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Cryptops (*Cryptops*) *spelaeoraptor* n. sp. a remarkable troglobitic species (Chilopoda: Scolopendromorpha) from Brazil

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Abstract

Cryptops (*Cryptops*) *spelaeoraptor* is here described from Toca do Gonçalo cave, Bahia state, Brazil. This species presents highly troglomorphic traits and can be separated from all other species of *Cryptops* by possessing a unique trait in Scolopendromorpha: the ultimate pair of legs presents saw teeth on each of the prefemur to tarsus 2 (rather than being concentrated on the tibia and tarsus 1) numbering 28+30+14+17+17.

Key words: Neotropics, Caatinga, Cryptopidae, taxonomy, caves

Introduction

The northeastern region of Brazil, dominated by the Caatinga (the only semi-arid biome in the country), has revealed, in recent years, several new troglobitic species (Volkmer-Ribeiro *et al*. 2010; Machado *et al.* 2011; Pellegrini & Ferreira 2011; Prevorcnik *et al*. 2012; Ratton *et al*. 2012; Simone 2012; Fiser *et al*. 2013; Hock & Ferreira 2013; Pellegrini & Ferreira 2014). Many caves located in this biome probably represent hotspots of subterranean biodiversity and new inventories will certainly improve the knowledge of the subterranean fauna of the region.

Recently, a new troglobitic species, *Cryptops* (*Trigonocryptops*) *iporangensis* Ázara & Ferreira, 2013 was described from Ressurgência da Areias Cave, Iporanga, São Paulo, Brazil. This species comprised the seventh troglobitic species described for the genus in the world. The other troglobitic species are: *C*. (*T.*) *longicornis* Ribaut, 1915, from mainland Spain; *C*. (*T.*) *cavernicolus* Matic, Negrea and Fundora Martinez, 1977, and *C*. (*T.*) *troglobius* Matic, Negrea and Fundora Martinez, 1977, from Cuba; *C*. (*Cryptops*) *vulcanicus* Zapparoli, 1990, from the Canary Islands; *C*. (*T.*) *roeplainsensis* Edgecombe, 2005, and *C*. (*T.*) *camoowealensis* Edgecombe, 2006, from Australia (Ribaut 1915; Matic *et al*. 1977; Serra 1981; Zapparoli 1990; Edgecombe 2005, 2006; Ázara & Ferreira 2013).

Eight species of *Cryptops* occur in Brazil: *C*. (*Trigonocryptops*) *galatheae* Meinert, 1886; *C*. (*T.*) *iheringi* Brölemann, 1902; *C*. (*Cryptops*) *heathi* Chamberlin, 1914; *C*. (*C.*) *dubiotarsalis* Bücherl, 1946; *C*. (*C.*) *schubarti* Bücherl, 1953; *C*. (*C.*) *goiasus* Chamberlin, 1958; *C*. (*T.*) *hephaestus* Ázara & Ferreira, 2013 and *C*. (*T.*) *iporangensis* Ázara & Ferreira, 2013 (Bücherl 1940, 1942; Minelli 2006; Ázara & Ferreira 2013).

With this study, the number of troglobitic species in the world rises to eight, and Brazilian species of *Cryptops* rises to nine.

Material and methods

The single known specimen was collected by hand and fixed in 70% ethanol. The stereoscopic images were acquired using a Leica M205, with the software Leica Application Suite auto montage to combine the images. The morphological measurements were made using a stereomicroscope (Zeiss Stemi 2000-c) with a millimetric lens.

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The specimen has been deposited in the Subterranean Invertebrate Collection of Lavras (ISLA) in the Biology Department/Zoology Division of the Federal University of Lavras, Lavras, Minas Gerais State, Brazil. We follow the terminology of Lewis *et al*. (2005) and Bonato *et al*. (2010) for external anatomy.

Taxonomy

Genus *Cryptops* Leach, 1815

Type species: *Scolopendra hortensis* Donovan, 1810, by monotypy.

Cryptops (*Cryptops*) *spelaeoraptor* n. sp. Ázara & Ferreira, 2014

(Figures 1–3, 5C–D)

Type material. Holotype: ISLA 5000 from Toca do Gonçalo cave (10º30'41"S, 40º53'39.8"W), Campo Formoso, Bahia, Brazil, 08/I/2014, *leg*. R. L. Ferreira.

Etymology. The name is given as a reference to the Latin word *spelaeus*, meaning "living in caves" and to the latin word *raptor*, meaning "one who kidnaps", referring to the last pair of legs, which probably constitute an effective predatory or defensive "device".

