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A new species of *Chaimowiczia* from the karstic Serra do Ramalho plateau, Brazil (Oniscidea, Synocheta, Styloniscidae)

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Abstract

Chaimowiczia belongs to the subfamily Iuiuniscinae, family Styloniscidae, and is currently composed of two troglobitic species: *C. tatus* and *C. uai*, both occurring in Brazil. A new species of Styloniscidae found in Brazil (Bahia state, Serra do Ramalho, Serra Verde cave) was allocated into this genus by the antenna flagellum with three articles; rectangular-shaped lateral pereonites epimera not apically acute and apex of pleopod 2 endopod with an acute tip and an acute or rounded lobe directed outwards. The new species, *C. obybytyra* **sp. nov.**, is here described and rises to 25 the number of troglobitic styloniscidean species known for Brazilian caves.

Keywords

amphibious isopods, Bahia state, Isopoda, troglobite, Neotropics, São Francisco basin

Introduction

Chaimowiczia Cardoso, Bastos-Pereira, Souza & Ferreira, 2021 consists in a recently described genus for the subfamily Iuiuniscinae (Styloniscidae) (Cardoso et al. 2021). The species allocated into the new genus presented the antenna flagellum with three articles; rectangular-shaped lateral pereonites epimera not apically acute and apex of pleopod 2 endopod with an acute tip and an acute or rounded lobe directed outwards (Cardoso et al. 2021).

Chaimowiczia is currently composed of two species: *C. tatus*, Cardoso, Bastos-Pereira, Souza & Ferreira, 2021 found in Gruta do Padre (Bahia state), and *C. uai*, Cardoso, Bastos-Pereira, Souza & Ferreira, 2021, found in Lapa d'Água do Zezé cave (Minas Gerais state), both in Brazil. Here another species of *Chaimowiczia* is described for a cave in the Bahia state, which consists in a troglobite, as well as most of the styloniscids found in Brazil (Cardoso et al. 2021). Such description rises to 25 the number of troglobitic styloniscidean species known for Brazilian caves (Cardoso et al. 2020a, b, 2021; Campos-Filho et al. 2022).

Materials and methods

Study area

The region of Serra do Ramalho, where Serra Verde cave is located, is one of the most important karstic areas in Brazil (Auler et al. 2001), represented by a huge carbonate plateau with more than 70 km (in the N-S direction) between Corrente river (North) and Carinhanha river (South), in the left bank of the São Francisco River. The carbonate outcrops rise between 550 and 780 m above sea level. The region is inserted in the Caatinga domain (the only Brazilian semiarid biome), with transitional areas to the Cerrado (Brazilian Savanna) (Cole 1960). The local climate is "Aw", according to Köppen's climate classification system, with dry winter and an average annual rainfall of 640 mm^3 (Alvares et al. 2013). The local karst presents a strongly undulating relief, with epigean drainages typically ephemeral, forming deep-steep incisions (da Silva et al. 2019). The area presents more than 180 known caves, some of them among the biggest caves recorded for Brazil, many with more than 5 km in extension (Auler et al. 2001).

Laboratory procedures

The specimens were manually collected with the aid of a hand net and fixed in 70% ethanol. The studied individuals were measured and photographed with a ZEISS Axio ZoomV16 stereomicroscope coupled with an Axio Cam 506 Color camera, dissected and mounted in slides using Hoyer's medium in the Center of Studies on Subterranean Biology of the Federal University of Lavras (**CEBS-UFLA**, Lavras, Brazil). Drawings were made either from photographs or from dissected specimens mounted in slides with the aid of a camera lucida coupled with the microscope Leica DM750. Later the illustrations were prepared in the software GIMP (v. 2.8) (Montesanto 2015, 2016) with a Cintiq Drawing Pad (Wacom). Some specimens were put into an ultrasonic bath (L200 Schuster) to clean the sediment adhered to the cuticle and mounted in stubs for posterior observation of dorsal cuticular structures under the scanning electron microscope Hitachi TM4000. Holotype and paratypes of the new species were deposited in the Subterranean Invertebrate Collection of Lavras (**ISLA-UFLA**) in the Center of Studies on Subterranean Biology of the Federal University of Lavras (CEBS-UFLA, Lavras, Brazil).

