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Shedding light into Brazilian subterranean isopods (Isopoda, Oniscidea): expanding distribution data and describing new taxa

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ABSTRACT
Fourteen species of terrestrial isopods (Oniscidea) from Brazilian karstic regions are described as new, i.e., *Novamundoniscus mandacaru* Campos-Filho, Araujo & Bichuette, n. sp. (Dubioniscidae), *Diploexochus exu* Campos-Filho, Sfenthourakis & Bichuette, n. sp., *Gabunillo enfurnado* Campos-Filho, Sfenthourakis & Bichuette, n. sp., *Venezillo moreirai* Campos-Filho, Carpio-Díaz & Bichuette, n. sp., *V. garimpeiro* Campos-Filho, Borja-Arrieta & Bichuette, n. sp., *V. dioi* Campos-Filho, Araujo & Taiti, n. sp., *V. limai* Campos-Filho, Carpio-Díaz & López-Orozco, n. sp., and *V. muriloi* Campos-Filho, Sfenthourakis & Taiti, n. sp. (Armadillidae) from the state of Bahia; *N. canopus* Campos-Filho, Gallo & Gallão, n. sp. from the state of Goiás, *Caraiboscia jabutiensis* Campos-Filho, Taiti & Bichuette, n. sp. (Philosciidae), *Circoniscus caeruleus* Campos-Filho, Sfenthourakis & Bichuette, n. sp. (Scleropactidae), *Trichorhina amplitelson* Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp. (Platyarthridae), and *N. kayabi* Campos-Filho, Sfenthourakis & Araujo, n. sp. from the state of Mato Grosso; and *Diploexochus carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp. from the state of Mato Grosso do Sul. In addition, knowledge on the distribution of *Benthana olfersii* (Brandt, 1833), *B. taeniata* Araujo & Buckup, 1994 (Philosciidae), *Ctenorillo ferrarai* Campos-Filho, Araujo & Taiti, 2014, *Cubaris murina* Brandt, 1833 (Armadillidae), and *Porcellionides pruinosus* Brandt, 1833 (Porcellionidae) is expanded. Distribution maps, characterization of the caves where the species were collected, and subterranean remarks are given.

KEY WORDS
Cave Oniscidea,
Neotropical region,
calcareous rocks,
troglobitic,
troglophilic,
new species.

RÉSUMÉ
Mise en lumière des isopodes souterrains brésiliens (Isopoda, Oniscidea) : élargissement des données de distribution et description de nouveaux taxons.
Quatorze espèces d'isopodes terrestres (Oniscidea) des régions karstiques brésiliennes sont décrites comme nouvelles, i.e., *Novamundoniscus mandacaru* Campos-Filho, Araujo & Bichuette, n. sp. (Dubioniscidae), *Diploexochus exu* Campos-Filho, Sfenthourakis & Bichuette, n. sp, *Gabunillo enfurnado* Campos-Filho, Sfenthourakis & Bichuette, n. sp., *Venezillo moreirai* Campos-Filho, Carpio-Díaz & Bichuette, n. sp., *V. garimpeiro* Campos-Filho, Borja-Arrieta & Bichuette, n. sp., *V. dioi* Campos-Filho, Araujo & Taiti, n. sp., *V. limai* Campos-Filho, Carpio-Díaz & López-Orozco, n. sp. et *V. muriloi* Campos-Filho, Sfenthourakis & Taiti, n. sp. (Armadillidae) de l'État de Bahia ; *N. canopus* Campos-Filho, Gallo & Gallão, n. sp. de l'État de Goiás, *Caraiboscia jabutiensis* Campos-Filho, Taiti & Bichuette, n. sp. (Philosciidae), *Circoniscus caeruleus* Campos-Filho, Sfenthourakis & Bichuette, n. sp. (Scleropactidae), *Trichorhina amplitelson* Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp. (Platyarthridae), et *N. kayabi* Campos-Filho, Sfenthourakis & Araujo, n. sp. de l'État du Mato Grosso, et *Diploexochus carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp. de l'État du Mato Grosso do Sul. En outre, les connaissances sur la distribution de *Benthana olfersii* (Brandt, 1833), *B. taeniata* Araujo & Buckup, 1994 (Philosciidae), *Ctenorillo ferrarai* Campos-Filho, Araujo & Taiti, 2014, *Cubaris murina* Brandt, 1833 (Armadillidae), et *Porcellionides pruinosus* Brandt, 1833 (Porcellionidae) sont élargies. Des cartes de distribution, la caractérisation des grottes où les espèces ont été collectées et des remarques sur le milieu souterrain sont données.

MOTS CLÉS
Oniscidea des cavernes,
région néotropicale,
roches calcaires,
troglobie,
troglophile,
nouvelles espèces.

INTRODUCTION

Terrestrial isopods (Oniscidea) comprise about 4000 species distributed in more than 500 genera and 38 or 39 families (Sfenthourakis & Taiti 2015; Dimitriou *et al.* 2019; Campos-Filho & Taiti 2021). Recently, molecular evidence contradicts the relationships of the genus *Ligia* Fabricius, 1798 (Ligiidae) with all other groups of Oniscidea, raising the discussion of the possibility of multiple invasions of the terrestrial environment (Dimitriou *et al.* 2019).

The Oniscidea occur in almost all terrestrial habitats around the globe, including caves (Schmalfuss 2003). In the last years, our knowledge on the diversity of Oniscidea from subterranean environments has increased considerably (e.g. Bedek *et al.* 2011, 2019; Taiti 2014; Reboleira *et al.* 2015; Kashani *et al.* 2016; Campos-Filho *et al.* 2019, 2020, 2022a; Cardoso *et al.* 2020a, b; Bastos-Pereira *et al.* 2017, 2022; Taiti & Montesanto 2018, 2020; Taiti *et al.* 2018; Taiti & Cardoso 2020). The diversity of terrestrial isopods in subterranean environments is closely related to favourable habitat conditions, such as high humidity, the occurrence of substrate heterogeneity, and a variety of microhabitats (Fernandes *et al.* 2016, 2019; Reboleira *et al.* 2022).

In Brazil, more than 220 species of Oniscidea are known, of which 79 were recorded in caves. Among them, 38 are considered troglobites (obligatory cave-dwellers) and several are troglophiles (facultative cave-dwellers) (Trajano & Carvalho 2017; Campos-Filho *et al.* 2018a, 2019, 2020, 2022a, b, c; Fernandez *et al.* 2019; Cardoso *et al.* 2020a, 2020b, 2021, 2022a, 2022b, 2023; Bastos-Pereira *et al.* 2022). However, for some Oniscidea taxa, these subterranean categories were not properly assigned due to the lack of efficient sampling outside caves. As mentioned in Campos-Filho *et al.* (2014),

endogean species, which generally occur in deep soil layers outside caves, can exhibit typical troglomorphic characters, such as the lack or reduction of body pigments and ommatidia.

After examining a large collection of terrestrial isopods from several calcareous caves and iron ore massifs along the Brazilian states of Bahia, Goiás, Mato Grosso, Mato Grosso do Sul, Pará, Sergipe, and São Paulo, 19 species in 11 genera (seven families) were recognized, of which 14 are considered new to the Science. Moreover, distribution maps and subterranean classification are provided.

MATERIAL AND METHODS

Taxonomy

Specimens were collected by hand with the aid of tweezers and brushes and stored in 70% or absolute ethanol. Information about caves (entrance, twilight, or aphotic zones) and environmental variables (temperature and relative air humidity) were also recorded. Descriptions are based on morphological characters after micropreparations in Hoyer's medium (Anderson 1954). For already described species, the synonym list includes the original description and subsequent records from Brazilian caves. For each new species, type material, etymology, description, and remarks are given. The classification of respiratory structures follows Paoli *et al.* (2002). The habitus images were taken with the stereomicroscope model Zeiss Discovery V.12 with an adapted camera Zeiss AxioCam Erc5s. The photographs were prepared with Adobe Photoshop CC Lite (v. 17.1.1). The appendages were illustrated with the aid of a camera lucida mounted on a CH2 Olympus microscope. The final illustrations were prepared using the software GIMP (v. 2.8) with the method proposed by Montesanto (2015, 2016). A map with the caves where all species occur, as well as hydrological attributes and human pressures due to economic activities in the region, are presented. The distribution map was constructed with QGIS software (v. 3.18.1) and edited with PowerPoint Microsoft 365 (v. 2108).

Material is deposited in the scientific collection of the Laboratório de Estudos Subterrâneos (LES), Universidade Federal de São Carlos, São Carlos, Brazil (curator: Maria E. Bichuette).

Study areas

João Rodrigues river karst system, Bambuí geomorphological group

The João Rodrigues River karst system comprises the Phanerozoic sedimentary covers of the Urucuia Group, which overlaps with the Neoproterozoic metasedimentary rocks of the Bambuí geomorphological group, represented by São Desidério and Serra da Mamona formations (Fig. 1A) (Rubbioli *et al.* 2019). The climate is hot (Caw) with a dry and cold season from May to September, and a hot and rainy season from October to April with a temperature average between 20°C and 26°C (Köppen 1948). The dominant vegetation is Cerrado (savanna-like biome), with transitions of Caatinga, rapidly replaced with monocultures or pastures to support beef cattle raising (Galvão *et al.* 2012). In addition, mineral exploration, mostly limestone extraction, constitutes an activity with great potential for intensification and expansion (Galvão *et al.* 2012). Therefore, the River João Rodrigues karst system can be considered threatened due to its proximity to urban areas, road traffic lines construction, and pollution of subterranean drainage (Gallão & Bichuette 2018).

Serra do Ramalho karst area, Bambuí geomorphological group

The Serra do Ramalho karst area, in the southwestern state of Bahia, Brazil, comprises the municipalities of Coribe, Feira da Mata, Carinhanha, and Serra do Ramalho. This area is on the left bank of the middle São Francisco River basin, being dominated by a plateau formed by carbonatic rocks belonging to the Bambuí geomorphological group, with a high number of caves mostly without legal protection (Figs 1B; 3B, C; 5A, D) (Rubbioli *et al.* 2019). The climate is tropical dry, characterized by a dry winter with annual precipitation of about 640 mm (Köppen 1948). The region main biome is Caatinga, composed of mesophytic and xeromorphic forests interspersed with Cerrado (Bichuette & Rizzato 2012).

São Domingos karst area, Bambuí geomorphological group

The São Domingos karst area is considered one of the most important speleological regions of Brazil. It has a high concentration of caves with huge sizes, and rich ornamentation with speleothems (Figs 1C; 4B). It consists of a mountain range, namely Serra do Calcário, oriented north-south, parallel to the sandstone scarp of Serra Geral. Large springs originate from the sandstone mountain range and after few kilometers, disappear into the limestone creating large cave systems (Rubbioli *et al.* 2019).

The region is inserted in the Cerrado Domain (Ab'Saber 2007), with the dry season between March and September, sometimes extending until October (Köppen 1948). The rainfall pattern is marked by floods from October to March, which bring large amounts of organic matter inside caves (Bichuette *et al.* 2019).

The Terra Ronca State Park (PETeR) (in Portuguese, Parque Estadual de Terra Ronca) extends in this karst area; it comprises about 57 000 ha, in the municipalities of São Domingos and Guarani de Goiás, state of Goiás. The park was created on July 7th, 1989 (Brazilian Law No. 10 879), and delimited by the Brazilian Decrees 4,700/1996 and 7,996/2013. Most caves in the park are legally protected, but some river springs on the Serra Geral plateau are still unprotected and threatened by deforestation for agricultural use.

Mambaí and Posse karst area, Bambuí geomorphological group

The Mambaí and Posse karst region is located in the northwestern state of Goiás, comprising the municipalities of Mambaí, Posse, and Nova Roma. The caves of this region have drainage systems along their extensions, and Mambaí hosts the most extensive cave, Gruna da Tarimba cave, with approximately 10.5 km (Rubbioli *et al.* 2019). This area is on the left margin of the Rio Paranã, which is part of the upper Rio Tocantins basin in the Cerrado, characterized by a tropical semi-humid climate with 4-5 dry months throughout the year (Nimer 1979).

Açungui geomorphological group
The Açungui geomorphological group extends from the south of the state of São Paulo to the north of the state of Paraná (Fig. 1D). It comprises the metamorphic limestone and dolomite rocks dated about 600 Mya, and it can be divided into Capiru, Votuverava, and Antinha formations, the last one concentrating most of the calcareous rocks (Rubbioli *et al.* 2019). The group is located in the Chacoan subregion, in all provinces of the Paraná domain (see Morrone *et al.* 2022). According to Köppen's criteria, the region has a subtropical humid climate, with rainfall occurring throughout the year and an average annual rainfall of about 4000 mm (Köppen 1948). The coldest season occurs from April to August with an average temperature of 18°C and precipitation above 100 mm, while the hottest and wettest season occurs from September to March, with temperatures of the hottest month of about 28°C and precipitation above 250 mm (Köppen 1948).

In this region are also included the Caverna do Diabo State Park (PECD) (in Portuguese, Parque Estadual da Caverna do Diabo), in the municipalities of Barra do Turvo, Cajati, Eldorado, and Iporanga, and the Intervales State Park (PEI) (in Portuguese, Parque Estadual de Intervales), in the municipalities of Guapiara, Eldorado Paulista, Iporanga, Ribeirão Grande, and Sete Barras. Both parks have a remarkable potential for tourism, including their caves (Fig. 2B).

Iraquara karst area, Una geomorphological group
The Iraquara karst area, located in the central part of the state of Bahia, comprises the calcareous rocks of the Salitre formation on the southern end of the Irecê Basin. This karst area is surrounded by quartzitic and sandstone mountains that canalize the subterranean waters to a southward flow, which favors the development of large meandering caves on the left side of the Rio Preto River and important labyrinthic caves on the right side (Figs 1E; 5B) (Rubbioli *et al.* 2019).

The main caves in the area are in the Lapa Doce cave system, composed of two large caves, Lapa Doce I with about 9 km of upstream extension, and Lapa Doce II with about 16 km of downstream extension. The latter is the fourth most extensive cave in the country (Rubbioli *et al.* 2019). Both caves are in the Environmental Protection area of Marimbus-Iraquara, and only part of Lapa Doce I is open for tourism. The region faces threats related to plantations, the use of pesticides, which causes soil and aquifers pollution, and the expansion of water exploration by the uncontrolled installation of artesian wells.

Ituaçu karst area, Una geomorphological group
The Ituaçu karst area is in the central part of the state of Bahia, on the Serra do Sincorá domain at the meridional part of the Chapada Diamantina plateau (Figs 1F; 4C). It is inserted in the Una geomorphological group and comprises the calcareous rocks of the Salitre formation, with limestone and dolomites intercalated with quartzites basins from the Espinhaço supergroup (Rubbioli *et al.* 2019).

The region is located in the Caatinga domain with an annual average temperature of 25.6°C, and annual precipitation varying from 232 to 1588 mm, with the rainy season from November to January and the dry season from June to August (Köppen 1948).

The Ituaçu region is under intense pressure by mining activities (Soares *et al.* 2005), with numerous processes for the extraction of limestone and land use activities, such as agriculture and livestock.

Andaraí karst area, Una Geomorphological group
The Andaraí karst area comprises the municipalities of Andaraí, Iramaia, Itaetê, Lajedinho, and Nova Redenção. The region does not have a high concentration of caves, but sparse, isolated ones occur among the relief predominantly covered by a dense layer of soil. The caves have a labyrinthine pattern, comprising large conduits crossing each other according to the angle of the fractures (Fig. 3A) (Rubbioli *et al.* 2019). The area is inserted into the Caatinga domain, with a semi-arid climate (hinterland), average rainfall of less than 800 mm, and an average annual temperature of about 26.5°C (Alvares *et al.* 2014). Many caves in this region are explored by tourists at different levels, and are not protected.

Caatinga formation
The Caatinga Formation occurs in north of the state of Bahia, and is placed among depressed zones within calcareous rocks of the Una geomorphological group (Rubbioli *et al.* 2019). This limestone is predominantly white, deposited in lakes or swamps with layers that are few meters deep (*c.* 10-20 m). Geologically, it is relatively recent, having been formed a few million years ago (Rubbioli *et al.* 2019). The caves are distributed in three regions, namely the Pacui-Abreus, Ourolândia (where a large number of mining companies are concentrated), and Itaguaçu da Bahia. Between the first two regions is located Toca do Gonçalo cave, which is known for its biospeleological richness (Rubbioli *et al.* 2019). The surrounding vegetation cover and climate characteristics follow the Andaraí karst area, mentioned above.

Sergipe Region, Canudos geomorphological supergroup
The Sergipe region comprises limestone rocks from the Sergipe-Alagoas sedimentary basin, represented by the Piaçabuçu, Cotinguiba, and Riachuelo formations, within Canudos geomorphological supergroup (Karmann & Sánchez 1979; Rubbioli *et al.* 2019). The Pedra Branca cave is located in the municipality of Maruim, state of Sergipe, along the rocks of the Riachuelo Formation, dating from Early Cretaceous (approximately 113 Mya). It comprises limestones, dolomites, and basal clastic rocks (Karmann & Sánchez 1979). The Pedra Branca cave extends for some 100 m, and it is heavily impacted by mangroves on the left side of the Sergipe River (Almeida *et al.* 2007). The region shows a tropical coastal climate with a strong rainfall gradient (east to west), ranging from 700 to 1500 mm (Alvares *et al.* 2014).

Corumbá geomorphological group
The Corumbá group comprises limestone and dolomites dated about 660 Mya in the western portion of the state of Mato Grosso do Sul and extending to Bolivia and Paraguay

Fig. 1. — Study area: **A**, outcrops of João Rodrigues River karst system, São Desidério, state of Bahia; **B**, Serra do Ramalho karst area, state of Bahia; **C**, Parque Estadual da Terra Ronca, São Domingos karst area, state of Goiás; **D**, outcrops and rainforest cover, Upper Ribeira karst area, state of São Paulo; **E**, outcrops in the region of Ituaçu, Chapada Diamantina, state of Bahia; **F**, siliciclastic landscape in Lençois region, Chapada Diamantina.

Fig. 2. — Study area: **A**, *Benthana olfersii* (Brandt, 1833), Gruta Água Luminosa cave, Iporanga, state of São Paulo; **B**, Gruta da Tapagem cave, touristic entrance, Eldorado, state of São Paulo; **C**, Toca da Serra Rica, Nobres, state of Mato Grosso; **D**, *Trichorhina amplitelson* Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp., Caverna do Jabuti, Curvelância, state of Mato Grosso.

(Rubbioli *et al.* 2019). It consists of a north-south plateau extending for *c.* 200 km, and forming an important water division with an altitude of 800 m. The group is unique in the context of the Brazilian geomorphological shield, as its tectonic activities have been recorded in the Paraguay Belt, and are related to the development of the Cenozoic Pantanal Basin, which is still subsiding (Campanha *et al.* 2011). The rainy season is from November to February, with an annual average precipitation of about 1300 mm, and an average annual temperature of 24°C (Köppen 1948). The vegetation is composed of savanna in contact with semi-deciduous seasonal forest (Boggiani & Clemente 1999).

The Serra da Bodoquena National Park (PNSB) (in Portuguese, Parque Nacional Serra da Bodoquena) has a territorial extension of 76481 ha. The Park was created in 2000, and since its creation, at least four rural settlements were established in the surroundings of the PNSB, where several relevant caves harboring endemic troglobites are located. Currently, livestock is the main economic activity of the region, followed by tourism, including speleotourism, which has increased

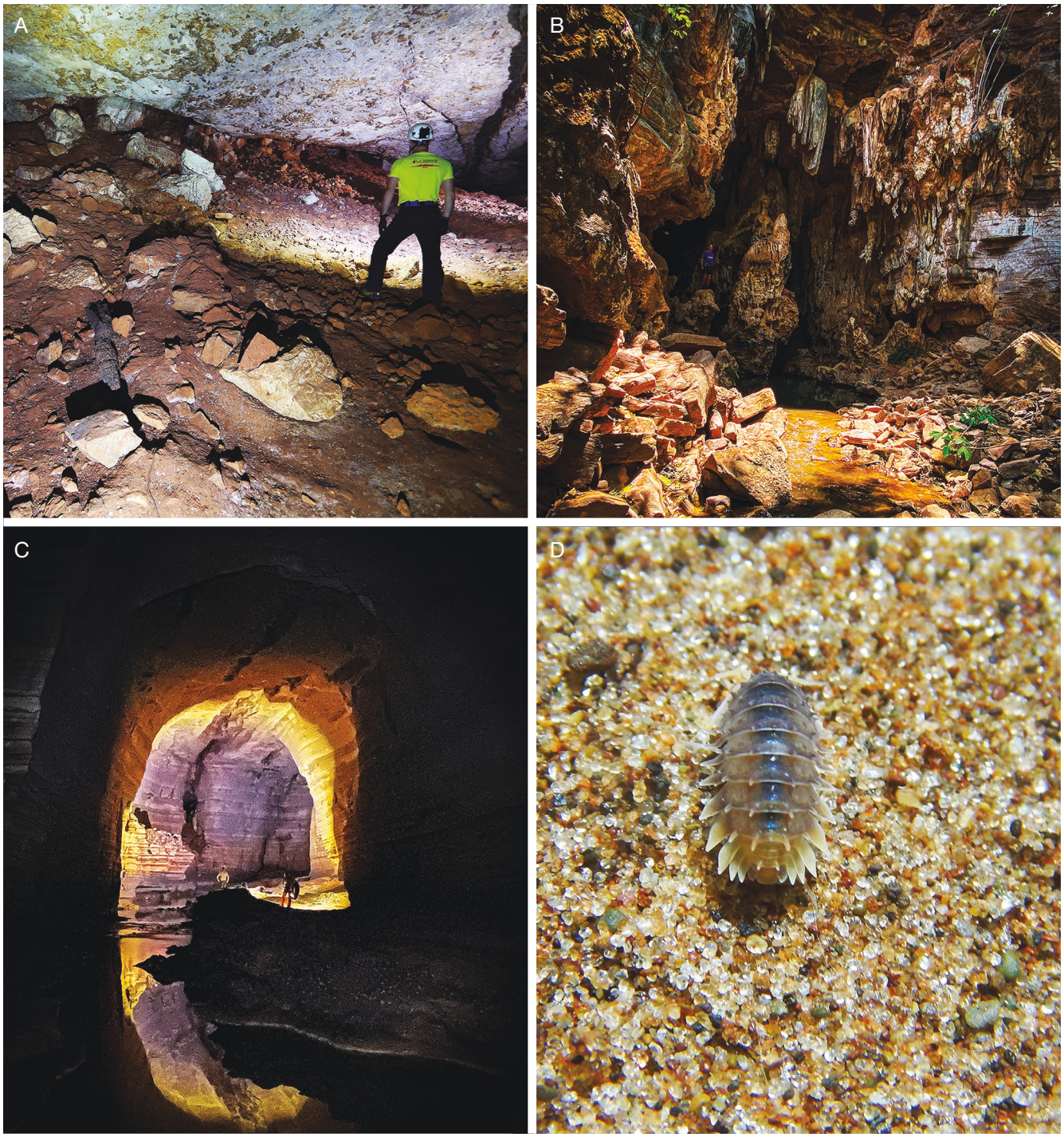

Fig. 3. — Study area: **A**, aphotic zone, Poço Azul do Milu cave, Chapada Diamantina; **B**, Gruna Boca da Lapa cave, Feira da Mata, State of Bahia; **C**, gallery of the Gruna Boca da Lapa cave; **D**, *Diploexochus exu* Campos-Filho, Sfenthourakis & Bichuette, n. sp., Gruna Boca da Lapa.

the economic importance for the municipalities of Bonito, Bodoquena, and Jardim (Cordeiro *et al.* 2014).

Nobres karst area, Araras geomorphological group

The Araras geomorphological group, dated from the Neoproterozoic, has a predominance of limestone, pelagic sediment, and another layer of dolomitic limestone (Fig. 2C) (Nogueira 2003). It is characterized by a straight strip extending from the Upper Paraguay River banks to the border with Bolivia, cutting the state in the east-west direction, where several calcareous caves are located (Nogueira 2003). The region is inserted into the Cerrado Domain (Ab'Saber 2007) and the climate is tropical, with dry winter from April to August, a rainy period during summer, from December to March, with an average annual precipitation of about 2000 mm, and an average annual temperature from 25 to 30°C (Köppen 1948).

Fig. 4. — Study area: **A**, *Venezillo congener* (Budde-Lund, 1904) from Lapa do Bezerra cave, São Domingos, state of Goiás; **B**, gallery of Lapa do Bezerra; **C**, Lapa do Bode cave, Ituaçu, state of Bahia; **D**, entrance of Gruta do Lapão cave, Lençóis, Chapada Diamantina.

Serra Leste, Rio Novo geomorphological group

The Serra Leste is located in the Rio Novo geomorphological group, on the Carajás formation, state of Pará, and it comprises the granite-greenstone outcrops, i.e., associations of granite-gneissic-migmatitic rocks with metavolcano-sedimentary sequences, with a predominance of metabasic rocks over the iron formations, on mafic-ultramafic and granitoid rocks (João *et al.* 2013).

The region has a humid tropical climate, with a rainy period from November to April and a dry season from June to September, an average annual precipitation over 1 500 mm, and an average annual temperature about 25°C (Köppen 1948). The vegetation is composed of dense rainforest and canga (savanna systems established on ferrous soils). The Serra Leste extends to the west, bordering Serra Pelada and Serra do Sereno, outside Floresta Nacional de Carajás and Parque Nacional dos Campos Ferruginosos. Moreover, Serra Pelada is unprotected by Brazilian laws. To date, iron ore mining is the main threat to the caves of the region.

Fig. 5. — Study area: **A**, Gruna Bem Bom cave, Carinhanha, state of Bahia; **B**, Lapa Doce cave, Iraquara, Chapada Diamantina; **C**, *Porcellionides pruinosus* (Brandt, 1833) foraging on guano, Lapa Doce cave; **D**, cave entrance of Gruna do Govi, Feira da Mata.

Chapada Diamantina Region, Espinhaço geomorphological supergroup

The Gruta do Lapão (Fig. 4D) is located in the municipality of Lençois, northern end of the Chapada Diamantina National Park (PNCD) (in Portuguese, Parque Nacional da Chapada Diamantina), state of Bahia. It stretches for some 1500 m and is one of the most important and imposing touristic caves in the siliciclastic rocks of Brazil. This rock belongs to the Tombador Formation, Chapada Diamantina region (Espinhaço geomorphological supergroup), comprising three rock associations, essentially conglomerate and sandstone, indicating environments of deposition that vary among fluvial, coastal and desert (Rubbioli *et al.* 2019).

The Gruta do Lapão cave is in the geomorphological context of Serra do Sincorá, at the northern end of Serra do Espinhaço, which is a set of mountain ranges with steep walls supported mainly by rocks of the Tombador formation (Pereira *et al.* 2017).

The cave surroundings and interior have a long history of use for mineral extraction, especially diamond mining and speleothem extraction, which permanently alters some of its natural environmental characteristics.

SYSTEMATIC ACCOUNT

Family PHILOSCIIDAE Kinahan, 1857

Genus *Benthana* Budde-Lund, 1908

Philoscia (*Benthana*) Budde-Lund, 1908: 289.

TYPE SPECIES. — *Philoscia picta* Brandt, 1833, by subsequent designation (Van Name 1936) (see Schmidt & Leistikow 2004).

DIAGNOSIS. — See Campos-Filho *et al.* (2015).

Benthana olfersii (Brandt, 1833)
(Figs 2A; 8A)

Philoscia Olfersii Brandt, 1833: 183.

Benthana olfersii – Campos-Filho *et al.* 2018a: 11 (for previous records). — Campos-Filho *et al.* 2020: 17, fig. 14.

MATERIAL EXAMINED. — **Brazil** • 1 ♂ (parts in micropreparations), 1 ♀; Gruta Água Luminosa cave, Iporanga, state of São Paulo; 24°17'8.42"S, 48°21'19.39"W; 831 m a.s.l.; 25.V.2021; M. E. Bichuette, J. E. Gallão, V. F. Sperandei & T. Zepon leg.; LES 27971.

DISTRIBUTION. — Typical in Atlantic Forest areas in the states of Rio de Janeiro and São Paulo (Campos-Filho *et al.* 2015a). In caves, it was recorded from Caverna VL-33, Itabirito, state of Minas Gerais (Campos-Filho *et al.* 2020). The present record extends the knowledge of its distribution for caves in the state of São Paulo, inserted in the Atlantic Forest.

Benthana taeniata Araujo & Buckup, 1994
(Fig. 8A)

Benthana taeniata Araujo & Buckup, 1994: 269, figs 1-13, 28. — Campos-Filho *et al.* 2018a: 11 (for previous records).

Benthana taeiata [sic] – Campos-Filho *et al.* 2020: 18, fig. 14.

MATERIAL EXAMINED. — **Brazil** • 1 ♂; Gruta da Tapagem cave (= Caverna do Diabo), Eldorado, state of São Paulo; 24°38'15.30"S, 48°24'03.30"W; 460 m a.s.l.; 25.III.2021; M. E. Bichuette, J. E. Gallão, V. F. Sperandei & T. Zepon leg.; LES 27972 • 1 ♀; same locality and collectors as previous; 26.III.2021; LES 28044.

DISTRIBUTION. — This species occurs in Atlantic Forest areas from the states of Distrito Federal to the state of Rio Grande do Sul (Campos-Filho *et al.* 2015a). In caves, it is recorded from Gruta Zeferino I cave, São Roque de Minas, state of Minas Gerais, and Ressurgência das Areias de Água Quente and Gruta do Capinzal caves, Iporanga, state of São Paulo (Campos-Filho *et al.* 2020). The present record extends our knowledge on its distribution to the PECD, state of São Paulo. Based on its distribution, the species is considered to be a troglophile.

Genus *Caraiboscia* Vandel, 1968

Caraiboscia Vandel, 1968: 109.

TYPE SPECIES. — *Caraiboscia microphthalma* Vandel, 1968, by monotypy (see Schmidt & Leistikow 2004).

DIAGNOSIS. — Emended after Leistikow (2001a): animals of small size; colorless; dorsal surface bearing fan-shaped or triangular scale-setae; pereonites 1-7 with one line of short *noduli laterales* per side, d/c coordinates almost on same line, b/c coordinates gradually decreasing; cephalon without frontal line and faint suprantennal line, eyes with 3-4 ommatidia, absent in endogean or troglobionts; telson triangular; antennula of three articles, distal article bearing one row of aesthetascs medially; antennal flagellum of three articles, apical organ long; mandibles with molar penicil dichotomized, left mandible with 2+1 penicils, righ mandible with 1+1 penicils; maxillula outer endite with eight teeth, one or two of them cleft at apex; maxilla with setose lobes; maxilliped endite bearing penicil rostrally; pereopod 1 carpus with transverse antennal grooming brush, distal seta cleft at apex, dactylar seta simple or slightly plumose; uropod protopod and exopod grooved on outer margin, endopod inserted proximally; genital papilla with truncate terminal spatula surpassing ventral shield; pleopod exopods without respiratory areas.

REMARKS
The genus *Caraiboscia* was erected by Vandel (1968) to include the new species *C. microphthalma* from Guadalupe Island, Caribbean Sea. Leistikow (2001a) re-described the species, but misinterpreted its country of origin as Equador, probably due to the title of Vandel's work. Schmalfuss (2003), considering Leistikow's work, repeated the mistake. The genus *Caraiboscia* shows affinities with the new genus *Nesophiloscia* from Galapagos Islands, erected in the same work by Vandel (1968).

To date, the genus comprises only two species, *C. microphthalma* and *C. christiani* Leistikow, 2001 from Península di Paria, Venezuela (Schmalfuss 2003), and it shows close phylogenetical relationships with *Colombophiloscia* Vandel, 1981 (Leistikow 2001b).

Caraiboscia jabutiensis
Campos-Filho, Taiti & Bichuette, n. sp.
(Figs 6; 7; 8B)

urn:lsid:zoobank.org:act:6624633A-A478-4C60-B44A-422EE464D4AF

TYPE MATERIAL. — **Holotype. Brazil** • ♂; Caverna do Jabuti, Curvelândia, state of Mato Grosso; 15°33'56.1"S, 57°59'20.04"W; 324 m a.s.l.; 29.IX.2017; J. E. Gallão, A. Chagas-Jr & R. Machado leg.; LES 27985.
Paratypes. Brazil • 1 ♂ (parts in micropreparations), 2 ♀ (one with parts in micropreparations); same data as holotype; LES 27986.

ETYMOLOGY. — The new species name refers to the locality where specimens were collected: Caverna do Jabuti.

DESCRIPTION
Maximum body length: ♂ 3 mm, ♀ 4 mm. Body pigments and eyes absent; cephalon with yellowish spots of muscle insertions. Body (Fig. 6A) with lateral sides almost parallel. Dorsal surface of cephalon and pereonites 1-3 slightly granulate, 4-7 only on posterior portion. Dorsal scale-setae triangular (Fig. 6B). *Noduli laterales* d/c and b/c coordinates as in Figure 6C and D, respectively. Cephalon (Fig. 6E, F) with lateral lobes triangular, slightly developed, suprantennal line faintly visible and bent down in middle. Pereonite 1 epimera with anterior corners slightly directed frontwards; pereonites 1-4 with posterior margins straight, 5-7 gradually arched

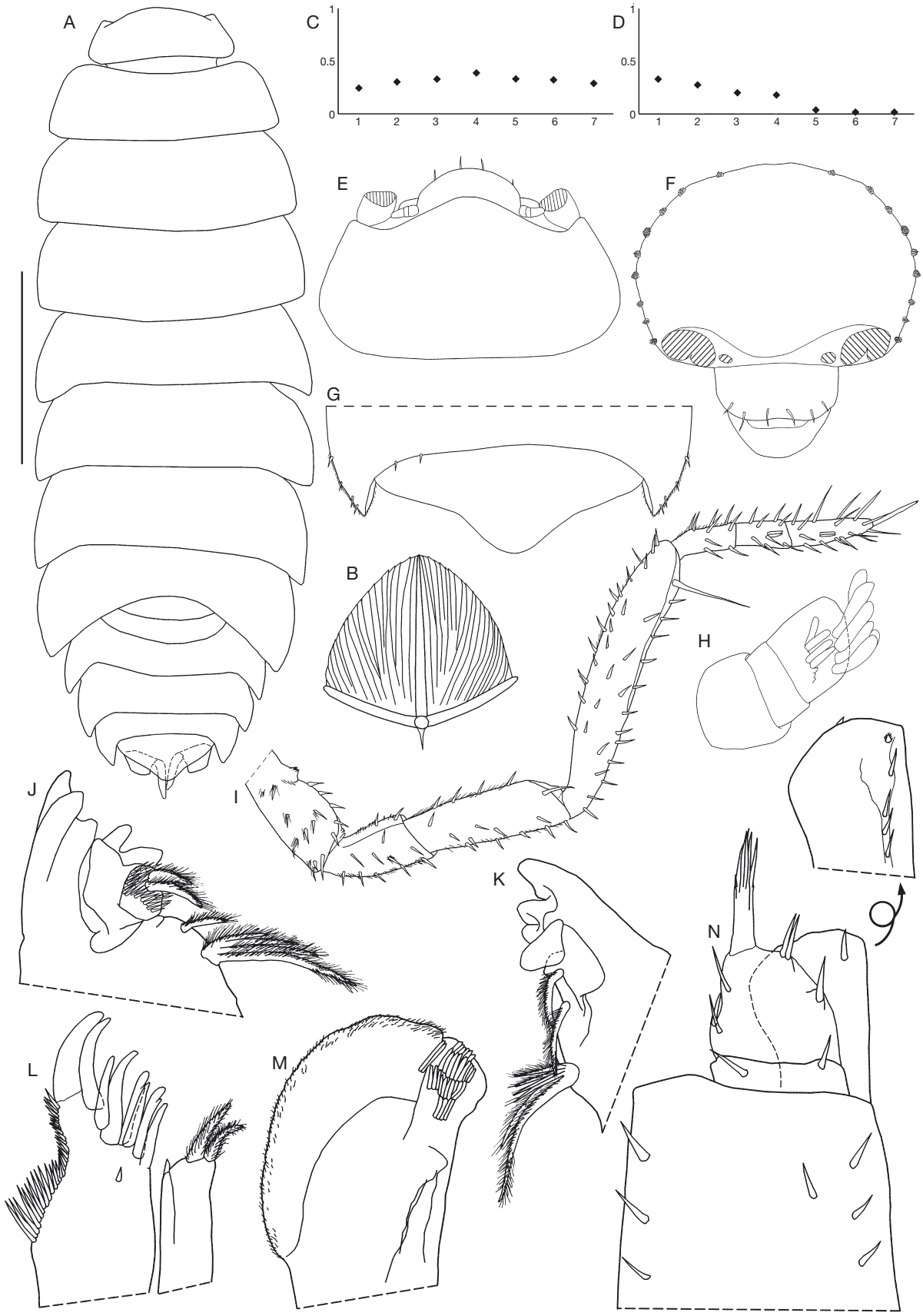

FIG. 6. — *Caraiboscia jabutiensis* Campos-Filho, Taiti & Bichuette, n. sp., female paratype, LES 27986: **A**, dorsal habitus; **B**, scale-seta; **C**, *noduli laterales* d/c coordinates; **D**, *noduli laterales* b/c coordinates; **E**, cephalon, dorsal view; **F**, cephalon, frontal view; **G**, pleonite 5 and telson; **H**, antennula; **I**, antenna; **J**, left mandible; **K**, right mandible; **L**, maxillula; **M**, maxilla; **N**, maxilliped. Scale bar: A, 1 mm.