Diagnosis. Very long setae on the first three antennal articles with the longest setae about the same length as the maximum width of antennal article 2; cephalic plate covered with transverse rows of fine, long setae, half the length of the longest setae on the first three antennal articles; anterior apex of the cephalic plate not indented; last pair of legs presenting 28 saw teeth on prefemur, 30 on femur, 24 on tibia, 17 on tarsus 1 and 17 on tarsus 2; the teeth of tarsus 2 on a ridge.

Description. Length (anterior margin of cephalic plate to posterior margin of ultimate tergite) 17.2 mm. Cephalic plate 0.7 mm long and 0.6 mm wide, antenna 3.5 mm long.

Head and three anterior most trunk segments light yellowish to whitish (Figure 1A). Posterior trunk segments and legs depigmented.

Cephalic plate not overlapping tergite 1, with about the same width and length; posterior corners rounded, sides convex, anterior apex not indented (Figure 1B). Paramedian sutures present only at the anterior part, extending about 1/3 the total length of the head plate. Head covered with transverse rows of long fine setae, the lateral sides with long fine scattered setae, half the length of the longest setae on the first three antennal articles.

Antenna composed of 17 articles; articles 1–5 increasing in length and decreasing in width, articles 2–12 having an average length of 0.42 mm and articles 13–17 an average length of 0.34 mm, maximum length of article 5 0.5 mm; articles quadrangular (Figure 1A). Article 1 with a transversal suture forming a ring on the anterior part. Articles 1–3 with a high density of very long setae of varied length, with the longest setae about the same length as the width of antennal article 2; articles 4–5 with a low density of these setae only in the anterior part of each article; from article 5, short, fine setae form a fur-like covering with long setae only encircling the proximal and distal part of each article; articles 14–17 without circle of setae on the distal part.

Anterior setose area on clypeus bearing four lanceolate setae; a disordered row of 15 prelabal setae; 4 lanceolate setae between anterior margin of clypeus and prelabal setae. Labrum with sidepieces notched (Figure 1E).

Anterior edge of forcipular coxosternite straight, with a disordered row of 7+7 submarginal setae. Inner surface of trochanteroprefemur with 6 lanceolate setae; surface of coxosternite and trochanteroprefemur with scattered fine and long setae. Femur, tibia and proximal part of tarsangulum with a row of lanceolate setae longer than the lanceolate setae of trochanteroprefemur. Tarsungulum articulated with trochanteroprefemur along wide hinge (Figure 1E).

Apical claw of second maxilla with slender hook distally, slightly curved on distal part, occupying 1/2 of article 3. Dorsal brush dense, running along the distal half of article 3.