Taxonomy

Family Styloniscidae Vandel, 1952
Genus *Chaimowiczia* Cardoso, Bastos-Pereira, Souza & Ferreira, 2021

***Chaimowiczia obybytyra* sp. nov.**
http://zoobank.org/E1EDC0BF-A3B5-48A7-B0D0-873DA3D7EC80

Type species. *Chaimowiczia tatus* Cardoso, Bastos-Pereira, Souza & Ferreira, 2021.

Material examined. ***Holotype*:** Brazil • Male; Bahia state, municipality of Coribe, Serra Verde cave; 13°43'26.03"S, 44°19'24.46"W; 20 Sep. 2021; G.M. Cardoso and R.L. Ferreira leg.; ISLA 95829. ***Paratypes*:** • 4 males; same data as for holotype; ISLA 95830 • 17 females, same data as for holotype; ISLA 95831.

Description. Maximum length: 12 mm. Colorless, eyes absent (Figs 1A, 6C, D). Dorsal surface smooth with sparse scale setae with short triangular base, long sensory sheathed hair and plaques with serrated distal margin (Fig. 1B). Cephalon (Fig. 1C, D) suprantennal line well defined, directed downwards and truncated in middle; round antennal lobes. Body (Figs 1A, 2A) convex, pereonites 1–7 epimera quadrangular, widely separated and outwardly extended, pereonites postero-lateral corners progressively directed backwards; pleon epimera 3–5 well developed, pleonite 5 distal margin as long as telson. Telson (Fig. 1E) distal half subtriangular, depressed with round apex. Antennula (Fig. 2B) with three articles divided by thin suture, covered with thin setae, distal article with one lateral and two apical aesthetascs. Antenna (Figs 1F, 2C) reaches pereonite 2 when extended backwards, fifth article of peduncle longer than flagellum; flagellum with three articles, first article longest. Mandibles as in Fig. 2D, E. Maxillula (Fig. 2F) outer ramus with 5 + 5 teeth, apically entire, and two thick plumose stalks; inner ramus with three slender penicils. Maxilla (Fig. 2G) bilobate, inner lobe wider than outer, covered by setae. Maxilliped (Fig. 2H) basis trapezoidal, distal portion wider than basal; palp apex with tufts of setae; endite shorter than palp, setose, apex with one conic penicil between two strong teeth. Pereopod 1 (Figs 1G, 3A) antennal grooming brush longitudinally on frontal face of carpus and propodus, dactylus with one claw; pereopod 7 with water conducting scale rows. Uropod (Fig. 1E) protopod surpasses distal margin of telson; exopod slightly longer than endopod, inserted at the same level, covered with pectinate scales.

Male. Pereopods 1, 6 and 7 (Figs 1G, 3F, 4A) covered with setae; merus sternal margin with proximal tuft of setae. Genital papilla triangular (Fig. 4B). Pleopod 1 (Fig. 4B) protopod trapezoid, sinuous margin, apex tapering; exopod covered with setae, triangular with sinuous external margin; endopod as long as exopod, flagelliform distal article. Pleopod 2 (Fig. 4C) exopod semi-oval, round distal margin, covered with setae; endopod of two articles, basal article quadrangular, shorter than exopod, distal article stout, apex with acute lobe (perpendicular) directed outwards. Pleopod 3 exopod (Fig. 4D) trapezoid, margin covered with thin setae, ventral face with lobe to hook pleopod 2. Pleopod 4 exopod (Fig. 4E) rhomboid, wider than

