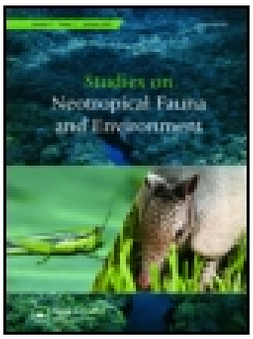

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A new species of *Metaprosekia* Leistikow, 2000 (Oniscidea, Philosciidae) from caves of the State of Mato Grosso, Brazil

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ABSTRACT

The present work aims to describe a new species of *Metaprosekia* from siliciclastic caves from Caverna Nova and Caverna Ponte de Pedra, Utiariti Formation, Municipality of Diamantino, State of Mato Grosso. *Metaprosekia utiariti* n. sp. easily differs from the congeneric species in the shape of male pleopods 1 and 2. Moreover, a map illustrating the lithology and hydrographic characteristics where the specimens were collected and conservation remarks are given.

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Terrestrial isopods; troglophilic species; cave fauna; Utiariti Formation; Neotropics

Introduction

Terrestrial isopods (Oniscidea) comprise more than 4,000 species in more than 500 genera and 38 families distributed in almost all terrestrial habitats (Schmalfuss 2003; Javidkar et al. 2015; Sfenthourakis & Taiti 2015; Dimitriou et al. 2019; Campos-Filho & Taiti 2021). In cave habitats, the group is one of the most representative taxa due to the favorable microhabitat conditions (Fernandes et al. 2016, 2019). To date, more than 210 species are known from Brazil, of which 74 are recorded from caves. Among them, 38 species are considered restricted cave-dwellers (troglobites) and several are facultative cave-dwellers (troglophiles) (Trajano & Carvalho 2017; Campos-Filho et al. 2018, 2019, 2020a, 2022; Cardoso et al. 2020a, 2020b, 2021, 2022, 2022, 2023).

The family Philosciidae comprises more than 500 species in more than 100 genera (Sfenthourakis & Taiti 2015) and probably does not represent a monophyletic group (Schmidt 2008). The family is mainly distributed in tropical and subtropical habitats (Schmidt 2002, 2003; Schmalfuss 2003), and it plays an important role in the decomposition of organic matter in tropical rainforests (Leistikow 2001). In Neotropics, the family comprises about 180 species in 47 genera (Schmalfuss 2003; Schmidt & Leistikow 2005; Grangeiro & Christoffersen 2010; Campos-Filho et al. 2017, 2018, 2019, 2020a; 2020b; López-Orozco et al. 2016, 2017, 2022; Carpio-Díaz et al. 2018; Grangeiro et al. 2021; Ocampo-Maceda et al. 2022).

The genus *Metaprosekia* Leistikow, 2000 includes four recognized species, *M. caupe* Campos-Filho, Araujo & Taiti, 2014, *M. igatuensis* Campos-Filho, Fernandes & Bichuette, 2020 and *M. quadriocellata* Campos-Filho, Araujo & Taiti, 2014 from Brazil, and *M. nodilinearis* Leistikow, 2000 from Venezuela (Leistikow 2000; Campos-Filho et al. 2014, 2020a). It is worth mentioning that in Brazil the representatives of the genus were recorded in caves and are considered troglophiles due to their endogean way of life (Campos-Filho et al. 2014), while the Venezuelan species occurs in the Andean montane forest domain (Leistikow 2000; Chacón-Moreno et al. 2020).

The present work aims to describe a new cave species of *Metaprosekia* from Utiariti Formation, State of Mato Grosso. Moreover, a distribution map and conservation remarks are provided.

Material and methods

Specimens were collected by hand with the aid of tweezers and brushes and were stored in ethanol 70GL and absolute. Information about the microhabitat was also recorded. Descriptions are based on morphological characters with the use of micropreparations in Hoyer's medium (Anderson 1954). The habitus

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images were taken with the stereomicroscope model Zeiss Discovery V.12 with an adapted camera Zeiss AxioCam Erc5s. The appendages were illustrated with 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 highlighting the caves and hydrological attributes is presented. The map was constructed with the ArcMap (v. 10.5) and the final edition with Adobe Photoshop CC (v. 2017.1.1). The material is deposited in the scientific collection of cave fauna of the Laboratório de Estudos Subterrâneos (LES), Universidade Federal de São Carlos, São Carlos, Brazil.