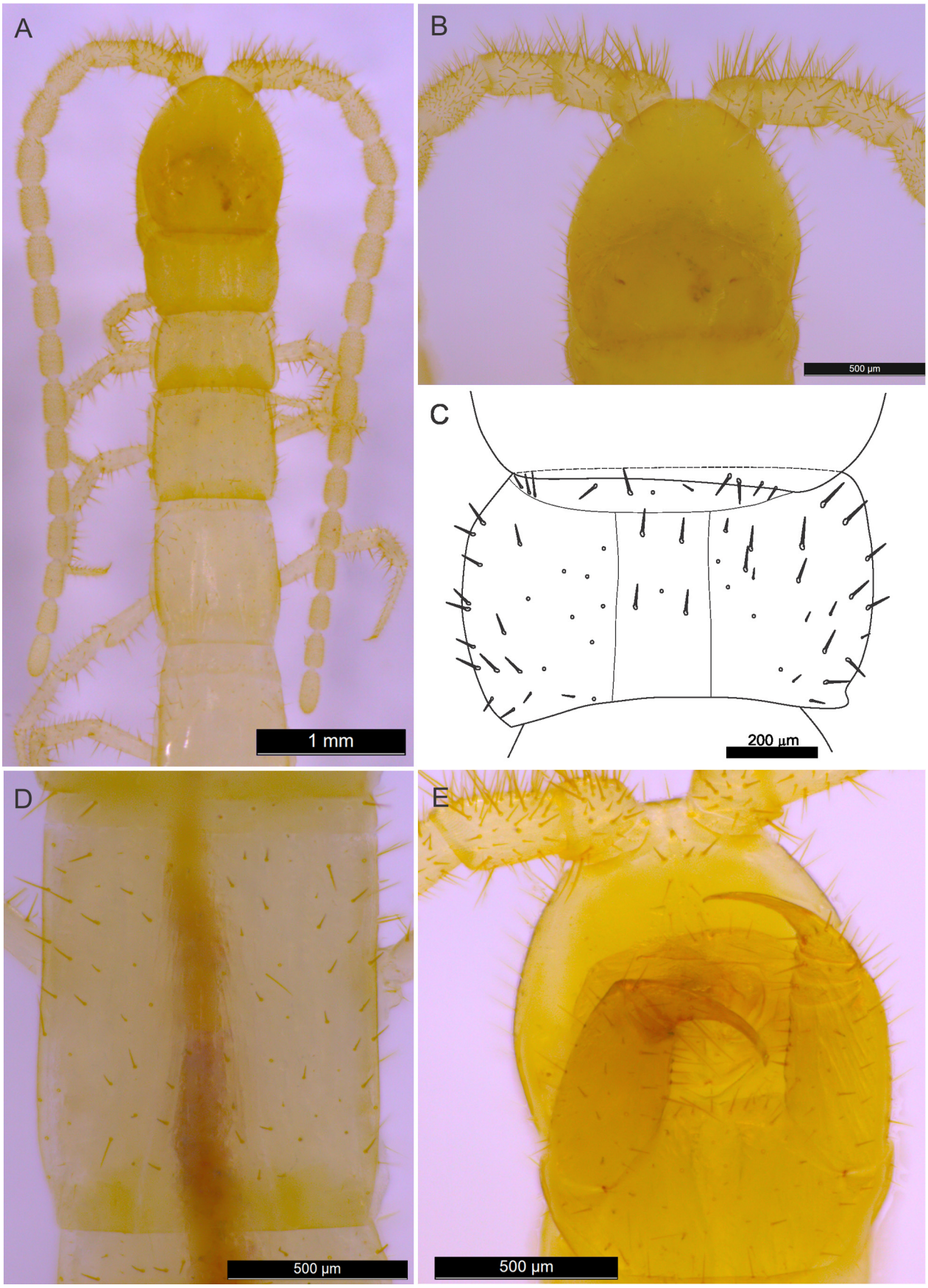

FIGURE 1. ***Cryptops* (*C.*) *spelaeoraptor* n. sp.** (ISLA 5000): A) Cephalic plate, antenna and anterior tergites; B) cephalic plate and three first antennal articles; C) first tergite; D) tergite 8; E) ventral view of head.