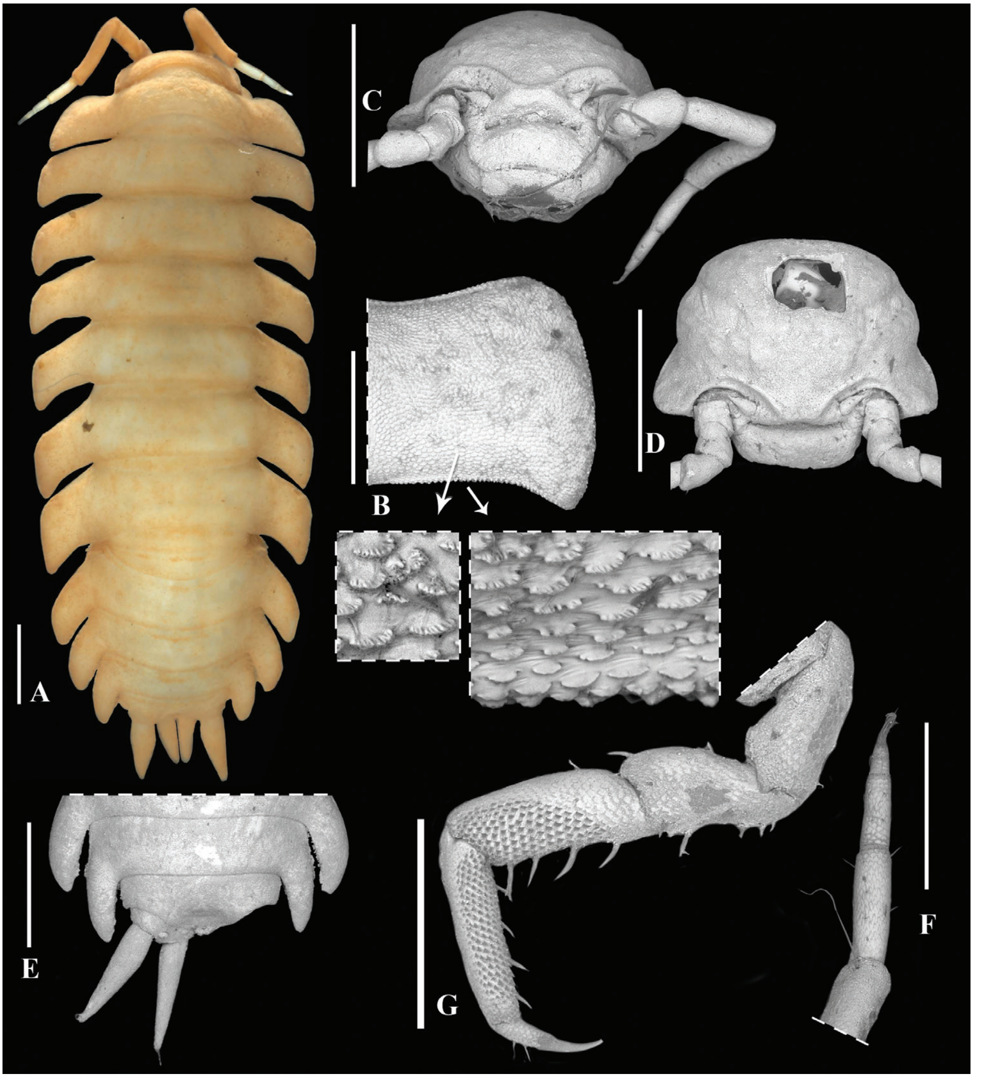

Figure 1. *Chaimowiczia obybytyra* sp. nov. Female paratype **A** habitus dorsal view **B** epimeron 1, dorsal view **C** cephalon, frontal view **D** cephalon, dorsal view **E** pleonites 4 and 5, uropod and telson, dorsal view **F** antennal flagellum **G** pereopod 1. Scale bar: 1mm (**A, C–E**); 500 µm (**B, G, F**).

long, covered with thin setae. Pleopod 5 exopod (Fig. 4F) ovoid, wider than long, covered with thin setae.

Etymology. The epithet "*obybytyra*" was given in reference to the name of the cave Serra Verde (in English, Green Mountain), that in the local Indian language "tupi-guarani" means: oby = green and ybytyra = mountain.