Study area

Caverna Nova and Caverna Ponte de Pedra, Municipality of Diamantino, State of Mato Grosso, are placed in the Amazon basin, Tapajós sub-basin (Figure 1). Both caves are inserted in siliciclastic rocks of the Utiariti Formation, Parecis Group (Upper Cretaceous) (Volkmer-Ribeiro et al. 2021). According to Köppen's criteria, the region shows a Tropical Savannah climate (Aw), with annual precipitation of about 1,850 mm and an average temperature of 24°C (Ramos et al. 2015; Bedek et al. 2018, 2020). The main vegetative cover is composed of Cerrado and riparian forest; however, the region suffers with high deforestation levels for agriculture and other human activities (Brown et al. 2013; Redo et al. 2013).

Results

Philosciidae Kinahan, 1857

Metaprosekia Leistikow, 2000

Type species

Metaprosekia nodilinearis Leistikow, 2000, by original designation (see Schmidt & Leistikow 2004).

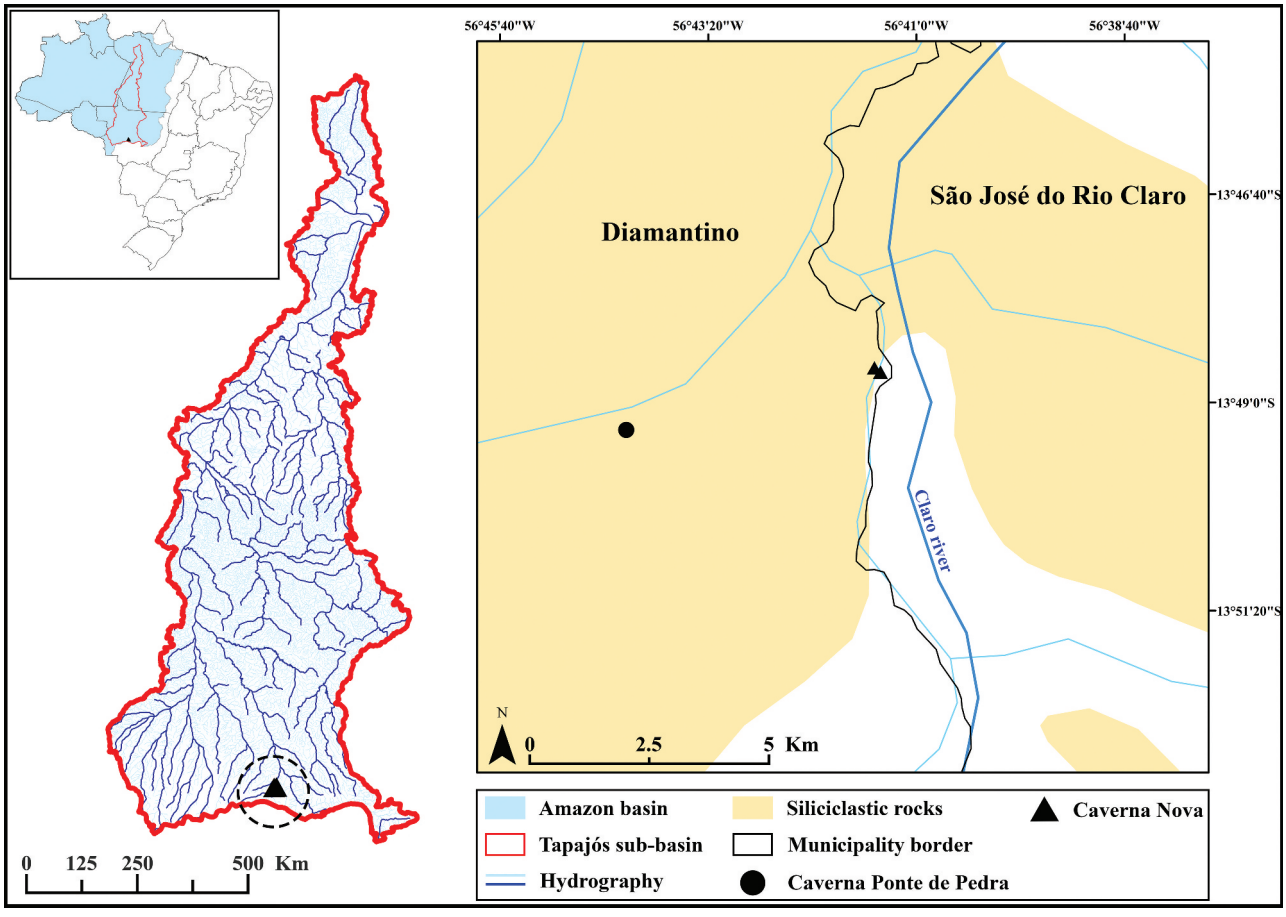

Figure 1. Map of the study area.

Metaprosekia utiariti Campos-Filho, Sfenthourakis and Bichuette, new species

Figures 2, 3, 4D

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Type material

Holotype: ♂, Caverna Nova, Diamantino, state of Mato Grosso; 13°48'36.7"S, 56°41'28.3"W; 342 m a.s.l.; 25.VI.2018; A. Chagas-Jr, L. M. Santos & D. Borges leg.; LES 27965. Paratypes: 1 ♂ (parts in micropreparations), 5 ♀♀ (one in micropreparations); same data as holotype; LES 27966 ● 2 ♂♂ (one with parts in micropreparations), 5 ♀♀ (one in micropreparations); Caverna Ponte de Pedra, Diamantino, state of Mato Grosso; 13°49'17.4"S, 56°44'15.1"W; 378 m a.s.l.; 23.VI.2018; same collectors as holotype; LES 27968. ● 1 ♂, 1 ♀; same locality and collectors as previous; 381 m a.s.l.; 25.VI.2018; LES 27967.

Description