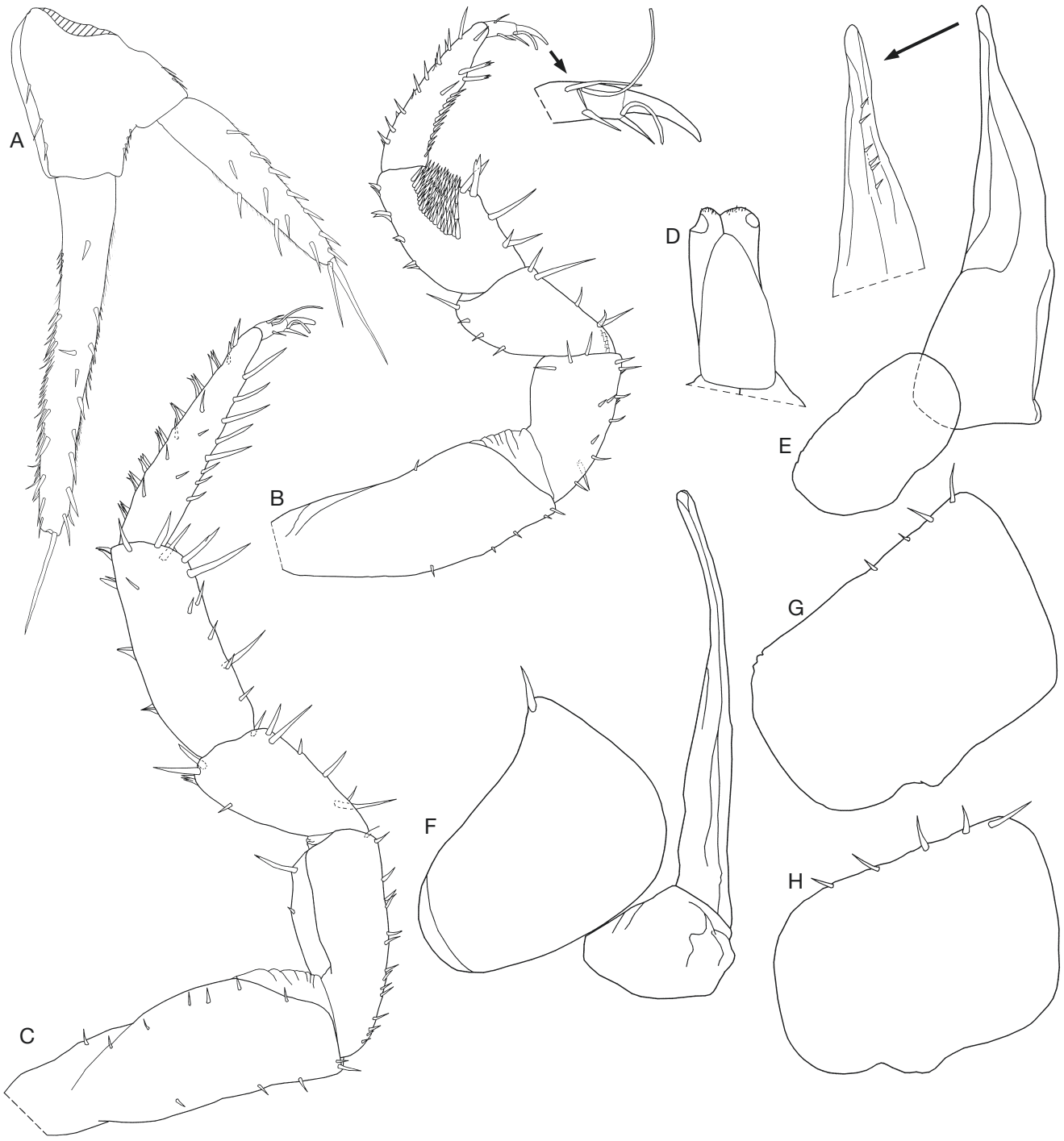

Fig. 7. — *Caraiboscia jabutiensis* Campos-Filho, Taiti & Bichuette, n. sp., **A**, female paratype, LES 27986: uropod; **B**-**H**, male paratype, LES 27986: pereopod 1 (**B**); pereopod 7 (**C**); genital papila (**D**); pleopod 1 (**E**); pleopod 2 (**F**); pleopod 3 exopod (**G**); pleopod 4 exopod (**H**).

(Fig. 6A). Pleon (Fig. 6A, G) slightly narrower than pereon, epimera of pleonites 3-5 short and directed backwards; telson about twice as wide as long, lateral margins slightly concave, and rounded apex. Antennula (Fig. 6H) with proximal and distal articles similar in length, distal article bearing one row of four stout aesthetascs medially plus 5-6 apically. Antenna (Fig. 6I) reaching pereonite 2 when extended backwards; flagellum first and second articles subequal in length, third article longest, second and third articles bearing two aesthetascs, apical bearing two short free sensilla. Mandibles (Fig. 6J, K) with dense cushion of setae on incisor process, molar penicil of five branches. Maxillula (Fig. 6L) inner endite with two apical penicils plus outer tip; outer endite with 4 + 4 teeth, inner set with two teeth apically cleft. Maxilla (Fig. 6M) inner lobe rounded, covered with thick setae; outer lobe rounded, three times as wide as inner lobe, covered with thin setae. Maxil-

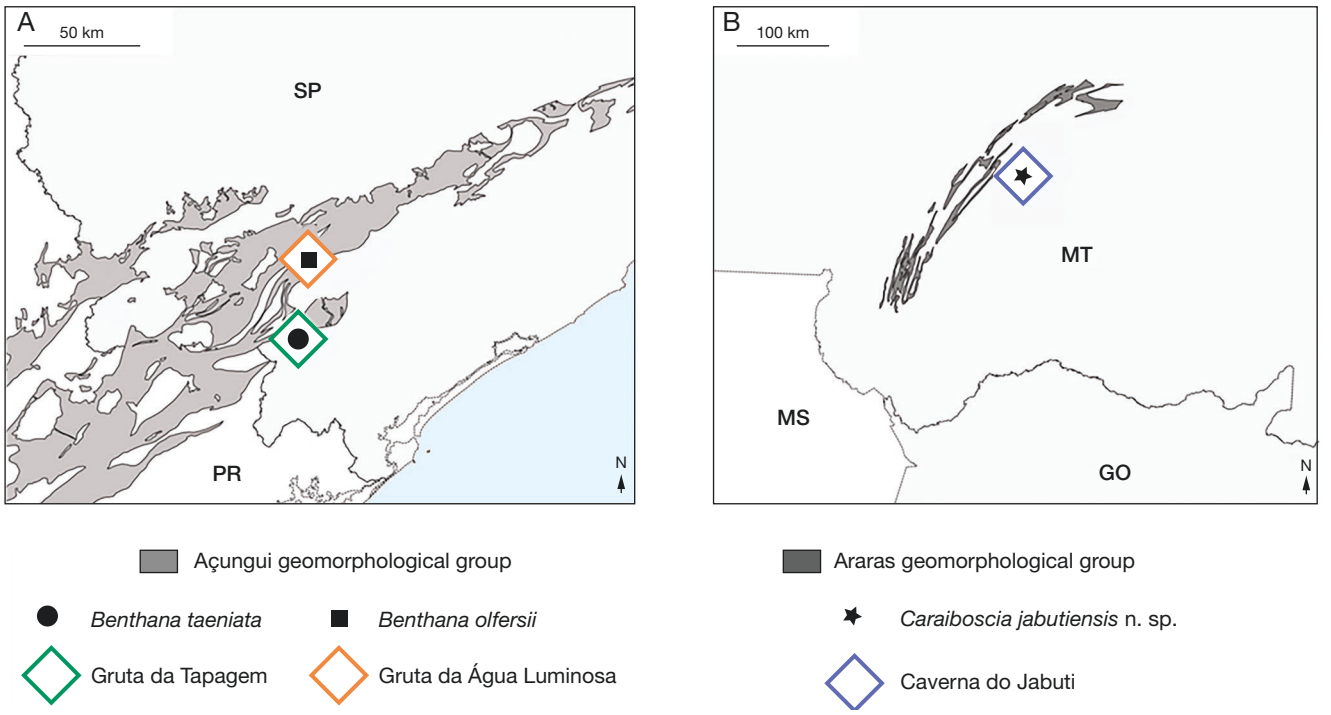

FIG. 8. — Distribution map of the Philosciidae representatives: **A**, *Benthana olfersii* (Brandt, 1833) and *B. taeniana* Araujo & Buckup, 1994; **B**, *Caraiboscia jabutiensis* Campos-Filho, Taiti & Bichuette, n. sp. Abbreviations of states: **GO**, state of Goias; **MS**, state of Mato Grosso do Sul; **MT**, state of Mato Grosso; **PR**, state of Paraná; **SP**, state of São Paulo.

liped (Fig. 6N) palp with two setae on proximal article; endite subrectangular, medial seta not surpassing distal margin, distal margin rounded. Pereopod 1-7 merus to propodus bearing sparse setae on sternal margin, pereopod 1 carpus with short transverse antennal grooming brush and distal seta hand-like; dactylus of two claws, inner claw shorter, dactylar and ungual setae simple, not surpassing outer claw. Uropod (Fig. 7A) protopod subquadrangular; exopod twice as long as endopod.

Male

Pereopods 1 and 7 without sexual dimorphism (Fig. 7B, C). Genital papilla (Fig. 7D) bearing triangular ventral shield, papilla with two subapical orifices. Pleopod 1 (Fig. 7E) exopod subquadrangular; endopod with distal portion straight and bearing small setae on medial margin. Pleopod 2 (Fig. 7F) exopod triangular, outer margin slightly concave bearing one seta; endopod flagelliform, stout, longer than exopod. Pleopod 3 and 4 exopods as in Figure 7G and H, respectively.

REMARKS

Caraiboscia jabutiensis Campos-Filho, Taiti & Bichuette, n. sp. is readily distinguished from its congeners by the absence of eyes and the shape of the male pleopods 1 and 2. Moreover, it differs in having the dorsal scale-setae triangular (vs fan-shaped in all other species), telson with lateral sides slightly concave (vs straight in all other species), antennal flagellum with apical organ slightly shorter than distal article (vs longer in all other species), outer endite of the maxillula with two teeth apically cleft (vs all simple in *C. christiani*; one cleft in *C. microphthalma*), dactylar seta apically simple (vs plumose in all other species), and uropod exopod twice as long as endopod (vs slightly longer in *C. christiani*) (see Vandel 1968; Leistikow 2001a).

The new species is tentatively placed into the genus since it shows most of its diagnostic characters. The absence of eyes and the shape of the male pleopod 1 exopod are considered autapomorphic conditions of the species, probably related to habitat selection and reproductive patterns. Future molecular analyses are needed to confirm the validity of both the genus and all its representatives.

The new species is considered to be a troglobite, and represents the first terrestrial isopod described in hypogenic caves from Brazil. It is the first troglobitic species for the region of Curvelândia and represents the first record of the genus from Brazil, expanding considerably our knowledge of its distribution.

Family DUBIONISCIDAE Schultz, 1995

Genus *Novamundoniscus* Schultz, 1995

Novamundoniscus Schultz, 1995: 406.

TYPE SPECIES. — *Phalloniscus vandeli* Lemos de Castro, 1960, by original designation (see Schmidt & Leistikow 2004).

DIAGNOSIS. — After Schultz (1995): animals of reduced size (2.4-6 mm); dorsal surface smooth covered with fan-shaped scale-setae;

pereonites 1-7 with one line of *noduli laterales* per side, d/c coordinates almost on same line, b/c coordinates gradually decreasing; glandular pores sparse along lateral margins of pereonites, pleonites 3-5, and uropod protopod and exopod (visible under high magnification); cephalon with lateral lobes well-developed, suprantennal line present, frontal line absent; eyes of 5-15 ommatidia (sometimes absent); pleon outline continuous with that of pereonite 7; telson triangular; antennula of three articles, distal article bearing aesthetascs in lateral rows; antennal flagellum of three articles, apical organ short; mandibles with molar penicil dicothomized, left mandible with 2+1 penicils, right mandible with 1+1 penicils; maxillula outer endite of 4+3-5 teeth, inner set of teeth apically simple and/or cleft; maxilla bilobate; maxilliped endite without ornamentation; pereopod 1 carpus with transverse antenna-grooming brush, distal seta apically double-fringed; pleopod exopods without respiratory areas; male endopod 1 with distal half tapering.

Novamundoniscus kayabi
Campos-Filho, Sfenthourakis & Araujo, n. sp.
(Figs 9; 10; 15)

urn:lsid:zoobank.org:act:4004BBE7-3C96-4502-BCB3-C45999E6C65F

TYPE MATERIAL. — **Holotype. Brazil** • ♂ (parts in micropreparations); Toca do Sorvete cave, Nobres, state of Mato Grosso; 14°26'40"S, 56°01'27.4"W; 334 m a.s.l.; 06.V.2015; M. E. Bichuette, A. Chagas-Jr & G. A. Nunes leg.; LES 27973.
Paratypes. Brazil • State of Mato Grosso: 1 ♂ (parts in micropreparations), 1 ♀; Gruta da Fazenda Borba cave, Nobres; 14°30'47"S, 58°58'06.2"W; 311 m a.s.l.; 24.IX.2015; M. E. Bichuette, A. Chagas-Jr & D. M. von Schimonsky leg.; LES 27982 • 1 ♂; Toca da Serra Rica cave, Nobres; 14°26'18.3"S, 56°00'25.1"W; 359 m a.s.l.; 04.V.2015; M. E. Bichuette, A. Chagas-Jr & G. A. Nunes leg.; LES 27983 • 1 ♂, 1 ♀ (in micropreparations); Duto do Quebó cave, Nobres; 14°26'45.7"S, 56°01'15.9"W; 330 m a.s.l.; 23.IX.2015; M. E. Bichuette, A. Chagas-Jr & D. M. von Schimonsky leg.; LES 27984.

ETYMOLOGY. — The new species is named in honor of the Kayabí indigenous people (Caiabis in Portuguese). The Kayabis are the biggest native population of the Tupí-Kawahíwa ethnicity inhabiting the state of Mato Grosso.

DESCRIPTION
Maximum body length: ♂ 2.5 mm, ♀ 5 mm. Color light brown with typical muscle spots insertions; distal portion of cephalon, pereonites 1-7, pleonites epimera and telson more pigmented. Body outline as in Figure 9A. Pereonite 1 epimera distinctly directed frontwards but not surpassing cephalon, pereonites 2-7 gradually more arched and directed backwards. Dorsal surface densely covered with fan-shaped scale-setae (Fig. 9B). One line of small piliform *noduli laterales* per side (Fig. 9B); d/c and b/c coordinates as in Figure 9C and D, respectively. Cephalon (Fig. 9E) with rounded lateral lobes, suprantennal line bent down in middle; eyes with 13 ommatidia. Pleonites 3-5 epimera well developed, acute and directed backwards (Fig. 9A). Telson (Fig. 9F) with lateral sides concave, apex rounded. Antennula (Fig. 9G) with proximal and distal articles subequal in length, distal article bearing about eight aesthetascs in three rows plus apical pair. Antenna (Fig. 9H) reaching fourth pereonite when extended backwards; flagellum with first and second articles subequal in length, third article bearing lateral aesthetascs, apical organ bearing two long free sensilla. Mandibles (Fig. 9I, J) with molar penicil of about 11 branches. Maxillula (Fig. 9K) inner endite with two hairy penicils, distal margin rounded; outer endite with 4+4 teeth apically simple, outer margin strongly concave with long setae. Maxilla (Fig. 9L) inner lobe rounded covered with thick setae; outer lobe twice as wide as inner lobe covered with thin setae. Maxilliped (Fig. 9M) palp with proximal article bearing two long setae; endite subrectangular, medial seta surpassing distal margin, distal margin slightly sinuous. Dactylus of two claws subequal in length, dactylar and ungual setae simple, not surpassing outer claw. Uropod (Fig. 10A) protopod subquadrangular, protopod and exopod grooved on outer margin, exopod and endopod similar in length, endopod inserted proximally.

Male
Pereopods 1 and 7 without apparent sexual dimorphism (Fig. 10B, C). Genital papilla (Fig. 10D) with triangular ventral shield, papilla longer than ventral shield bearing two subapical orifices. Pleopod 1 (Fig. 10D) exopod subtriangular, inner margin rounded, outer margin almost straight; endopod more than twice as long as exopod, distal portion tapering, directed downwards, bearing short setae on medial portion. Pleopod 2 (Fig. 10E) exopod triangular, outer margin concave bearing two short setae; endopod distinctly longer than exopod. Pleopod 3 and 4 exopods (Fig. 10F, G) triangular, outer margin almost straight bearing short setae. Pleopod 5 exopod (Fig. 10H) triangular, outer margin convex bearing short setae.

REMARKS
The genus *Novamundoniscus* was erected by Schultz (1995) to allocate the members of *Phalloniscus* Budde-Lund, 1908 recorded from tropical and temperate zones of the Americas. Leistikow & Wägele (1999) mentioned that the ascription of the following species into *Novamundoniscus* is dubious, *Phalloniscus avrilensis* (Van Name, 1940) from Haiti, *P. baldoni* (Arcangeli, 1930) from Costa Rica, *P. barbouri* (Van Name, 1926) from Brazil and Panama, *P. langi* (Van Name, 1936) and *P. pearsei* (Van Name, 1936) from Guiana, *P. loyolai* Zardo, 1989, *P. meridionalis* Araujo & Buckup, 1994, and *P. setosus* Lemos de Castro, 1960 from Brazil.

To date, the genus includes nine species strictly distributed in South America (Vandel 1952; Lemos de Castro 1960; Schultz 1995; Lopes & Araujo 2003; Campos-Filho *et al.* 2018a, b). According to the generic diagnosis proposed here, *Phalloniscus meridionalis* (see Araujo & Buckup 1994) should be placed into *Novamundoniscus*. The remaining species mentioned need to be revised in order to clarify with certainty their taxonomic status.

Novamundoniscus kayabi Campos-Filho, Sfenthourakis & Araujo, n. sp. is similar to *N. macrophthalmus* (Lemos de Castro, 1960) in having the eyes composed of 13 ommatidia; however, it differs in the cephalon with lateral lobes well-developed (vs slightly developed in *N. macrophthalmus*), maxillula outer endite with outer set of teeth simple (vs all

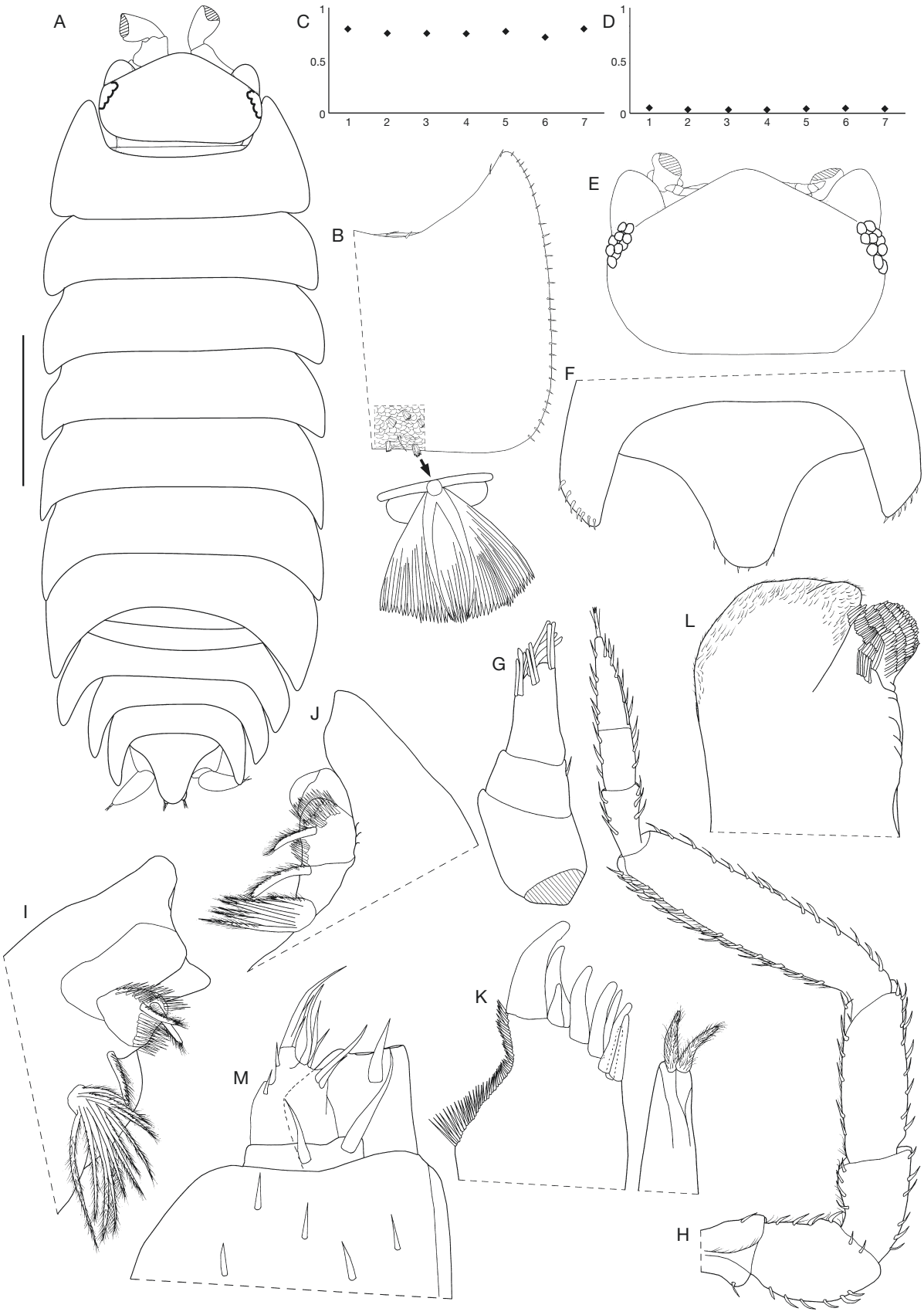

FIG. 9. — *Novamundoniscus kayabi* Campos-Filho, Sfenthourakis & Araujo, n. sp., female paratype, LES 27984: **A**, habitus, dorsal view; **B**, pereonite 1 and scale-seta; **C**, *noduli laterales* d/c coordinates; **D**, *noduli laterales* b/c coordinates; **E**, cephalon, dorsal view; **F**, pleonite 5 and telson; **G**, antennula; **H**, antenna; **I**, left mandible; **J**, right mandible; **K**, maxillula; **L**, maxilla; **M**, maxilliped. Scale bar: A, 1 mm.

Fig. 10. — *Novamundoniscus kayabi* Campos-Filho, Sfenthourakis & Araujo, n. sp., male holotype, LES 27973: **A**, uropod; **B**, pereopod 1; **C**, pereopod 7; **D**, genital papilla and pleopod 1; **E**, pleopod 2; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

cleft in *N. macrophthalmus*), and male pleopod 1 exopod subtriangular (vs subquadrangular in *N. macrophthalmus*) (see Lemos de Castro 1960). The color pattern of the body sometimes is not useful to distinguish species, since it can vary according to the available resources. However, *Novamundoniscus kayabi* Campos-Filho, Sfenthourakis & Araujo, n. sp. does not exhibit any particular characteristic, while *N. macrophthalmus* has the pereonite 1, 3-7 strongly pigmented with the pereonite 2 unpigmented, which allows a first morphological characterization.

Novamundoniscus kayabi Campos-Filho, Sfenthourakis & Araujo, n. sp. is considered to be a troglophile, due to the absence of troglomorphic characters and its wide distribution in the region of Nobres.

Novamundoniscus mandacaru
Campos-Filho, Araujo & Bichuette, n. sp.
(Figs 11; 12; 15)

urn:lsid:zoobank.org:act:606E8E10-CBB2-4B05-8AFA-C9F6C3AA902E

TYPE MATERIAL. — **Holotype. Brazil** • ♂ (parts in micropreparations); Gruta do Mandacaru cave, Ituaçu, state of Bahia; 13°50'23.46"S, 41°19'14.52"W; 523 m a.s.l.; 23.II.2019; M. E. Bichuette, D. F. Torres & J. E. Gallão leg.; LES 27994.
Paratype. **Brazil** • 1 ♀ (in micropreparations), 1 juvenile; same data as holotype; LES 27995.

ETYMOLOGY. — The new species is named after the native Brazilian Cactaceae *Cereus jamacaru*, also known as Mandacaru, typical for xeric environments. This name is used also for the locality where the specimens were collected, namely Gruta do Mandacaru.

DESCRIPTION
Maximum body length: ♂ and ♀ 3 mm. Color brown with typical muscle spot insertions; cephalon, pereonites 1-5 posterior portion, pereonites 6 and 7, pleon and telson more pigmented. Body outline as in Figure 11A. Pereonite 1 slightly directed frontwards, not surpassing cephalon, pereonites 2-7 gradually more arched and directed backwards. Dorsal surface densely covered with fan-shaped scale-setae (Fig. 11B). One line of piliform *noduli laterales* per side, longer than scale-setae (Fig. 11B); d/c and b/c coordinates as in Figure 11C and D, respectively. Cephalon (Fig. 11E, F) with rounded lateral lobes, suprantennal line bent down in middle; eyes with 5-6 ommatidia. Pleon slightly narrower than pereon, epimera slightly developed, acute and directed backwards (Fig. 11A). Telson (Fig. 11G) with lateral sides slightly concave, apex right-angled. Antennula (Fig. 11H) distal article longest bearing about seven aesthetascs in two rows plus apical pair. Antenna (Fig. 11I) reaching second pereonite when extended backwards; flagellum with first and second articles subequal in length, third article bearing lateral aesthetascs, apical organ bearing two long free sensilla. Mandibles (Fig. 11J, K) with molar penicil of about five branches. Maxillula (Fig. 11L) inner endite with two hairy penicils, distal margin rounded; outer endite with 4+3 teeth, two apically cleft at apex, outer margin strongly concave equipped with long setae. Maxilla (Fig. 11M) inner lobe rounded covered with thick setae; outer lobe twice as wide as inner lobe covered with thin setae. Maxilliped (Fig. 11N) palp with proximal article bearing two long setae; endite subrectangular, medial seta surpassing distal margin, distal margin sinuous. Dactylus of two claws subequal in length, dactylar and ungual setae simple, not surpassing outer claw. Uropod (Fig. 12A) protopod subquadrangular, protopod and exopod grooved on outer margin, exopod longer than endopod, endopod inserted almost at same level.

Male
Pereopod 7 without apparent sexual dimorphism (Fig. 12B). Genital papilla (Fig. 12C) with triangular ventral shield, papilla longer than ventral shield bearing two subapical orifices. Pleopod 1 (Fig. 12D) exopod subtriangular, slightly longer than wide, inner margin rounded, outer margin slightly concave; endopod stout, longer than exopod, medial portion with lobe, distal portion triangular, directed outwards, bearing short setae on medial margin. Pleopod 2 (Fig. 12E) exopod triangular, outer margin concave bearing four long setae; endopod longer than exopod. Pleopod 3 and 4 exopods (Fig. 12F, G) triangular, outer margin almost straight bearing long setae. Pleopod 5 exopod (Fig. 12H) triangular, outer margin slightly convex bearing long setae.

REMARKS
Novamundoniscus mandacaru Campos-Filho, Araujo & Bichuette, n. sp. is readily distinguished from the congeneric species in the shape of the male pleopod 1.

This species is considered to be a troglophile due to the absence of troglomorphic characters. The cave where the specimens of *N. mandacaru* Campos-Filho, Araujo & Bichuette, n. sp. were collected is inserted in the Caatinga domain (Morrone *et al.* 2022). Probably the species inhabits caves due to their resources and favorable micro-habitat conditions (Fernandes *et al.* 2016, 2019).

Novamundoniscus canopus
Campos-Filho, Gallo & Gallão, n. sp.
(Figs 13-15)

urn:lsid:zoobank.org:act:7042A02A-7E67-4AFC-ABEA-E7F8085C42CB

TYPE MATERIAL. — **Holotype. Brazil** • ♂ (parts in micropreparations); Lapa do São Bernardo cave, Guarani de Goiás, state of Goiás; 13°48'44.9"S, 46°20'59.4"W; 631 m a.s.l.; 19.IV.2021; J. E. Gallão, J. S. Gallo, D. F. Torres & V. F. Sperandei leg.; LES 27996.
Paratype. **Brazil** • 1 ♀ (in micropreparations); same data as holotype; LES 27997.

ETYMOLOGY. — The new species is named after the star Canopus, Carina constellation, southern celestial hemisphere. In navigation systems, this star was used to indicate the position of the South Pole. In the Brazilian national flag, it represents the state of Goiás.

DESCRIPTION
Maximum body length: ♂ 6 mm, ♀ 4.5 mm. Color brown with typical muscle spot insertions; cephalon, antennae, pereonites 1-7 epimera, pleon, telson, and uropods strongly pigmented. Body outline as in Figure 13A. Pereonite 1 slightly directed frontwards, not surpassing cephalon, pereonites 3-7 gradually more arched and directed backwards. Dorsal surface densely covered with fan-shaped scale-setae (Fig. 13B). One line of piliform *noduli laterales* per side, similar in length as scale-setae (Fig. 13B); d/c and b/c coordinates as in Figure 13C and D, respectively. Cephalon (Fig. 13E, F) with triangular lateral lobes, slightly directed outwards,

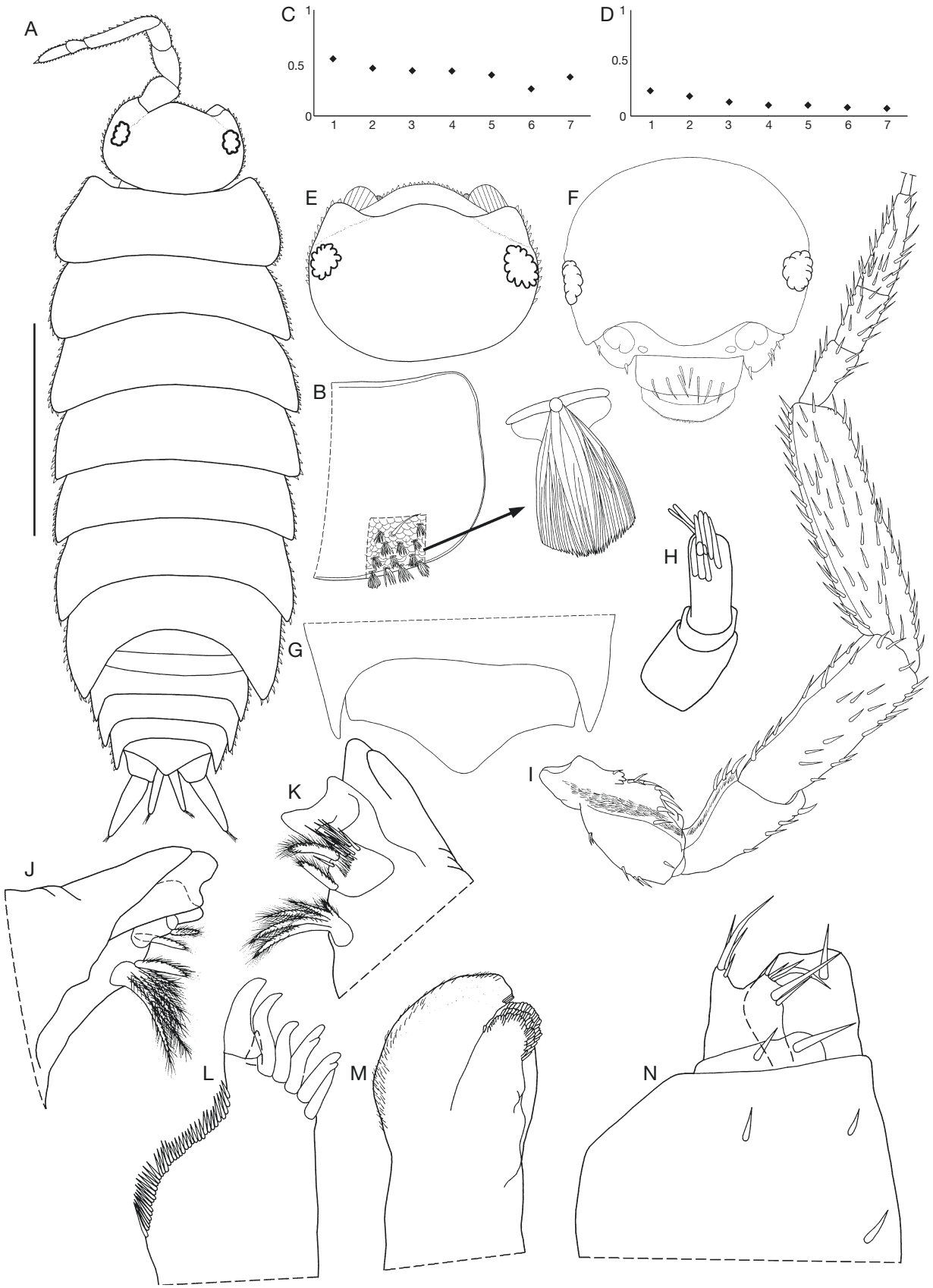

FIG. 11. — *Novamundoniscus mandacaru* Campos-Filho, Araujo & Bichuette, n. sp., female paratype, LES 27995: **A**, dorsal habitus; **B**, pereonite 1 and scale-seta; **C**, *noduli laterales* d/c coordinates; **D**, *noduli laterales* b/c coordinates; **E**, cephalon, dorsal view; **F**, cephalon, frontal view; **G**, pleonite 5 and telson; **H**, antennula; **I**, antenna; **J**, left mandible; **K**, right mandible; **L**, maxillula outer endite; **M**, maxilla; **N**, maxilliped. Scale bar: A, 1 mm.