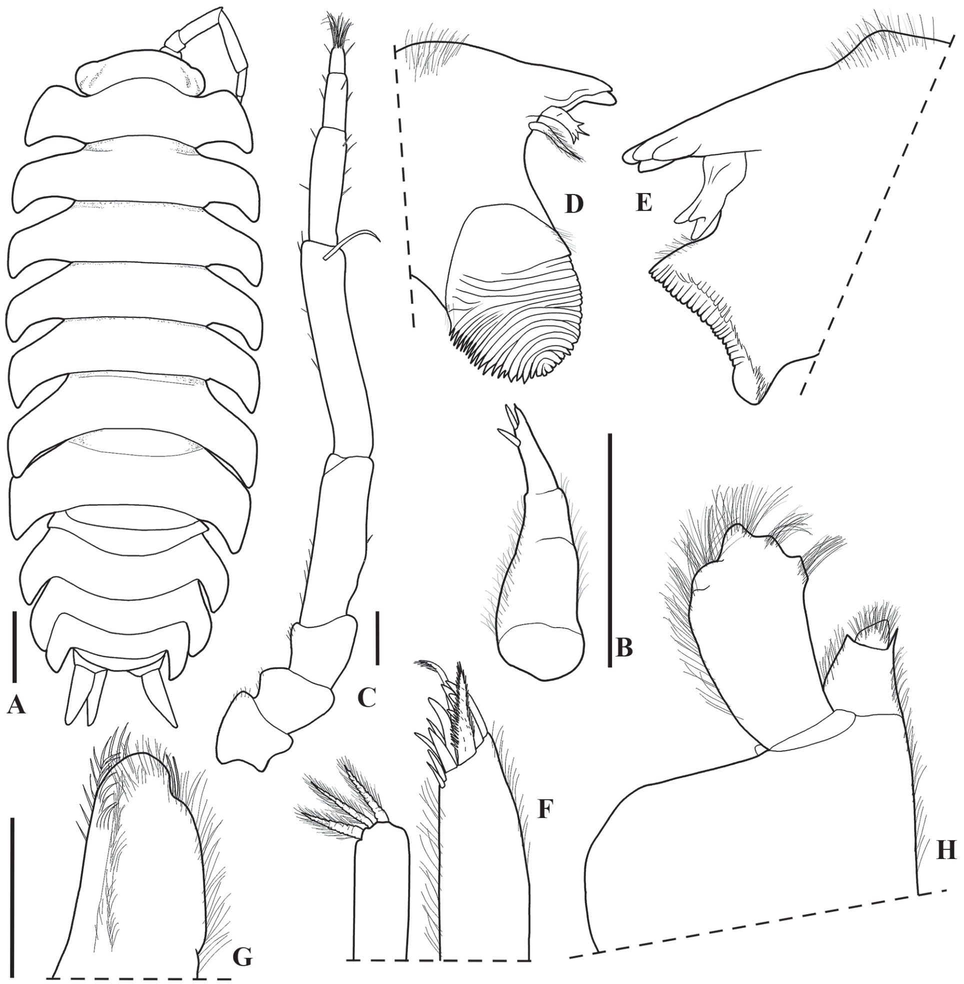

Figure 2. *Chaimowiczia obybytyra* sp. nov. Female paratype **A** habitus, dorsal view. Male paratype **B** antennula **C** antenna **D** right mandible **E** left mandible **F** maxilla **G** maxillula **H** maxilliped. Scale bars: 1 mm (**A**); 0.2 mm (**B–I**).

Discussion

Chaimowiczia obybytyra sp. nov. is larger than the other two species of the genus. The new species is similar to *C. uai* due to the antennal lobes and shape of pereonite 1 epimera, while the similarity with *C. tatus* is in the pleopod 2 endopod apex. A comparison among the morphology of the three species is presented on Table 1.

Chaimowiczia tatus and *C. obybytyra* sp. nov. inhabit caves situated around 63 km far from each other, while *C. uai* represents the southernmost record of the genus until the present (around 143 km far from *C. obybytyra* sp. nov.) (Fig. 5). Besides the distance, geographical barriers exist among the three species, since Corrente River separates the

Table 1. Comparative morphological characters for the three species of *Chaimowiczia*.

Characters	*C. tatus*	*C. uai*	*C. obybytyra* sp. nov.
Body size (mm)	9	8	12
Antennula distal article: number/ position of aesthetascs	two apical	two apical	one lateral, two apical
Antennal lobes	quadrangular	rounded	rounded
Anterior portion of pereonite 1: epimera directed	outward	frontward	frontward
Pleonite 5 posterior margin ___ telson	shorter than distal margin of telson	surpassing distal margin of telson	as long as telson
Uropod endopod ___ exopod	endopod longer than exopod	endopod as long as exopod	endopod slightly shorter than exopod