Maximum body length: male 2 mm, female 3 mm. Body pigments absent. Body outline as in Figure 2A. Dorsum covered with fan-shaped scale setae (Figure 2B). *Noduli laterales* piliform (Figure 2B); d/c and b/c coordinates as in Figure 2C and D, respectively. Cephalon (Figure 2E, F) with lateral lobes not well-developed, frontal line absent, suprantennal line bent downwards in middle; eyes composed up to four ommatidia. Pereonite 1 epimera with anterior corners slightly directed frontwards; pereonites 1–4 with posterior margins straight, 5–7 gradually arched (Figure 2A). Pleon (Figure 2A, G) narrower than pereon, epimera of pleonites 3–5 short and directed backward; telson twice as wide as long, triangular with lateral margins almost straight, apex slightly rounded. Antennula (Figure 2H) of three articles, distal article longest, bearing three lateral aesthetascs plus apical pair. Antenna (Figure 2I) reaching pereonite 2 when extended backward; flagellum of three articles, proximal and medial articles subequal in length; distal article longest bearing two lateral aesthetascs, apical organ long, bearing two short free sensilla. Mandibles with dense cushion of setae on incisor process, molar process of five branches, left mandible (Figure 2J) with 2 + 1 penicils, right mandible (Figure 2K) with 1 + 1 penicils. Maxillula (Figure 2L) inner endite with two apical penicils; outer endite with 3 + 4 teeth, inner set with two teeth apically cleft. Maxilla (Figure 2M) inner lobe rounded, covered with thick setae; outer lobe rounded, about three times as wide as inner lobe, covered with thin setae. Maxilliped (Figure 2N) palp with two setae on proximal article; endite subrectangular, medial seta surpassing distal margin, distal margin rounded, rostral surface with setose sulcus. Pereopods 1–7 (Figure 3B, C) 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 organ and ungual seta simple, not surpassing outer claw. Uropod (Figure 3A) protopod subquadrangular; protopod and exopod outer margins grooved, bearing glandular pores; exopod twice as long as endopod, endopod inserted proximally.