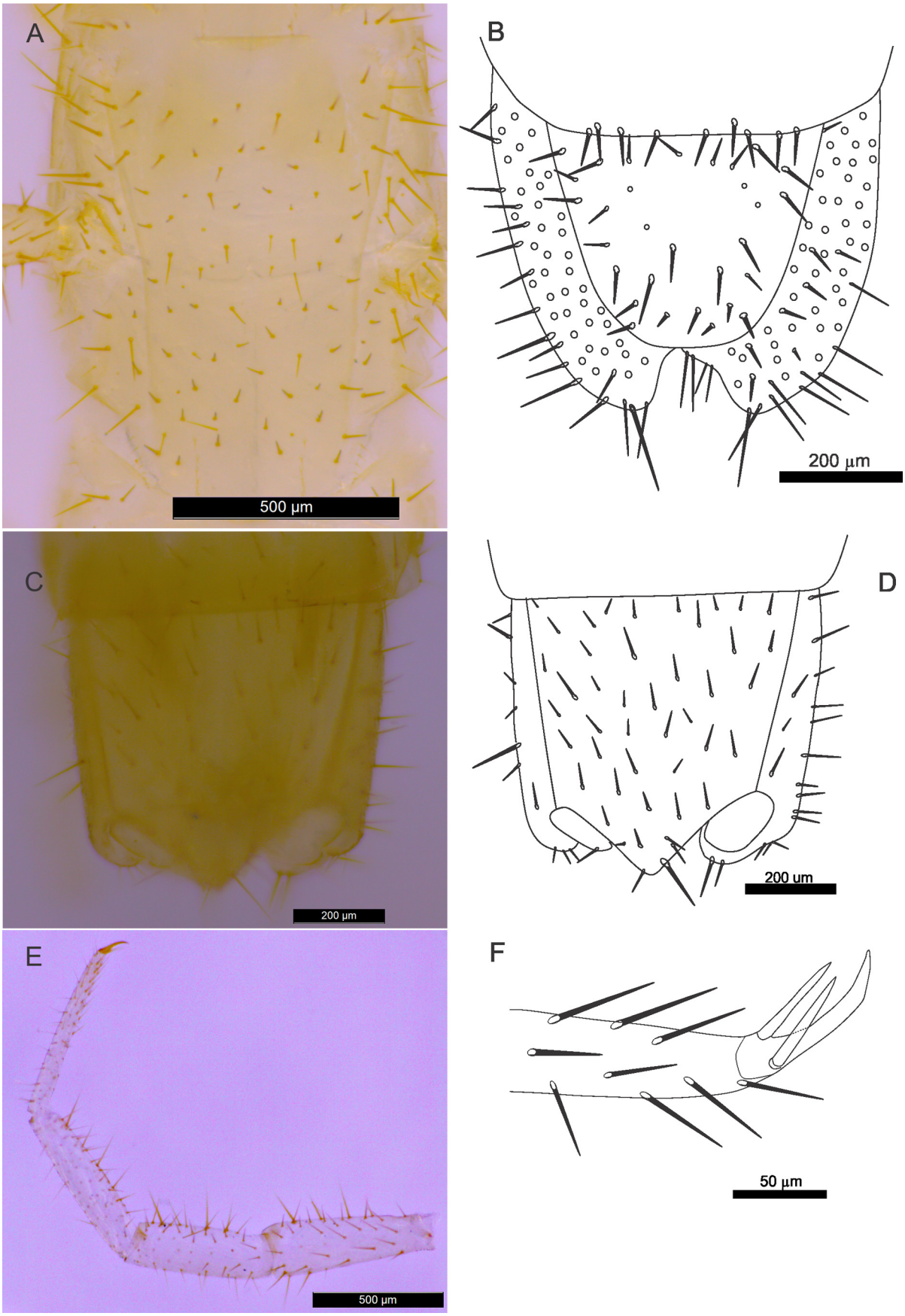

FIGURE 2. ***C.*** **(*C.*)** ***spelaeoraptor*** **n. sp.** (ISLA 5000): A) Sternite 4; B) sternite of ultimate leg-bearing segment; C–D) tergite of ultimate leg-bearing segment; E) leg 10, lateral view; F) pretarsus of leg 10.