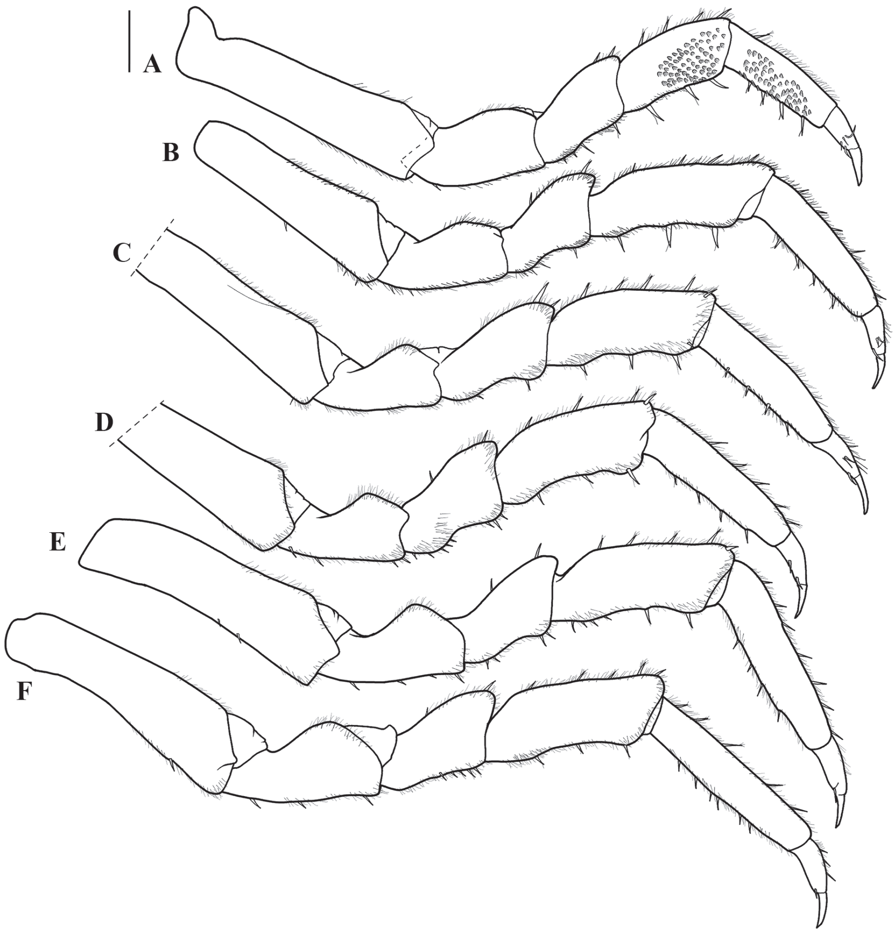

Figure 3. *Chaimowiczia obybytyra* sp. nov. Male paratype **A** pereopod 1 **B** pereopod 2 **C** pereopod 3 **D** pereopod 4 **E** pereopod 5 **F** pereopod 6. Scale bar: 0.2mm.

region of Santana, where *C. tatus* occur, from Serra do Ramalho, where *C. obybytyra* sp. nov. was found. *Chaimowiczia obybytyra* sp. nov. and *C. uai* are also separated by Carinhanha River. These rivers may have represented vicariant events that separated the species along the speciation process within such genus of Styloniscidae in those Brazilian caves.