FIG. 12. — *Novamundoniscus mandacaru* Campos-Filho, Araujo & Bichuette, n. sp.: **A**, female paratype, LES 27995: uropod; **B**-**H**: male holotype, LES 27994: pereopod 7 (**B**); genital papilla (**C**); pleopod 1 (**D**); pleopod 2 (**E**); pleopod 3 exopod (**F**); pleopod 4 exopod (**G**); pleopod 5 exopod (**H**).

suprantennal line bent down in middle; eyes composed of 13-14 ommatidia. Pleon slightly narrower than pereon, epimera developed, acute and directed backwards (Fig. 13A, G). Telson (Fig. 13G) with lateral sides concave, apex acute. Antennula (Fig. 13H) proximal and distal articles similar in length, distal article bearing about 14 aesthetascs in four rows plus apical pair. Antenna (Fig. 13I) reaching third pereonite when extended backward; flagellum with first and second articles subequal in length, second and third articles bearing lateral aesthetascs, apical organ bearing two long free

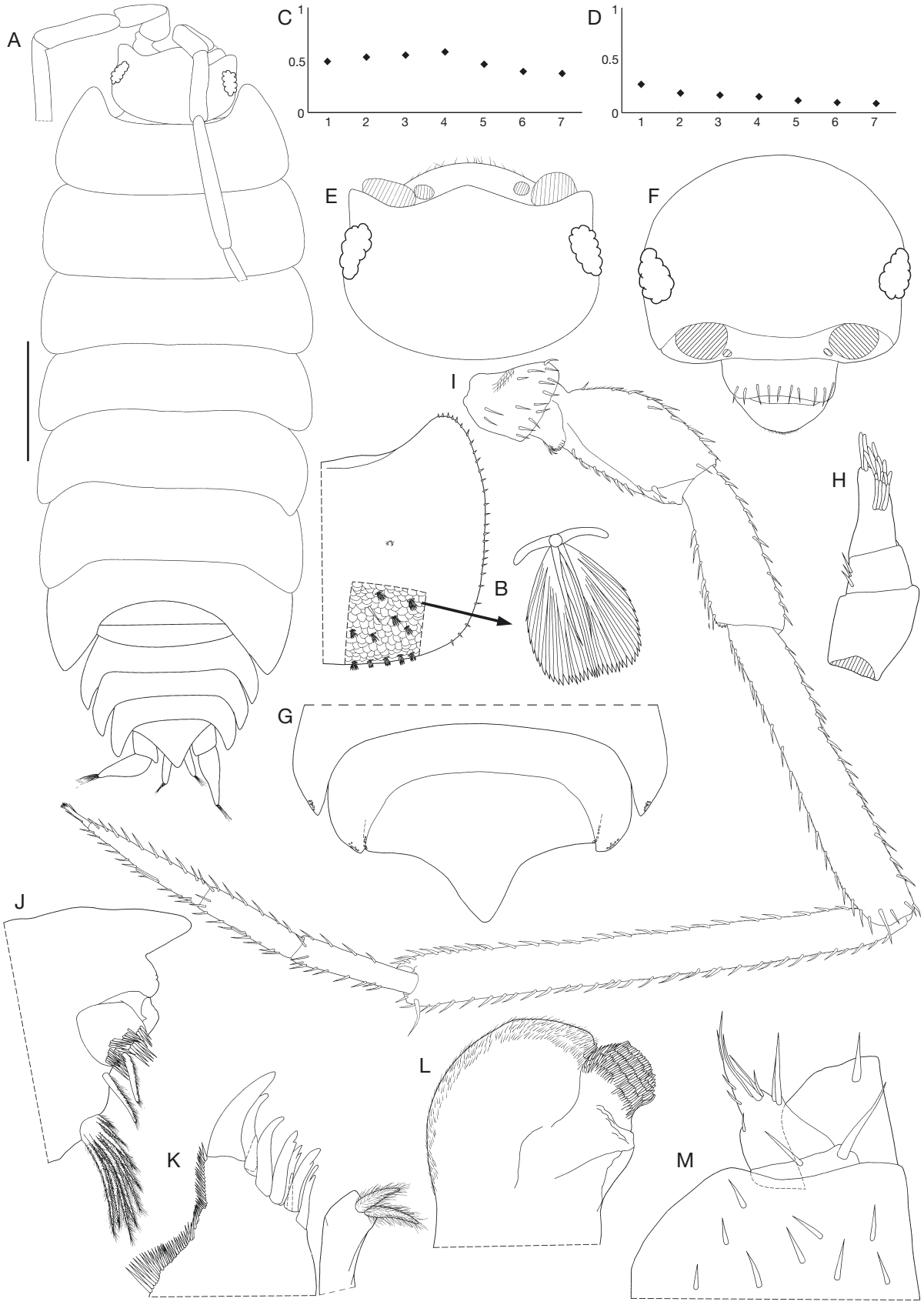

FIG. 13. — *Novamundoniscus canopus* Campos-Filho, Gallo & Gallão, n. sp., female paratype, LES 27996: **A**, dorsal habitus; **B**, pereonite 1 and scale-seta; **C**, *noduli laterales* d/c coordinates; **D**, *noduli laterales* b/c coordinates; **E**, cephalon, dorsal view; **F**, cephalon, frontal view; **G**, pleonites 4 and 5, and telson; **H**, antennula; **I**, antenna; **J**, right mandible; **K**, maxillula; **L**, maxilla; **M**, maxilliped. Scale bar: A, 1 mm.

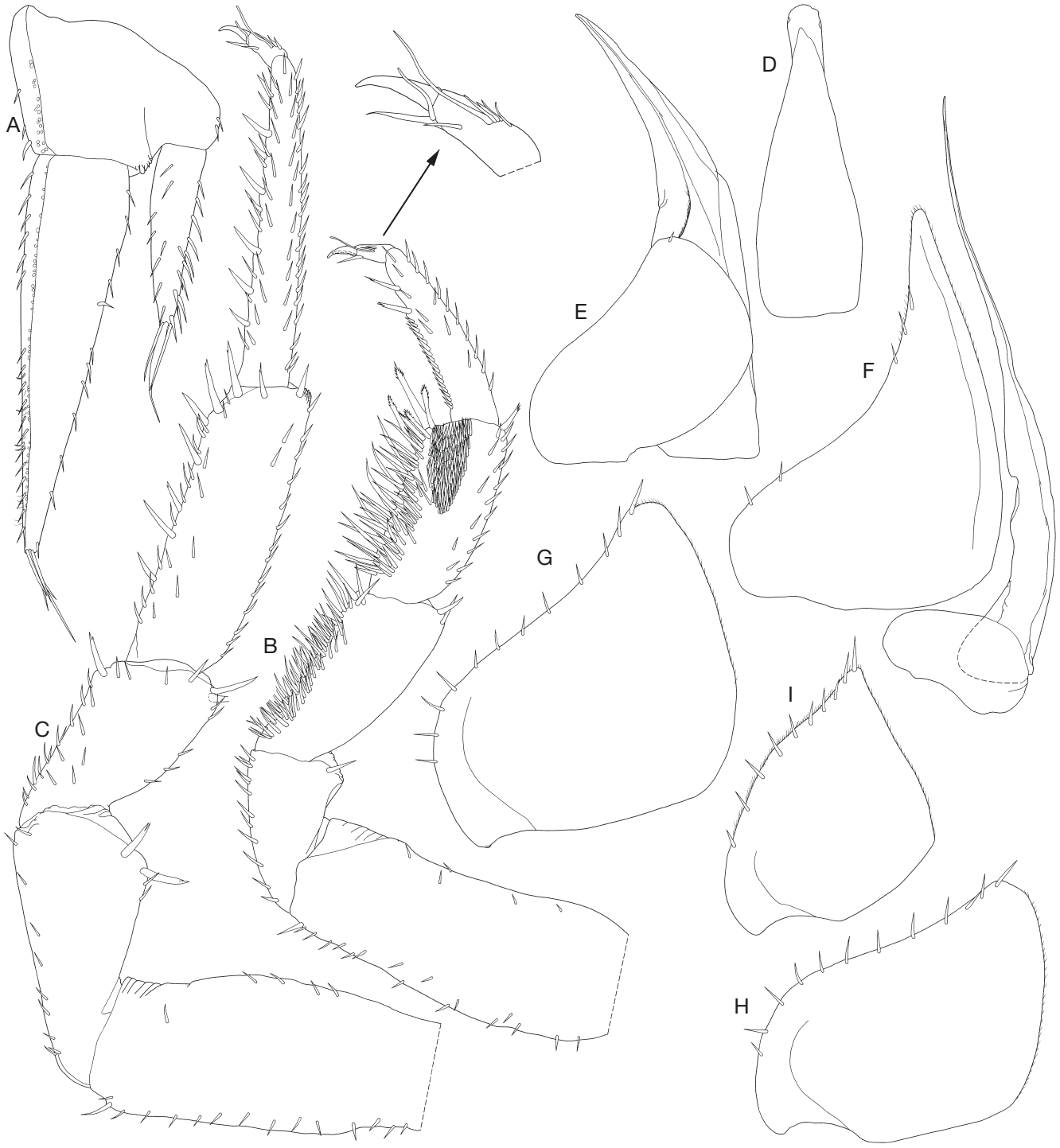

Fig. 14. — *Novamundoniscus canopus* Campos-Filho, Gallo & Gallão, n. sp.: **A**, female paratype, LES 27996: uropod; **B**-**I**, male holotype, LES 27994: pereopod 1 (**B**); pereopod 7 (**C**); genital papila (**D**); pleopod 1 (**E**); pleopod 2 (**F**); pleopod 3 exopod (**G**); pleopod 4 exopod (**H**); pleopod 5 exopod (**I**).

sensilla. Mandibles (Fig. 13J) with molar penicil of about ten branches. Maxillula (Fig. 13K) inner endite with two hairy penicils, distal margin rounded; outer endite with 4+4 teeth, outer set apically cleft, outer margin strongly concave equipped with long setae. Maxilla (Fig. 13L) inner lobe rounded covered with thick setae; outer lobe twice as wide as inner lobe covered with thin setae. Maxilliped (Fig. 13M) palp with proximal article bearing two long setae; endite subrectangular, medial seta surpassing distal margin, distal margin rounded. Dactylus of two claws subequal in length, dactylar and ungual setae simple, not surpassing outer claw. Uropod (Fig. 14A) protopod subquadrangular, protopod and exopod grooved on outer margin, exopod twice as long as endopod, endopod insertion slightly proximal.

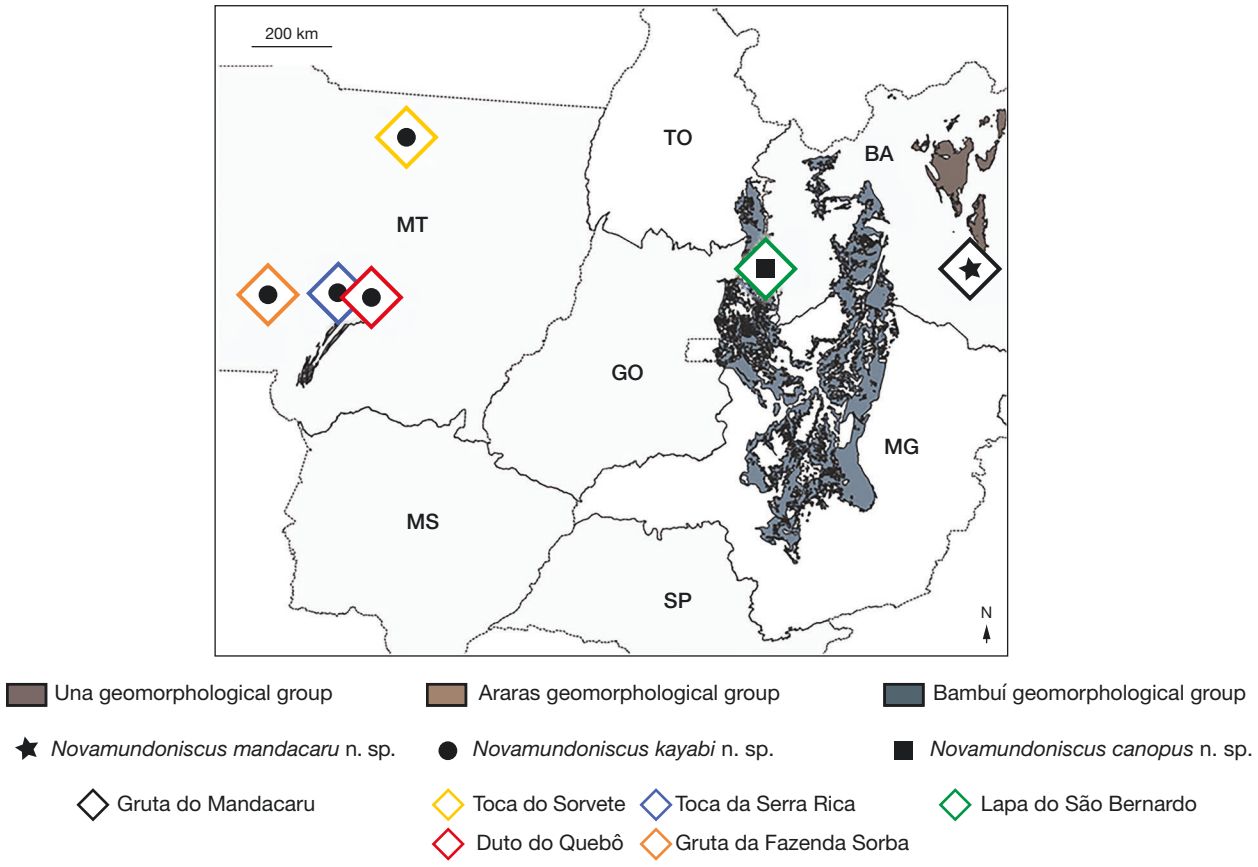

FIG. 15. — Distribution map of the *Novamundoniscus* species: *Novamundoniscus mandacaru* Campos-Filho, Araujo & Bichuette, n. sp., *N. kayabi* Campos-Filho, Sfenthourakis & Araujo, n. sp. and *N. canopus* Campos-Filho, Gallo & Gallão, n. sp. Abbreviations of states: **BA**, Bahia; **GO**, Goias; **MG**, Minas Gerais; **MS**, Mato Grosso do Sul; **MT**, Mato Grosso; **SP**, São Paulo; **TO**, Tocantins.

Male

Pereopods 1-3 merus and carpus bearing dense brush of setae on sternal margin (Fig. 14B). Pereopod 7 without apparent sexual dimorphism (Fig. 14C). Genital papilla (Fig. 14D) with triangular ventral shield, papilla longer than ventral shield bearing two subapical orifices. Pleopod 1 (Fig. 14E) exopod subtriangular, about twice as long as wide, inner margin convex, outer margin slightly concave; endopod more than twice as long as exopod, distal portion tapering, directed outwards. Pleopod 2 (Fig. 14F) exopod triangular, outer margin concave bearing five setae; endopod distinctly longer than exopod. Pleopod 3 and 4 exopods (Fig. 14G, H) triangular, outer margin slightly concave bearing many setae. Pleopod 5 exopod (Fig. 14I) triangular, outer margin sinuous bearing many setae.

REMARKS

Novamundoniscus canopus Campos-Filho, Gallo & Gallão, n. sp. is similar to *N. macrophthalmus* and *N. kayabi* Campos-Filho, Sfenthourakis & Araujo, n. sp. in having the eyes composed of 13-14 ommatidia; it differs in the cephalon with lateral lobes well-developed (vs slightly developed in *N. macrophthalmus*), telson with distal margin acute (vs right-angled in *N. macrophthalmus*, rounded in *N. canopus* Campos-Filho, Gallo & Gallão, n. sp.), maxillula outer endite with four teeth cleft (vs entire in *N. canopus* Campos-Filho, Gallo & Gallão, n. sp.), uropod exopod longer (vs similar in length in *N. canopus* Campos-Filho, Gallo & Gallão, n. sp.), male pereopods 1-3 merus and carpus bearing brush of setae on sternal margin (vs sparse setae on both species), male pleopod 1 exopod with outer margin slightly concave (vs straight in *N. macrophthalmus* and *N. canopus* Campos-Filho, Gallo & Gallão, n. sp.), and male pleopod 1 endopod with distal part directed outwards (vs downwards in *N. canopus* Campos-Filho, Gallo & Gallão, n. sp.) (see Lemos de Castro 1960).

Also this species is considered to be a troglophile due to the absence of troglomorphic characteristics, and probably inhabits caves for exploring their resources and finding appropriate micro-habitat conditions during certain periods of the year (Fernandes *et al.* 2016, 2019).

Family SCLEROPACTIDAE Verhoeff, 1938

Genus *Circoniscus* Pearse, 1917

Circoniscus Pearse, 1917: 4.

TYPE SPECIES. — *Circoniscus gaigei* Pearse, 1917, by monotypy (see Schmidt & Leistikow 2004).

DIAGNOSIS. — After Schmidt (2007): animals with endoantennal conglobation; roller habitus (*sensu* Schmalfuss 1984); dorsal surface smooth bearing small scale-setae; pereonites 1-7 with one line of short *noduli laterales* inserted at same line and near posterior margins; cephalon with wide frontal shield, sometimes projecting backwards over vertex, eyes composed of many ommatidia (absent in troglobionts); pereonite 1 epimera with posterior schisma, pereonite 2 and 3 epimera with ventral lobe or simple; pleon outline continuous with that of pereonite 7; telson triangular with broad rounded apex not covering uropod endopods; antennula of three articles; antennal flagellum of two subequal articles (sometimes distal article slightly longer), apical organ subequal or longer than distal article of flagellum; mandibles with molar penicil dichotomized, left mandible with 2+1 penicils, righ mandible with 1+1 penicils; maxillula outer endite with 4+5-6 teeth, outer set bearing four or five teeth apically cleft, accessory tooth and slender seta between outer and inner sets; maxilla bilobate; maxilliped endite bearing one penicil; pereopods 1-7 merus and carpus bearing scales on sternal margins (sometimes wide and dense); pereiopod 1 carpus with transverse antenna-grooming brush (sometimes wide); pereopod 7 basis with vestigial water-conducting scale-rows, ischium and/or merus sometimes sexually dimorphic; dactylar seta simple or hirsute, ungual seta simple; uropod protopod subrectangular and flattened; pleopod 1 and 2 exopods with respiratory areas; male pleopod 1 endopod tip bent outwards; male pleopod 5 exopod triangular with distal portion elongated.

Circoniscus caeruleus
Campos-Filho, Sfenthourakis & Bichuette, n. sp.
(Figs 16-18; 21)

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TYPE MATERIAL. — **Holotype. Brazil** • ♂ (parts in micropreparations); Caverna Lagoa Azul, Nobres, state of Mato Grosso; 14°26'48.1"S, 56°1'33.2"W; 350 m a.s.l.; 24.IX.2017; J. E. Gallão, R. Machado & A. Chagas-Jr leg.; LES 27987.
Paratype. Brazil • 1 ♀ (parts in micropreparations); same locality as holotype; 5.V.2015; M. E. Bichuette, A. Chagas-Jr & G. A. Nunes leg.; LES 27988.

ETYMOLOGY. — The new species is named after the typical blue color of the water in the cave where the specimens were collected.

DESCRIPTION
Maximum body length: ♂ 3 mm, ♀ 6.5 mm. Animal without body pigments. Body (Fig. 16A) strongly convex; dorsal surface bearing small triangular scale-setae (Fig. 16B). *Noduli laterales* as in Figure 16A, G, I. Cephalon (Fig. 16C-E) frontal shield rectangular, bent backwards over vertex, frontal margin broadly rounded; eyes composed of about 10-11 ommatidia. Pereonites 1 and 2 with ventral lobes; pereonites 1-4 with posterior margin straight, 5-7 gradually more concave; pereonite 1 epimera with anterior corners directed frontwards, those of 2-4 with outer margin rounded, and those of 5-7 subquadrangular (Fig. 16A, E, G-J). Pleon (Fig. 16A, K) with epimera 3-5 well developed, directed backwards with acute apices; telson slightly broader than long, with slightly concave sides. Antennula (Fig. 16L) distal article longest, conical bearing about four lateral aesthetascs arranged in two rows and apical tip. Antenna (Fig. 16M) short and stout, not surpassing pereonite 1 when extended backwards; flagellum with subequal articles, distal article bearing two lateral aesthetascs; apical organ slightly longer than distal article of flagellum. Mandibles (Fig. 17A, B) with dense cushion of setae on incisor process, molar penicil consisting of about 10 branches. Maxillula (Fig. 17C) inner endite with two apical penicils, distal margin bearing outer tip; outer endite with 4+5 teeth, inner set with four teeth apically cleft. Maxilla (Fig. 17D) inner lobe rounded and covered with thick setae; outer lobe rounded, twice as wide as inner lobe, covered with thin setae. Maxilliped (Fig. 17E) palp with one strong seta on proximal article; endite subrectangular, medial seta short, not surpassing distal margin, distal margin covered with thin setae and bearing one seta on outer portion, rostral surface with setose sulcus ending with one short penicil. Pereopod 1 carpus with short antennal grooming brush; dactylus with two claws, ungual and dactylar setae simple, surpassing outer claw. Uropod (Fig. 16K) protopod enlarged, filling gap between pleonite 5 and telson, slightly surpassing distal margin of telson; exopod inserted on median margin, endopod twice as long as exopod and inserted proximally.

Male
Pereopod 1 (Fig. 18A) merus and carpus with sternal margin covered with short scales and sparse strong setae. Pereopod 7 (Fig. 18B) ischium elongated, sternal margin straight; merus bearing triangular lobe on rostral portion; carpus twice as long as merus. Pleopod 1 (Fig. 18C) exopod triangular, outer margin slightly concave on distal portion; endopod twice as long as exopod, distal portion bent outwards and bearing small setae on medial margin. Pleopod 2 (Fig. 18D) exopod triangular, outer margin concave; endopod flagelliform, slightly longer than exopod. Exopods of pleopods 3 and 4 as in Figure 18E and F, respectively. Pleopod 5 exopod (Fig. 18G) with outer margin sinuous, inner margin grooved to accommodate pleopod 2 endopod.

REMARKS
The genus *Circoniscus* comprises 10 species endemic to South America (Schmidt 2007; Campos-Filho *et al.* 2018a). To date, Brazil holds the highest diversity in the genus, with nine species present in the country, i.e., *C. bezzii* Arcangeli, 1931, *C. buckupi* Campos-Filho & Araujo, 2011, *C. carajasensis* Campos-Filho & Araujo, 2011, *C. gaigei* Pearse, 1917, *C. hirsutus* Schmidt, 2007, *C. incisus* Souza & Lemos de Castro, 1991, *C. intermedius* Souza & Lemos de Castro, 1991, *C. ornatus* (Verhoeff, 1941), and *C. pallidus* Arcangeli, 1936 (see Campos-Filho *et al.* 2018a).

Circoniscus caeruleus Campos-Filho, Sfenthourakis & Bichuette, n. sp. differs from all other species of the genus in having a triangular lobe on the rostral surface of the male pereopod 7 merus. Only one species of the genus is recorded from the state of Mato Grosso, *C. intermedius* (Schmidt 2007; Campos-Filho *et al.* 2014), from which it differs in having the eyes composed of 10-11 ommatidia (vs 20 in *C. intermedius*), pereonite 2 epimera with ventral lobe (vs absent in *C. intermedius*), telson slightly wider than long (vs as wide as

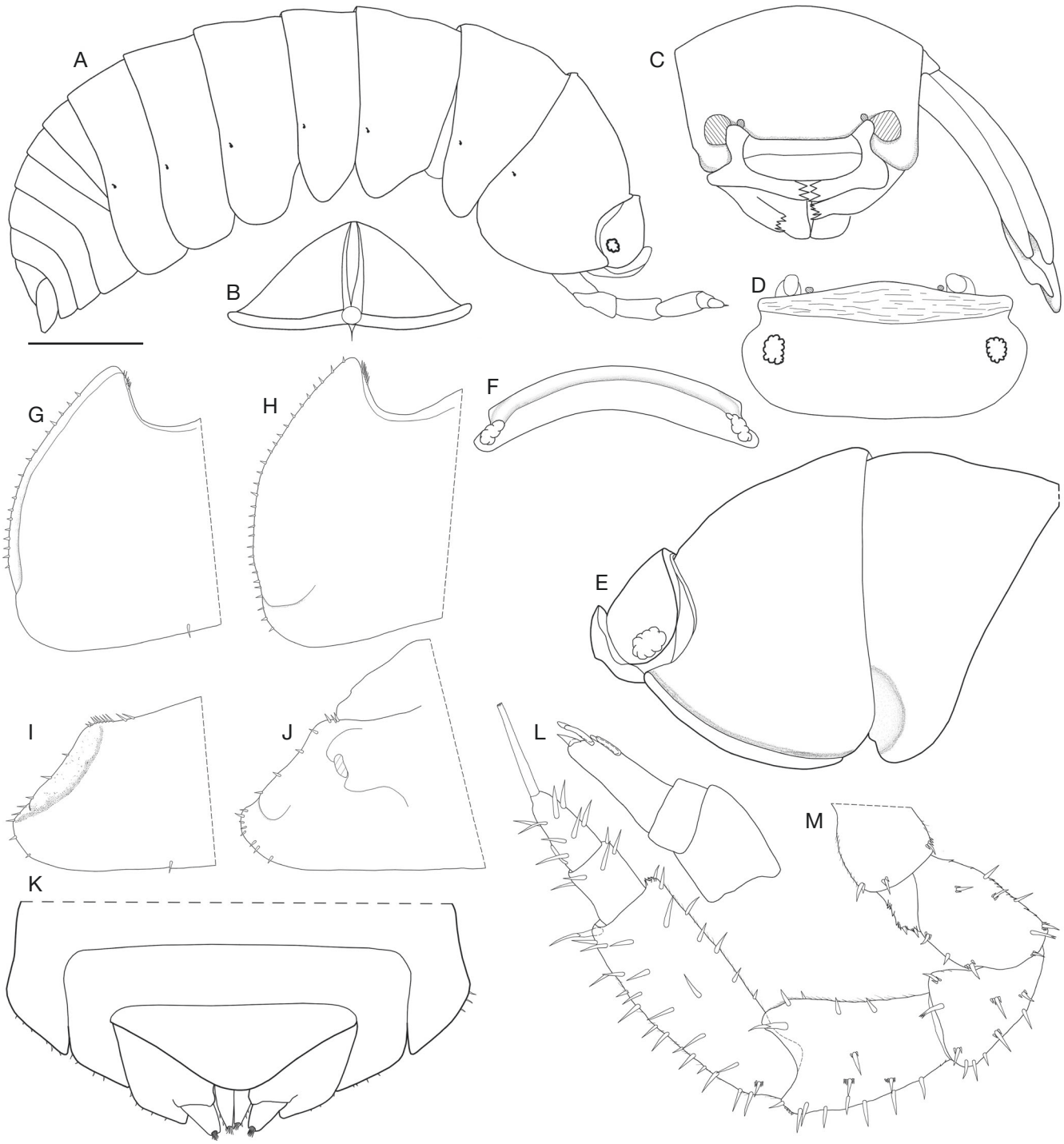

Fig. 16. — *Circoniscus caeruleus* Campos-Filho, Sfenthourakis & Bichuette, n. sp., male holotype, LES 27987: **A**, lateral habitus; **B**, scale-seta; **C**, cephalon and pereonites 1 and 2, frontal view; **D**, cephalon, dorsal view; **E**, cephalon, and pereonites 1 and 2, lateral view; **F**, cephalon, back view; **G**, pereonite 1 epimera, dorsal view; **H**, pereonite 1 epimera, ventral view; **I**, pereonite 2 epimera, dorsal view; **J**, pereonite 2 epimera, ventral view; **K**, pleonites 4 and 5, telson, and uropods; **L**, antennula; **M**, antenna. Scale bar: A, 1 mm.

long in *C. intermedius*), and male pleopod 1 exopod triangular, and as wide as long (vs heart-shaped, and slightly wider than long in *C. intermedius)* (see Souza & Lemos de Castro 1991; Schmidt 2007).

This species is considered to be a troglophile. However, its body is pigmentless and the number of ommatidia is reduced, characters typically observed in troglobitic species. The species has a preference for highly humid places, composed of silt and guano substrates. Moreover, in the aphotic zone, its abundance is reduced, probably due to the lack of resources. More sampling efforts should be paid outside caves to confirm its classification as a troglophile.

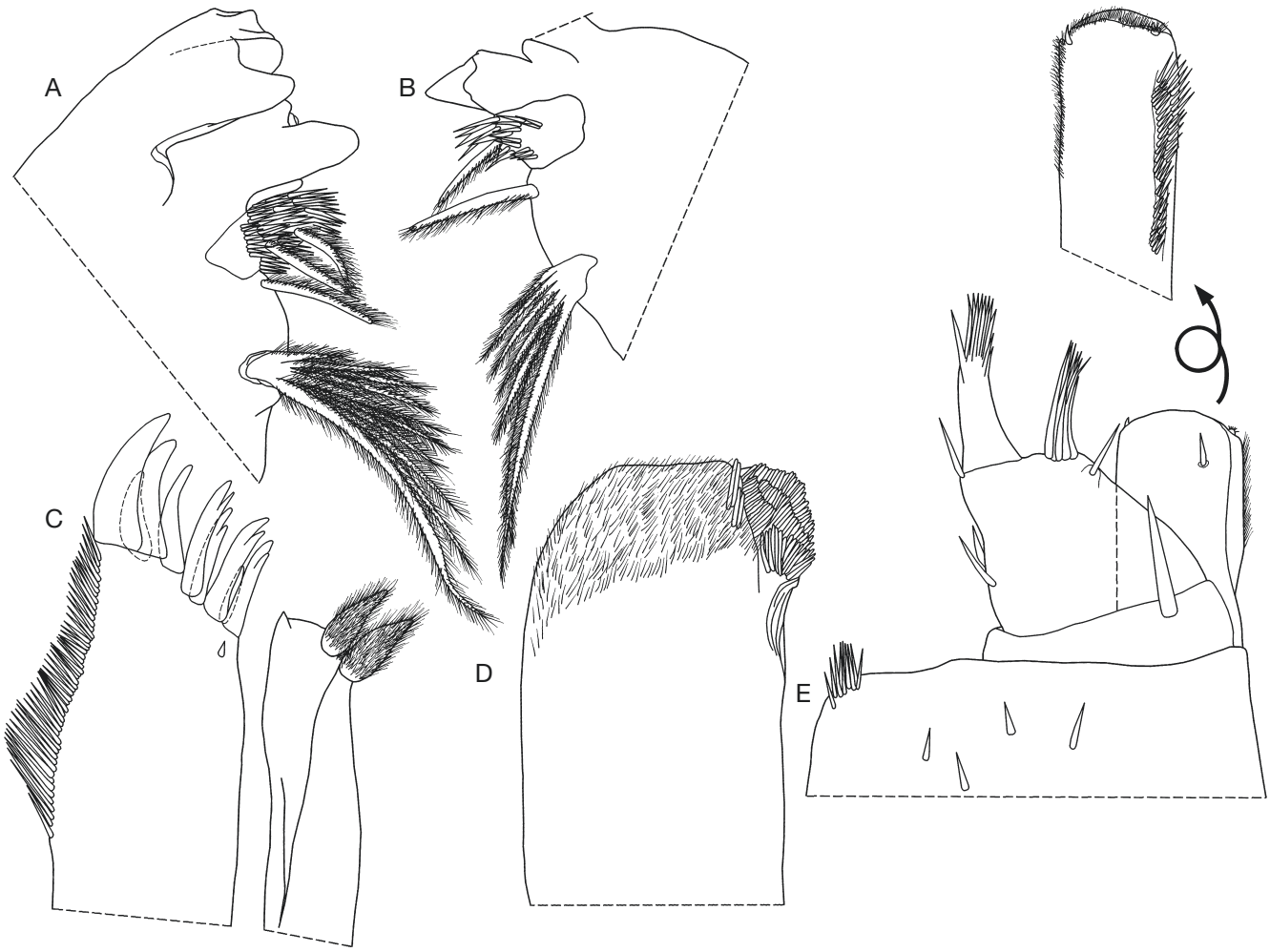

Fig. 17. — *Circoniscus caeruleus* Campos-Filho, Sfenthourakis & Bichuette, n. sp., male holotype, LES 27987: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped.

Family Platyarthridae Verhoeff, 1949

Genus *Trichorhina* Budde-Lund, 1908

Trichorhina Budde-Lund, 1908: 293.

Type species. — *Bathytropa thermophila* Dollfus, 1896 [synonym of *Alloniscus tomentosus* Budde-Lund, 1893], by original designation (see Schmidt & Leistikow 2004).

Diagnosis. — See Carpio-Díaz *et al.* (2018).

Trichorhina amplitelson
Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp.
(Figs 2D; 19-21)

urn:lsid:zoobank.org:act:4B96C1B2-5207-4F38-A125-40AAEB620903

Type material. — **Holotype. Brazil** • ♂; Caverna do Jabuti, Curvelândia, state of Mato Grosso; 15°33'56.2"S, 57°59'20"W; 324 m a.s.l.; 29.IX.2017; J. E. Gallão, R. Machado & A. Chagas-Jr leg.; LES 27989.

Paratypes. Brazil • State of Mato Grosso: 9 ♂ (one with parts in micropreparations), 12 ♀ (one in micropreparations); same data as holotype; LES 27990 • 1 ♂; same data as holotype; LES 27991 • 1 ♀; Gruta do Isopoda cave, Sítio Bom Jesus, Mirassol do Oeste; 15°35'23.1"S, 58°00'22.4"W; 30.IX.2017; J. E. Gallão, A. Chagas-Jr & R. Machado leg.; LES 27992 • 2 ♂, 5 ♀; Caverna Labirinto, same municipality and state as previous; 15°32'50"S, 58°01'29.28"W; 234 m a.s.l.; 20.IX.2017; same collectors as previous; LES 27993.

Etymology. — The name of the new species refers to the wide shape of the telson, typical of this species.