Male

Pereopods 1 and 7 without sexual dimorphism (Figure 3B, C). Genital papilla (Figure 3D) bearing triangular ventral shield, papilla slightly longer than ventral shield with two subapical orifices. Pleopod 1 (Figure 3E) exopod subquadrangular, distal margin almost straight; endopod more than twice as long as exopod, distal portion narrow, directed outwards and bearing small setae on subapical medial margin. Pleopod 2 (Figure 3F) exopod triangular, outer margin slightly concave bearing one seta; endopod flagelliform, about three times as long as exopod. Pleopod 3 and 4 exopods as in Figure 3G and H, respectively. Pleopod 5 exopod (Figure 3I) triangular, outer margin sinuous, bearing three long setae, inner margin grooved to accommodate pleopod 2 endopod.

Etymology

The new species is named after the Brazilian Utiariti indigenous people. The word Utiariti, also a dialect of the Aruak language, means the place of clever people, *utia* = clever, *halíti* = people. Moreover, it refers the karstic formation where Caverna Nova and Caverna Ponte de Pedra are inserted.

Remarks

The genus *Metaprosekia* was erected by Leistikow (2000) to allocate the new species *M. nodilineares* from 'La Campaña,' eastern slope of Andes, Venezuela. The genus is mainly defined by animals of small size, dorsal surface covered with fan-shaped or pointed scale-setae, pereonites 1–7 epimera with *noduli laterales* inserted at same level from lateral margins, cephalon with suprantennal line and eyes composed of 3–4 ommatidia, antennula with one lateral tuft of aesthetascs plus apical pair, maxillula outer endite with 4 + 4 teeth (some of them cleft at apex),

