ***Trichorhina anhanguera* sp. nov.**			×
23. *Trichorhina guanophila*		×	
Porcellionidae			
24. *Porcellionides pruinosus*		×	
Armadillidiidae			
25. *Armadillidium vulgare*			×
Armadillidae			
26. ***Ctenorillo ferrarai* sp. nov.**	×		
27. *Cubaris murina*		×	
28. *Gabunillo aridicola*		×	

Current Brazilian laws guarantee cave preservation when a cave reaches the maximum level of relevance, and this is only possible when there are rare or endemic troglobitc species (e.g. Mattox *et al*., 2008; Cardoso *et al*., 2014). Thus, although laws protect at least part of the obligate cave fauna, the conservation acts cannot come into effect if species remain undescribed. In fact, this is a major problem for biodiversity conservation, including the subterranean biota (Bichuette & Trajano, 2010), throughout the world. For this reason, taxonomic studies of subterranean species in Brazil have crucial importance for the preservation of both environment and species, particularly the endemic ones, and any delay in taxonomic research in caves may yield permanent loss to biodiversity, even before the species are discovered and described (e.g. Trajano, 2000; Bichuette & Trajano, 2005; Fišer, Zagmajster & Ferreira, 2013). Taxonomic impediment is the major problem for the development of subterranean research and cave conservation in Brazil; therefore, investment in this field is a priority in the country (e.g. Cordeiro, Borghezan & Trajano, 2014).

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