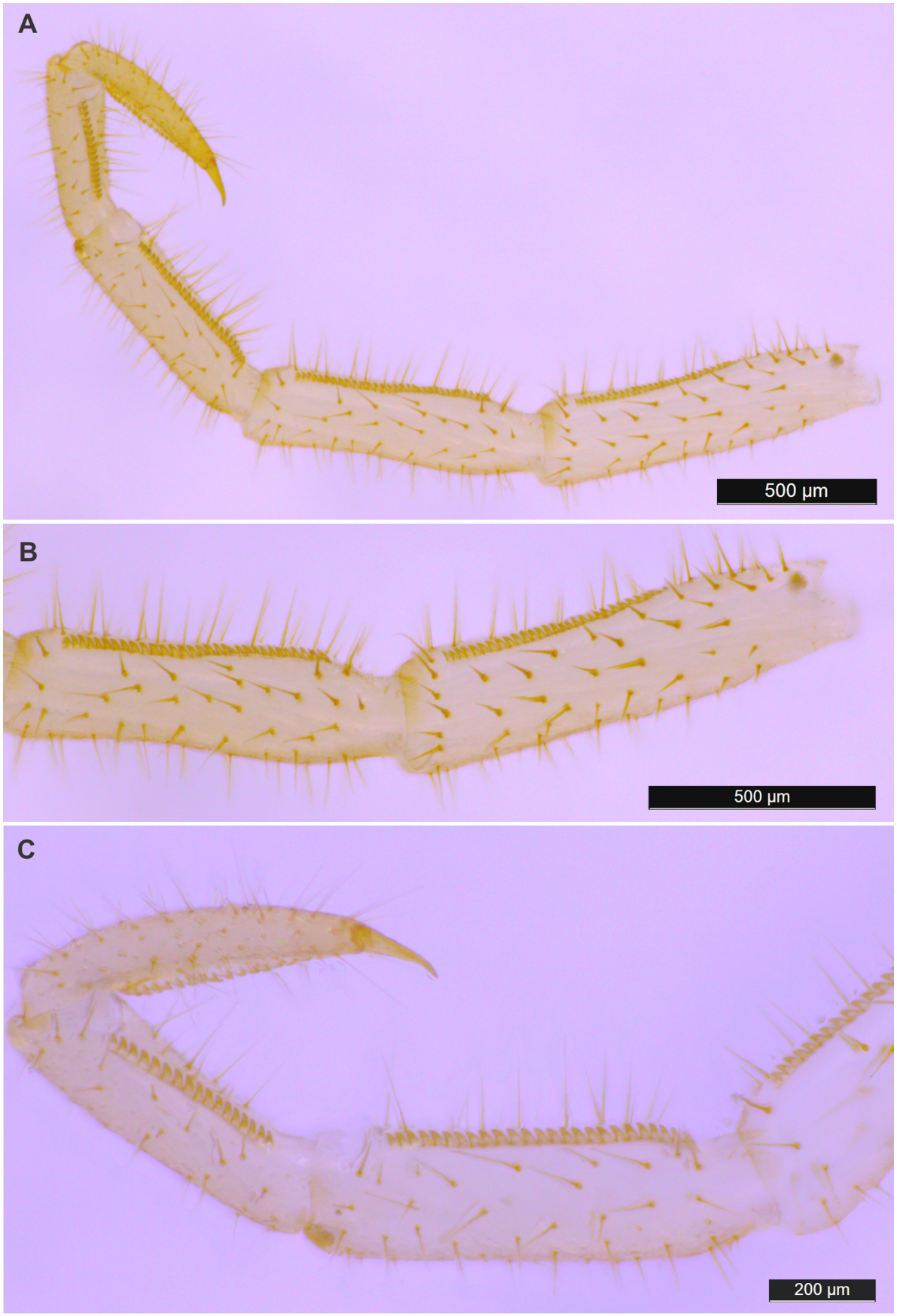

FIGURE 3. ***C.*** **(*C.*)** ***spelaeoraptor*** **n. sp.** (ISLA 5000): A) Leg 21, lateral view; B) saw teeth on prefemur and femur of leg 21, lateral view; C) saw teeth on tibia, tarsus 1 and 2 of leg 21, lateral view.