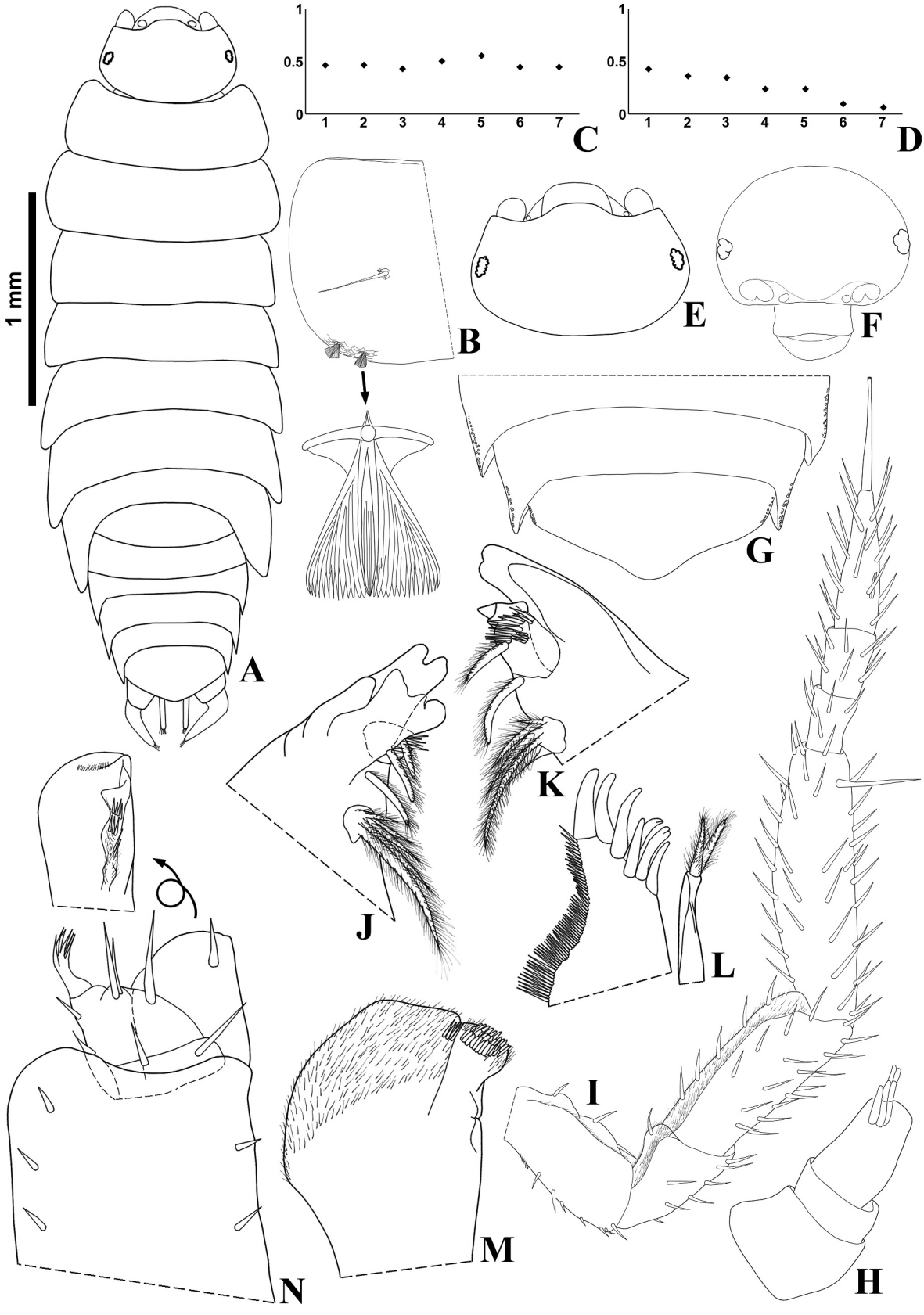

Figure 2. *Metaprosekia utiariti* n. sp. ♀ paratype from Caverna Nova (LES 27966): A. Habitus, dorsal view; B. Pereonite 1; C. *Noduli laterales* d/c coordinates; D. *Noduli laterales* b/c coordinates; E. Cephalon, dorsal view; F. Cephalon, frontal view; G. Pleonites 4, 5 and telson; H. Antennula; I. Antenna; J. Left mandible; K. Right mandible; L. Maxillula; M. Maxilla; N. Maxilliped.