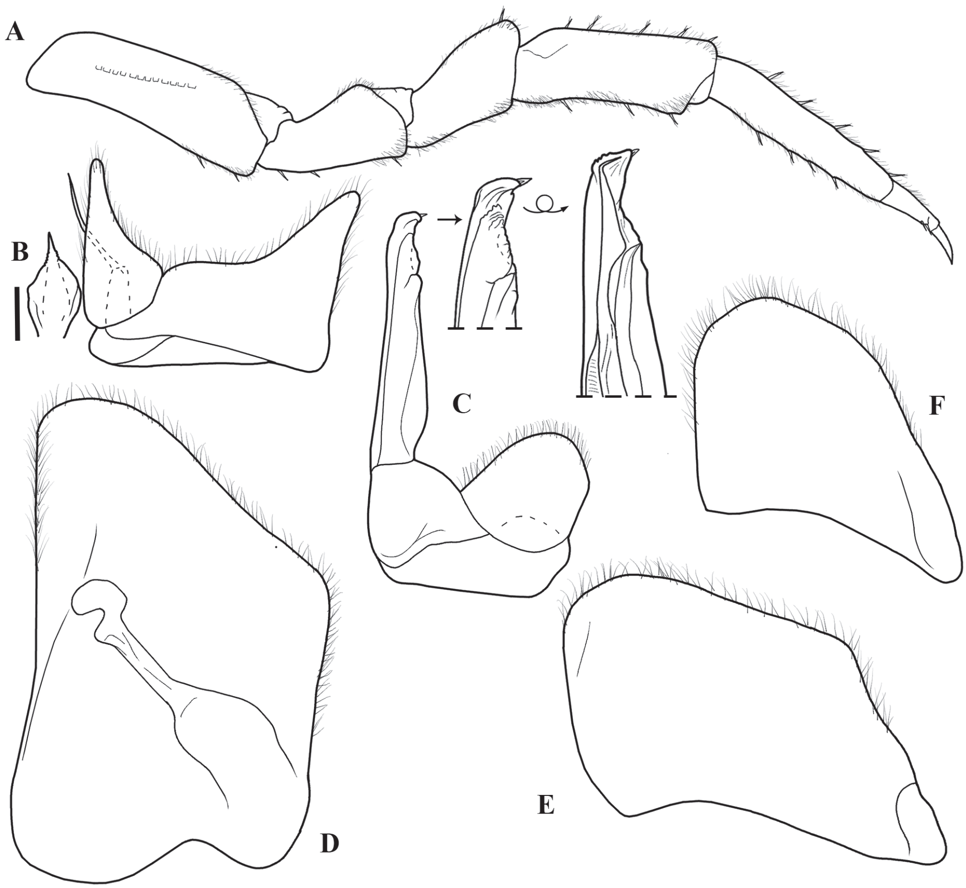

Figure 4. *Chaimowiczia obybytyra* sp. nov. Male paratype **A** pereopod 7 **B** genital papilla and pleopod 1 **C** pleopod 2 **D** pleopod 3 exopod, ventral view **E** pleopod 4 exopod, dorsal view **F** pleopod 5 exopod, dorsal view. Scale bar: 0.2mm.

Habitat and ecological remarks

Specimens of *Chaimowiczia obybytyra* sp. nov. were only observed in the Serra Verde cave. Such cave has at least 1,730 meters of horizontal projection, presenting the main conduit from which secondary passages develop. It is important to note that the cave is still under exploration, and the area where the specimens were collected was not mapped, since it remains flooded along the rainy period. Although the cave presents a wide entrance (Fig. 6A), there is a constriction on the cave conduit (20 meters from the entrance), which is quite long, thus preventing the general public to access the interior of the cave. The conduit that follows this constriction is relatively dry, although there are signs that the runoff water penetrates the cave in rainy periods. Since our team visited the cave during the dry period, the substrates were predominantly dry (near the entrance), however, as entering into the cave, its galleries become progressively wetter, and the conduits in the final portion were quite wet (Fig. 6B). Specimens of