Description

Maximum body length: ♂ 2.8 mm, ♀ 3.5 mm. Animal without body pigments (Fig. 2D). Body (Fig. 19A) slightly convex and robust. Dorsal surface covered with fan-shaped scale-setae (Fig. 19B). One line of *noduli laterales* per side, inserted close to posterior margins and more or less at same distance from lateral margins, d/c and b/c coordinates as in Figure 19C, D, respectively. Cephalon (Fig. 19E, F) with lateral lobes triangular, protruding frontwards; supraantennal line slightly concave, frontal line absent; eyes composed

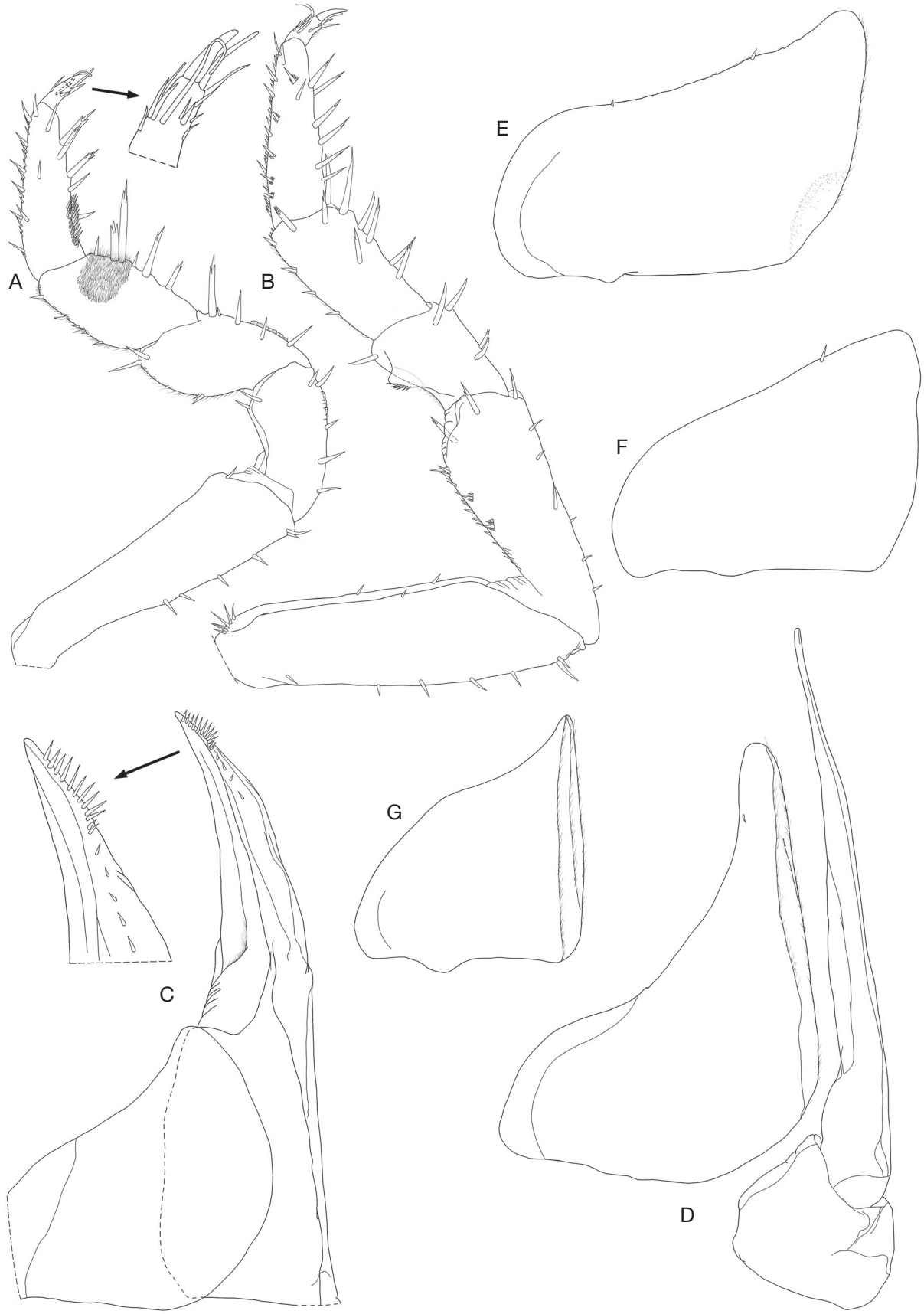

FIG. 18. — *Circoniscus caeruleus* Campos-Filho, Sfenthourakis & Bichuette, n. sp., male holotype, LES 27987: **A**, pereopod 1; **B**, pereopod 7; **C**, pleopod 1; **D**, pleopod 2; **E**, pleopod 3 exopod; **F**, pleopod 4 exopod; **G**, pleopod 5 exopod.

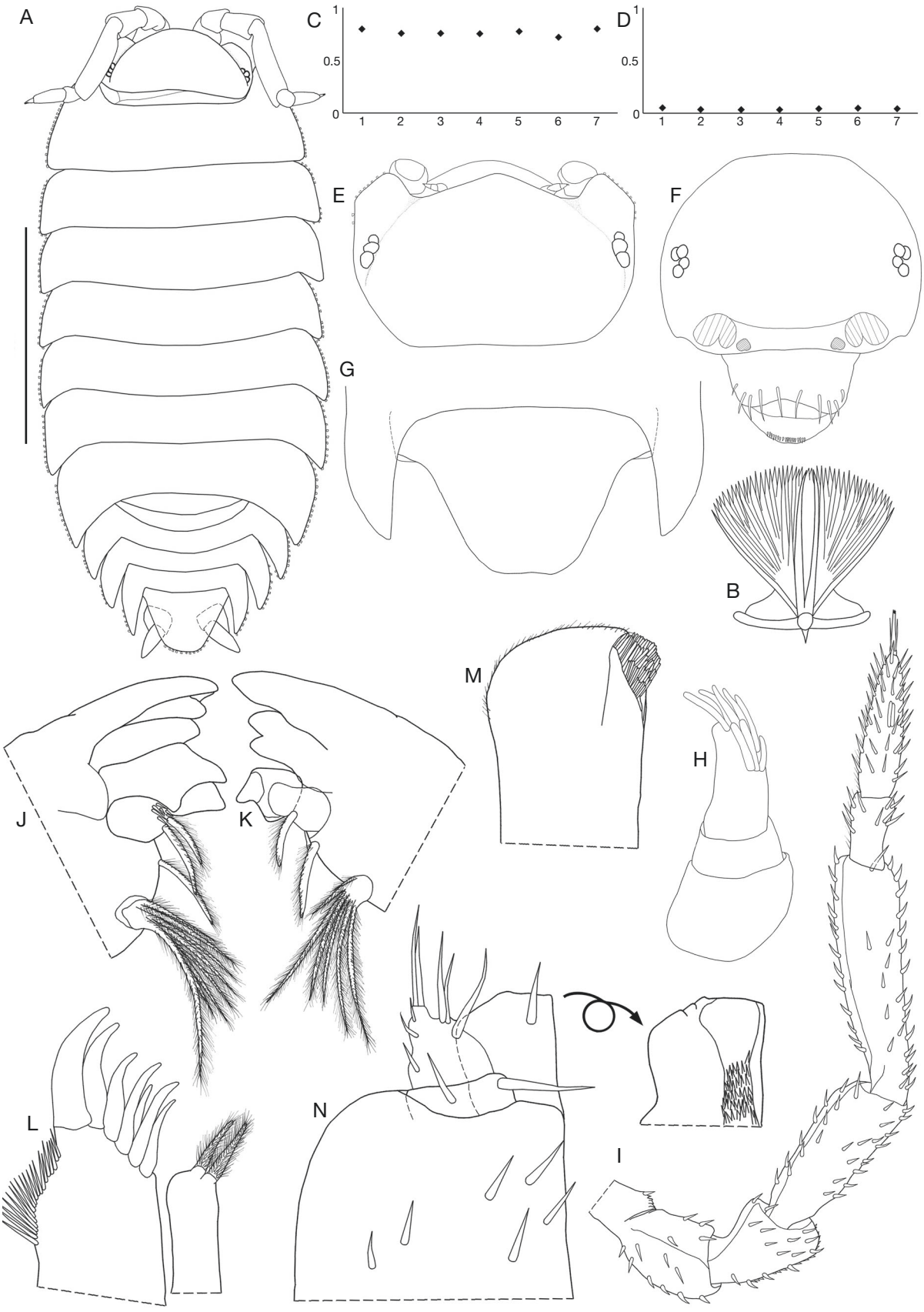

FIG. 19. — *Trichorhina amplitelson* Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp., female paratype, LES 27990: **A**, dorsal habitus; **B**, scale-seta; **C**, *noduli laterales* d/c coordinates; **D**, *noduli laterales* b/c coordinates; **E**, cephalon, dorsal view; **F**, cephalon, frontal view; **G**, pleonite 5 and telson; **H**, antennula; **I**, antenna; **J**, left mandible; **K**, right mandible; **L**, maxillula; **M**, maxilla; **N**, maxilliped. Scale bar: A, 1 mm.

FIG. 20. — *Trichorhina amplitelson* Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp.: **A**, female paratype, LES 27990 uropod; **B-I**, male paratype, LES 27990: 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 (**I**).

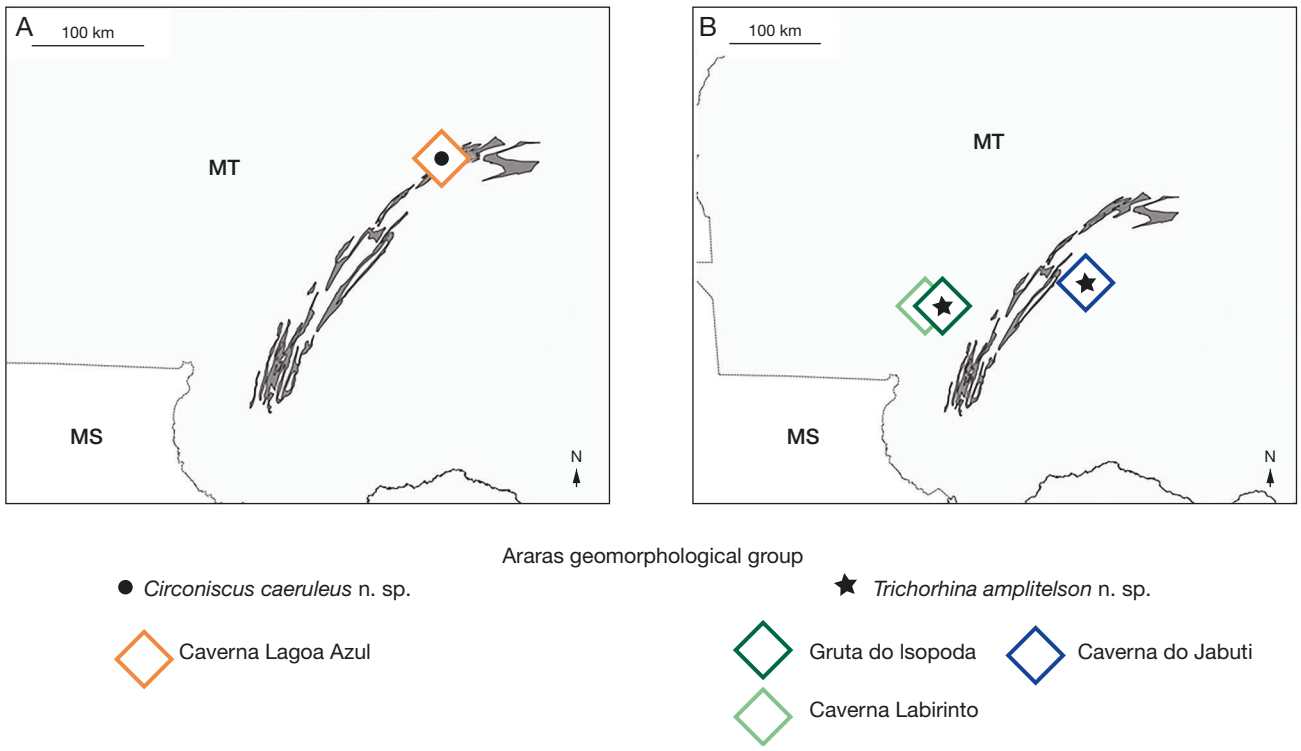

FIG. 21. — Distribution map of Scleropactidae and Platyarthridae representatives: **A**, *Circoniscus caeruleus* Campos-Filho, Sfenthourakis & Bichuette, n. sp.; **B**, *Trichorhina amplitelson* Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp. Abbreviations of states: **MS**, Mato Grosso do Sul; **MT**, Mato Grosso.

of four or five ommatidia. Pereonite 1 epimera directed frontwards, pereonite 2-7 epimera pointing backwards (Fig. 19A). Pleon (Fig. 19A, G) with outline continuous with that of pereonite 7; epimera of pleonites 3-5 falciform, directed backwards; telson trapezoidal, almost as wide as long, distal portion slightly narrower than proximal portion, apex broadly rounded. Antennula (Fig. 19H) of three articles, distal article longest with several aesthetascs inserted apically and sub-apically. Antenna (Fig. 19I) when extended posteriorly surpassing posterior margin of pereonite 1; flagellum with two articles, second article about twice as long as first, bearing two lateral aesthetascs, apical organ short with long free sensilla. Mandibles with molar penicil dichotomized consisting of up to eight branches, left mandible (Fig. 19J) with 2+1 penicils, right mandible (Fig. 19K) with 1+1 penicils. Maxillula (Fig. 19L) inner branch with two subequal penicils, distal portion rounded; outer branch with 3+4 teeth simple. Maxilla (Fig. 19M) with setose and bilobate apex; outer lobe about three times as wide as inner lobe, distal margin rounded. Maxilliped (Fig. 19N) basis rectangular bearing sparse setae; endite subrectangular, medial seta surpassing distal margin. Uropod (Fig. 20A) protopod and exopod grooved on outer margin bearing glandular pores, exopod slightly longer than endopod, endopod inserted proximally. Pereopod sternal setae with cleft apex; pereopod 1 with antennal grooming brush reaching median margin of carpus; dactylus with long inner claw, ungual seta simple, dactylar seta simple surpassing outer claw.

Male

Pereopods 1 and 7 (Fig. 20B, C) without sexual dimorphism. Genital papilla as in Figure 20D. Pleopod 1 (Fig. 20E) exopod subovoid, about twice as broad as long; endopod about three times as long as exopod, distal part acute. Pleopod 2 (Fig. 20F) exopod triangular, outer margin concave bearing short setae; endopod flagelliform longer than exopod. Pleopod 3 and 4 exopods as in Figure 20G, H, respectively. Pleopod 5 exopod (Fig. 20I) triangular, outer margin slightly convex bearing short setae.

REMARKS

The genus *Trichorhina* comprises about 70 species distributed in tropical and subtropical areas of the globe (Schmalfuss 2003; Boyko *et al.* 2008). The genus was morphologically re-defined by Carpio-Díaz *et al.* (2018). Molecular data contradict its monophyly within Platyarthridae (Javidkar *et al.* 2015, 2017). The members of the genus exhibit reduced size, body pigments and/or ommatidia are reduced or absent, the dorsal surface is covered with fan-shaped scale-setae, and the pereopods are short, bearing sternal fringes of setae (see Campos-Filho *et al.* 2014, 2015b, 2016). The dorsal scale-setae reduce the adhesion of microparticles facilitating the movement of the animals in non-consolidated substrates. Several species of the genus occur in caves and until more sampling outside caves is made, they are considered to be troglophile.

To date, 35 species of the genus are known from Brazil, of which eight are recorded from subterranean environments, i.e.

T. acuta Araujo & Buckup, 1994, *T. anhanguera* Campos-Filho, Araujo & Taiti, 2014, *T. cipoensis* Campos-Filho, Bichuette & Taiti, 2016, *T. curupira* Campos-Filho, Araujo & Taiti, 2014, *T. guanophila* Souza-Kury, 1993, *T. kaingangi* Campos-Filho, 2015, *T. pataxosi* Campos-Filho, Bichuette & Taiti, 2016, and *T. yiara* Campos-Filho, Araujo & Taiti, 2014 (Campos-Filho *et al.* 2018a for complete references).

Trichorhina amplitelson Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp. is easily distinguished from all the previously mentioned species in the wide shape of the telson. Only *T. acuta* has eyes composed of four ommatidia; however, the new species differs in having the molar penicil of the mandibles composed up to eight branches (vs six in *T. acuta*), outer endite of the maxillula with teeth apically simple (vs two apically cleft in *T. acuta*) (see also Araujo & Buckup 1994).

In a broader comparison, *T. aethiopica* Arcangeli, 1941, *T. giannellii* Arcangeli, 1929, *T. hospes* Silvestri, 1918, *T. minima* Schmalfuss & Ferrara, 1978, *T. paraensis* Souza-Kury, 1997, *T. silvestrii* Arcangeli, 1936, and *T. vandeli* Rioja, 1955, also have eyes composed of four ommatidia. As common within Oniscidea, most of the characters used in taxonomic descriptions until the middle of the 20th century were generic, and comparisons were not presented. *Trichorhina amplitelson* Campos-Filho, Carpio-Díaz & Borja-Arrieta, n. sp. differs in having colorless body (vs grey-brownish in *T. aethiopica*), cephalon with lateral lobes well-developed (vs slightly developed in *T. hospes* and *T. paraensis*), telson trapezoidal (vs triangular in all the above mentioned species), antenna with apical organ short (vs elongated in *T. paraensis*), mandibles with molar penicil dichotomized and composed of eight branches (vs simple in *T. hospes* and *T. paraensis*, three branches in *T. silvestrii*, several branches in *T. vandeli*), maxillula outer endite with all teeth apically simple (vs two cleft in *T. hospes*, *T. paraensis*, *T. silvestrii*, and *T. vandeli*), maxilla outer lobe wider than inner lobe (vs subequal in *T. hospes*), and male pleopod 1 exopod sub-ovoid (vs heart-shaped in *T. minima* and *T. vandeli*, subquadrangular in *T. paraensis*) (Silvestri 1918; Arcangeli 1929, 1936, 1941; Rioja 1955; Mulaik 1960; Schmalfuss & Ferrara 1978; Souza-Kury 1997).

Within Oniscidea, the morphology of the mouth parts is relatively stable among congeneric species (see Schmidt 2002, 2003). In most cases, few variations can be observed, such as the apical shape of the teeth of the outer endite of maxillula, and relative width of the lobes of the maxilla. Nevertheless, in *T. micros* and *T. minutissima* as described by Budde-Lund (1913), the outer teeth on the outer endite of the maxillula are pectinate, a character state not observed in the remaining members of the genus. This shape of teeth is considered to be plesiomorphic and it is present in other genera of Oniscidea, *e.g.*, *Ligia*, *Alboscia* Schultz, 1995, *Benthana* Budde-Lund, 1908, *Ctenoscia* Verhoeff, 1928, and *Paractenoscia* Taiti & Rossano, 2015 (Philosciidae) (see Leistikow 1997, 2001b; Schmidt 2008; Taiti & Rossano 2015; Campos-Filho *et al.* 2015a, 2020). Therefore, these two species of *Trichorhina* need to be revised in order to clarify their taxonomy.

Family Armadillidae Brandt, 1831

Genus *Ctenorillo* Verhoeff, 1942

Ctenorillo Verhoeff, 1942: 23.

Type species. — *Ctenorillo buddelundi* Verhoeff, 1942, by monotypy (synonym of *Cubaris regulus* Van Name, 1920) (see Schmidt & Leistikow 2004).

Diagnosis. — See Carpio-Díaz *et al.* (2018).

Ctenorillo ferrarai
Campos-Filho, Araujo & Taiti, 2014
(Figs 22; 23)

Ctenorillo ferrarai Campos-Filho, Araujo & Taiti, *in* Campos-Filho *et al.*, 2014: 412, figs 37-40, table 1. — Fernandes *et al.* 2019: 1119.

Material examined.— **Brazil** • many ♂ and ♀, state of Pará, Curionópolis, Serra Leste karst system, Spelayon Team leg.: SL_0120 cave; 5°59'8.64"S, 49°37'12.47"W; 13.IX.2014; LES 006131 • same locality as previous; 22.I.2015; LES 6189 • SL_0159 cave; 5°59'59.28"S, 49°36'55.42"W; 04.IX.2014; LES 6144 • same locality as previous; 14.I.2015; LES 6211 • SL_0170 cave; 6°0'2.12'S, 49°36'58.89"W; 05.IX.2014; LES 6147 • SL_0172 cave; 6°0'32.84"S, 49°38'8.21"W; 11.X.2014; LES 6149 • same locality as previous; 15.I.2015; LES 6219 • SL_0239 cave; 5°59'42.15"S, 49°36'54.65"W; 09.X.2014; LES 6175 • SL_0151 cave; 6°0'12.18"S, 49°36'58.35"W; 03.IX.2014; LES 6140 • SL_0171 cave; 6°0'1.02"S, 49°36'58.67"W; 05.IX.2014; LES 6148 • SL_0182; 6°0'17.48"S, 49°37'5.81"W; 15.IX.2014; LES 6153 • SL_0204 cave; 11.IX.2014; LES 006161 • SL_0212 cave; 11.IX.2014; LES 6166 • SL_0230 cave; 5°59'54.30"S, 49°36'54.88"W; 10.IX.2014; LES 006173 • SL_0251 cave; 6°0'36.88"S, 49°38'10.90"W; 11.X.2014; LES 6179 • SL_0253 cave; 6°0'37.77"S, 49°38'15.51"W; 18.IX.2014; LES 6180 • same locality as previous; 19.I.2015; LES 6256 • same as previous; LES 6257 • SL_0255 cave; 6°0'39.82"S, 49°38'26.63"W; 10.X.2014; LES 6182 • SL_0259 cave; 6°0'38.52"S, 49°38'16.36"W; 17.IX.2014; LES 6185 • SL_0128 cave; 5°59'44.39"S, 49°37'16.69"W; 23.I.2015; LES 6196 • SL_0134 cave; 6°0'2.33"S, 49°36'51.48"W; 14.I.2015; LES 6197 • SL_0140 cave; 6°0'10.75"S, 49°36'59.32"W; 13.I.2015; LES 6201 • same as previous; LES 6202 • SL_0142 cave; 6°0'7.96"S, 49°37'0.40"W; 13.I.2015; LES 6203 • SL_0143 cave; 6°0'9.23"S, 49°37'0.40"W; 13.I.2015; LES 6204 • SL_0144 cave; 6°0'38.73"S, 49°38'20.85"W; 26.I.2015; LES 6205 • same as previous; LES 6206 • SL_0145 cave; 6°0'12.06"S, 49°36'59.74"W; 13.I.2015; LES 6207 • SL_0157 cave; 5°59'58.66"S, 49°36'55.77"W; 14.I.2015; LES 6210 • SL_0161 cave; 6°0'12.42"S, 49°37'0.03"W; 13.I.2015; LES 6213 • SL_0166 cave; 6°0'0.52"S, 49°36'54.37"W; 15.I.2015; LES 6215 • SL_0181 cave; 6°1'18.32"S, 49°37'27.45"W; 18.I.2015; LES 6221 • SL_0183 cave; 6°1'16.44"S, 49°37'32.17"W; 15.I.2015; LES 6222 • SL_0186 cave; 6°0'15.02"S, 49°36'57.98"W; 13.I.2015; LES 6223 • SL_0188 cave; 6°1'15.98"S, 49°37'30.96"W; 15.I.2015; LES 6224 • SL_0196 cave; 5°59'36.18"S, 49°36'46.79"W; 18.I.2015; LES 6226 • SL_0197 cave; 5°59'38.06"S, 49°36'43.37"W; 18.I.2015; LES 6228 • SL_0202 cave; 5°59'37.46"S, 49°36'51.28"W; 25.I.2015; LES 6230 • SL_0204 cave; 6°1'17.57"S, 49°37'28.20"W; 16.I.2015; LES 6233 • SL_0212 cave; 6°1'18.87"S, 49°37'27.25"W; 18.I.2015; LES 6234 • SL_0123 cave; 5°59'11.57"S, 49°37'13.81"W; 15.I.2015; LES

FIG. 22. — Distribution map of *Ctenorillo ferrarai* Campos-Filho, Araujo & Taiti, 2014. Abbreviations: **PA**, state of Pará; **SL**, Serra Leste; **TO**, state of Tocantins.

6236 • SL_0217 cave; 6°0'39.47"S, 49°38'18.05"W; 19.I.2015; LES 6239 • SL_0223 cave; 5°59'12.32"S, 49°35'58.30"W; 18.I.2015; LES 6244 • SL_0240 cave; 5°59'36.25"S, 49°36'49.49"W; 18.I.2015; LES 6251 • SL_0242 cave; 5°59'47.81"S, 49°36'50.01"W; 18.I.2015; LES 6252 • SL_0247 cave; 5°59'50.91"S, 49°36'54.36"W; 19.I.2015; LES 6253 • SL_0250 cave; 6°0'36.49"S, 49°38'10.94"W; 19.I.2015; LES 6254 • SL_0254 cave; 6°0'38.10"S, 49°38'16.10"W; 19.I.2015; LES 6258 • SL_0258 cave; 6°0'38.52"S, 49°38'16.36"W; 20.I.2015; LES 6260 • SL_0127 cave; 5°59'44.39"S, 49°37'16.69"W; 23.I.2015; LES 6263.

REMARKS

All the specimens examined show morphological characters similar to the type specimens of *C. ferrarai* as described in Campos-Filho *et al.* (2014), especially the number and arrangement of the dorsal tubercles. Moreover, as mentioned by the authors, this is the best character to distinguish species of *Ctenorillo* (see also Schmalfuss & Ferrara 1983; Taiti *et al.* 1998). This species (Fig. 22) was previously recorded from Gruta N5S 07, Gruta Cris 11 caves and Serra Leste cave system, FLONA Carajás (FLONA – National Forest), Canaã dos Carajás, Carajás geomorphological group, state of Pará (Campos-Filho *et al.* 2014). To date, it is considered to be a troglophile, visiting caves to exploit their resources and for their favourable micro-habitat conditions (Fernandes *et al.* 2016, 2019).

Genus *Cubaris* Brandt, 1833

Cubaris Brandt, 1833: 489.

TYPE SPECIES. — *Cubaris murina* Brandt, 1833, by subsequent designation (Barnard 1932).

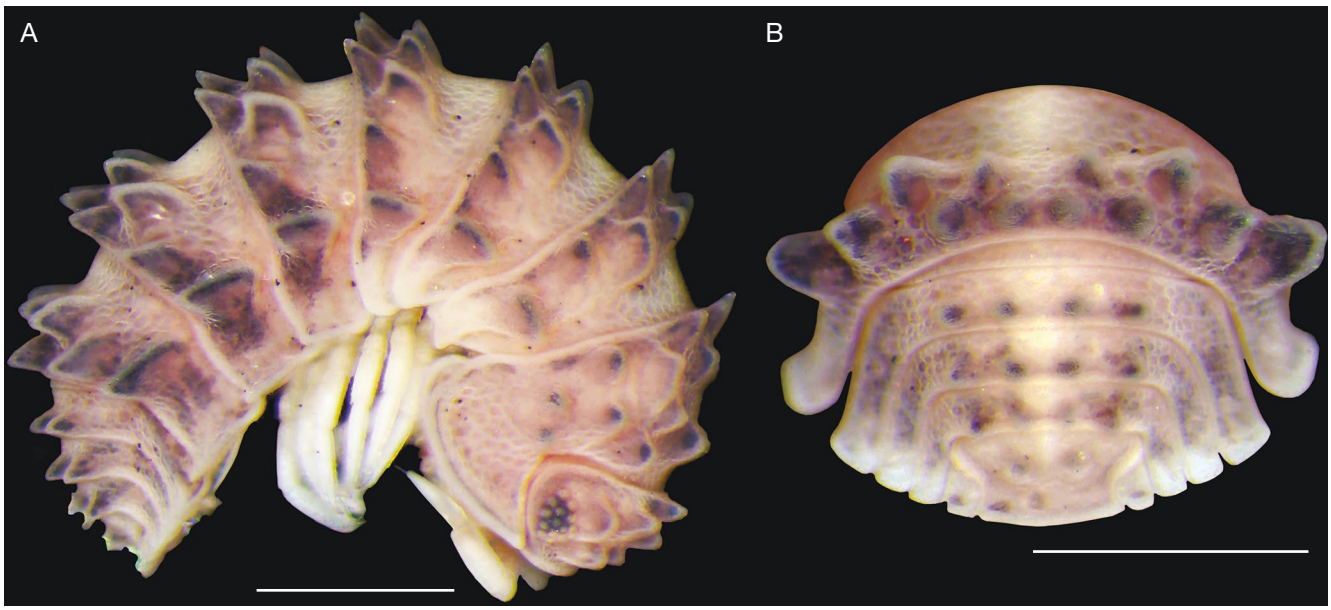

Fig. 23. — Photographs of *Ctenorillo ferrarai* Campos-Filho, Araujo & Taiti, 2014, male specimen from Serra Leste cave system: **A**, lateral habitus; **B**, dorsal view of the pereonite 7, pleon, telson, and uropods. Scale bars: 1 mm.

Diagnosis. — After Schmalfuss & Ferrara (1983) and Taiti *et al.* (1998): animals with complete endoantennal conglobation; roller habitus (*sensu* Schmalfuss 1984); dorsal surface smooth or granulated covered with short tricorn, semi-circular or elongated scale-setae; pereonites 1-7 with one line of short *noduli laterales* inserted at same line and near posterior margins; cephalon with subrectangular frontal shield delimited from vertex by frontal line, lateral lobes well developed, suprantennal line absent; pereonite 1 epimera with anterior corners developed frontwards to fit cephalon during conglobation, posterior corner concave, short triangular lobe on ventral; pereonite 2 epimera bearing rectangular lobe direted outwards (sometimes reduced); pereonites 1-7 epimera directed backwards; pleon outline continuous with that of pereonite 7; pleonites 3-5 epimera subrectangular and well-developed; telson hour-glass shaped, distal margin slightly convex; mandibles with molar penicil semi-dichotomized, left mandible with 2+1 penicils, right mandible with 1+1 penicils; maxillula of 4+5-6 teeth apically simple; maxilla bilobate; maxilliped endite bearing two long setae on distal margin plus medial seta; pereopod 1 carpus with longitudinal antennal grooming brush; uropod protopod rectangular, flattened, filling gap between pleonite 5 and telson, medial margin concave bearing small exopod, endopod longer than exopod; pleopod exopods with monospiracular pleopodal lungs (see also Collinge 1916; Taiti & Ferrara 1987; Lewis 1998; Lillemets & Wilson 2002).

Remarks

Brandt (1833) erected *Cubaris* to allocate *C. brunnea* (synonym of *C. murina*) from Guyana, *C. cinerea* and *C. murina* from Brazil, *C. flavescens* (synonym of *Venezillo f.*), *C. limbata* (synonym of *Bethalus limbatus*), and *C. nigricans* (synonym of *Venezillo n.*) from South Africa. To date, the genus comprises about 60 species with a circumtropical distribution (Schmalfuss 2003). Several species have been mistakenly assigned to the genus which still needs a comprehensive revision (see Schmalfuss 2003). The present diagnosis is tentative, aiming to assist future studies on the genus.

Cubaris murina Brandt, 1833
(Fig. 30A)

Cubaris murina Brandt, 1833: 190. — Campos-Filho *et al.* 2014: 417, fig. 40, Table 1. — Fernandes *et al.* 2019: 1119.

Material examined. — **Brazil** • State of Sergipe: 1 ♂, 1 ♀; Caverna Pedra Branca, Maruim; 10°46'18.4"S, 37°07'53.5"W; M. E. Bichuette leg; LES 10817 • State of Bahia: 1 ♂, 2 ♀; Gruta Lapa do Manga II cave, São Desidério; 12°22'20.8"S, 44°59'37.4"W; 05.XI.2008; M. E. Bichuette, T. Scatolini & D. Pedroso leg.; LES 6271 • 1 ♂; Gruna do Govi cave, Feira da Mata; 13°56'43.3"S, 44°14'26"W; 682 m a.s.l.; 12.X.2020; M. E. Bichuette, D. F. Torres, J. S. Gallo, L. S. Horta & J. E. Gallão; LES 27998 • 3 ♂; Toca do Gonçalo cave, Umburanas; 10°30'39"S, 40°53'40"W; 20.VI.2015; M. Bolfarini, D. M. v. Schimonsky & J. E. Gallão leg.; LES 7333 • 1 ♂, 2 ♀; Poço Azul do Milu cave, Nova Redenção; 12°47'01.9"S, 41°08'50.58"W; 348 m a.s.l.; 02.XI.2016; M. E. Bichuette, J. E. Gallão & M. J. Rosendo leg.; LES 27999 • State of Goiás: 1 ♀, 3 juveniles; Gruta da Tarimba cave, Mambaí; 14°24'51.7"S, 46°10'34.1"W; X.2012; 753 m a.s.l.; M. E. Bichuette, J. E. Gallão, L. B. Simões, C. S. Fernandes & T. Zepon leg; LES 10264 • 2 ♂, 6 ♀; Caverna Fundo de Quintal, Mambaí; 14°29'16.0"S, 46°07'08.4"W; 699 m a.s.l.; X.2012; M. E. Bichuette, J. E. Gallão, L. B. Simões, C. S. Fernandes & T. Zepon leg; LES 10269 • 1 ♀, 3 juveniles; same data as previous; LES 10271.

Distribution. — Circumtropical species (Schmalfuss 2003). In Brazil, it was recorded from the states of Bahia, Espírito Santo, Mato Grosso, Mato Grosso do Sul, Pará, Paraná, Santa Catarina, and Tocantins (Campos-Filho *et al.* 2018a). In caves, it was recorded from Gruta dos Brejões and Gruta Lapa do Manga II, João Rodrigues River karst system, state of Bahia (Campos-Filho *et al.* 2014; Fernandes *et al.* 2019). The present work constitutes the first record of this species from caves in the state of Goiás, and it extends our knowledge of its distribution within the state of Bahia.

Genus *Diploexochus* Brandt, 1833

Diploexochus Brandt, 1833: 492.

TYPE SPECIES. — *Diploexochus echinatus* Brandt, 1833, by monotypy (see Schmidt & Leistikow 2004).

DIAGNOSIS. — Animals with endoantennal conglobation; roller (*sensu* Schmalfuss 1984) with spiny or tuberculate dorsum; pereonites 1-7 with one line of *noduli laterales* inserted on same line from lateral margins, near or over outer posterior tubercle; cephalon with rectangular frontal shield, strongly developed upwards, and slightly curved backwards, suprantennal line absent; pereonites 1-7 and pleonites 3-5 well developed, concave, and directed outwards; pereonite 1 epimera with schisma on posterior corners, lateral margin strongly grooved; pereonites 1-7 with ventral lobes and/or shallow ridges to fit pereonites epimera during conglobation; pleon outline continuous with that of pereonite 7; telson hourglass-shaped, distal portion slightly concave or convex, or straight; antennula of three articles; antennal flagellum of two articles, apical organ short; mandibles with molar penicil simple or semi-dichotomized, left mandible with 2+1 penicils, right mandible with 1+1 penicils; maxillula outer endite composed of 4+5-6 teeth, outer set apically entire; maxilla bilobate; maxilliped endite subrectangular bearing two short triangular setae plus medial seta; uropod protopod enlarged and flattened to fit space between pleonite 5 and telson, exopod short inserted near medial margin; pleopod 1-5 exopods with monospiracular pleopodal lungs.

Diploexochus carrapicho
Campos-Filho, López-Orozco & Taiti, n. sp.
(Figs 24-26; 30B)

urn:lsid:zoobank.org:act:46E43019-9E9D-44DC-A333-4955024EF591

TYPE MATERIAL.— **Holotype. Brazil** • ♂ (parts in micropreparations); Gruta Alex 1 cave, Bodoquena, Assentamento Campina, state of Mato Grosso do Sul; 20°36'19"S, 56°42'36"W; 356 m a.s.l.; 15.V.2011; S. C. Escarpinati leg.; LES 28000.
Paratypes. Brazil • 2 ♀ (one with parts in micropreparations); same data as holotype; LES 28001.

ETYMOLOGY. — The new species is named after the seeds of *Bidens alba*, known as Picão-preto in Brazil, or carrapicho. The name carrapicho refers to the spine-shaped form of the seeds of this plant conferring high adherence to animal furs or human clothes. During conglobation, the new species resembles the shape of this seed.

DESCRIPTION
Maximum body length: ♂ 4 mm, ♀ 6 mm. Color faint due to long preservation in ethanol. Body (Fig. 24A, B) strongly convex, bearing elongate and spine-shaped tubercles, arranged as follows: vertex of cephalon with eight tubercles in two rows; pereonite 1 with 14 tubercles in three rows; pereonites 2-7 with 12 tubercles in two rows; pleonites 3-5 and telson with two paramedian tubercles each (Fig. 24A, B, G, H). Dorsal surface with semi-circular scale-setae (Fig. 24C). *Noduli laterales* short, inserted at base of second tubercles near posterior margins (Fig 24A, B). Cephalon (Fig. 24B, E-G) with frontal shield prominent, distinctly protruding above vertex; eyes with 10-12 ommatidia. Pereonites 1-7 epimera (Fig. 24A, D) strongly concave and directed outwards; pereonite 1 epimera with rounded lateral margin grooved for all its length, inner lobe of schisma rounded, slightly extending beyond posterior margin of outer lobe; pereonite 2-7 epimera (Fig. 24A) triangular and elongated; pereonite 2 epimera ventrally with narrowly rounded lobes directed outwards (Fig. 24A, D); pereonite 3 epimera ventrally with broad triangular lobes directed outwards (Fig. 24D); pereonite 4-7 epimera with triangular lobes gradually increasing and directed backwards (Fig. 24D). Pleonite 3-5 epimera (Fig. 24H, I) well-developed, triangular, directed outwards; telson (Fig. 24H) with dorsum slightly depressed, distal margin slightly concave. Antennula (Fig. 25A) proximal article longest, distal article bearing about six aesthetascs inserted apically and subapically. Antenna (Fig. 25B) short, not surpassing posterior margin of pereonite 1 when extended backwards; flagellum distal article more than twice as long as first and bearing two lateral aesthetascs. Mandibles (Fig. 25C, D) with molar penicil semi-dichotomized. Maxillula (Fig. 25E) inner endite bearing two penicils, distal margin rounded; outer endite of 4+6 teeth. Maxilla (Fig. 25F) inner lobe covered with thick setae; outer lobe three times as wide as inner lobe covered with thin setae. Maxilliped (Fig. 25G) basis rectangular bearing sparse scale-setae; proximal article of palp with two distinct setae; endite subrectangular, medial seta surpassing distal margin. Pereopods 1-7 with sparse setae along sternal margin; dactylus of two claws, ungual and dactylar setae simple, not surpassing outer claw. Uropod (Fig. 26A, B) protopod with distal part triangular, elongated, medial margin concave; endopod bearing dense fringe of setae and glandular pores on inner margin; exopod short inserted dorsally on distinct lobe near medial margin.