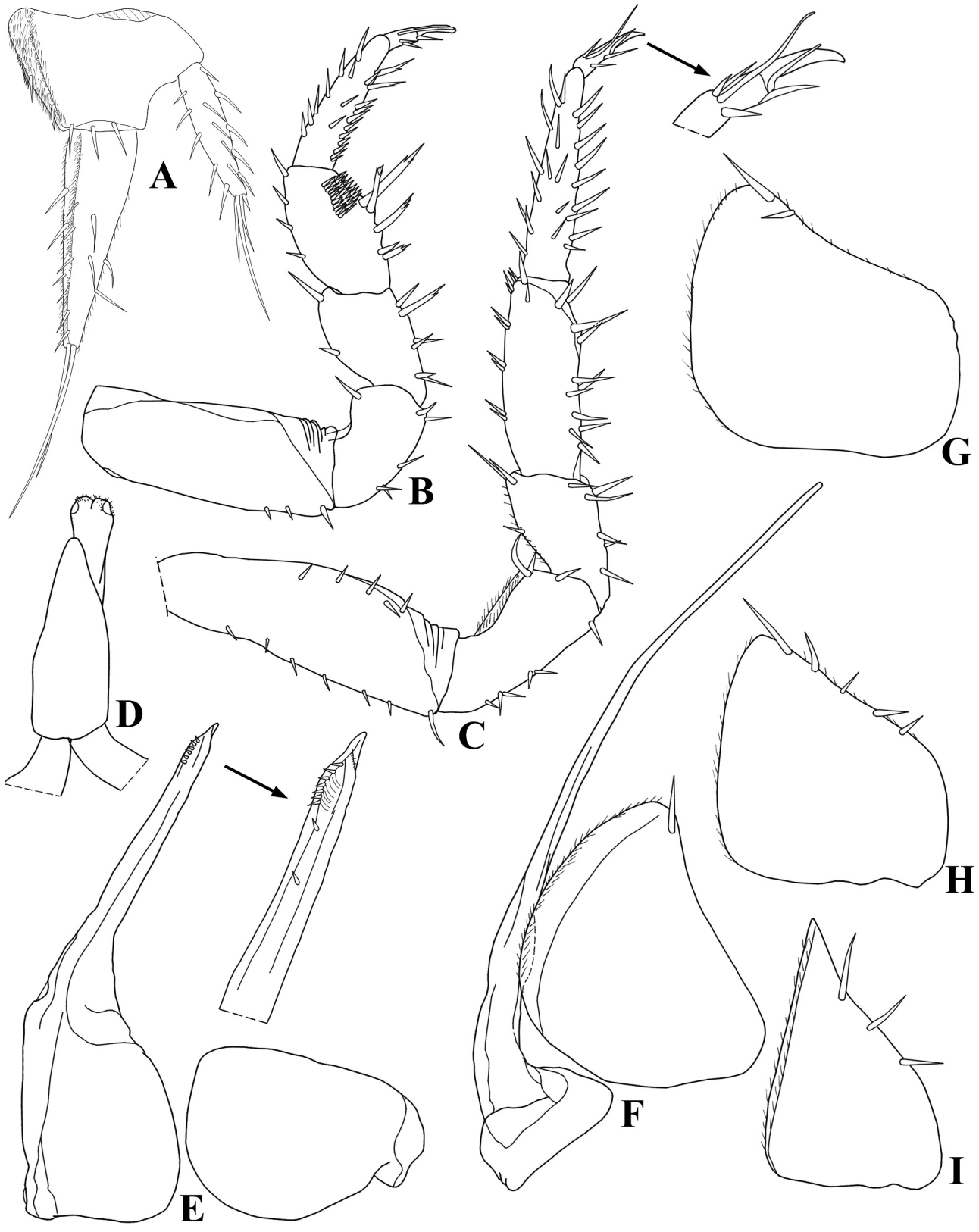

Figure 3. *Metaprosekia utiariti* n. sp. ♀ paratype from Caverna Nova (LES 27966): A. Uropod. ♂ paratype from Caverna Nova (LES 27966): B. Pereopod 1; C. Pereopod 7; D. Genital papilla; E. Pleopod 1; F. Pleopod 2; G. Pleopod 3 exopod; H. Pleopod 4 exopod; I. Pleopod 5 exopod.

maxilliped endite with rostral penicil and pleopod exopods without respiratory structures (see Leistikow 2000, 2001; Campos-Filho et al. 2014, 2020a). Most of the diagnostic characters proposed for the genus are present in the new species described here. Regarding the composition of the outer endite of the maxillula (3 + 4) and the absence of the rostral penicil on maxilliped endite in the new species, probably these characters are peculiar to the species.

Metaprosekia utiariti n. sp. easily differs from congeneric species in the distinct shape of the male pleopod 1 endopod with distal portion narrow and directed outwards. Moreover, it differs in having the suprantennal line bent downwards in the middle (vs. straight in *M. caupe* and *M. nodilinearis*), antennula with three lateral aesthetascs (vs. six in *M. caupe*; five in *M. igatuensis, M. nodilinearis,* and *M. quadriocellata*), antenna with apical organ slightly shorter than distal article of flagellum (vs. subequal in length in *M. caupe* and *M. quadriocellata*; longer in *M. nodilinearis*;), male pleopod 1 endopod with distal portion narrow and not apically bended (vs. tapering and apically bent outwards in *M. caupe, M. nodilinearis,* and *M. quadriocellata*; tapering in *M. igatuensis*), male pleopod 2 endopod almost three times as long as exopod (vs. twice as long as exopod in *M. caupe*; one and a half times longer than exopod in *M. igatuensis; M. nodilinearis* and *M. quadriocellata*), and male pleopod 5 exopod triangular with distal portion elongated and acute (vs. subtriangular with distal portion not elongated and right-angled in *M. caupe*; subrhomboid with distal portion not elongated and rounded in *M. igatuensis*; subtriangular with distal portion not elongated and rounded in *M. nodilinearis*; triangular with distal portion not elongated and right-angled in *M. quadriocellata*) (see figures in Leistikow 2000; Campos-Filho et al. 2014, 2020a).