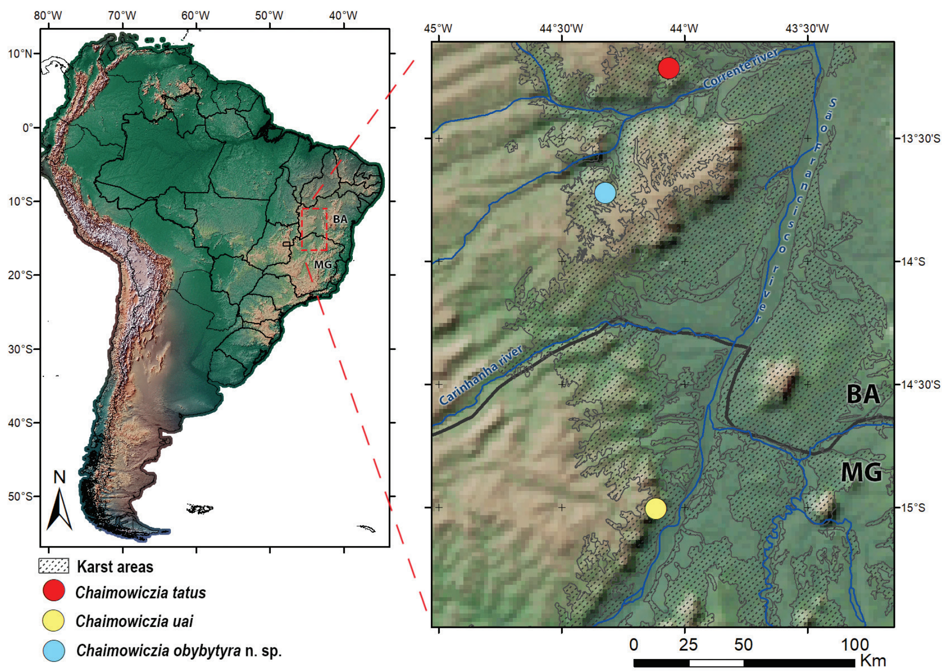

Figure 5. Map with the distribution of *Chaimowiczia* species in the Brazilian states of Bahia and Minas Gerais.

Chaimowiczia obybytyra sp. nov. (Fig. 6C) was found in small ponds in a lower-level conduit, which still maintained these small water collections, even at the height of the drought season. An expedition accomplished by speleologists during the rainy season revealed the inner conduits partially flooded, thus indicating the wide variation in the water table between dry and rainy seasons.

Chaimowiczia obybytyra sp. nov. also exhibits well-developed epimera on the pereonites and pleonites 3–5, as on the other two congeneric species *C. uai* and *C. tatus*. Cardoso et al. (2021) hypothesized that such morphology could be related to a "ghost predation in the past" in a period when the ancestor populations could be under a predator selective pressure. However, this hypothesis still needs further studies in order to be confirmed (or refuted). It is interesting to highlight, however, the co-occurrence of *Chaimowiczia* species with amphipod species of the genus *Spelaeogammarus* (Amphipoda: Artesiidae). All the known species of *Chaimowiczia* share their habitat with such amphipods: *C. uai* co-occur with *S. uai* Bastos-Pereira & Ferreira, 2017; *C. tatus* co-occur with *S. santanensis* Koenemann & Holsinger, 2000; and *C. obybytyra* sp. nov. co-occur with an undescribed species of *Spelaeogammarus* (Fig. 6D) (Bastos-Pereira & Ferreira 2017; Cardoso et al. 2021). Although it is very unlikely that the amphipods could act as predator of adult isopods, it is interesting to consider at least an eventual competition for the scarce food resources occurring inside the caves. Furthermore, while adults of both isopod and amphipod are comparable in size, predation (which was already observed for *Spelaeogammarus* species – RLF personal observations) could