Male
Pereopod 7 (Fig. 26C) without sexual dimorphism. Pleopod 1 (Fig. 26D) exopod subtriangular, twice as wide as long, outer portion narrow, medial portion rounded bearing five small setae; endopod three times as long as exopod. Pleopod 2 (Fig. 26E) exopod triangular, outer margin concave bearing four setae; endopod flagelliform, longer than exopod. Pleopod 3 and 4 exopods as in Figure 26F, G, respectively. Pleopod 5 exopod (Fig. 26H) rhomboid, distal margin almost straight bearing many setae.

REMARKS
The genus *Diploexochus* was erected to allocate *Armadillo echinatus* from Brazil (Brandt 1833; Lemos de Castro 1967). Several Armadillidae species belonging to other genera were incorrectly assigned to *Diploexochus* (see Schmalfuss 2003 for an overview). To date, the genus comprises three species exclusively distributed in South America, *D. echinatus*, *D. obscurus* Cardoso, Bastos-Pereira & Ferreira, 2023, and *D. spinatus* Cardoso, Bastos-Pereira & Ferreira, 2023 (Campos-Filho *et al.* 2017; Cardoso *et al.* 2023).

Among the diagnostic characteristics proposed here, the shape and direction of the pereonites 1-7 and pleonites 3-5 epimera, pereonite 1 epimera with large schisma on posterior corners and strongly grooved outer margin, shape

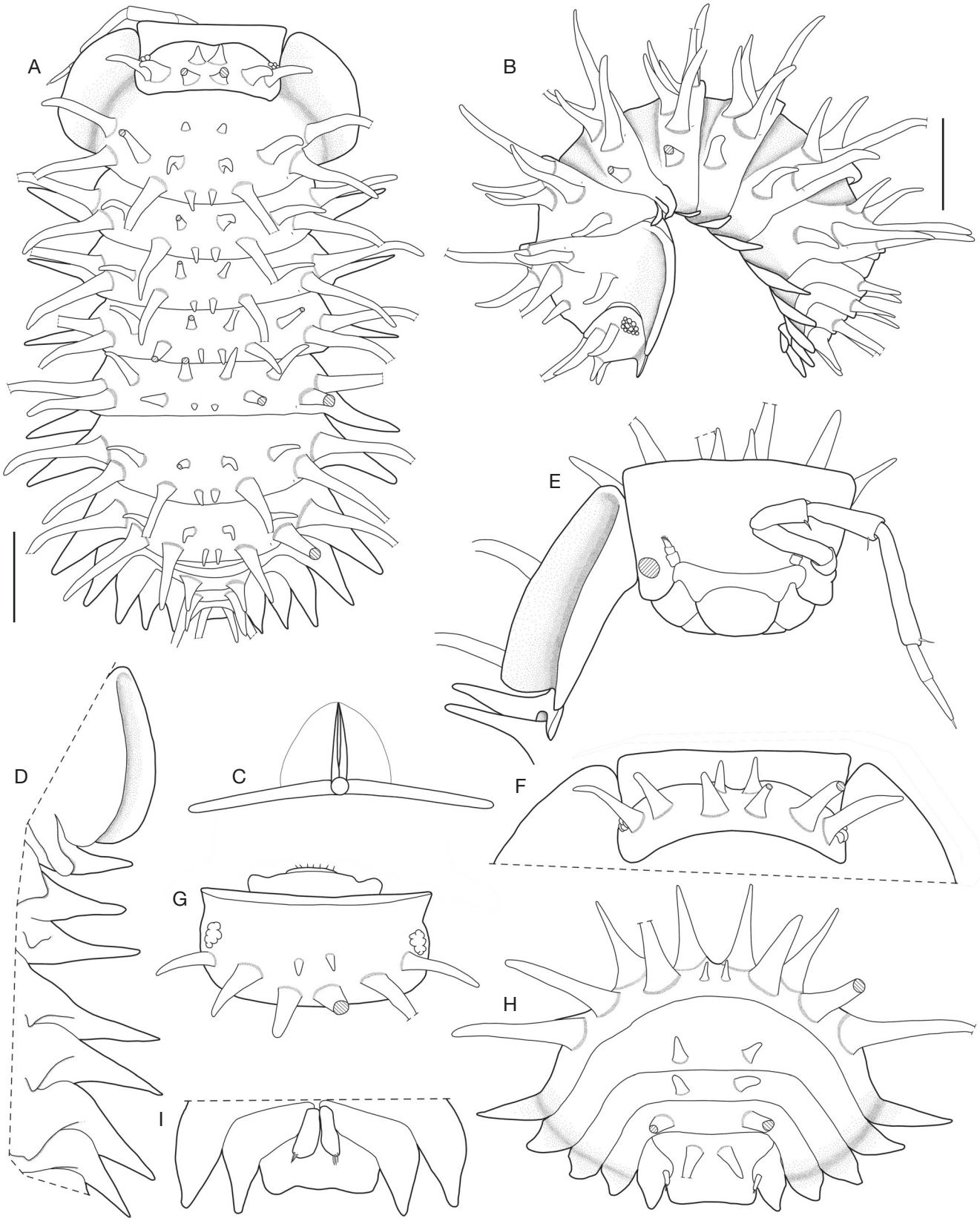

Fig. 24. — *Diploexochus carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp., female paratype LES 28001: **A**, dorsal habitus; **B**, lateral habitus; **C**, scale-seta; **D**, pereonite 1-7 epimera, ventral view; **E**, cephalon and pereonites 1-3, frontal view; **F**, cephalon and pereonite 1, back view; **G**, cephalon, dorsal view; **H**, pereonite 7, pleon, telson, and uropods, dorsal view; **I**, pleonites 4 and 5, telson and uropods, ventral view. Scale bar: A, 1 mm.

FIG. 25. — *Diploexochus carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp., female paratype LES 28001: **A**, antennula; **B**, antenna; **C**, left mandible; **D**, right mandible; **E**, maxillula; **F**, maxilla; **G**, maxilliped.

of the frontal shield of the cephalon, and tuberculated or spiny dorsum, are the most distinctive characters of the genus. Regarding the last character, also other members of the family have well-developed dorsal tubercles, e.g. *Parakermania* Vandel, 1973, *Calmanesia* Collinge, 1922, *Laureola* Barnard, 1960, *Pseudolaureola* Kwon, Ferrara & Taiti, 1992, and some species of *Venezillo* Verhoeff, 1928 (see Collinge 1922; Van Name 1936; Barnard 1958, 1960; Mulaik 1960; Taiti & Ferrara 1979; Kwon *et al.* 1992; Kwon & Taiti 1993). As in other tuberculated genera of Armadillidae, the best taxonomic characteristic to distinguish the species within a genus is the number and arrangement of the dorsal tubercles on the cephalon, pereon, and pleon (see also Campos-Filho *et al.* 2014; Taiti 2018).

Diploexochus carrapicho Campos-Filho, López-Orozco & Taiti, n. sp. can be distinguished from the congeneric species in having the dorsal surface covered with spiny shaped

FIG. 26. — *Diploexochus carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp.: **A**, **B**, female paratype LES 28001: uropod frontal view (**A**); uropod, ventral view (**B**), **C**-**H**, male holotype, LES 28000: pereopod 7 (**C**); pleopod 1 (**D**); pleopod 2 (**E**); pleopod 3 exopod (**F**); pleopod 4 exopod (**G**); pleopod 5 exopod (**H**).

tubercles and in the number and arrangement of the dorsal tubercles (see Campos-Filho *et al.* 2017; Cardoso *et al.* 2023). Moreover, it differs in having pereonite 2 epimera with ventral lobe directed outwards (vs downwards in *D. echinatus* and *D. spinatus*), telson with distal margin slightly concave (vs distinctly concave in *D. echinatus*; slightly convex in *D. obscurus*; straight in *D. spinatus*), mandibles with molar penicil semi-dichotomized (vs simple in all other species), and uropod protopod with distal part triangular (vs subrectangular in all other species).

The spiny dorsal surface is an adaptation against predators (Schmalfuss 1984). The specimens of *D. carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp. were collected in the Serra da Bodoquena karst region, in the Pantanal wetland region (Sallun Filho & Karmann 2007). This species is considered to be a troglophile, and probably inhabits caves to exploit their resources and for favourable micro-habitat conditions (Fernandes *et al.* 2016, 2019).

Diploexochus exu
Campos-Filho, Sfenthourakis & Bichuette, n. sp.
(Figs 27-29; 30B)

urn:lsid:zoobank.org:act:5ED17375-A69D-4695-83E0-33DB9F268A83

TYPE MATERIAL. — **Holotype. Brazil. •** ♀; Gruna Boca da Lapa cave, Feira da Mata, state of Bahia; 13°56'46.4"S, 44°11'12"W; 544 m a.s.l.; 15.X.2020; M. E. Bichuette, D. F. Torres, J. S. Gallo, L. S. Horta & J. E. Gallão leg.; LES 28002.
Paratypes. Brazil • 6 ♀ (one with parts in micropreparations); same data as holotype; LES 28003.

ETYMOLOGY. — The new species is named after Exu, a divinity of the Candomblé Afro-Brazilian religion. In the Candomblé, Exu is the messenger of the orixás divinities, transiting between the world of humans and the gods. He is considered the owner of the paths, the crossroads, the perspectives, the past, and the future, and he is responsible for order and disorder.

DESCRIPTION
Maximum body length: 6.5 mm. Color brown with typical muscle insertion spots; cephalon, pereonite 1, pereonite 2-7 posterior portions, pleon, telson and uropods strongly pigmented. Body (Fig. 27A) strongly convex, bearing triangular tubercles, arranged as follows: vertex of cephalon with eight tubercles in two rows; pereonite 1 with 13 tubercles in three rows; pereonite 2 with 11 tubercles in two rows; pereonites 3 and 4 with nine tubercles in two rows; pereonites 5-7 with seven tubercles in one row; pleonites 5 and telson with two tubercles on median portion (Fig. 27B). Dorsal surface with semi-circular scale-setae (Fig. 27C). *Noduli laterales* short, inserted on outer part of second tubercle from lateral margins (Fig. 27A). Cephalon (Fig. 27A, D, E) with frontal shield prominent, distinctly protruding above vertex; eyes with 10 ommatidia; pereonite 1-7 epimera (Fig. 27A, E-H) strongly concave; pereonite 1 epimera with rounded, lateral margin grooved on posterior corner for about one quarter of its length, inner lobe of schisma rounded, not extending beyond posterior margin of outer lobe; pereonite 2-7 epimera (Fig. 27F, I, J) triangular and elongated; pereonite 2 epimera with narrow and rounded lobe directed outwards (Fig. 27F, J); pereonites 3 and 4 without lobe; pereonites 5-7 with ventral sulcus (Fig. 27F). Pleonite 3-5 epimera (Fig. 27K) triangular; telson (Fig. 27K, L) dorsum slightly depressed, distal margin slightly convex. Antennula (Fig. 27M) with proximal and distal articles similar in length, distal article bearing about six aesthetascs inserted apically and subapically. Antenna (Fig. 27N) short, not surpassing posterior margin of pereonite 1 when extended backwards; flagellum distal article about three times as long as first, bearing two lateral aesthetascs. Mandibles (Fig. 28A, B) with molar penicil dichotomized. Maxillula (Fig. 28C) inner endite bearing two penicils, distal margin rounded; outer endite of 4+6 teeth, outer set apically entire. Maxilla (Fig. 28D) inner lobe covered with thick setae; outer lobe three times as wide as inner lobe covered with thin setae. Maxilliped (Fig. 28E) basis rectangular bearing sparse setae; proximal article of palp with two distinct setae; endite subrectangular, medial seta surpassing distal margin, ventral sulcus setose ending with short seta. Uropod (Fig. 29A, B) protopod enlarged on basal part, distal part subtriangular, broad, medial margin concave; endopod short bearing setae; exopod short inserted dorsally on distinct lobe near medial margin. Pereopods 1-7 (Fig. 29C, D) with sparse setae along sternal margin; pereopod 1 carpus with longitudinal antenna-grooming brush; dactylus of two claws, ungual and dactylar setae simple, not surpassing outer claw. Pleopod 1 exopod (not drawn) sub-circular, twice as wide as long, outer portion narrow, median portion rounded bearing five small setae. Pleopod 2 exopod (Fig. 29E) triangular, outer margin concave. Pleopod 3 and 4 exopods as in Figure 29F, G, respectively. Pleopod 5 exopod (Fig. 29H) rhomboid, distal margin almost straight bearing many setae.

REMARKS
Within Oniscidea, most of the morphological characters used in taxonomy to describe and distinguish species are those of males (e.g., Taiti & Ferrara 1980; Leistikow 1999; Campos-Filho *et al.* 2015a; Reboleira *et al.* 2015). As mentioned previously, though, conglobating representatives, especially within the Armadillidae, male characters are not always useful, e.g., in *Ctenorillo*, *Tuberillo* Schultz, 1982, and *Venezillo* (Van Name 1936; Schmalfuss & Ferrara 1983; Taiti & Gruber 2010). Thus, other characters, such as the conglobating mechanism, the presence and arrangement of dorsal tubercles (in tuberculated animals), and the shape of the lateral schisma of pereonite 1 (if present), are useful to distinguish species, even in the absence of males. *Diploexochus exu* Campos-Filho, Sfenthourakis & Bichuette, n. sp. easily differs in the shape and arrangement of dorsal tubercles. Moreover, it can be distinguished in having the pereonite 1 epimera with lateral groove of about one quarter of the length of

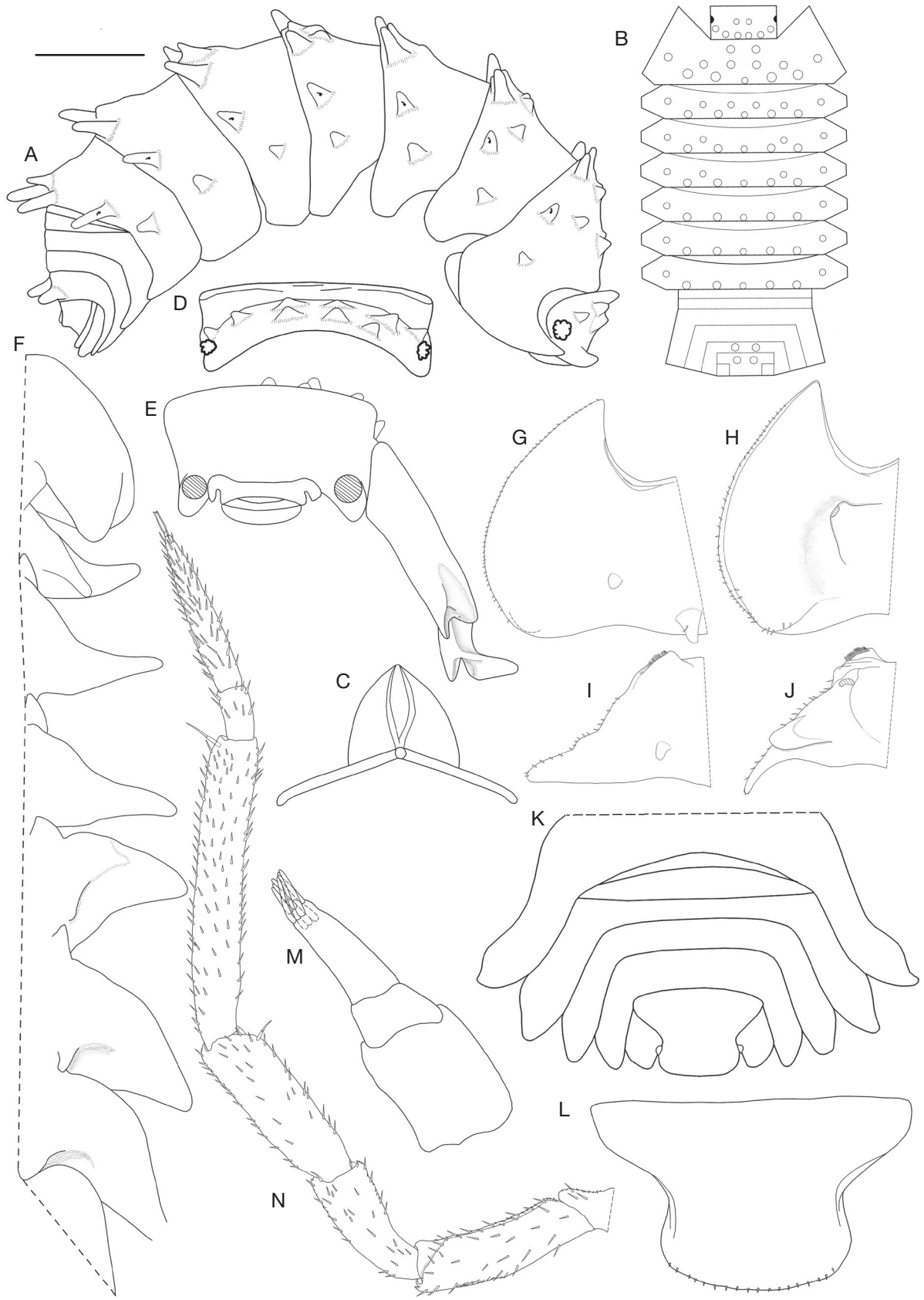

Fig. 27. — *Diploexochus exu* Campos-Filho, Sfenthourakis & Bichuette, n. sp., female paratype LES 28003: **A**, lateral habitus; **B**, tubercles schem; **C**, scale-seta; **D**, cephalon, back view; **E**, cephalon and pereonites 1 and 2, frontal view; **F**, pereonite 1-7 epimera, ventral view; **G**, pereonite 1 epimeron, dorsal view; **H**, pereonite 1 epimeron, ventral view; **I**, pereonite 2 epimeron, dorsal view; **J**, pereonite 2 epimeron, ventral view; **K**, pereonite 7, pleon, telson and uropods, dorsal view, **L**, telson; **M**, antennula; **N**, antenna. Scale bar: A, 1 mm.

FIG. 28. — *Diploexochus exu* Campos-Filho, Sfenthourakis & Bichuette, n. sp., female paratype LES 28003: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped.

the epimeron (vs all epimeron grooved in *D. echinatus*, *D. carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp., and *D. spinatus*; about two thirds of the epimeron lenth in *D. obscurus*), telson with distal margin slightly convex (vs concave in *D. echinatus*; slightly concave in *D. carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp.; slightly convex in *D. obscurus*; straight in *D. spinatus*), eyes composed of about 10 ommatidia (vs about 20 in *D. echinatus* and *D. spinatus*; 16 in *D. obscurus*), mandibles with molar penicil semi-dichotomized (vs simple in all other species), and uropod protopod with distal portion subquadrangular (vs subrectangular in *D. echinatus*, *D. obscurus*, and *D. spinatus*; triangular in *D. carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp.) (see also Campos-Filho *et al.* 2017; Cardoso *et al.* 2023).

This species is considered to be a troglophile due to the absence of troglomorphic characteristics. It probably inhabits caves to exploit their resources and favourable micro-habitat conditions (Fernandes *et al.* 2016, 2019).

Genus *Gabunillo* Schmalfuss & Ferrara, 1983

Gabunillo Schmalfuss & Ferrara, 1983: 128.

TYPE SPECIES. — *Gabunillo coecus* Schmalfuss & Ferrara, 1983, by original designation and monotypy (see Schmidt & Leistikow 2004).

DIAGNOSIS. — After Schmalfuss & Ferrara (1983): animals of reduced size (up to 3.5 mm); endoantennal conglobation; roller (*sensu* Schmalfuss 1984); dorsal surface smooth bearing triangular or fringed scale-setae; pereonites 1-7 with one line of short *noduli laterales* per side; cephalon with lateral lobes not well-developed, frontal shield fused with cephalon, frontal line interrupted on middle, suprantennal line absent; eyes reduced or absent; pereonite 1 epimera with schisma on posterior corners, lateral margin grooved; pereonite 2 and 3 epimera with transverse ventral ridge, sometimes absent; telson triangular; antennula of three articles; antennal flagellum of two articles, apical organ short; mandibles with molar penicil dichotomized, left mandible with 2+1 penicils, right mandible with 1+1 penicils; maxillula outer endite of 4+4 teeth, outer set apically entire; maxilla bilobate; uropod protopod enlarged and flattened, exopod very short inserted sub-terminally; pleopod exopods without respiratory structures.

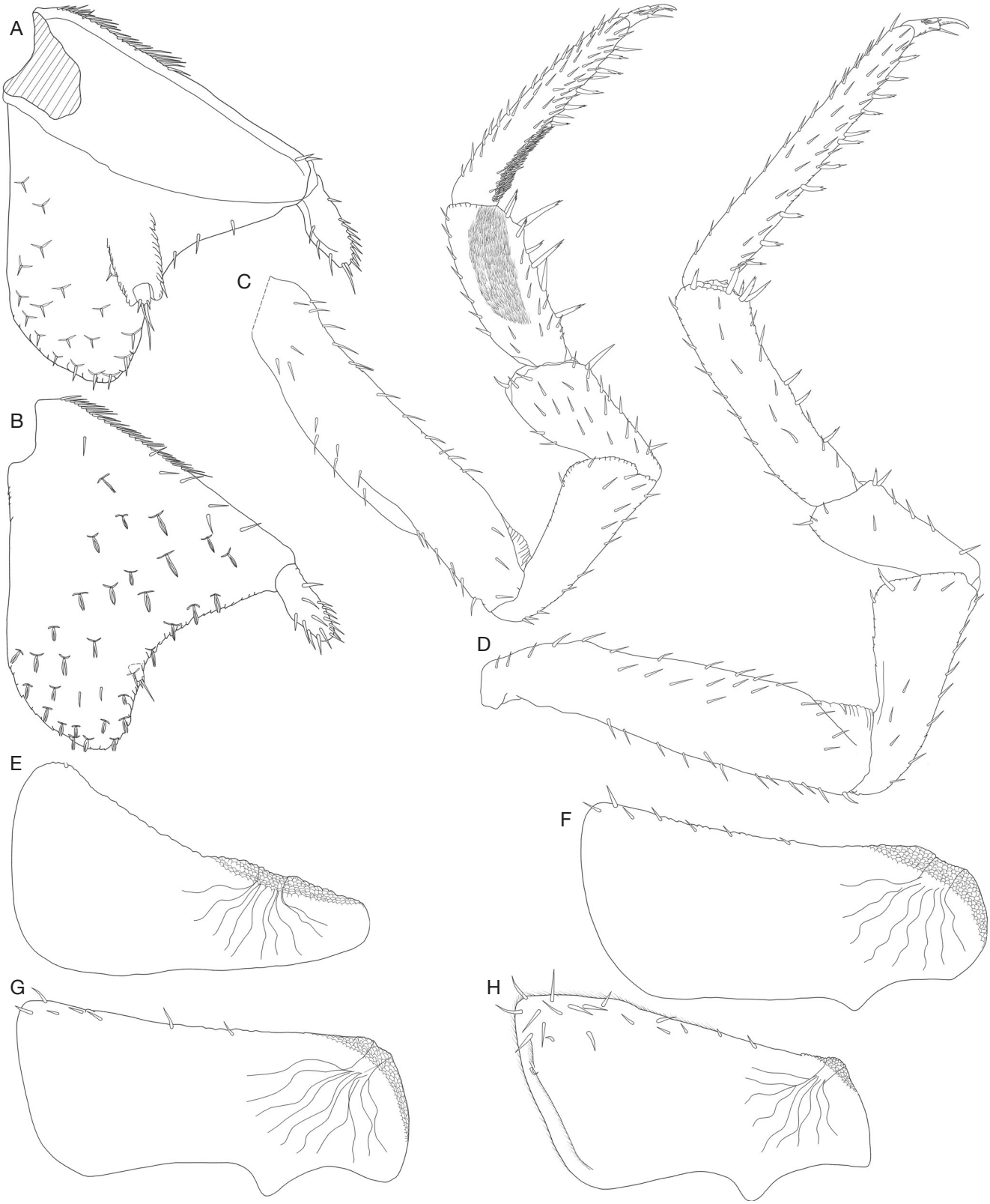

FIG. 29. — *Diploexochus exu* Campos-Filho, Sfenthourakis & Bichuette, n. sp., female paratype LES 28003: **A**, uropod, frontal view; **B**, uropod; **C**, pereopod 1; **D**, pereopod 7; **E**, pleopod 2 exopod; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

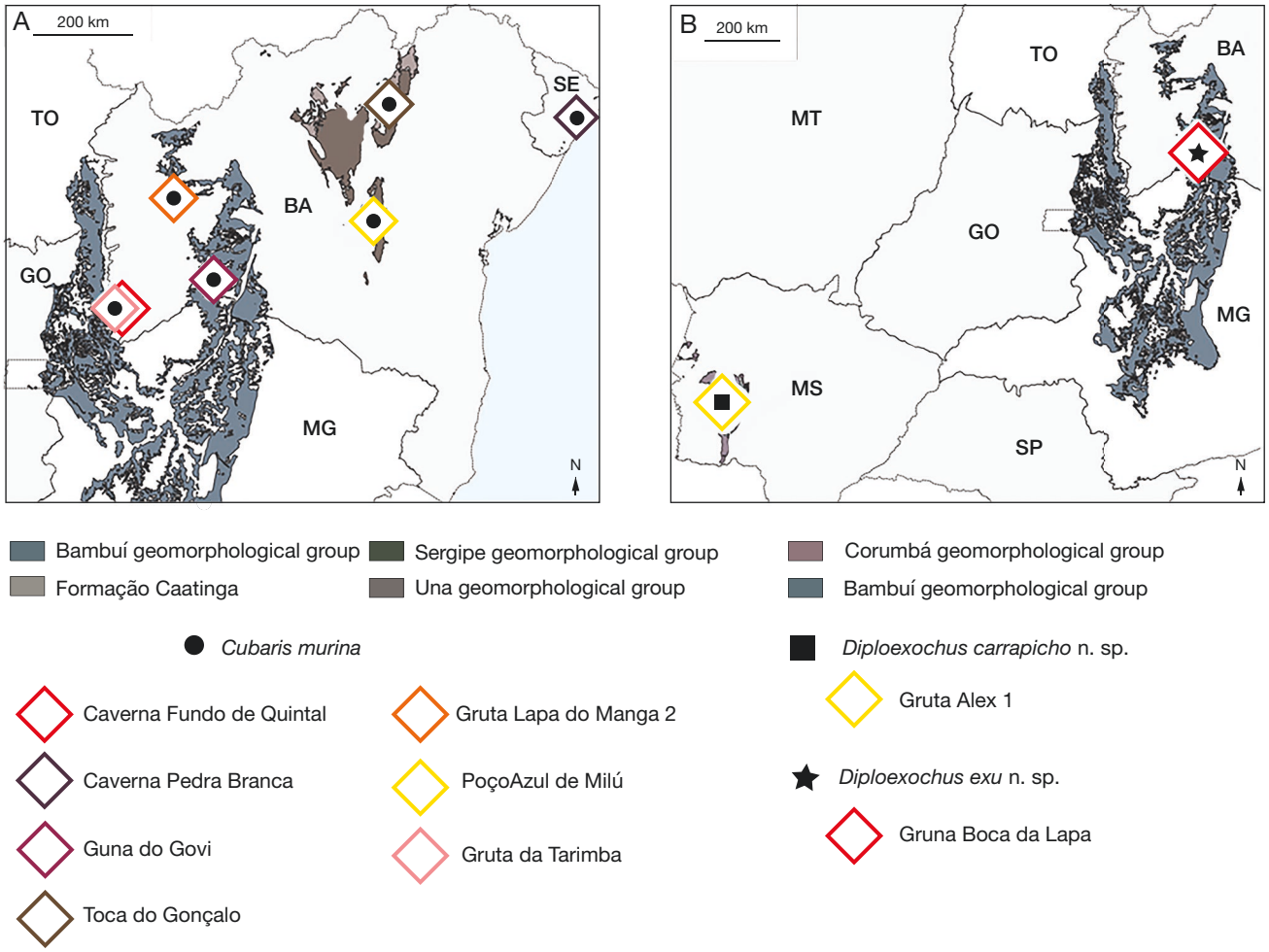

Fig. 30. — Distribution map of the Armadillidae representatives: **A**, *Cubaris murina* (Brandt, 1833); **B**, *Diploexochus carrapicho* Campos-Filho, López-Orozco & Taiti, n. sp., and *D. exu* Campos-Filho, Sfenthourakis & Bichuette, n. sp. Abbreviations of states: **BA**, Bahia; **GO**, Goias; **MG**, Minas Gerais; **MS**, Mato Grosso do Sul; **MT**, Mato Grosso; **SE**, Sergipe; **SP**, São Paulo; **TO**, Tocantins.

Gabunillo enfurnado
Campos-Filho, Sfenthourakis & Bichuette, n. sp.
(Figs 31-34; 49A)

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Microsphaeroniscus sp. – Fernandes *et al.* 2016: 7, table 1; 2019: 1110, fig. 2d, table 1.

Type material.— **Holotype. Brazil** • ♀; Gruta do Enfurnado cave, Coribe, state of Bahia; 13°38'45"S, 44°12'08"W; 15.IV.2010; M. E. Bichuette & J. E. Gallão leg.; LES 28004.
Paratypes. Brazil • Same data as holotype: 16 ♀ (one in micropreparations); LES 6416 • 4 ♀; LES 6415; 18 ♀, 6416; 3 ♀, 6417; 16 ♀, 6418) • 2 ♀; same locality as holotype; VII.2007; M. E. Bichuette, F. D. Passos & B. S. Brito leg; LES 6421 • 2 ♀; same as previous; LES 6423 • 8 ♀; same as previous; LES 6425 • 1 ♀; same locality and collectors as previous; 11.VIII.2007; LES 6426 • 1 ♀; same locality as holotype; 5.V.2007; E. Trajano & D. Sansone leg.; LE 6422 • 7 ♀; same locality and collectors as previous; IX.2007; LES 6428 • 1 ♀; same locality and collectors as previous; LES 6429 • 1 ♀; same locality and collectors as previous; LES 6430.

Etymology. — The new species is named after the locality where the specimens were collected, Gruna do Enfurnado. In Portuguese, the term 'enfurnado' is a verbal term meaning 'to be placed in the cave'.

Description
Maximum body length: 3.5 mm. Body pigments and eyes absent. Body strongly convex (Figs 31A; 34A). Dorsal surface covered with triangular scale-setae (Figs 31B; 34D). *Noduli laterales* short inserted near posterior margins and more or less at same distance from lateral margins (Fig. 31E, G). Cephalon (Figs 31A, C, D; 34B, C) with frontal shield subquadrangular, frontal line faintly visible. Pereonite 1 epimera with convex lateral margins, anterior corners directed frontwards, outline continuous with cephalon; pereonite 2-4 epimera rounded, 5-7 subquadrangular; pereonite 1 epimera laterally grooved on all length, ventral lobe of schisma rounded, not surpassing dorsal lobe; pereonite 2 epimera without ventral lobe (Fig. 31A, C, E-H). Pleonite 3-5 epimera subquadrangular, outline continuous with that of pereonite 7; telson with lateral margins slightly concave (Figs 31A, I; 34A). Antennula (Fig. 31J)

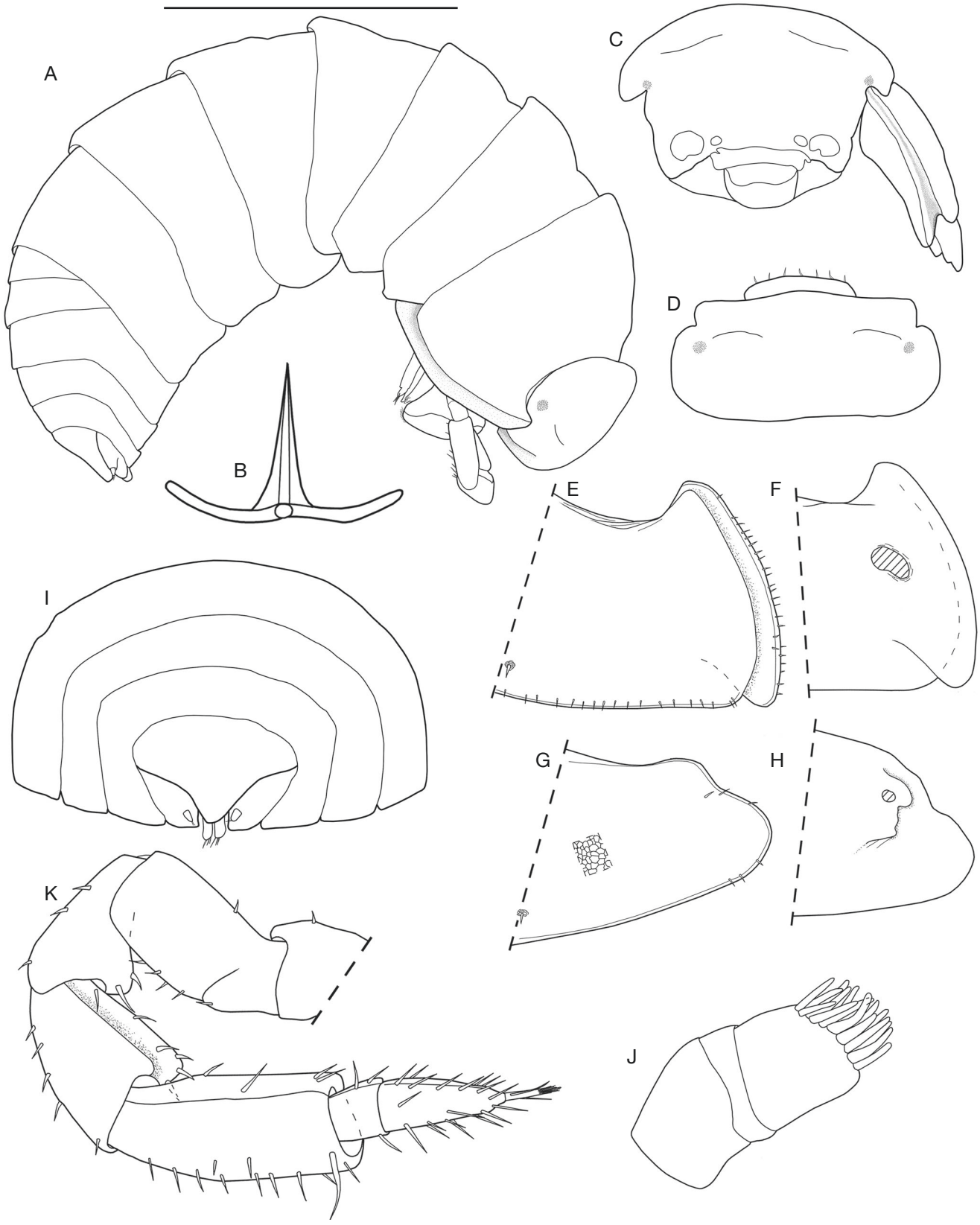

FIG. 31. — *Gabunillo enfurnado* Campos-Filho, Sfenthourakis & Bichuette, n. sp., female paratype, LES 6416: **A**, lateral habitus; **B**, scale-seta; **C**, cephalon and pereonites 1 and 2, frontal view; **D**, cephalon, dorsal view; **E**, pereonite 1 epimeron, dorsal view; **F**, pereonite 1 epimeron, ventral view; **G**, pereonite 2 epimeron, dorsal view; **H**, pereonite 2 epimeron, ventral view; **I**, pleonites 3-5, telson, and uropods, dorsal view; **J**, antenulla; **K**, antenna. Scale bar: A, 1 mm.