Microhabitat

Caverna Nova (Figure 4A, B) is formed by conglomerate blocks, and it has a narrow entrance. The cave surroundings are impacted, with native vegetation close to the outcrops forming a small native vegetation refuge surrounded by large plantations of soybean and cotton. Caverna Ponte de Pedra (Figure 4C, D) is a tunnel periodically flooded in the rainy season, which brings a high amount of organic matter to the cave, and at the same time the substrate is washed. The isopods were recorded in low abundance, and they are mainly endogean. Specimens *Metaprosekia utiariti* n. sp. were recorded in sandy substrate with little organic matter (animal feces), and some were buried in the twilight zone of both caves. The caves are certainly important locations for maintenance of their populations. *Metaprosekia utiariti* n. sp. is considered a troglophilic species.

Discussion

In the whole of South America, Brazil holds the highest amount of suitable lithology for the development of karstic systems (Auler 2002, 2004, 2019; CECAV–Centro Nacional de Pesquisa e Conservação de Cavernas 2018) and has a relatively high number of caves, ca. 22,000 (CECAV 2021). Despite this impressive number of caves, our knowledge about the biodiversity of many karstic groups is poor and due to the taxonomic impediment, the high diversity and geographical spread of karst outcrops, the difficulty in assessing some caves, or the neglected collection in certain lithologies, such as siliciclastic rocks (Campos-Filho et al. 2014; CECAV 2018). Even though the number of studies on terrestrial isopods in Brazilian caves has increased in the last years, the amount of material waiting formal taxonomic identification or description is growing in scientific collections (e.g. Silva & Ferreira 2015; Trajano et al. 2016; Bichuette et al. 2019), something expected for a megadiverse country (Lamoreux et al. 2006). Considering the diversity of siliciclastic caves, the new species becomes more relevant being the fifth known species of the genus, the fourth from caves, and the first troglophilic species for the region of Diamantino, suggesting an even higher diversity than already recorded.

Until recently, all Brazilian caves could be partially protected if they satisfy certain prerequisites, such as the presence of obligatory cave-dweller taxa (troglobite) which assure that the cave will not be exploited, especially by mining projects (BRAZIL 2008). Unfortunately, the new species described herein does not allow for such an appeal. To make the situation worse, a recent Brazilian decree, n° 10.935 published in 12 January 2022, allows the destruction of maximum relevance caves, seriously threatening all subterranean biodiversity of the country, which could lead to the complete loss of the unknown and already known biodiversity (Oliveira et al. 2022). Moreover, most of the Brazilian caves are outside of conservation units (SNIF 2018), and these caves are currently under critical threats, e.g. deforestation of surrounding vegetation for cattle grazing and establishment of monocultures, mining, urban expansion, and others (Trajano 2000; Gallão & Bichuette 2018).

Cave habitats are extremely important not just for obligatory cave-dwellers, but also for their overall fauna and surrounding communities (Campos-Filho et al.