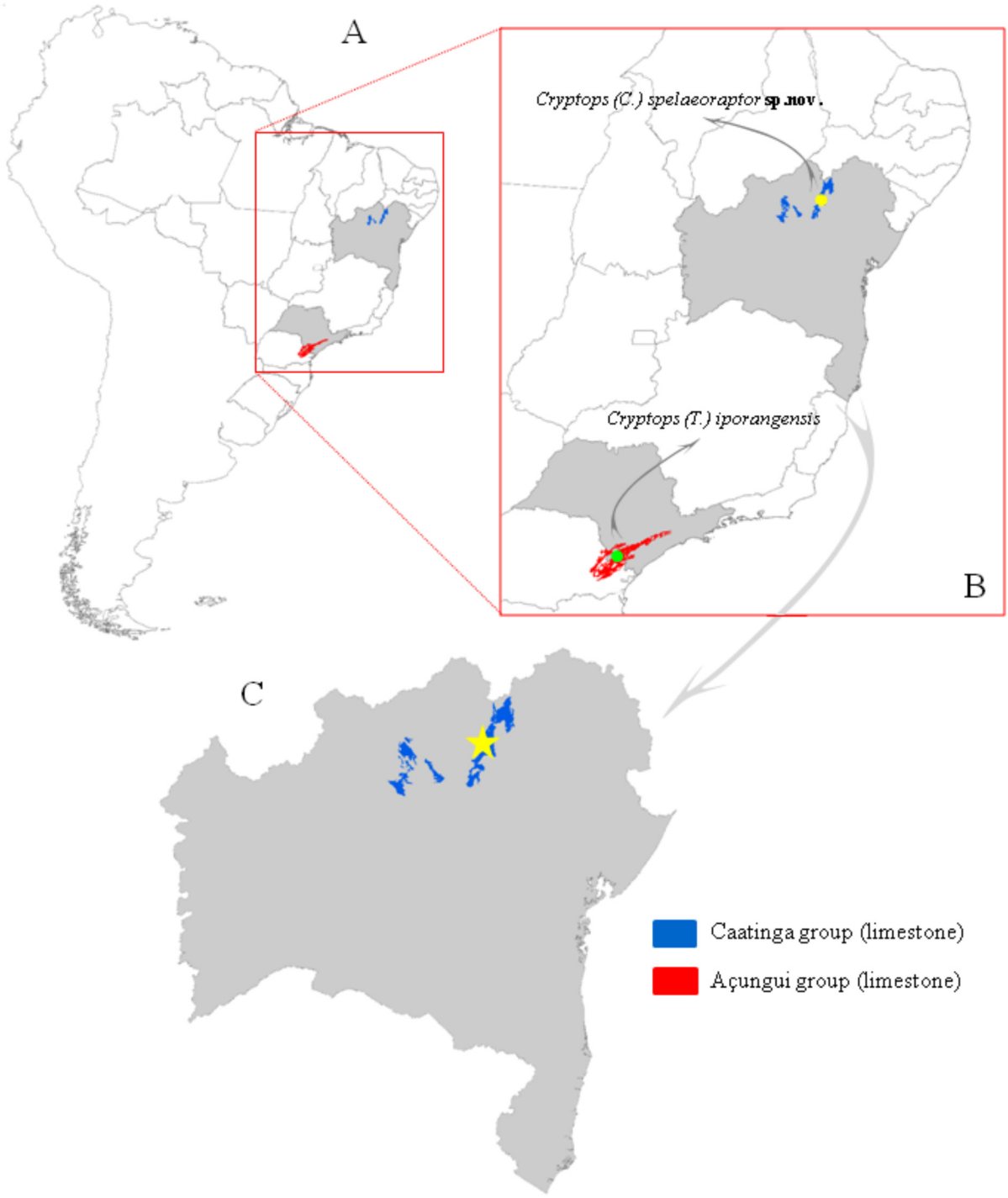

FIGURE 4. A) Map of South America showing Brazil; B) Map of Southeast and Northeast Brazil, showing the locality-type of the ***Cryptops* (*T.*) *iporangensis*** and ***Cryptops* (*C.*) *spelaeoraptor* n. sp.**; C) Map of Bahia State showing in detail the location of the Toca do Gonçalo cave.

Tergite 1 with complete anterior transverse suture (Figure 1C). Tergites 1–21 with homogeneous short and long setae. Tergites 1–19 with paramedian sutures, 4–19 with lateral crescentic sulci. Tergites 1–21 with scattered long fine setae (Figure 1D). Tergite 21 slightly longer than wide, posterior margin with rounded apex (Figure 2C–D). Pretergites 2–20 with a transverse irregular row of fine setae and some scattered fine setae, with the pretergite 6 a fifth of the total length of that tergite.

Spiracles elongated, elliptical.

Sternites 2–19 with median longitudinal and curved transverse sulci, their intersection forming a depression. Sternites 1–20 with short and long setae (Figure 2A). Sternite of ultimate leg-bearing segment with sides gently convex and converging posteriorly; posterior corners rounded (Figure 2B); Coxopleural pore field elliptical, with about 40 pores; short and moderately long setae only in the ventral portion of the pore field, less numerous than pores. Posterior margin of coxopleuron with spiniform setae.

Legs long and thin, e.g., leg 10 with prefemur 0.4 mm, femur 0.3 mm, tibia 0.2 mm, tarsus 0.4 mm (Figure 2E). Legs 1–20 with tarsi not bipartite. Ultimate pair of legs: prefemur 0.8 mm, femur 0.7 mm, tibia 0.6 mm, tarsus 1 0.4 mm, tarsus 2 0.5 mm; prefemur and femur about 4 times as long as their maximal width at the distal end. Ventral part of leg 1 with strong lanceolate setae on prefemur, femur and tibia, dorsal and ventral part of tarsus 1 and 2 and dorsal part of femur, prefemur and tibia with fine lanceolate setae; setae on legs 2 to 20 similar but less dense. Distal spinose processes lacking on prefemur, femur and tibia. Pair of accessory spines of pretarsus on legs 1–20 divergent, 2/3 the length of pretarsus (Figure 2F); accessory spines lacking on ultimate leg. All segments of the ultimate pair of legs bearing saw teeth, the teeth the same size on each segment (Figure 3A), 28 on prefemur, 30 on femur (Figure 3B), 24 on tibia, 17 on tarsus 1 and 17 on tarsus 2, with the teeth of tarsus 2 on a ridge (Figure 3C).

Discussion

Cryptops (*C*.) *spelaeoraptor* is unique within Scolopendromorpha in that it has the ultimate pair of legs bearing saw teeth on all segments except coxa and trochanter, with all the teeth about the same size, which can be easily separated from all other species of the genus *Cryptops* in the world.