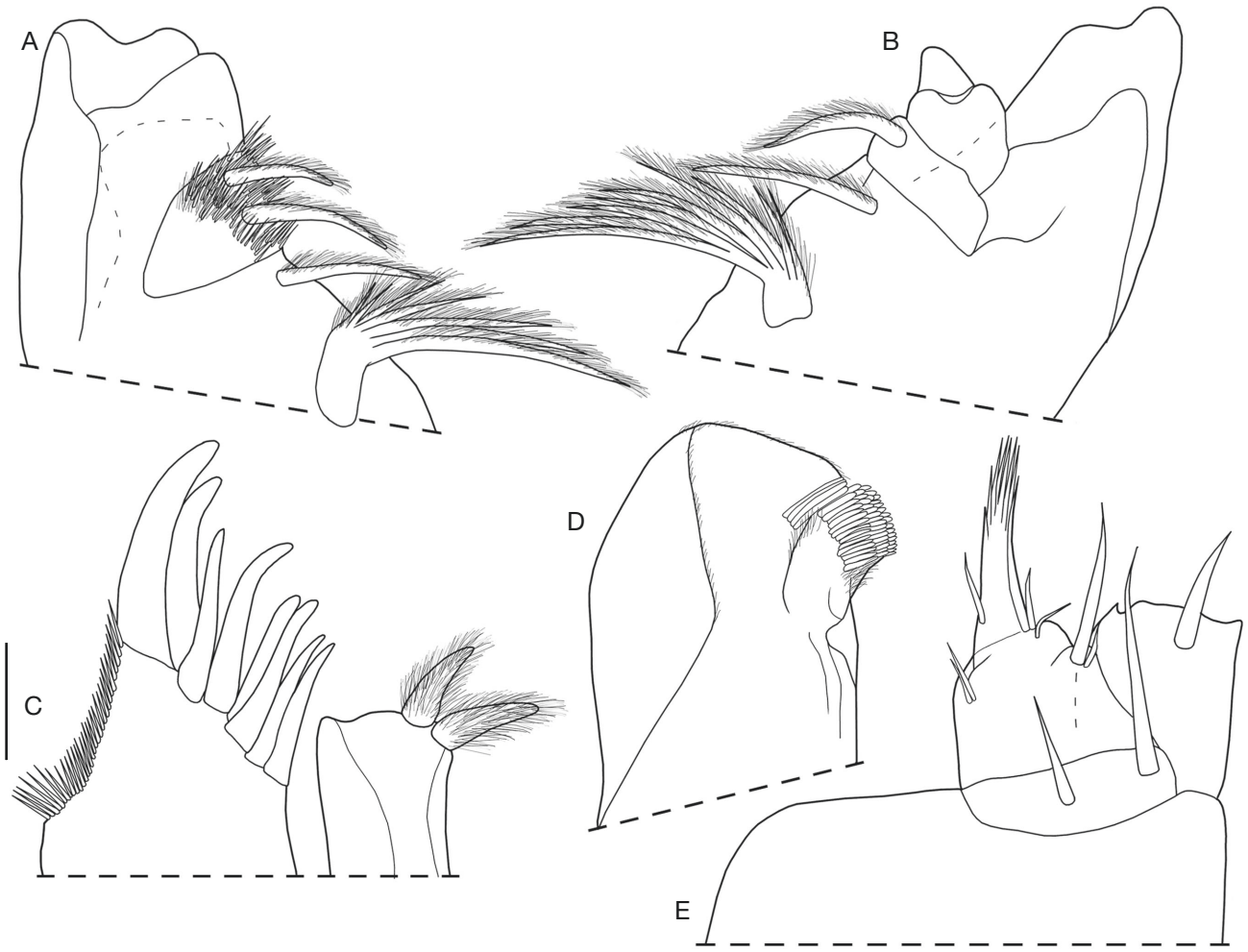

FIG. 32. — *Gabunillo enfurnado* Campos-Filho, Sfenthourakis & Bichuette, n. sp., female paratype, LES 6416: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped.

proximal and distal articles similar in length, distal article bearing many apical aesthetascs. Antenna (Fig. 31K) short, stout, not surpassing pereonite 1 when extended backwards; flagellum distal article twice as long as proximal article; apical organ bearing two long free sensilla. Mandibles (Fig. 32A, B) with dense cushion of setae on incisor process, molar penicil of 7-9 branches. Maxillula (Fig. 32C) inner endite with two transverse apical penicils, distal margin bearing outer tip; outer endite as in diagnosis. Maxilla (Fig. 32D) inner lobe rounded covered with thick setae; outer lobe rounded, three times as wide as inner lobe, covered with thin setae. Maxilliped (Fig. 32E) palp with two distinct setae on proximal article; endite subrectangular, medial seta strong, surpassing distal margin, distal margin with inner tip and one triangular seta. Pereopods stout; pereopod 1-7 merus to propodus bearing sparse setae on sternal margin and apically cleft; pereopod 1 carpus with short transverse antennal grooming brush; dactylus of two claws, inner claw short, ungual and dactylar setae simple, not surpassing outer claw (Fig. 33B, C). Uropod (Fig. 33A) protopod subtriangular, filling gap between pleonite 5 and telson, endopod inserted proximally, and surpassing protopod. Pleopod 1 exopod (Fig. 33D) ovoid. Pleopod 2 exopod (Fig. 33E) subtriangular, medial margin serrate, distal margin slightly concave bearing two small setae. Pleopod 3 and 4 exopods (Fig. 33F, G) rectangular, medial margin truncated and serrate, distal margin straight bearing small setae. Pleopod 5 exopod (Fig. 33H) triangular, medial margin serrate, distal margin slightly convex bearing short setae.

REMARKS

The genus *Gabunillo* was erected by Schmalfuss & Ferrara (1983) to include the troglobitic species *G. coecus* from Grotte de Pahau and Grotte de N'Doumbou, Lastourville, Gabon. Souza *et al.* (2010) described a second species, *G. aridicola* Souza, Senna & Kury, 2010 from Gruta do Sobradinho cave, Aiuába, state of Ceará, Brazil.

In the SEM photographs of *G. aridicola* provided by Souza *et al.* (2010), it is possible to observe that the pereonite 1

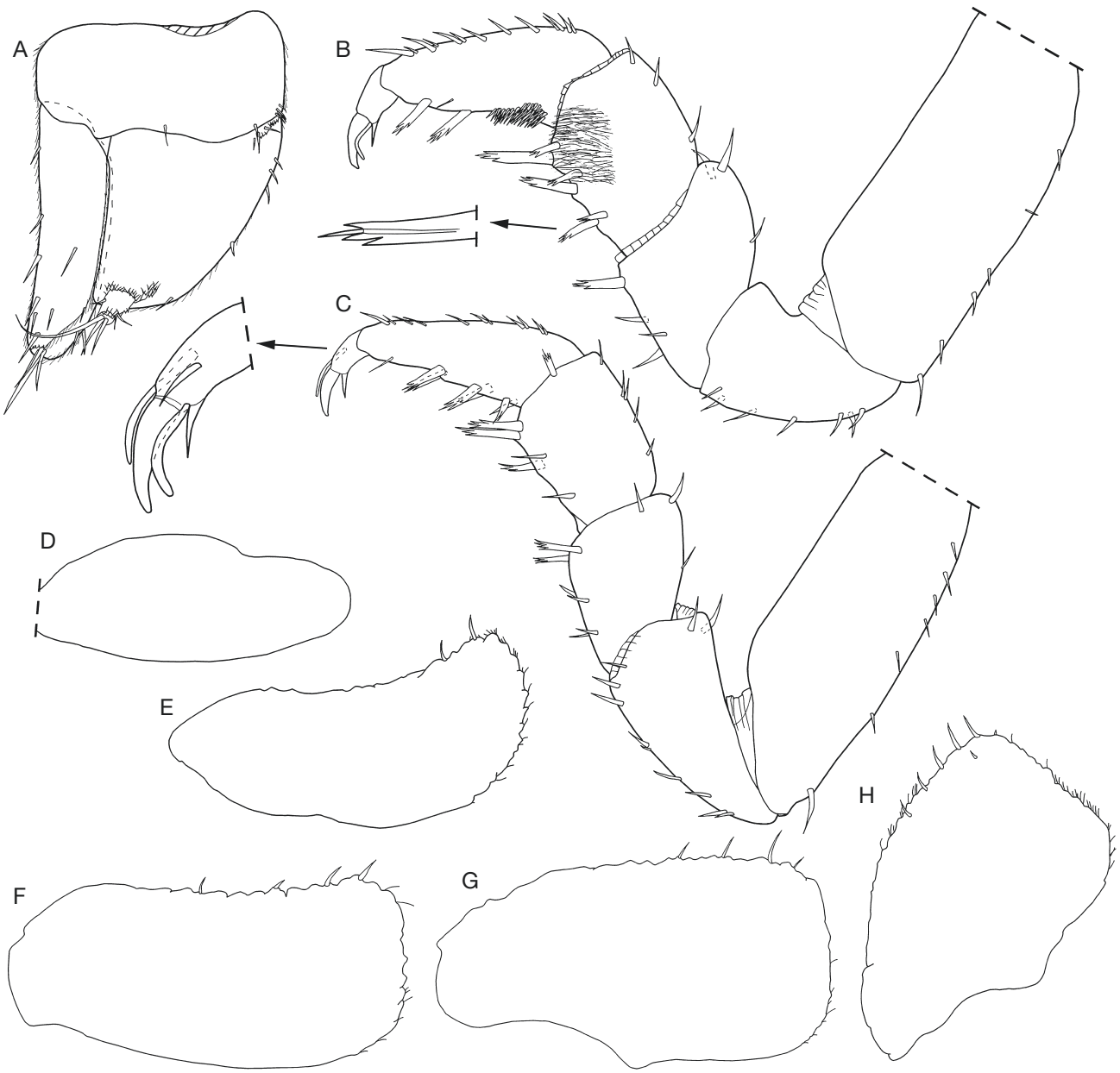

FIG. 33. — *Gabunillo enfurnado* Campos-Filho, Sfenthourakis & Bichuette, n. sp., female paratype, LES 6416: **A**, uropod; **B**, pereopod 1; **C**, pereopod 7; **D**, pleopod 1 exopod; **E**, pleopod 2 exopod; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

epimeron is grooved on its posterior corner and not developing along its lateral margin, the pereonite 1-3 epimera have ventral lobes, that are less developed on pereonites 2 and 3, the uropod protopod is trapezoidal with short exopod dorsally inserted, and the pleopod exopods have a lateral opening, typical of covered monospiracular pleopodal lungs (see also Paoli *et al.* 2002). Considering these characters, *G. aridicola* does not belong to *Gabunillo* but a reexamination of this species is necessary for its correct generic placement.

Gabunillo enfurnado Campos-Filho, Sfenthourakis & Bichuette, n. sp. is considered to be a troglobitic due to the absence of body pigments and eyes. The cave where the specimens were collected, Gruna do Enfurnado, lies in the Brazilian xeric region, namely Caatinga. This region is part of the Chacoan Domain (see Morrone *et al.* 2022).

Genus *Venezillo* Verhoeff, 1928

Venezillo Verhoeff, 1928b: 113.

TYPE SPECIES. — *Armadillo clausus* Budde-Lund, 1885, by monotypy (see Schmidt & Leistikow 2004).

DIAGNOSIS. — See Carpio-Díaz *et al.* (2018).

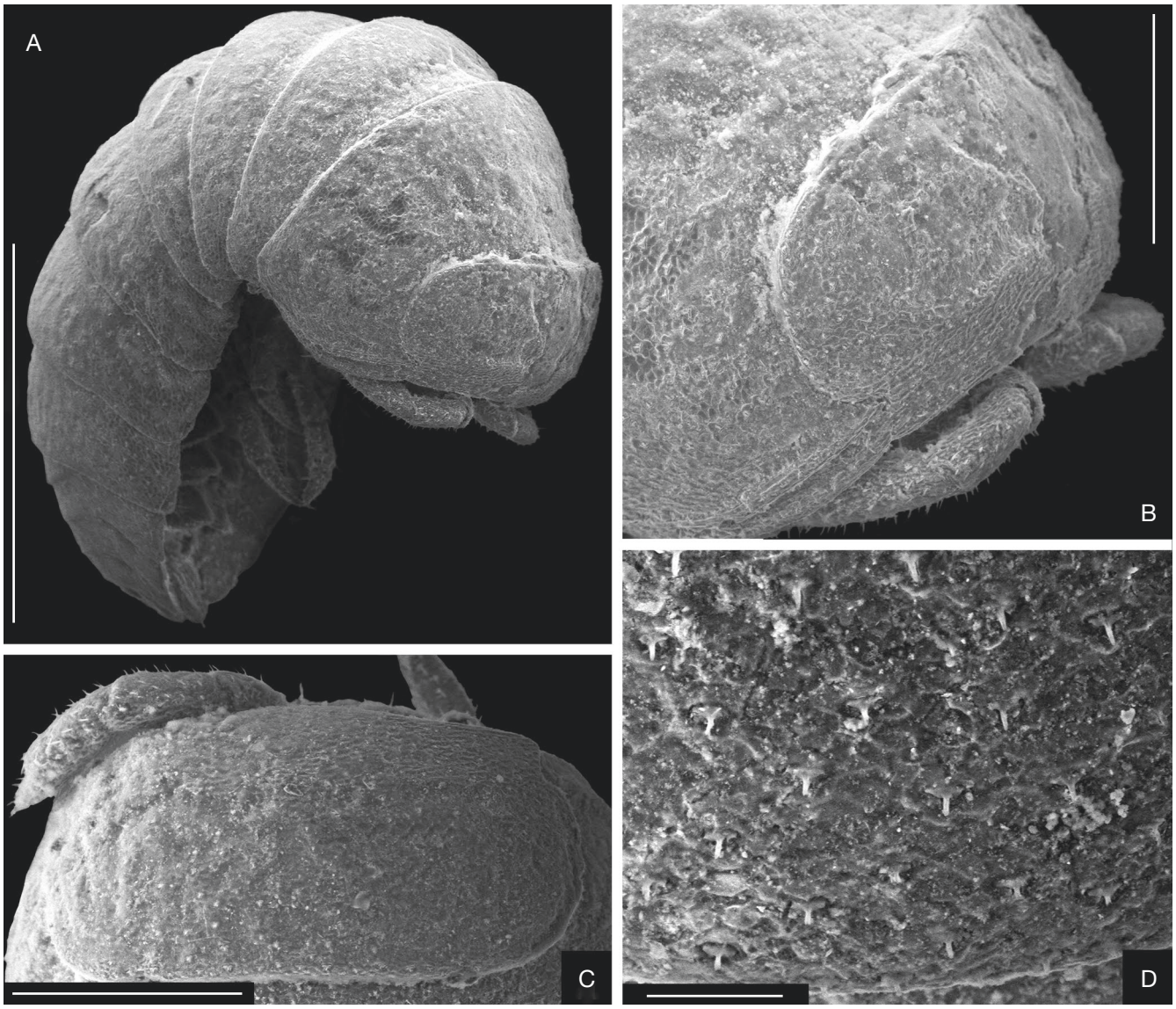

FIG. 34. — *Gabunillo enfurnado* Campos-Filho, Sfenthourakis & Bichuette, n. sp., SEM photographs: **A**, habitus, lateral-oblique view; **B**, pereonite 1 epimeron and cephalon; **C**, cephalon, dorsal view; **D**, dorsal cuticle. Scale bar: A, 500 µm; B, C, 300 µm; D, 50 µm.

Venezillo congener (Budde-Lund, 1904)
(Figs 4A; 49B)

Armadillo congener Budde-Lund, 1904: 108.

Venezillo congener – Campos-Filho *et al.* 2019: 438, figs 14-16, 17D.

MATERIAL EXAMINED. — **Brazil** • 1 ♂, 5 ♀, 1 juvenile; Lapa do Bezerra cave, São Domingos, state of Goiás; 13°32'50.6"S, 46°22'34.7"W; 610 m a.s.l.; 20.XI.2020; M. E. Bichuette, J. E. Gallão, J. S. Gallo, D. F. Torres, G. C. Rabello & V. F. Sperandei leg.; LES 28005.

DISTRIBUTION. — Species endemic to Brazil recorded from the states of Goiás and Mato Grosso do Sul (Campos-Filho *et al.* 2018a, 2019). It is considered a troglophile and has been recorded from several caves in São Domingos, state of Goiás (Campos-Filho *et al.* 2019).

Venezillo moreirai
Campos-Filho, Carpio-Díaz & Bichuette, n. sp.
(Figs 35-37; 49B)

urn:lsid:zoobank.org:act:61959E04-6D41-456D-A115-2419CF6912DE

TYPE MATERIAL. — **Holotype. Brazil** • ♂; Lapa do Bode cave, Ituaçu, state of Bahia; 13°50'10.14"S, 41°17'5.14"W; II.2019; M. E. Bichuette, D. F. Torres & J. E. Gallão leg.; LES 28006.
Paratypes. Brazil • 1 ♂ (parts in micropreparations), 2 ♀ (one with parts in micropreparations); same data as holotype; LES 28007.

ETYMOLOGY. — The new species is named *in memoriam* of the Brazilian musician Antônio Carlos Moraes Pires, also known as Moraes Moreira. The musician was born in the municipality of Ituaçu, and he was famous for his engagement with the Brazilian cultural movement "Novos Baianos", with compositions allusive to the culture of the country.

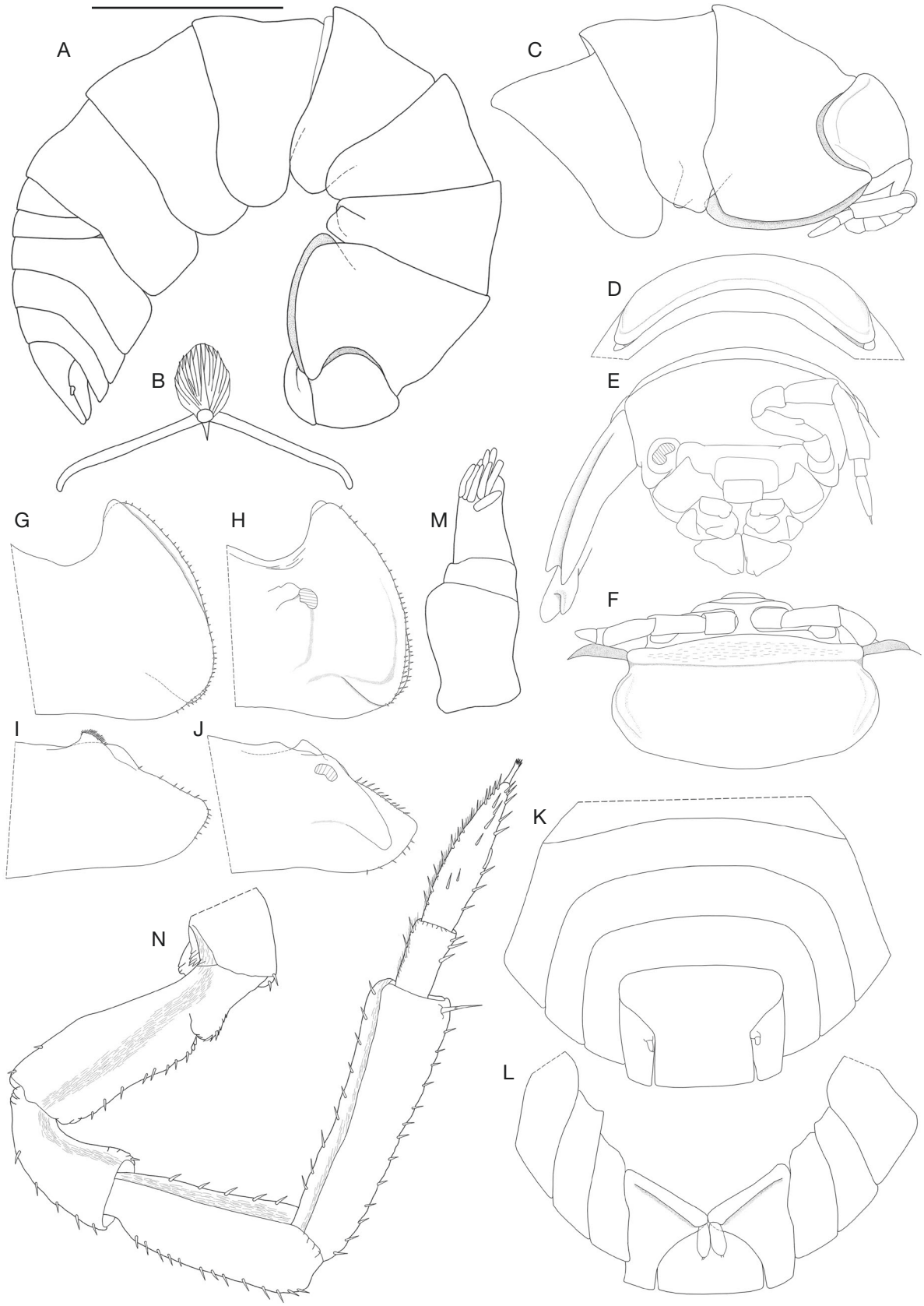

FIG. 35. — *Venezillo moreirai* Campos-Filho, Carpio-Díaz & Bichuette, n. sp., female paratype, LES 28007: **A**, lateral habitus; **B**, scale-seta; **C**, cephalon and pereonites 1-3, lateral view; **D**, cephalon, back view; **E**, cephalon and pereonites 1 and 2, frontal view; **F**, cephalon and pereonite 1 epimera, dorsal view; **G**, pereonite 1 epimeron, dorsal view; **H**, pereonite 1 epimeron, ventral view; **I**, pereonite 2 epimeron, dorsal view; **J**, pereonite 2 epimeron, ventral view; **K**, pleonites 3-5, telson, and uropods, dorsal view; **L**, pleonites 3-5 epimera, telson, and uropods, ventral view; **M**, antenulla; **N**, antenna. Scale bar: A, 1 mm.

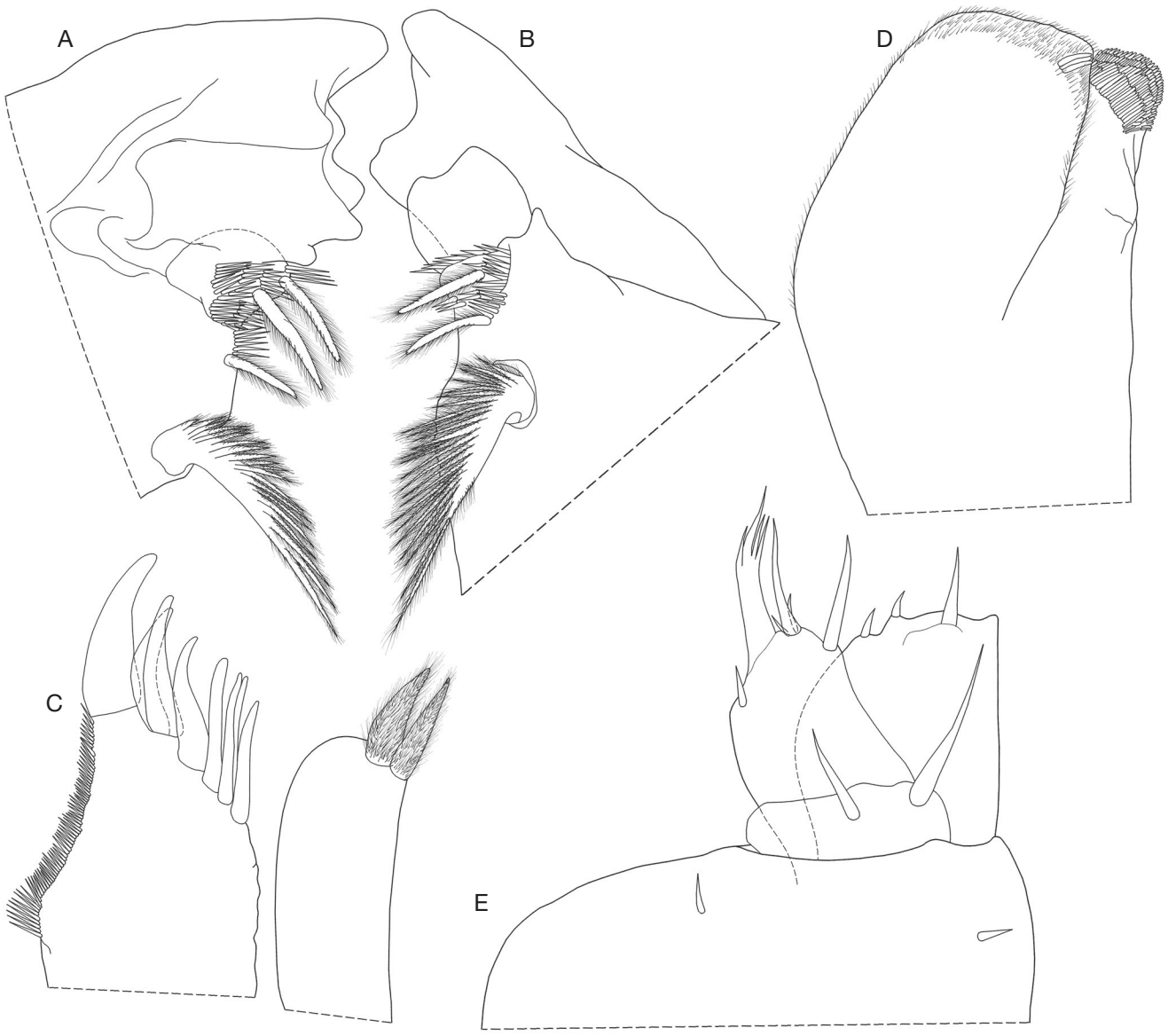

FIG. 36. — *Venezillo moreirai* Campos-Filho, Carpio-Díaz & Bichuette, n. sp., female paratype, LES 28007: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped.

DESCRIPTION

Maximum body length: ♂ 6.5 mm, ♀ 6 mm. Color faintly brown with typical muscle spots insertions; pereonite 1-7 epimera, pleon and proximal portions of telson and uropods more pigmented. Body in lateral view as in Figure 35A. Dorsal surface smooth with fan-shaped semicircular scale-setae (Fig. 35B). One line of small *noduli laterales* per side, inserted near posterior margins. Cephalon (Fig. 35C-F) with rectangular frontal shield, slightly bent backwards and not protruding above vertex, suprantennal line absent; eyes absent, only dots of pigments present. Pereonite 1 epimera rounded, anterior corner directed frontwards, schisma on posterior corners, inner and outer lobes of schisma rounded, ventral lobe shorter than dorsal lobe, lateral margin grooved throughout entire length; pereonite 2 epimera with ventral lobe obliquely directed outwards, not surpassing outer margin of epimeron; pereonite 3 epimera rounded, pereonite 4-7 epimera subquadrangular (Fig. 35A, G-J). Pleonite 3-5 epimera subrectangular, well developed; telson hourglass-shaped, proximal part slightly wider than distal one, distal margin straight (Fig. 35K, L). Antennula (Fig. 35M) of three articles, proximal and distal articles subequal in length, distal article with about nine aesthetascs. Antenna (Fig. 35N) short and stout, distal article of peduncle longer than flagellum; flagellum of two articles, distal article three times as long as proximal one, bearing two lateral aesthetascs; apical organ short bearing two sensilla. Mandibles with molar penicil semidichotomized, left mandible (Fig. 36A) with 2+1 penicils, and right mandible (Fig. 36B) with 1+1 penicils. Maxillula (Fig. 36C) inner endite with two penicils, distal margin rounded; outer endite of 4+4 teeth, all simple. Maxilla (Fig. 36D) inner lobe rounded covered with thick setae; outer lobe twice as wide as inner lobe, rounded and covered with

FIG. 37. — *Venezillo moreirai* Campos-Filho, Carpio-Díaz & Bichuette, n. sp., **A**, **B**, female paratype, LES 28007: (**A**) uropod, frontal view; (**B**) uropod; **C**-**J**, male paratype, LES 28007: pereopod 1 (**C**); pereopod 7 (**D**); genital papilla (**E**); pleopod 1 exopod (**F**); pleopod 2 exopod (**G**); pleopod 3 exopod (**H**); pleopod 4 exopod (**I**); pleopod 5 exopod (**J**).

thin setae. Maxilliped (Fig. 36E) basis subrectangular; proximal article of palp with two long setae; endite subquadrangular, medial seta surpassing distal margin, outer margin rounded, distal margin bearing two short triangular setae. Pereopod 1 carpus with transverse antennal grooming brush; dactylus with inner claw reaching median portion of outer claw, dactylar and ungual setae simple, not surpassing outer claw. Uropod (Fig. 37A, B) protopod subrectangular, flattened, inner margin concave, endopod inserted proximally, exopod short, inserted dorsally on slight protuberance. Pleopod exopods with monospiracular covered lungs.

Male

Pereopods (Fig. 37C, D) without particular modifications; pereopod 7 ischium with sternal margin straight. Genital papilla (Fig. 37E) with slender and triangular ventral shield, two subapical orifices. Pleopod 1 (Fig. 37F) exopod triangular, wider than long, medial margin rounded, outer margin straight with one short seta; endopod three times as long as exopod, distal portion slightly directed outwards and bearing short setae. Pleopod 2 (Fig. 37G) exopod triangular, outer margin distinctly concave bearing many short setae; endopod flagelliform, longer than exopod. Pleopod 3-5 exopods as in Figure 37H-J.

Remarks

The genus *Venezillo* comprises 136 species widely distributed in the tropics (Boyko *et al.* 2008; Schmalfuss 2003). The genus is mainly characterized by the conglobation ability, one line of *noduli laterales* per side, large frontal shield of the cephalon, pereonite 1 with a schisma, pereonite 2 with a triangular ventral lobe, telson hourglass-shaped, and pleopod exopods with monospiracular covered lungs (see Arcangeli 1957; Carpio-Díaz *et al.* 2018). As mentioned previously, *Venezillo* has many species dubiously assigned to it (see Schmalfuss 2003), and many descriptions were based on generic characteristics, not allowing comparisons. The genus needs a full revision to clarify its taxonomy.

To date, only one species of the genus, *V. congener*, is known from Brazil (see Campos-Filho *et al.* 2018a, 2019).

Venezillo moreirai Campos-Filho, Carpio-Díaz & Bichuette, n. sp. is distinguished from *V. congener* in the absence of ommatidia (vs eyes composed of 18 ommatidia in *V. congener*), pereonite 1 epimera with ventral lobe of schisma shorter than outer lobe (vs subequal in *V. congener*), pereonite 2 epimera with ventral lobe concave on posterior margin and distally rounded (vs straight posterior margin and triangular in *V. congener*), pereonite 3 epimera without ventral lobe or notch (vs present in *V. congener*), and male pleopod 1 exopod with outer margin straight (vs sinuous in *V. congener*) (see Campos-Filho *et al.* 2019).

Based on the faint pigmentation and the absence of eyes, the species is considered to be a troglobite. As for *Gabunillo enfurnado* Campos-Filho, Sfenthourakis & Bichuette, n. sp. too, the locality where the specimens of *V. moreirai* Campos-Filho, Carpio-Díaz & Bichuette, n. sp. were collected lies within the Brazilian xeric region of Caatinga, Chacoan subregion (Morrone *et al.* 2022).

Venezillo garimpeiro

Campos-Filho, Borja-Arrieta & Bichuette, n. sp.

(Figs 38-40; 49B)

urn:lsid:zoobank.org:act:06791B62-09E8-4A3F-BD26-C4E8F327A96F

Type material. — **Holotype. Brazil** • ♂ (parts in micropreparations); Gruta do Lapão cave, Lençois, Chapada Diamantina, state of Bahia; 12°32'25.30"S, 41°24'9.75"W; 17.II.2020; M. E. Bichuette, D. F. Torres, G. C. Rabello & J. E. Gallão leg.; LES 28008. **Paratypes. Brazil** • 2 ♀ (one with parts in micropreparations); same data as holotype; LES 28009.

Etymology. — The new species name refers to the people who work in the "garimpo". In Brazil, the term garimpo means the place where gold or diamonds are extracted in alluvial lands or breaking gravel, and the people working there are popularly called "garimpeiros".

Description

Maximum body length: ♂ 7.5 mm, ♀ 7 mm. Color brown with typical muscle spot insertions. Body in lateral view as in Figure 38A. Dorsal surface smooth with semicircular scale-setae (Fig. 38B). One line of small *noduli laterales* per side, inserted near posterior margins. Cephalon (Fig. 38C-G) with rectangular frontal shield, slight bent backwards and slightly protruding above vertex, suprantennal line absent; eyes with 11 ommatidia. Pereonite 1 epimera with rounded lateral margin, anterior corner directed frontwards, schisma on posterior corners, inner and outer lobes of schisma rounded, ventral lobe shorter than dorsal lobe, lateral margin grooved about half of its length; pereonite 2 epimera with ventral lobe obliquely directed outwards, not surpassing outer margin; pereonite 3-7 epimera subquadrangular (Fig. 38A, D, H-K). Pleonite 3-5 epimera subrectangular, well developed; telson hourglass-shaped, proximal part slightly wider than distal one, distal margin straight (Fig. 38L, M). Antennula (Fig. 38N) of three articles, proximal and distal articles subequal in length, distal article bearing about eight aesthetascs at apex. Antenna (Fig. 38O) short and stout, distal article of peduncle longer than flagellum; flagellum of two articles, distal article three times as long as proximal one, bearing two lateral aesthetascs; apical organ short bearing two sensilla. Mandibles with molar penicil semidichotomized, left mandible (Fig. 39A) with 2+1 penicils, and right mandible (Fig. 39B) with 1+1 penicils. Maxillula (Fig. 39C) inner endite with two penicils, distal margin rounded; outer endite of 4+6 teeth, all simple. Maxilla (Fig. 39D) inner lobe rounded covered with thick setae; outer lobe twice as wide as inner lobe, rounded and covered with thin setae. Maxilliped (Fig. 39E) basis subrectangular; proximal article of palp with two setae distinct in length; endite subquadrangular, medial seta surpassing distal margin, outer margin rounded, distal margin bearing two short triangular setae. Pereopod 1 carpus with transverse antennal grooming brush; dactylus with inner claw reaching median portion of outer claw, dactylar and ungual setae simple, not surpassing outer claw. Uropod (Fig. 38L, M) protopod subrectangular, flattened, inner margin concave, endopod inserted proximally, exopod short, inserted dorsally on slight protuberance. Pleopod exopods with monospiracular covered lungs.