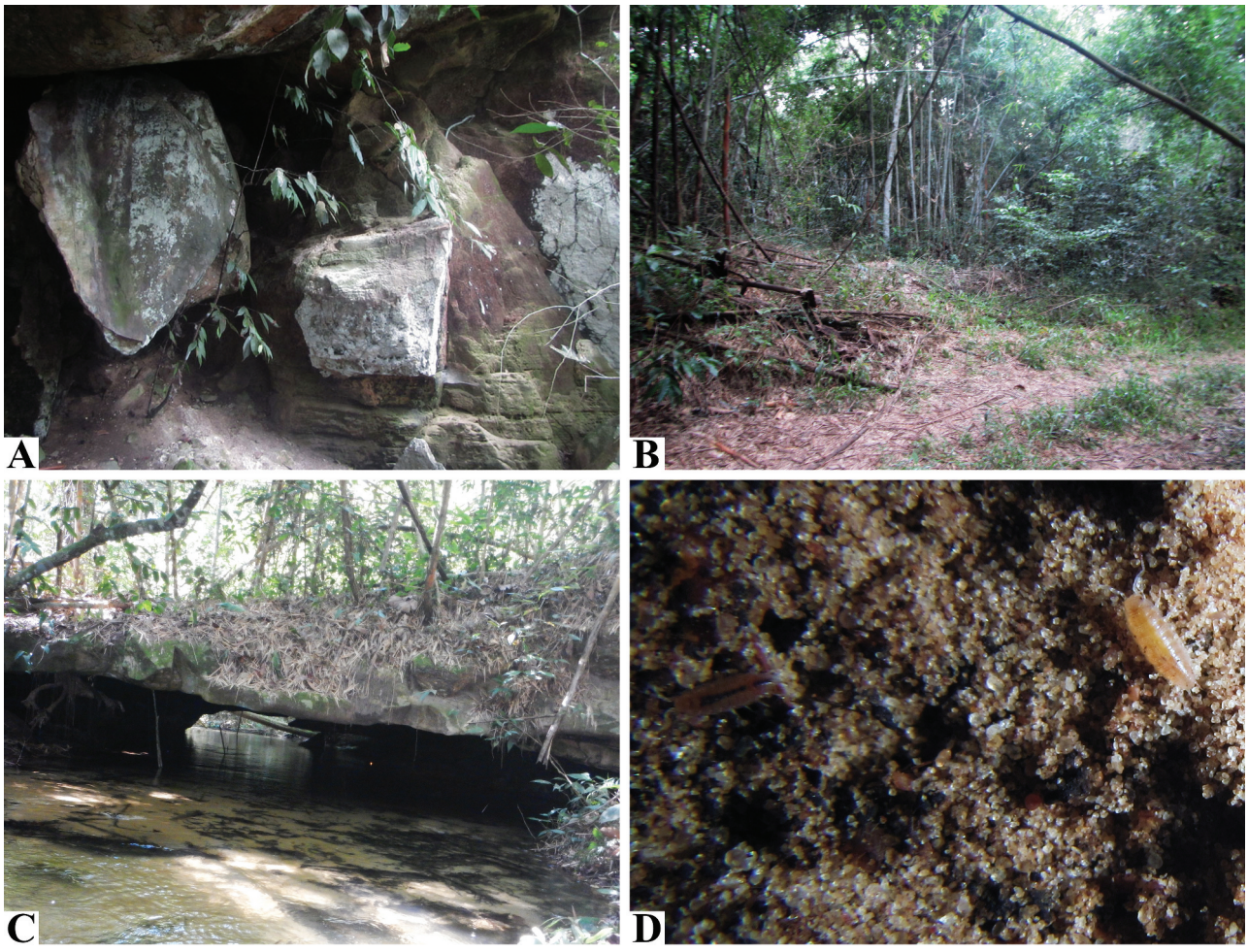

Figure 4. A. Caverna Nova, conglomerate blocks in the entrance; B. Caverna Ponte de Pedra with small drainage crossing; C. Vegetation close to Caverna Ponte de Pedra; D. *Metaprosekia utiariti* n. sp. in the natural habitat, sandy substrate. Photos: A. Chagas-Jr.

2014, 2020a). As is well known, cave habitats offer favorable environmental conditions such as stability in humidity and temperature (Fernandes et al. 2016). Depending on its location and topography, a cave may act as potential refuge for surrounding or migrating taxa, especially those in dry areas (Chacoan dominion, sensu Morrone et al. 2022). Urgent conservation efforts and sustainable strategic plans, including the participation of the surrounding inhabitants of the cave, should be proposed in order to preserve these peculiar habitats.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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