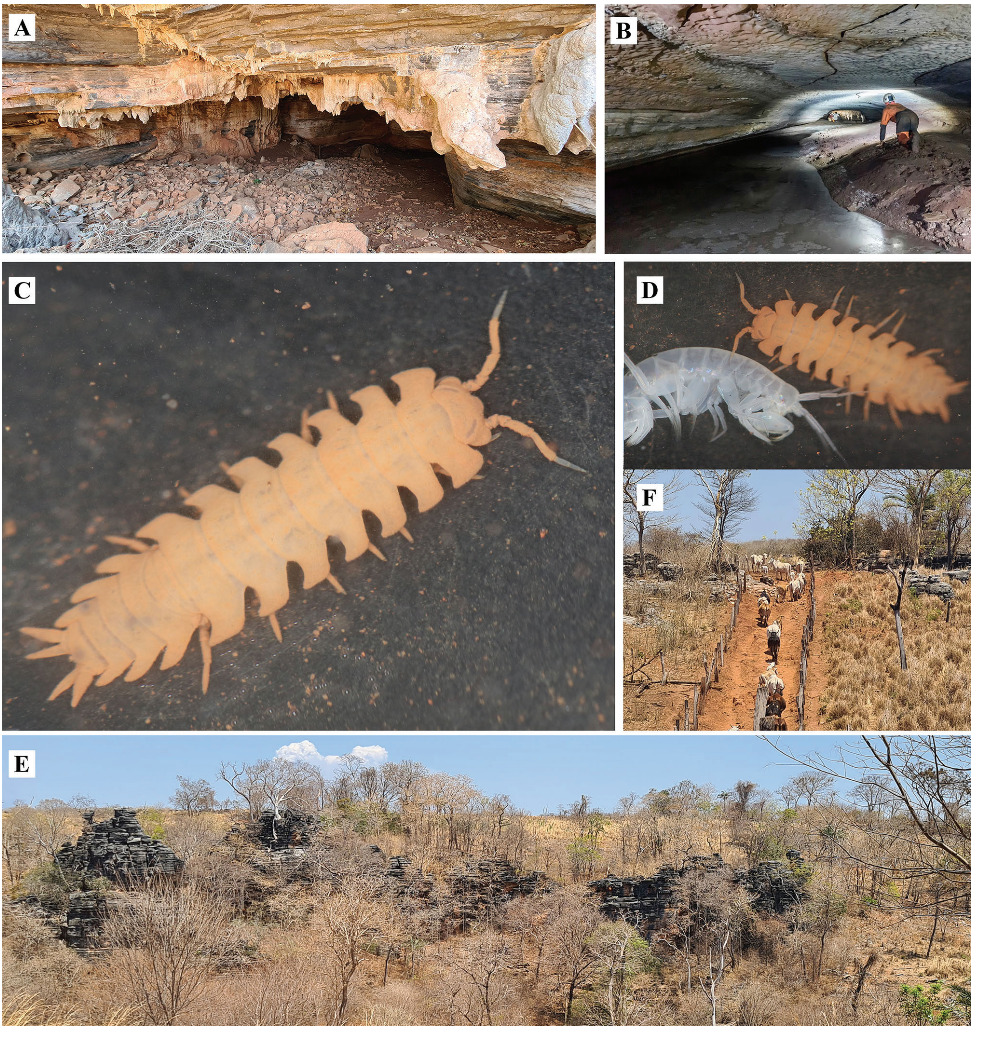

Figure 6. A Serra Verde cave's entrance **B** main conduit in rainy season **C** specimen of *Chaimowiczia obybytyra* sp. nov., *in situ* **D** specimen of *Chaimowiczia obybytyra* sp. nov. and *Spelaeogammarus* sp., *in situ* **E** pastures and livestock in the vicinity of the cave **F** Karst outcrop where the cave is located (Photo by Daniel Menin).

eventually occur between adult amphipods and juvenile isopods, though this is still speculative. In that case, the predation could be also acting currently, not only in the past, as hypothesized by Cardoso et al. (2021).

Two other aspects are also worth mentioning in this context: the first is the fact that all *Chaimowiczia* species have the body surface covered by sediment (which gives the species a brownish color, Fig. 6C). Such sediment adheres to the dorsal modified scales. Hence, living specimens of *Chaimowiczia* present the body surface quite similar in texture to the sediment with which they are associated. This may eventually represent a texture camouflage, in the case that adult *Spelaeogammarus* sp. feed on juvenile *Chaimowiczia*. The second fact is related to apparent niche segregation between *Chaimowiczia* and *Spelaeogammarus* species. While the former is benthic, frequently found digging the sediment and burying themselves, *Spelaeogammarus* sp. is an active swimming species (RLF personal observation). Again, further studies are highly advisable in order to address such hypothesis, not only based on observations *in situ* but also under laboratory conditions.

Conservation issues

As previously mentioned, the constriction on the conduit close to the entrance prevents residents to access the cave's inner portion. Hence, the cave is quite preserved. However, the external landscape surrounding the cave is severely altered. Only remnants of the original vegetation remain, especially close to the limestone outcrops (Fig. 6E). Most of the pristine forests were removed for pastures. During our visit, cattle were observed in the cave surroundings (Fig. 6F), compacting the exposed soil, which is highly vulnerable to erosional processes. Furthermore, the topography of the external area surrounding the cave entrance (which is located at the bottom of a valley) certainly contributes to the input of external sediments to the cave during rainy periods. Thus, the denudation of external soils can intensify erosive processes and, consequently, increase the sediment input to the cave, silting up microhabitats. It is important to note that other cave-restricted species were observed in this cave, as the undescribed species of *Spelaeogammarus*, millipedes, springtails, among others, which shows the biological relevance of this cave. Accordingly, it is highly recommendable that the cave surrounding be protected, especially by the reforestation of the immediate external landscape, to protect the cave and consequently the unique species it presents.

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