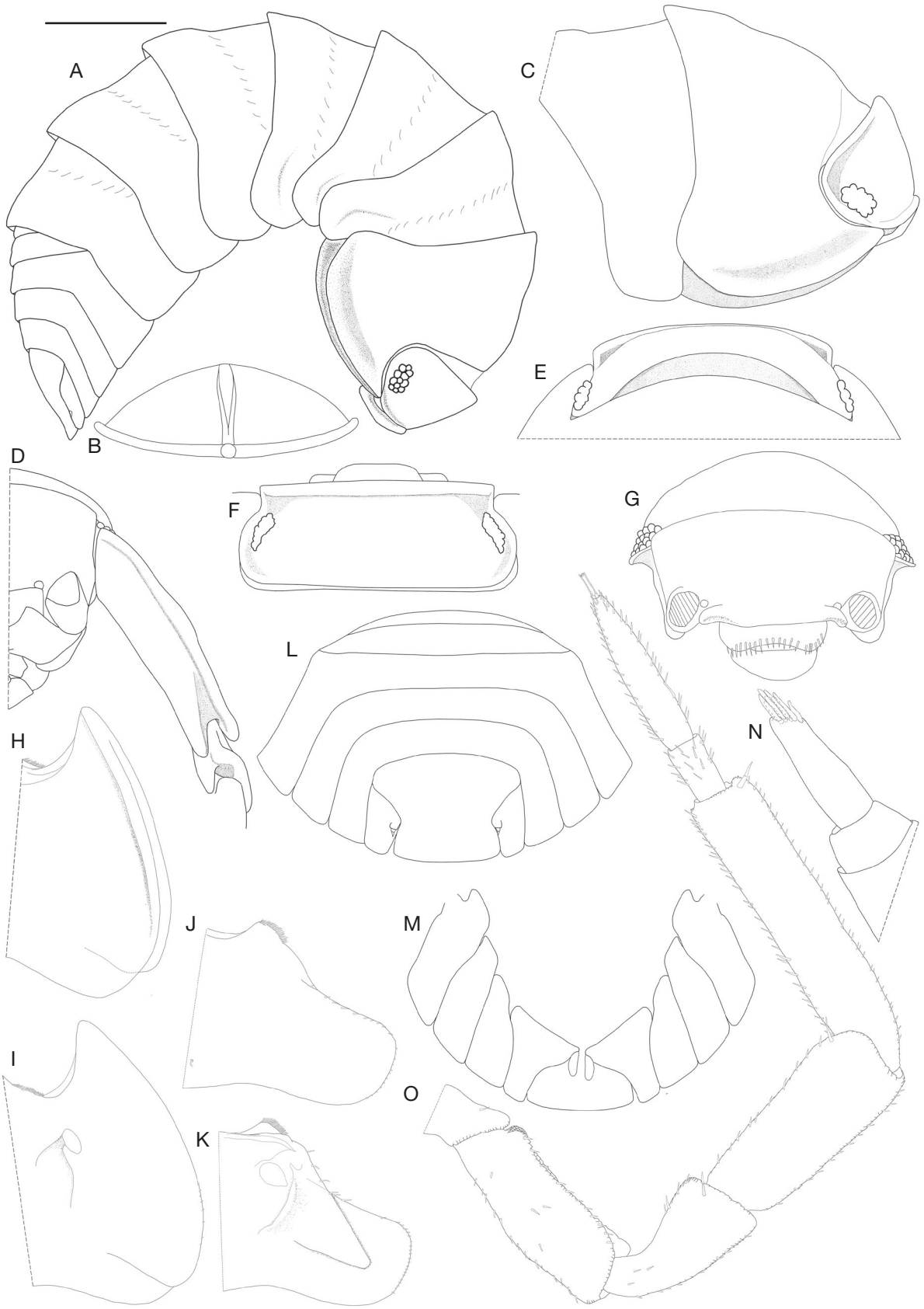

Fig. 38. — *Venezillo garimpeiro* Campos-Filho, Borja-Arrieta & Bichuette, n. sp., female paratype, LES 28009: **A**, lateral habitus; **B**, scale-seta; **C**, cephalon and pereonites 1 and 2, lateral view; **D**, cephalon and pereonites 1 and 2, frontal view; **E**, cephalon and pereonite 1, back view; **F**, cephalon, dorsal view; **G**, cephalon, frontal view; **H**, pereonite 1 epimeron, dorsal view; **I**, pereonite 1 epimeron, ventral view; **J**, pereonite 2 epimeron, dorsal view; **K**, pereonite 2 epimeron, ventral view; **L**, pleon, telson, and uropods, dorsal view; **M**, pleonite 3-5 epimera, telson, and uropods, ventral view; **N**, antennula; **O**, antenna. Scale bar: A, 1 mm.

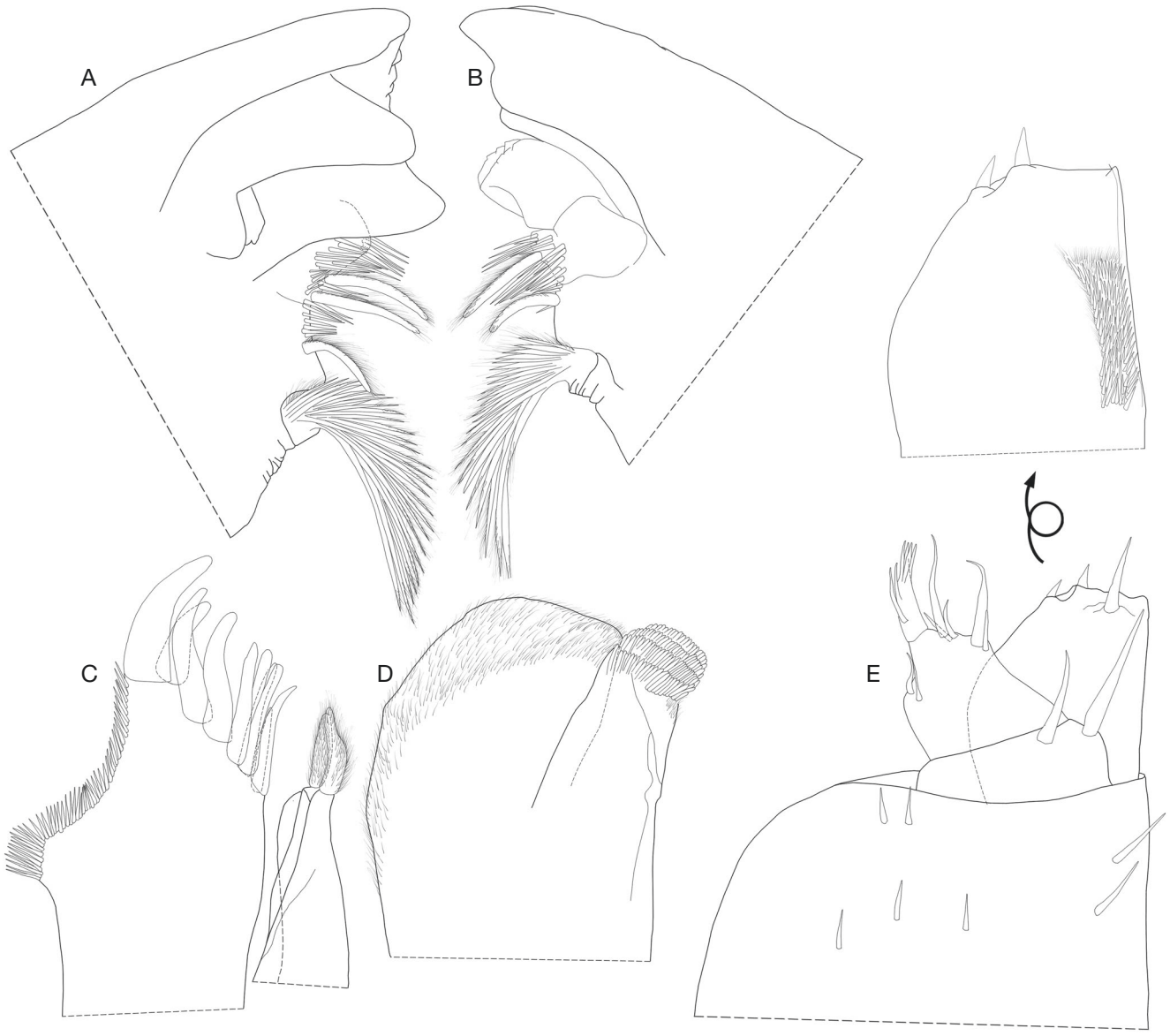

Fig. 39. — *Venezillo garimpeiro* Campos-Filho, Borja-Arrieta & Bichuette, n. sp., female paratype, LES 28009: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped.

Male

Pereopods (Fig. 40A, B) without particular modifications; pereopod 7 ischium with sternal margin straight. Genital papilla (Fig. 40C) with slender and triangular ventral shield, two subapical orifices. Pleopod 1 (Fig. 40D) exopod triangular, as wide as long, medial margin rounded, outer margin slightly concave, medial and outer margins bearing many short setae; endopod twice as long as exopod, distal portion slightly directed outwards and bearing short setae, subapically slightly inflated. Pleopod 2 (Fig. 40E) exopod triangular, outer margin distinctly concave bearing many setae; endopod flagelliform, longer than exopod. Pleopod 3-5 exopods as in Figure 40F-H.

Remarks

The new species is among the Neotropical representatives of *Venezillo* with a smooth dorsal surface, and is comparable with those having 10-13 ommatidia, namely *V. colomboi* (Arcangeli, 1929) (12 ommatidia) and *V. sanchezi* (Boone, 1934) (13 ommatidia) from Cuba, *V. nevadensis* (Mulaik, 1960) (13 ommatidia) from Mexico, and *V. zigzag* (Dollfus, 1896) (12 ommatidia) from Caribbean islands (see Van Name 1936; Mulaik 1960). Moreover, *V. garimpeiro* Campos-Filho, Borja-Arrieta & Bichuette, n. sp. differs in having the pereonite 1 epimera grooved for about half of their length (vs one quarter in *V. colomboi* and *V. nevadensis*, in all length in *V. sanchezi* and *V. zigzag*), pereonite 1 epimera with ventral lobe of schisma not surpassing dorsal lobe (vs surpassing in *V. nevadensis*), male pereopod 7 basis without distal sternal lobe covered with thin setae (vs present in *V. colomboi*), and male pleopod 1 exopod as wide as long (vs twice as wide as long in *V. colomboi*) (see Arcangeli 1929; Van Name 1936; Mulaik 1960).

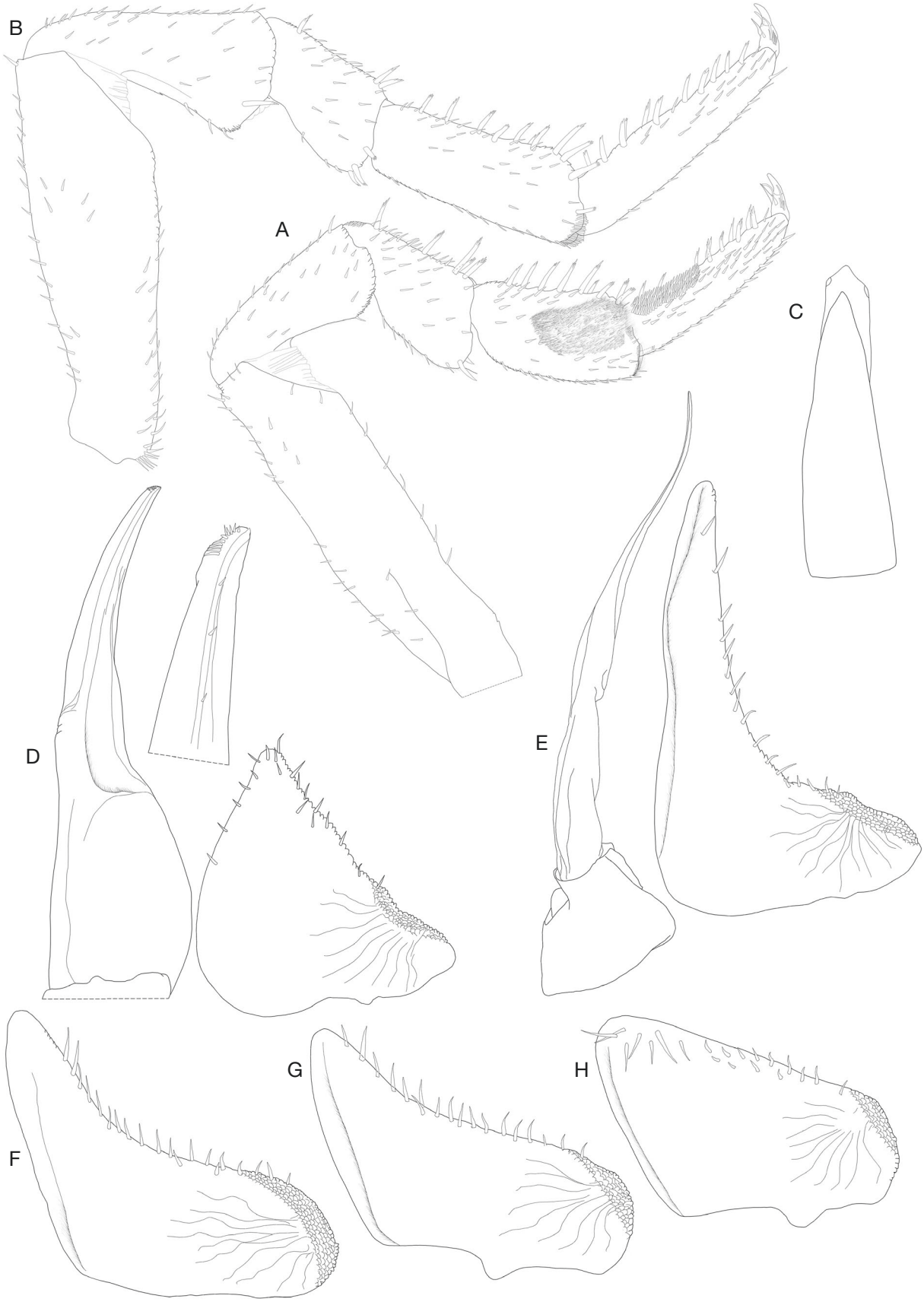

Fig. 40. — *Venezillo garimpeiro* Campos-Filho, Borja-Arrieta & Bichuette, n. sp., male holotype, LES 28008: **A**, pereopod 1; **B**, pereopod 7; **C**, genital papilla; **D**, pleopod 1 exopod; **E**, pleopod 2 exopod; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

This species is considered to be a troglophile due to the absence of troglomorphic characters. The locality where the specimens were collected is located in the high plateau ranges in the central-southern region of the state of Bahia, exhibiting a mosaic of Caatinga and Atlantic Forest domains (Morrone *et al.* 2022).

Venezillo dioi Campos-Filho, Araujo & Taiti, n. sp. (Figs 41-43; 49B)

urn:lsid:zoobank.org:act:498666A4-9867-465B-AEDB-49D0DC77C399

TYPE MATERIAL. — **Holotype. Brazil** • ♂ (parts in micropreparations); Gruna Bem Bom cave, Carinhanha, state of Bahia; 13°35'03.3"S, 43°57'51.2"W, 692 m a.s.l.; 28.XI.2015; M. E. Bichuette & J. E. Gallão leg.; LES 28010.

ETYMOLOGY. — The new species is named after Diocleciano Pereira Pinto Neto, also known as Dió, who assures the preservation of the Gruna Bem Bom cave.

DESCRIPTION

Body length: 5 mm. Color brown with typical muscle spot insertions. Body in lateral view as in Figure 41A. Cephalon and pereonite 1 with low bosses, pereonites 2-7 and pleon smooth; dorsal surface bearing semicircular scale-setae (Fig. 41B). One line of small *noduli laterales* per side, inserted near posterior margins (Fig. 41A). Cephalon (Fig. 41C-F) with rectangular frontal shield slightly protruding above eyes in frontal view, slightly bent backwards above vertex, not protruding above vertex, suprantennal line absent; eyes with about 15 ommatidia. Pereonite 1 epimera with rounded lateral margins, anterior corner directed frontwards, schisma on posterior corners, ventral and dorsal lobes of schisma rounded, ventral lobe slightly shorter than outer lobe, lateral margin grooved for entire length; pereonite 2 epimera with ventral lobe obliquely directed outwards, not surpassing outer margin of epimeron; pereonite 2-4 epimera with rounded lateral margin, 5-7 subquadrangular (Fig. 41A, G-J). Pleonite 3-5 epimera subrectangular, well developed; telson hour-glass shaped, proximal part wider than distal one, distal margin straight (Fig. 41K, L). Antennula (Fig. 41M) of three articles, proximal and distal articles similar in length, distal article bearing about six aesthetascs. Antenna (Fig. 41N) short and stout, distal article of peduncle longer than flagellum; flagellum of two articles, distal article about twice as long as proximal one, bearing two lateral aesthetascs; apical organ short bearing two sensilla. Mandibles with molar penicil semidichotomized, left mandible (Fig. 42A) with 2+1 penicils, and right mandible (Fig. 42B) with 1+1 penicils. Maxillula (Fig. 42C) inner endite with two transverse penicils, distal margin rounded; outer endite of 4+6 teeth, all simple, accessory tooth on outer set. Maxilla (Fig. 42D) inner lobe rounded covered with thick setae; outer lobe about twice as wide as inner lobe, rounded and covered with thin setae. Maxilliped (Fig. 42E) basis subrectangular; proximal article of palp with two setae distinct in length; endite subquadrangular, medial seta surpassing distal margin, outer margin rounded, distal margin bearing two short triangular setae. Uropod (Fig. 43A) protopod subrectangular, flattened, inner margin concave, endopod inserted proximally, exopod short, inserted dorsally on slight protuberance. Pereopod 1 (Fig. 43B) carpus with transverse antennal grooming brush; pereopod 7 (Fig. 43C) ischium with sternal margin straight; dactylus with inner claw reaching median portion of outer claw, dactylar and ungual setae simple, not surpassing outer claw. Genital papilla (Fig. 43D) with slender and triangular ventral shield, two subapical orifices. Pleopod exopods with monospiracular covered lungs. Pleopod 1 (Fig. 43E) exopod triangular, about twice as wide as long, medial margin rounded, outer margin sinuous, distal margin triangular; endopod three times as long as exopod, distal portion slightly bent outwards and bearing short setae. Pleopod 2 (Fig. 43F) exopod triangular, outer margin distinctly concave bearing few short setae; endopod flagelliform, longer than exopod. Pleopod 3-5 exopods as in Figure 43G-I.

REMARKS

Within the Neotropical *Venezillo*, only four species have eyes composed of 15 ommatidia, namely *V. galapagoensis* (Miers, 1877) from the Galápagos Islands (Ecuador), *V. jamaicensis* (Richardson, 1912) from Jamaica, *V. osorioi* (Mulaik, 1960) from Mexico, and *V. ramsdeni* (Boone, 1934) from Cuba. *Venezillo dioi* Campos-Filho, Araujo & Taiti, n. sp. differs in having the cephalon and pereonite 1 with low bosses (vs entire surface tuberculated in *V. galapagoensis* and *V. jamaicensis*, entire surface smooth in *V. osorioi* and *V. ramsdeni*), and pereonite 1 epimera grooved on entire length (vs half length in *V. galapagoensisi* and *V. jamaicensis*, one quarter of length in *V. osorioi* and *V. ramsdeni*) (see Van Name 1936).

The cave where the specimens were collected is located in the Brazilian xeric region of Caatinga (Morrone *et al.* 2022). This species is considered to be a troglophile due to the absence of troglomorphic characteristics.

Venezillo limai Campos-Filho, Carpio-Díaz & López-Orozco, n. sp. (Figs 44; 45; 49B)

urn:lsid:zoobank.org:act:046BDF22-196C-44EB-B6BA-4FDC40AB6842

TYPE MATERIAL. — **Holotype. Brazil** • 1 ♀ (parts in micropreparations); Lapa Doce cave system, Chapada Diamantina, state of Bahia; 12°20'3.8"S, 41°36'15.67"W; 701 m a.s.l.; 30.X.2016; M. E. Bichuette, J. E. Gallão & M. J. Rosendo leg.; LES 28011.

ETYMOLOGY. — The new species is named *in memoriam* of Simpliciano de Oliveira Lima Filho, also known as Sr Lima (Sr in Portuguese means mister). Mister Lima was a great discoverer of several caves in the Chapada Diamantina region, and founder of the Bahia Society of Speleology (SBAE) (in Portuguese, Sociedade Bahiana de Espeleologia). To date, he is considered a reference among speleologists all over the country, and a great protector of caves in the state of Bahia.

DESCRIPTION

Body length: 4 mm. Body pigments absent. Body in lateral view as in Figure 44A. Dorsal surface smooth bearing semicircular scale-setae (Fig. 44B). One line of small *noduli laterales* per side, inserted near posterior margins (Fig. 44A).

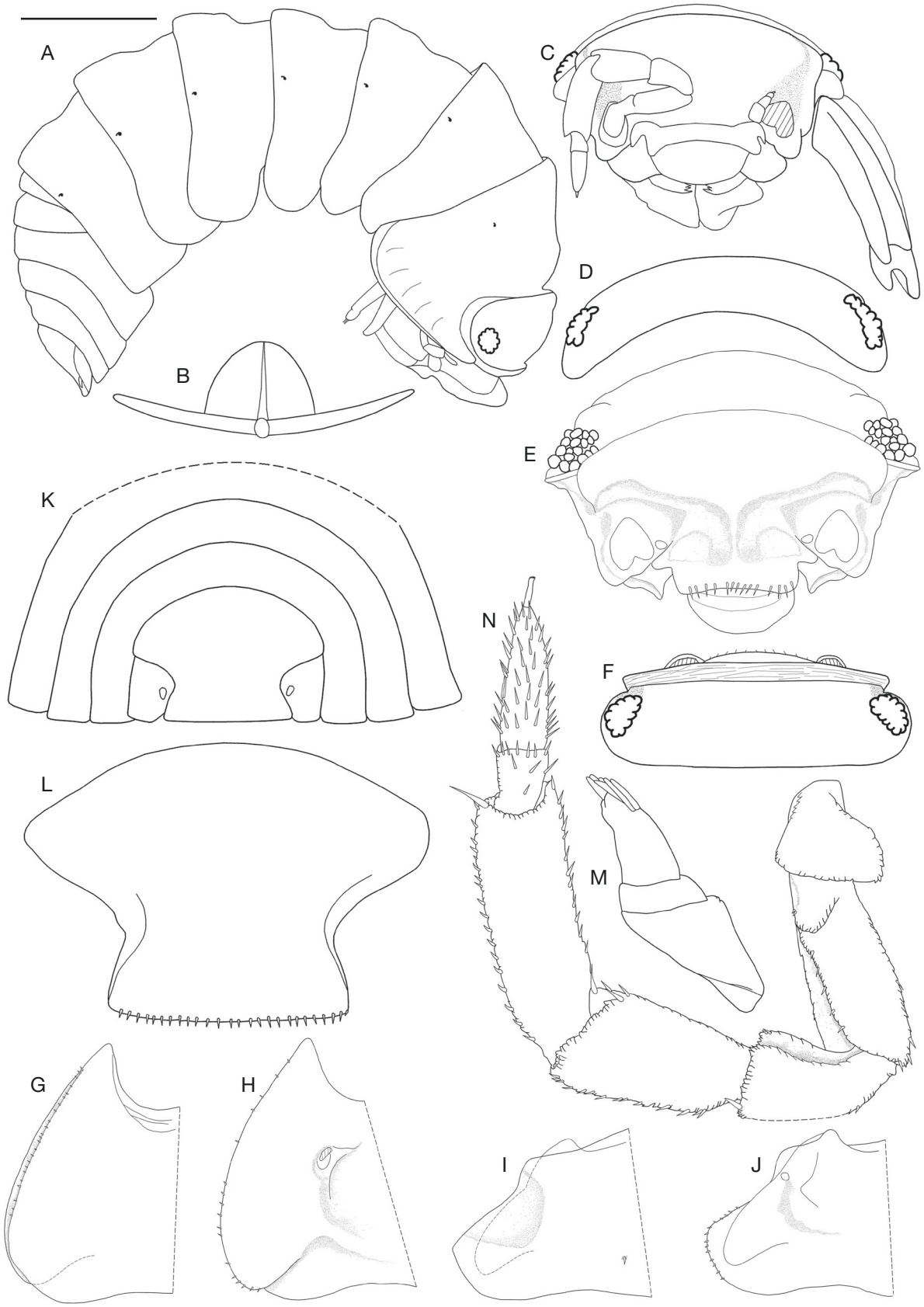

FIG. 41. — *Venezillo dioi* Campos-Filho, Araujo & Taiti, n. sp., male holotype, LES 28010: **A**, lateral habitus; **B**, scale-seta; **C**, cephalon and pereonites 1 and 2, frontal view; **D**, cephalon, back view; **E**, cephalon, frontal view; **F**, cephalon, dorsal view; **G**, pereonite 1 epimeron, dorsal view; **H**, pereonite 1 epimeron, ventral view; **I**, pereonite 2 epimeron, dorsal view; **J**, pereonite 2 epimeron, ventral view; **K**, pleonites 3-5, telson, and uropods, dorsal view; **L**, telson; **M**, antennula; **N**, antenna. Scale bar: A, 1 mm.

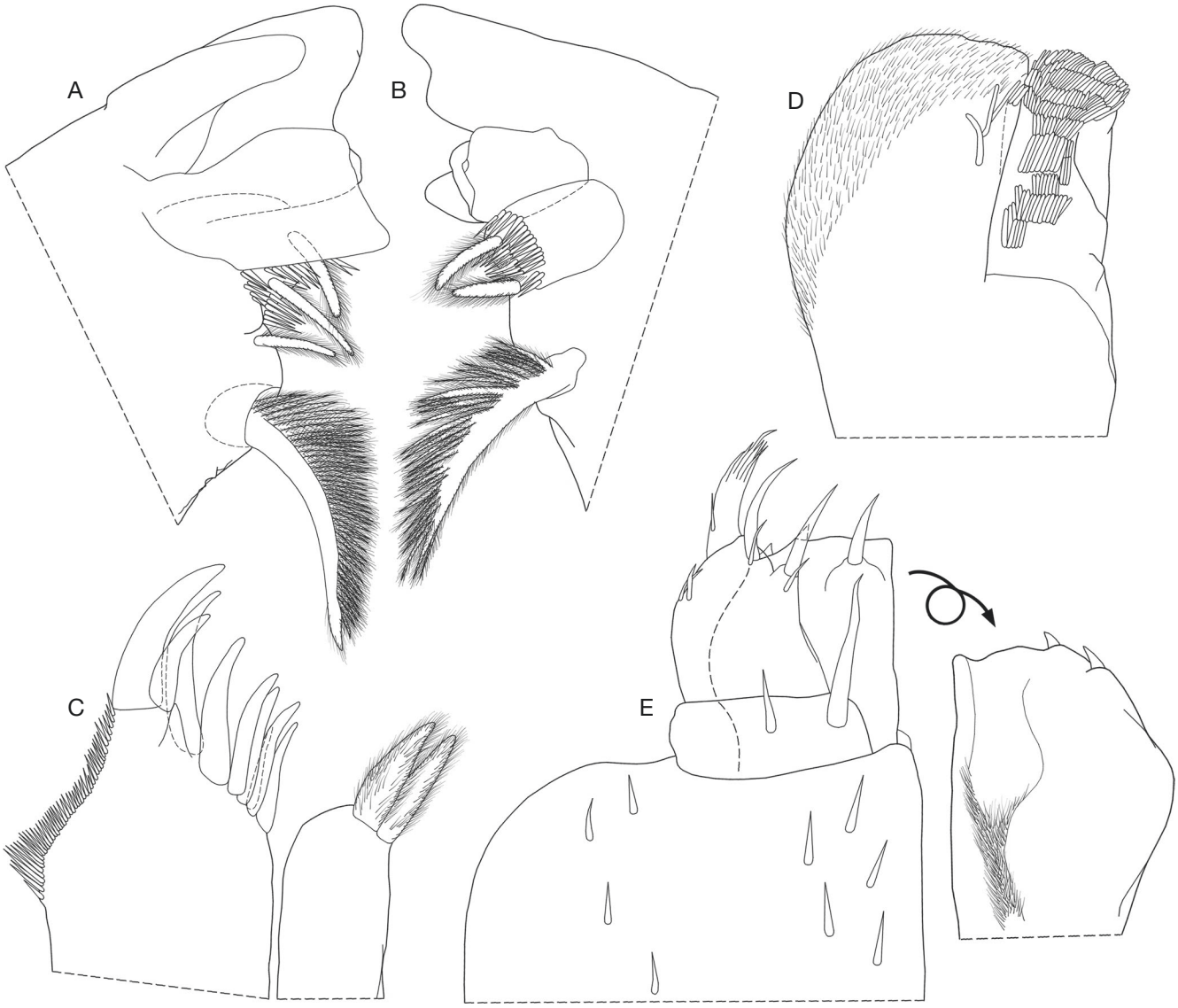

Fig. 42. — *Venezillo dioi* Campos-Filho, Araujo & Taiti, n. sp., male holotype, LES 28010: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped.

Cephalon (Fig. 44A, C) with rectangular frontal shield, slightly bent backwards and not protruding above vertex, suprantennal line absent; eyes absent, few dots of pigments visible on eyes position. Pereonite 1 epimera with rounded lateral margin, anterior corner directed frontwards, schisma on posterior corners, ventral and dorsal lobes of schisma rounded and subequal, lateral margins grooved for entire length; pereonite 2 epimera with ventral lobe obliquely directed outwards, posterior margin concave, not surpassing outer margin of epimeron; pereonite 2 epimera rectangular, 3-7 subquadrangular (Fig. 44A, D-G). Pleonites 3-5 epimera subrectangular, well developed; telson hourglass-shaped, proximal part wider than distal one, distal margin straight (Fig. 44H). Antennula (Fig. 44I) of three articles, proximal article longest, distal article bearing about six aesthetascs. Antenna (Fig. 44J) short and stout, distal article of peduncle longer than flagellum; flagellum of two articles, distal article about twice as long as proximal one, bearing four lateral aesthetascs; apical organ short bearing two sensilla. Mandibles with molar penicil semidichotomized, left mandible (Fig. 44K) with 2+1 penicils, and right mandible (Fig. 44L) with 1+1 penicils. Maxillula (Fig. 44M) inner endite with two penicils, distal margin rounded; outer endite of 4+5 teeth, all simple. Maxilla (Fig. 44N) inner lobe rounded covered with thick setae; outer lobe about three times as wide as inner lobe, rounded and covered with thin setae. Maxilliped (Fig. 44O) basis subrectangular; proximal article of palp with two setae distinct in length; endite subquadrangular, medial seta surpassing distal margin, outer margin rounded, distal margin bearing two short triangular setae. Uropod (Fig. 45A) protopod subrectangular, flattened, inner margin concave, endopod inserted proximally, exopod short, inserted dorsally on small protuberance. Pereopods 1-7 stout bearing sparse strong setae on sternal margin; pereopod 1 (Fig. 45B) carpus with

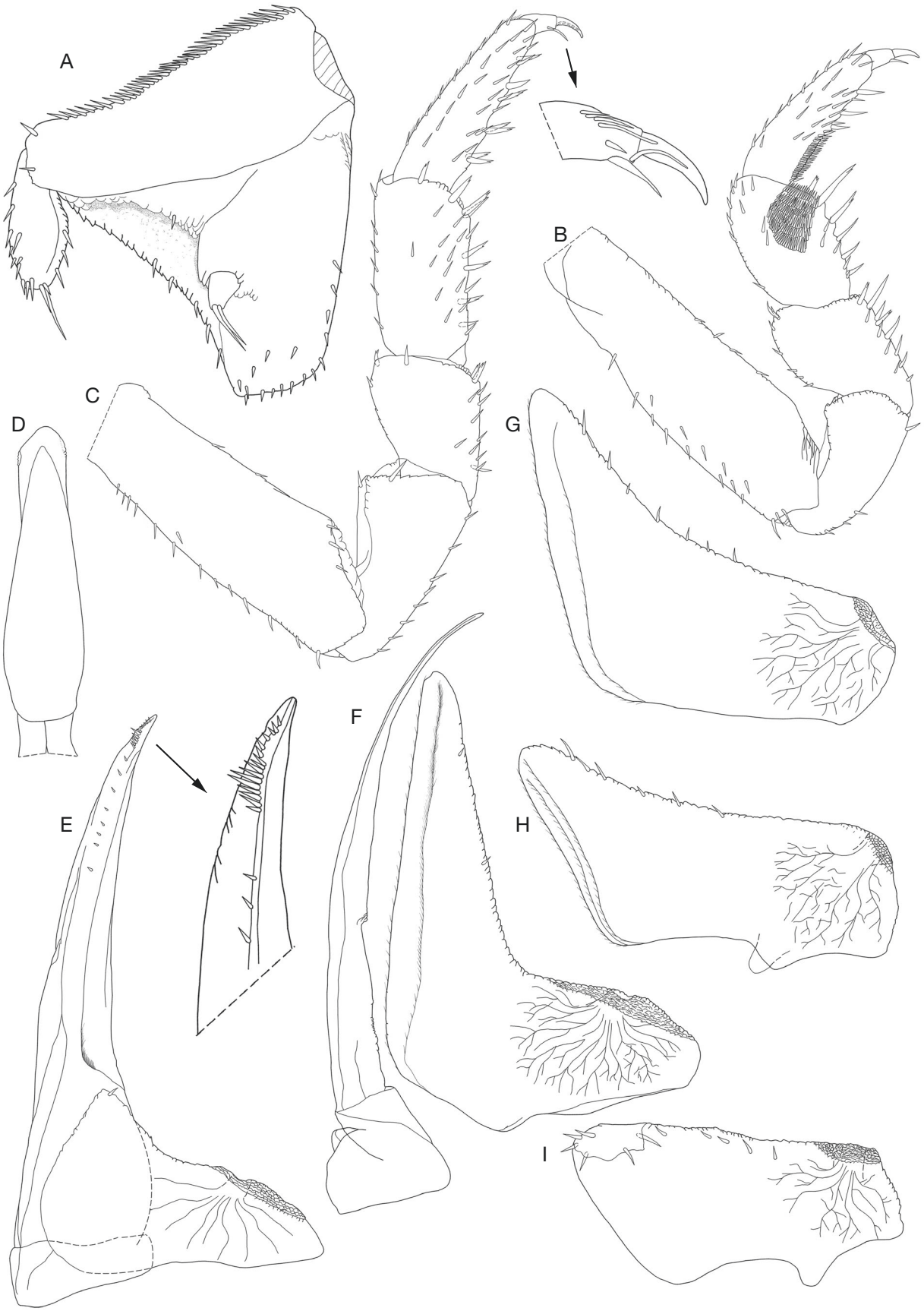

Fig. 43. — *Venezillo dioi* Campos-Filho, Araujo & Taiti, n. sp., male holotype, LES 28010: **A**, uropod; **B**, pereopod 1; **C**, pereopod 7; **D**, genital papilla; **E**, pleopod 1; **F**, pleopod 2; **G**, pleopod 3 exopod; **H**, pleopod 4 exopod; **I**, pleopod 5 exopod.