The other species of *Cryptops* usually present saw teeth mainly on the tibia and tarsus, with some species also presenting a saw tooth distally on the femur (e.g. *Cryptops* (*C*.) *doriae* Pocock, 1891, from SE Asia). In very few species, such as *Cryptops (C.) inermipes* Pocock, 1888 from Christmas Island, the saw teeth are lacking on the ultimate pair of legs. However no species currently known possesses teeth on the prefemur or tarsus 2. The only two species of scolopendromorphs that most resemble the pattern of spines of this new species belong to another family, Scolopocryptopidae. These are *Kethops utahensis* (Chamberlin, 1909), from SW USA which presents a prefemur with 3 saw teeth, femur with 2–3, tibia with 9–10 and tarsus with 1, and *Thalkethops grallatrix* Crabill, 1960, from SW USA which has a prefemur with 7, femur with 11, tibia with 11 and tarsus 1 with 1 (Chamberlin, 1909; Crabill, 1960).

Cryptops (*C*.) *spelaeoraptor* has an anterior transverse suture and complete paramedian sutures on tergite 1, while *Cryptops* (*C*.) *heathi* has an anterior transverse suture curved medioposteriorly, with a depression at its center and with paramedian sutures, which do not exceed the transverse suture but instead form a W-shape where they meet, resembling some species of *Newportia* Gervais, 1847.

Cryptops (*C*.) *spelaeoraptor* can be separated from all other Brazilian species of the subgenus *Cryptops* in having saw teeth on all segments of the ultimate pair of legs. *Cryptops* (*C*.) *dubiotarsalis* has 6–10 saw teeth on the tibia and 2–4 on tarsus 1; *Cryptops* (*C*.) *schubarti* has 7–11 on the tibia and 3 on tarsus 1; *Cryptops* (*C*.) *goiasus* has 6 on the tibia and 4 on tarsus 1 and *Cryptops* (*C*.) *heathi* has 1 on the prefemur, 4 on the tibia and 2 on tarsus 1.

Cryptops (*C*.) *spelaeoraptor* shows highly troglomorphic traits, including very long trunk, antennae, legs and a high density of long setae on the cephalic plate and on the first three antennal articles. The new species differs from all other troglobitic species of *Cryptops* in possessing very long setae on cephalic plate, these arranged in transverse rows, and on the three first articles and by presenting saw teeth on all segments of the ultimate pair of legs. The new troglobitic species has elongate antennae, about 5 times the length of the cephalic plate. The highest antennal elongation in the genus is observed in *C*. (*T*.) *roeplainsensis*, this being 8.9 times the length of the cephalic plate.