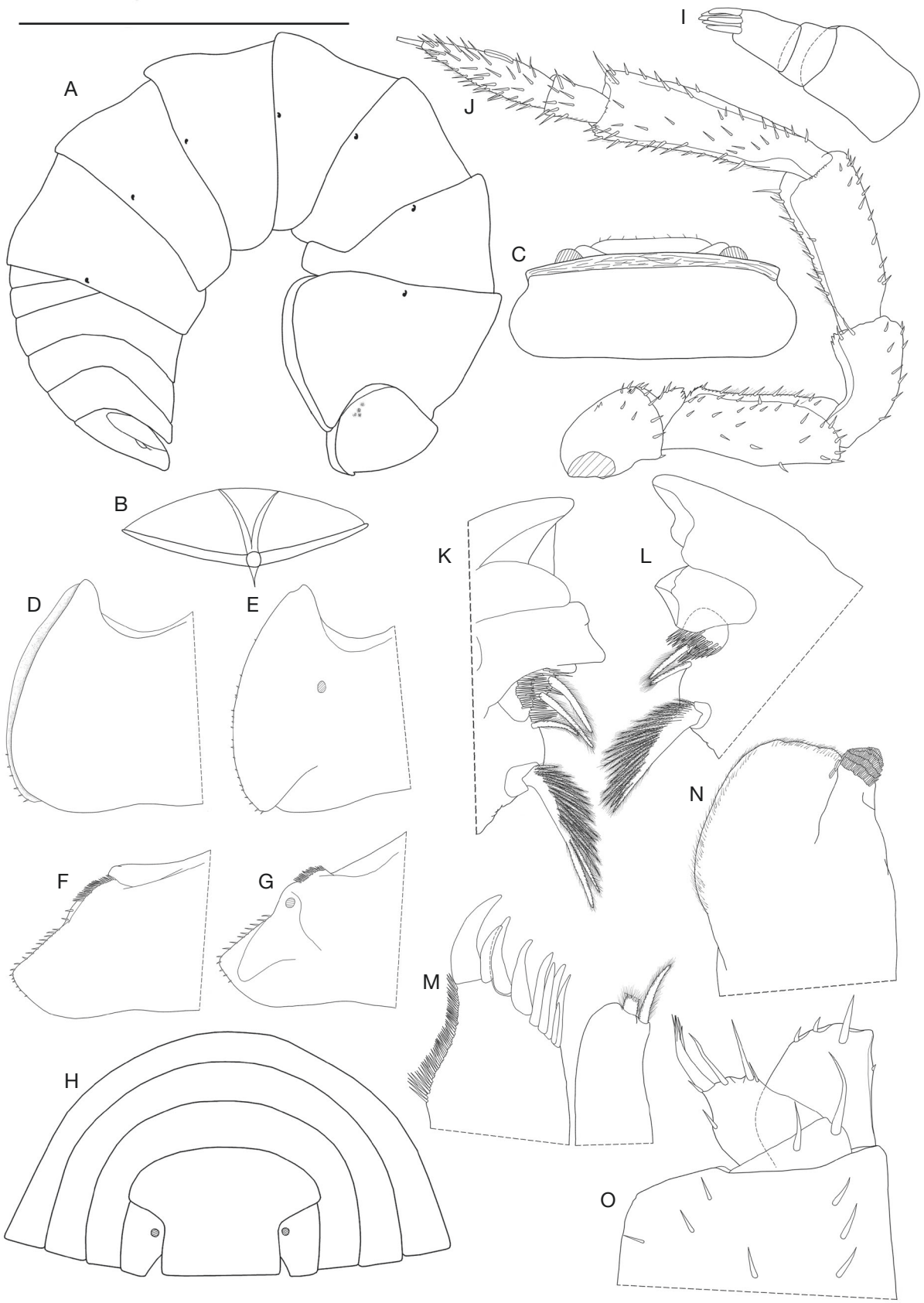

Fig. 44. — *Venezillo limai* Campos-Filho, Carpio-Díaz & López-Orozco, n. sp., female holotype, LES 28011: **A**, lateral habitus; **B**, scale-seta; **C**, cephalon, dorsal view; **D**, pereonite 1 epimeron, dorsal view; **E**, pereonite 1 epimeron, ventral view; **F**, pereonite 2 epimeron, dorsal view; **G**, pereonite 2 epimeron, ventral view; **H**, pleonites 3-5, telson, and uropods, dorsal view; **I**, antennula; **J**, antenna; **K**, left mandible; **L**, right mandible; **M**, maxillula; **N**, maxilla; **O**, maxilliped. Scale bar: A, 1 mm.

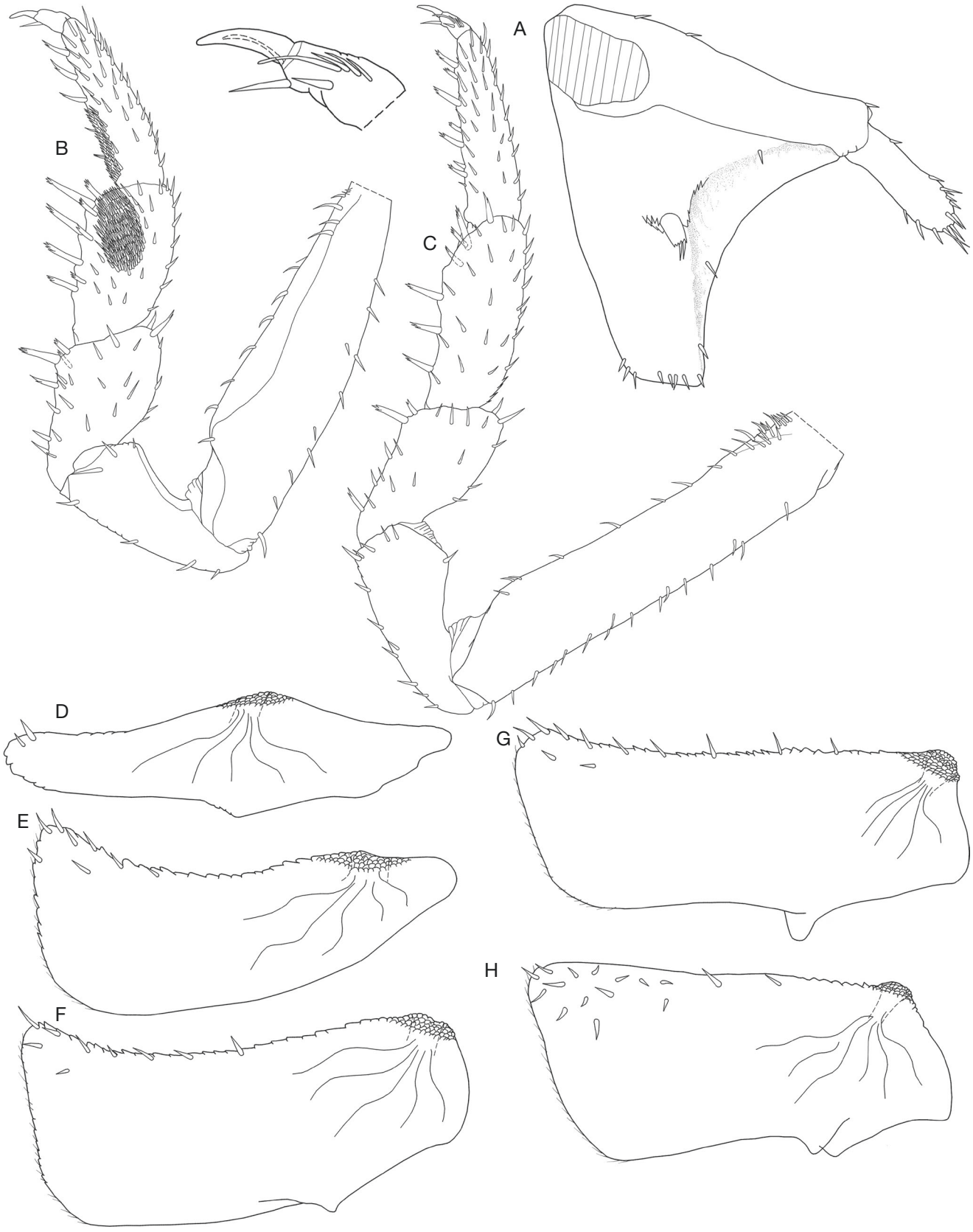

Fig. 45. — *Venezillo limai* Campos-Filho, Carpio-Díaz & López-Orozco, n. sp., female holotype, LES 28011: **A**, uropod; **B**, pereopod 1; **C**, pereopod 7; **D**, pleopod 1 exopod; **E**, pleopod 2 exopod; **F**, pleopod 3 exopod; **G**, pleopod 4 exopod; **H**, pleopod 5 exopod.

transverse antennal grooming brush; pereopod 7 (Fig. 45C) ischium with sternal margin straight; dactylus with inner claw reaching median portion of outer claw, dactylar and ungual setae simple, not surpassing outer claw. Pleopod exopods with monospiracular covered lungs (Fig. 45D-H).

Remarks

In the absence of ommatidia, *V. limai* Campos-Filho, Carpio-Díaz & López-Orozco, n. sp. is similar to *V. moreirai* Campos-Filho, Carpio-Díaz & Bichuette, n. sp.; however, it differs in the shape of the dorsal scale-setae, pereonite 1 epimera with lobes of the schisma subequal, pereonite 2 epimera rectangular. Moreover, the caves where both species were collected are geographically distant from each other (see Fig. 48).

Due to the absence of pigments and eyes, *V. limai* Campos-Filho, Carpio-Díaz & López-Orozco, n. sp. is considered to be a troglobite. Lapa Doce cave is placed into the Brazilian xeric region of Caatinga, Chacoan domain (Morrone *et al.* 2022).

Venezillo muriloi
Campos-Filho, Sfenthourakis & Taiti, n. sp.
(Figs 46-48; 49B)

urn:lsid:zoobank.org:act:16DEE86C-274A-4ECD-BAE3-52CECDC7942C

Type material. — **Holotype. Brazil** • ♂ (parts in micropreparations); Gruna do Govi cave, Feira da Mata, state of Bahia; 13°56'43.3"S, 44°14'26"W; 682 m a.s.l.; 12.X.2020; M. E. Bichuette, D. F. Torres, J. S. Gallo, L. S. Horta & J. E. Gallão leg.; LES 28048.

Etymology. — The new species is named after Murilo de Andrade Valle, a Brazilian speleologist of the Grupo Bambuí de Pesquisas Espeleológicas (GBPE), for his contribution to the knowledge of speleology and dedication to the conservation of the Brazilian subterranean habitats.

Description

Body length: 5,5 mm. Color brown with typical muscle spot insertions. Body in lateral view as in Figure 46A. Cephalon, pereon, and telson tuberculated, arranged as follow (Fig. 46B): cephalon with 14 tubercles, pereonite 1 with 24 tubercles, pereonites 2 with 18 tubercles, pereonites 3-6 with 16 tubercles, pereonite 7 with 14 tubercles, and telson with two tubercles. Dorsal surface bearing semicircular scale-setae (Fig. 46C). One line of small *noduli laterales* per side, inserted on lateral side of second tubercle from lateral margin (Fig. 46D, F). Cephalon (Fig. 46I-M) with rectangular frontal shield strongly protruding above vertex, upper portion slightly bent backwards, suprantennal line absent; eyes with about 20 ommatidia. Pereonite 1 epimera with rounded lateral margin, anterior corner directed frontwards, schisma on posterior corners, ventral and dorsal lobes of schisma rounded, ventral lobe shorter than dorsal lobe, lateral margin grooved for one quarter of length; pereonite 2 epimera with ventral lobe obliquely directed outwards, not surpassing outer margin of epimeron; pereonite 3-7 with ventral sulcus gradually increasing; pereonite 2-7 epimera subrectangular, pereonites 6 and 7 epimera with low sulcus on ventral side (Fig. 46A, D-H, J). Pleonite 3-5 epimera subrectangular, well developed; telson hourglass-shaped, proximal part wider than distal one, distal margin straight (Fig. 46N, O). Antennula (Fig. 46P) of three articles, proximal and distal articles similar in length, distal article bearing about five aesthetascs. Antenna (Fig. 46Q) short and stout, distal article of peduncle longer than flagellum; flagellum of two articles, distal article about four times as long as proximal one, bearing two lateral aesthetascs; apical organ short bearing two sensilla. Mandibles with molar penicil semidichotomized, left mandible (Fig. 47A) with 2+1 penicils, and right mandible (Fig. 47B) with 1+1 penicils. Maxillula (Fig. 47C) inner endite with two penicils, distal margin rounded bearing lateral tip; outer endite of 4+6 teeth, all simple. Maxilla (Fig. 47D) inner lobe rounded, covered with thick setae; outer lobe about three times as wide as inner lobe, rounded and covered with thin setae. Maxilliped (Fig. 47E) basis subrectangular; proximal article of palp with two setae distinct in length; endite subquadrangular, medial seta surpassing distal margin, outer margin rounded, distal margin bearing two short triangular setae. Uropod (Fig. 46N) protopod subrectangular, flattened, inner margin concave, endopod inserted proximally, exopod short, inserted dorsally on small protuberance. Pereopod 1 (Fig. 48A) carpus with transverse antennal grooming brush; pereopod 7 (Fig. 48B) ischium with sternal margin straight; dactylus with inner claw reaching median portion of outer claw, dactylar and ungual setae simple, not surpassing outer claw. Genital papilla (Fig. 48C) with slender and triangular ventral shield, two subapical orifices. Pleopod exopods with monospiracular covered lungs. Pleopod 1 (Fig. 48D) exopod triangular, about twice as wide as long, medial margin rounded, outer margin straight bearing one short seta; endopod more than three times as long as exopod, distal portion slightly bent outwards and bearing short setae. Pleopod 2 (Fig. 48E) exopod triangular, outer margin distinctly concave bearing few short setae; endopod flagelliform, longer than exopod. Pleopod 3-5 exopods as in Figure 48F-H.

Remarks

In having a tuberculated dorsal surface *Venezillo muriloi* Campos-Filho, Sfenthourakis & Taiti, n. sp. is similar to many other species of the genus, i.e., *V. aguayoi* (Boone, 1934) from Cuba, *V. bellavistanus* Schultz, 1995 from Paraguay, *V. boneti* (Mulaik, 1960), *V. llamasi* Rioja, 1954, *V. macrosoma* (Mulaik, 1960), *V. pleogoniophorus* (Rioja, 1951), *V. soyatlanensis* (Mulaik, 1960), *V. sylvicola* (Mulaik, 1960), and *V. walkeri* (Pearse, 1911) from Mexico, *V. culebrae* (Van Name, 1936), *V. perlatus* (Dollfus, 1896), and *V. silvarum* (Dollfus, 1896) from Caribbean and Virgin Islands, *V. galapagoensis* (Miers, 1877) from the Galápagos Islands (Ecuador), *V. jamaicensis* (Richardson, 1912) from Jamaica, *V. multipunctatus* (Budde-Lund, 1885), *V. rubropunctatus* (Budde-Lund, 1893), *V. scaberrimus* (Dollfus, 1893), and *V. truncorum* (Budde-Lund,

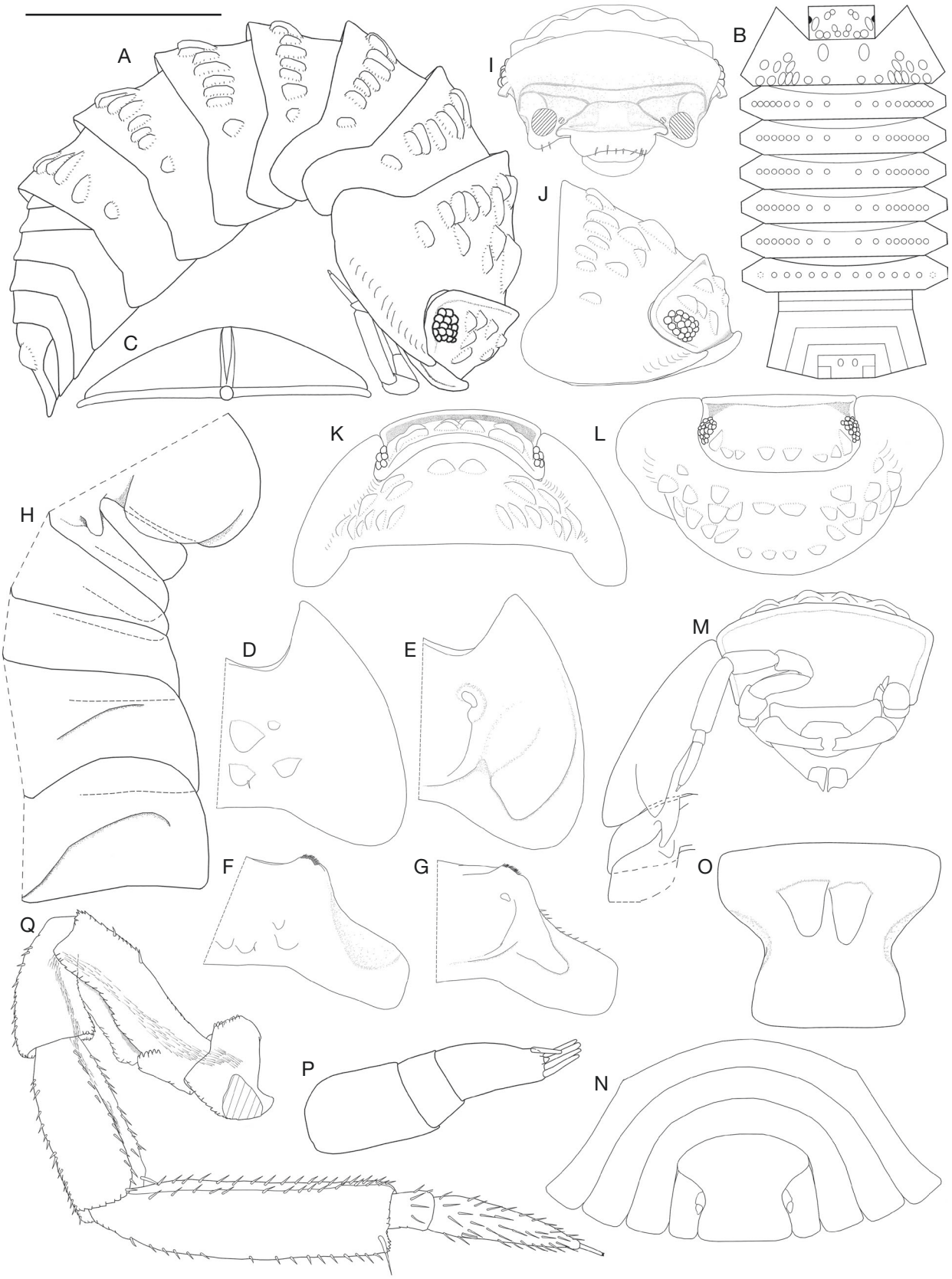

FIG. 46. — *Venezillo muriloi* Campos-Filho, Sfenthourakis & Taiti, n. sp., male holotype, LES 28048: **A**, lateral habitus; **B**, tubercles schem; **C**, scale-seta; **D**, pereonite 1 epimeron, dorsal view; **E**, pereonite 1 epimeron, ventral view; **F**, pereonite 2 epimeron, dorsal view; **G**, pereonite 2 epimeron, ventral view; **H**, pereonite 1-7 epimera, ventral view; **I**, cephalon, frontal view; **J**, cephalon and pereonite 1, lateral view; **K**, cephalon and pereonite 1, back view; **L**, cephalon and pereonite, dorsal view; **M**, cephalon and pereonites 1-3, frontal view; **N**, pleonites 3-5, telson, and uropods, dorsal view; **O**, telson; **P**, antennula; **Q**, antenna. Scale bar: A, 1 mm.

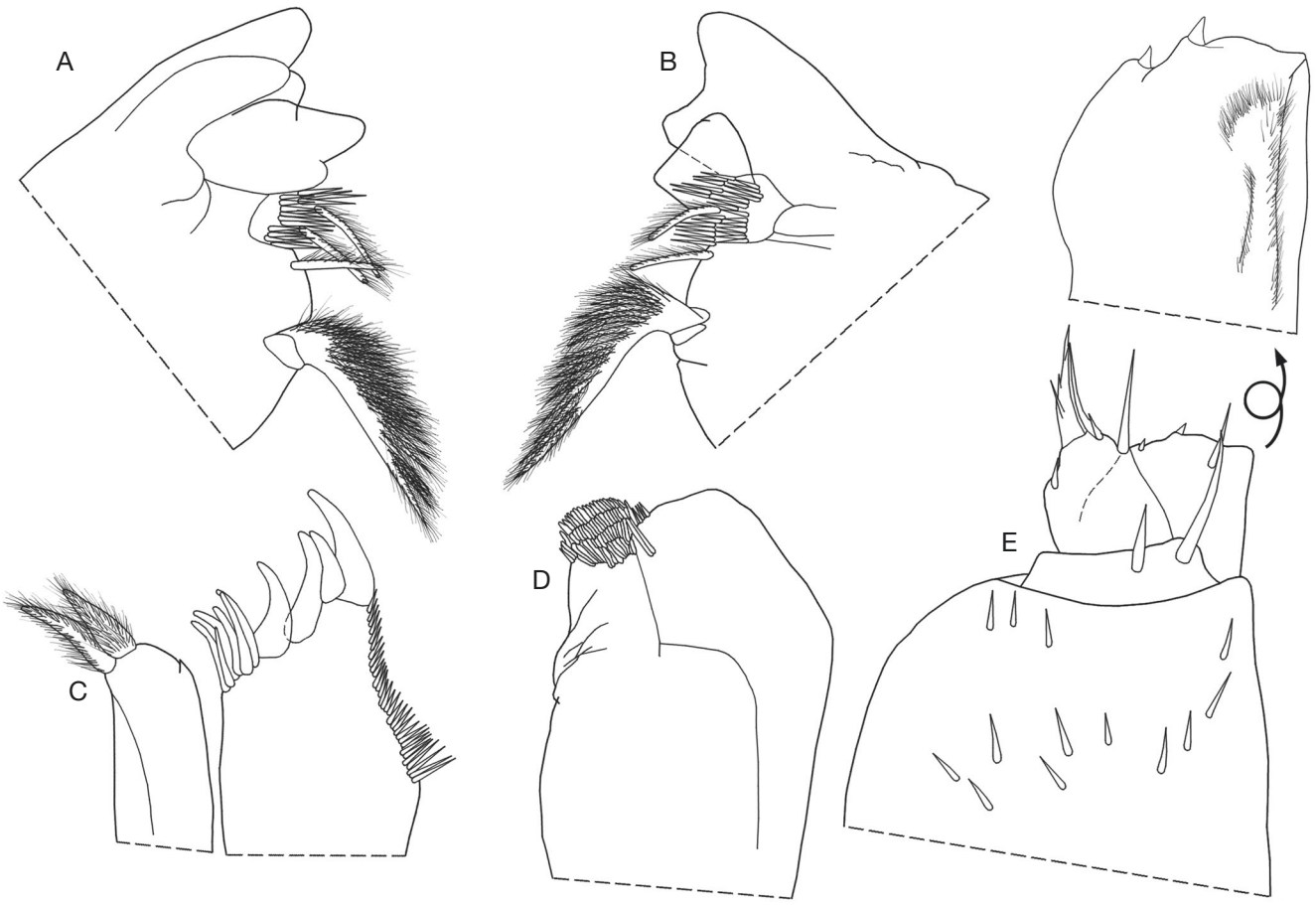

FIG. 47. — *Venezillo muriloi* Campos-Filho, Sfenthourakis & Taiti, n. sp., male holotype, LES 28048: **A**, left mandible; **B**, right mandible; **C**, maxillula; **D**, maxilla; **E**, maxilliped.

1893) from Venezuela, *V. phylax* (Van Name, 1936) from Hispaniola, *V. verrucosus* (Budde-Lund, 1904) from Ecuador, and *V. vincentis* (Budde-Lund, 1904) from Caribbean islands and Colombia. It differs in having a smooth pleon and a telson bearing two tubercles (vs pleon and telson smooth in *V. aguayoi*, *V. bellavistanus*, *V. jamaicensis*, *V. llamasi*, *V. macrosoma*, *V. silvarum*, *V. truncorum*, *V. vincentis*, and *V. walkeri*; pleon smooth with telson bearing one tubercle in *V. sylvicola;* pleonite 3-5 epimera bearing one tubercle plus three tubercles on telson in *V. galapagoensis*; pleon and telson tuberculated in *V. boneti*, *V. culebrae*, *V. multipunctatus*, *V. perlatus*, *V. phylax*, *V. pleogoniophorus*, *V. soyatlanensis*, and *V. verrucosus*), cephalon with frontal shield distinctly protruding upwards (vs slightly protruding in *V. macrosoma*; not protruding in *V. sylvicola*), eyes composed of about 20 ommatidia (vs 4-5 in *V. boneti*; 12 in *V. soyatlanensis*; 14 in *V. bellavistanus* and *V. macrosoma*; 15 in *V. galapagoensis* and *V. jamaicensis*; 12-14 in *V. llamasi*; 16 in *V. rubropunctatus*, *V. phylax*, *V. truncorum*, *V. verrucosus*, and *V. walkeri;* 8-9 in *V. pleogoniophorus*; 17 in *V. sylvicola* and *V. multipunctatus*), pereonite 1 epimeron with lateral groove for one quarter of its length (vs about one third of its length in *V. culebrae*, *V. macrosoma*, *V. soyatlanensis*, and *V. truncorum*; about half of its length in *V. galapagoensis* and *V. jamaicensis*; almost all of its length in *V. bellavistanus*; entirely grooved in *V. aguayoi*, *V. boneti*, *V. llamasi*, *V. multipunctatus*, *V. phylax*, *V. pleogoniophorus*, *V. scaberrimus*, *V. silvarum*, and *V. walkeri*), and pereonite 2 epimeron with ventral lobe subtriangular (vs subquadrangular in *V. llamasi*) (see Van Name 1936; Rioja 1951, 1954; Mulaik 1960; Schultz 1995).

However, regarding the above-mentioned species with dorsal tubercles, schisma on pereonite 1 epimera, and hourglass shape of telson, it is worth mentioning that *V. boneti*, *V. multipunctatus*, *V. perlatus*, *V. pleogoniophorus*, *V. scaberrimus*, and *V. soyatlanensis*, are probably mistakenly assigned to the genus (see Van Name 1936; Mulaik 1960). These species seem to belong to other Armadillidae genera, but an examination of the type material of these taxa is needed to clarify their taxonomy.

The cave where the specimens of *V. muriloi* Campos-Filho, Sfenthourakis & Taiti, n. sp. were collected is located in the Brazilian xeric region of Caatinga (Morrone *et al.* 2022). This species is considered to be a troglophile due to the absence of troglomorphic characteristics. Probably the species moves inside caves to exploit resources and favourable micro-habitat conditions therein (Fernandes *et al.* 2016, 2019).

FIG. 48. — *Venezillo muriloi* Campos-Filho, Sfenthourakis & Taiti, n. sp., male holotype, LES 28048: **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.

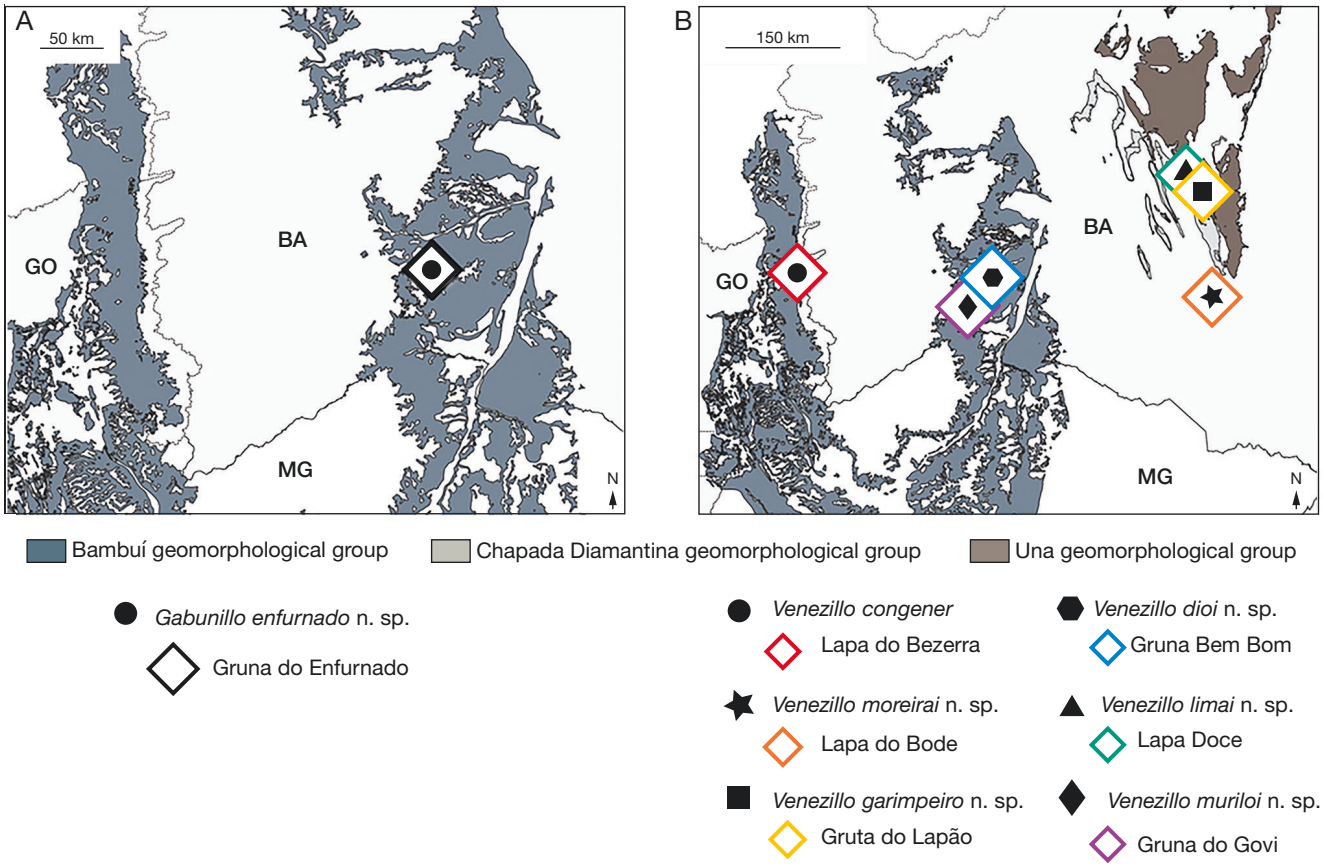

FIG. 50. — Distribution map of the Armadillidae representatives: **A**, *Gabunillo enfurnado* Campos-Filho, Sfenthourakis & Bichuette, n. sp.; **B**, new taxa of *Venezillo* Verhoeff, 1928. Abbreviations of states: **BA**, Bahia; **GO**, Goias; **MG**, Minas Gerais.

Family PORCELLIONIDAE Brandt, 1831

Genus *Porcellionides* Miers, 1877

TYPE SPECIES. — *Porcellio* (*Porcellionides*) *jelskii* Miers, 1877, by subsequent designation (Schmalfuss & Ferrara 1978) (= *Porcellio pruinosus* Brandt, 1833) (see Schmidt & Leistikow 2004).

DIAGNOSIS. — See Vandel (1962) and Schmalfuss & Ferrara (1978).

Porcellionides pruinosus Brandt, 1833
(Fig. 5C; 50)

Porcellio pruinosus Brandt, 1833: 19.

Porcellionides pruinosus – Campos-Filho *et al.* 2014: 412, fig. 40.

MATERIAL EXAMINED. — **Brazil** • State of Bahia: 1 ♂, 2 ♀; Lapa Doce cave, Iraquara; 12°20'03.8"S, 41°36'15.67"W; 701 m a.s.l.; 17.III.2017; M. E. Bichuette, J. E. Gallão, T. Zepon and M. J. Rosendo leg.; LES 28013 • 2 ♀; same locality as previous, V.1997; LES 28014 • 1 ♂, 2 ♀; Toca da Tiquara cave, Campo Formoso; 13.XII.2020; M. E. Bichuette & A. Carvalho leg.; LES 28015.

DISTRIBUTION. — Cosmopolitan species of Mediterranean origin (Schmalfuss 2003). In caves, it was previously recorded from Gruta Alto da Cruz cave, Iraquara, and Lapa do Bode cave, Itaetê, both caves in the state of Bahia (Campos-Filho *et al.* 2014). The present record expands our knowledge on its distribution within the state

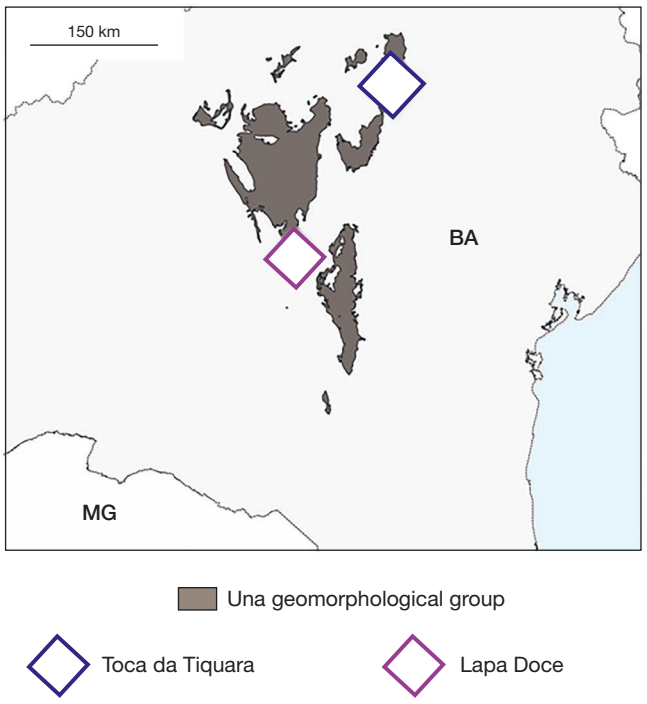

FIG. 49. — Distribution map of *Porcellionides pruinosus* (Brandt, 1833). Abbreviations of states: **BA**, Bahia; **MG**, Minas Gerais.

of Bahia. The presence of this species inside caves is related with available resources and favourable micro-climatic habitat conditions (Fernandes *et al.* 2016, 2019).

DISCUSSION

In South America, Brazil holds the highest number of areas with suitable lithology for the development of karstic systems (Auler *et al.* 2001), with a relatively high amount of recorded caves (CECAV 2022). However, our knowledge about the biodiversity of many karstic areas is still incomplete. Regarding subterranean biodiversity, the taxonomic impediment (Campos-Filho *et al.* 2014), together with the high diversity and geographical spread of karst outcrops, the difficulty in assessing some caves, and insufficient sampling in certain lithological areas (CECAV 2022), delay the recognition of this particular fauna. As expected in megadiverse countries, even if the number of biodiversity studies has increased in the last years, the amount of material waiting for formal taxonomic identification or description is growing in scientific collections (e.g. Lamoreux *et al.* 2006; Trajano *et al.* 2016; Bichuette *et al.* 2019).

The present work recognized 19 species of terrestrial isopods, of which 14 are described as new, constituting one of the most comprehensive studies on Brazilian Oniscidea from subterranean environments after Campos-Filho *et al.* (2014). The total number of terrestrial isopods from Brazil is now of 234 species. Moreover, our knowledge about the Oniscidea subterranean biodiversity increases to 93 species and 43 are considered to be troglobites (see also Campos-Filho *et al.* 2022c).

Until recently, Brazilian caves could be partially protected if they satisfied certain prerequisites, such as the presence of obligatory cave-dwelling taxa, assuring that the cave would not be exploited, especially by mining projects (BRAZIL 2008). Recently, the Brazilian Decree n° 10.935 published on January 12th, 2022 allowed the destruction of caves, seriously threating all subterranean biodiversity, and leading to the probable loss of the already known but also the unknown subterranean biodiversity of the country (Oliveira *et al.* 2022). Moreover, most of the Brazilian caves are outside of conservation units (SNIF 2018), and face critical threats, such as deforestation of surrounding areas for cattle grazing and establishment of monocultures, mining, and urban expansion (Trajano 2000; Gallão & Bichuette 2018).

Cave habitats are extremely important for both obligatory cave-dwellers and the overall fauna and surrounding communities (Campos-Filho *et al.* 2014; Reboleira *et al.* 2022), due to their resources and favourable habitat conditions (Fernandes *et al.* 2016, 2019). Beside the description of three troglobitic species, the present work clearly stresses out the importance of cave habitats for other taxa, since caves may act as a potential refuge for taxa exploiting the surrounding habitats. This is of particular significance for caves in dry areas (Chacoan dominion, *sensu* Morrone *et al.* 2022). Urgent conservation efforts and sustainable strategic plans, including both caves and the surrounding areas, should be established in order to preserve these peculiar habitats.

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