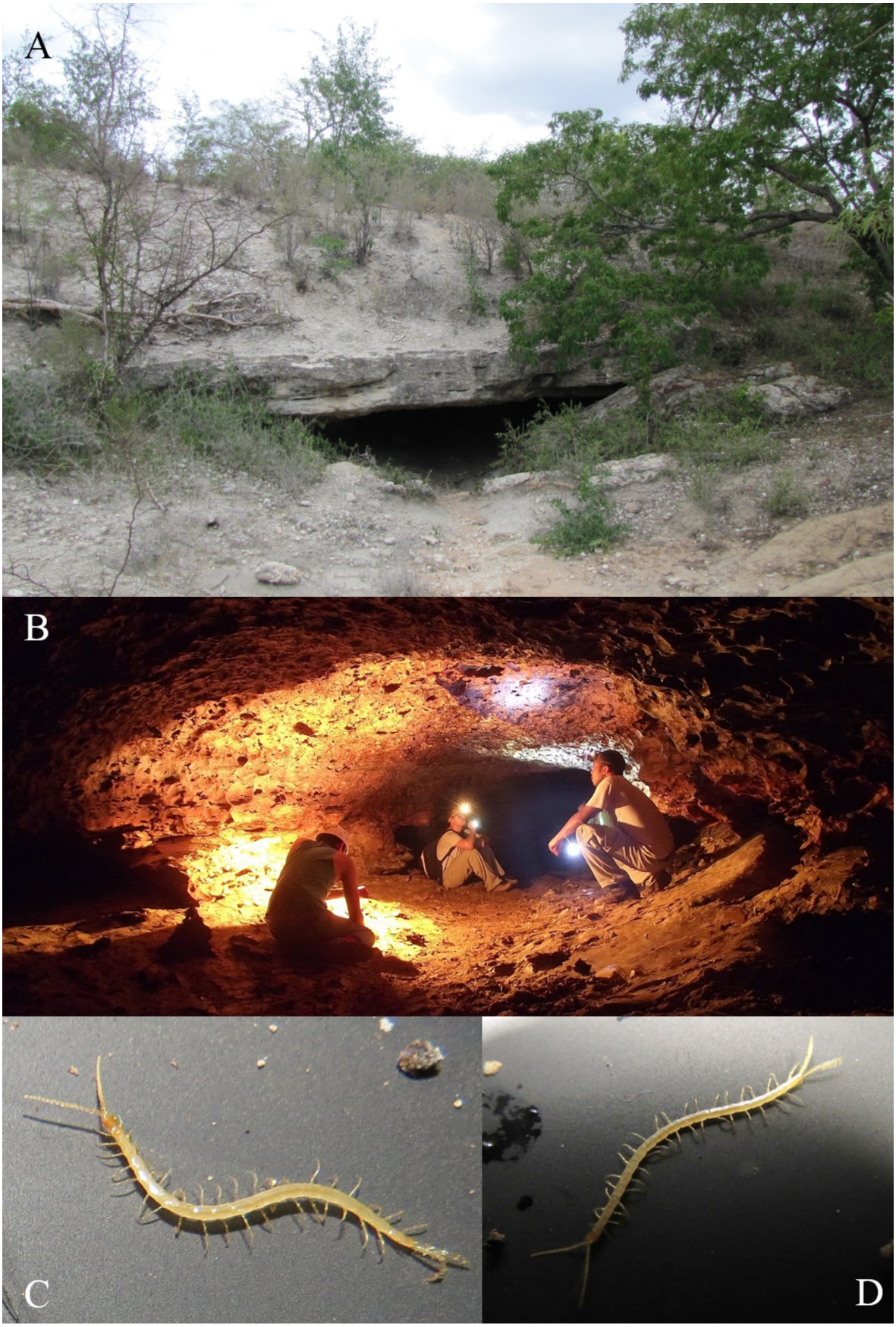

FIGURE 5. A) Entrance of the Toca do Gonçalo Cave; B) inner conduit of the cave; C–D) ***Cryptops* (*C.*) *spelaeoraptor n. sp.***, living specimen inside the cave.

Ecological remarks

Caves are characterized by absence of light, and stable temperature and humidity (Culver 1982). These conditions limit drastically the primary productivity by photosynthesis, making the largest pool of resources allochthonous in origin (Culver 1982; Souza-Silva 2003; Simon *et al.* 2007; Souza-Silva *et al.* 2007).

Under these conditions of low resource availability, a predatory species needs to be very efficient. Although Lewis (2010) had theorized that the saw teeth in *Cryptops* might not have a primary function of predation, we can hypothesize that this new morphology can be advantageous for this purpose. Accordingly, the saw teeth on all segments of the last pair of legs could hold potential prey more efficiently, improving the capture and thus, the feeding. Considering the food scarcity observed in caves (Gonçalo cave is a typical oligotrophic system), any improvement in capture ability would be selectively advantageous. Potential preys include crickets (including an undescribed troglomorphic species), cockroaches and especially silverfishes (Zygentoma: Nicoletiidae), these also troglomorphic. However, such legs can eventually be useful in defense against predators, since there is a relatively big population of a troglobitic species of Prodidomidae spiders (undescribed) in the cave which inhabits the same area where the single specimen of *C.* (*C.*) *spelaeoraptor* was found.

The Toca do Gonçalo cave is developed in limestones from the Caatinga group (of Quaternary age) (Figure 4A–C). The cavity is approximately 500 meters long, and is divided into two interconnected levels: a dry upper level, and a lower rather humid level, with several flooded passages (in contact with the phreatic level).

This cave comprises one of the richest caves regarding troglobitic species in Brazil, and also one of the most threatened by human activities. Its entrance is located in a small village and the water table (accessible only through the cave) constitutes the only water source for the locals (Figure 5A). Water has been extracted from the cave by a diesel pump, which has considerably polluted the cave. In 2010, a farmer from another village installed an additional pump (electric) in the cave. This pump was removing water throughout the day. This action resulted in a considerable lowering of the base level, which, allied with the great drought that occurred in the area in recent years (considered the most intense in the last 50 years), has led to the exposure of conduits that were always formerly submerged (Figure 5B). The single specimen of *C. (C.) spelaeoraptor* n. sp. was found in one of these conduits previously submerged. The specimen was observed under a rock on the muddy floor (Figure 5C–D). It is important to mention that our team has visited the cave several times (since 1998) and only one specimen was found, which suggests its extreme rarity.

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