

A new species of *Ceriochernes* Beier, 1937 (Pseudoscorpiones, Chernetidae) from Northeastern Brazil

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Abstract

A new species of pseudoscorpion from the genus *Ceriochernes* is described from Lapa dos Peixes cave, northeastern Brazil. This study provides a detailed morphological description, diagnostic characteristics, and illustrations for *Ceriochernes* sp1. Additionally, we present a comparative discussion of the genus *Ceriochernes* and include a habitat description. We also emphasize the need for further exploration in uncharted areas, as additional new species are likely to be discovered.

1. Introduction

Pseudoscorpions represent an important order of arachnids, with a worldwide distribution except for Antarctica (Benavides 2019). They inhabit a variety of environments, including tree trunks, leaf litter, spaces under rocks, and caves, where they can exhibit significant diversity. The order presents 26 families (and one extinct), 15 of which occur in Brazil, with 10 families already recorded in caves. Among these, Chernetidae stands out as the third-largest pseudoscorpion family, consisting of approximately 731 species (17% of pseudoscorpion diversity) and 120 genera (WAC 2024), including *Ceriochernes*, the focus of this study.

The genus *Ceriochernes* was first described based on specimens found in Phillipines (Beier, 1937), and further expanded by the description of additional species from Sri Lanka, Nepal and Brazil (Beier, 1973; Beier, 1974; Mahnert, 1985). This disjunct distribution can be due to vicariance or, alternatively, to the lack of detailed studies along the distributional

gap of the genus.

From the 8 valid species of *Ceriochernes*, 3 occur in Brazil: *Ceriochernes brasiliensis* Beier, 1974 from Santa Catarina state, Southern Brazil; *Ceriochernes foliaceosetosus* Beier, 1974, from Amazon state, Northern Brazil and *Ceriochernes foliaceosetosus* Beier, 1974 *Ceriochernes amazonicus* Mahnert, 1985, the most widespread distributed species in the country, with records from Santa Catarina, Pernambuco and Amazonas states, spanning from Southern to Northern Brazil.

In this study, we describe a new species of *Ceriochernes* found in a cave from Bahia state, northeastern Brazil. We herein provide a complete description of the new species, discuss some potential traits that could indicate adaptations to cave life and also provide some aspects of the species' habitat and threats.

2. Methodology

Study area

Specimens of the new species of *Ceriochernes*, herein described were collected in the Lapa dos Peixes cave, which is part of the Água Clara cave system (ACCS), located in the karst region of Serra do Ramalho, municipality of Carinhanha, Bahia state, Brazil (Fig. 1). The ACCS has approximately 24 km, and is composed of four limestone caves trespassed by an intermittent stream, active during the rainy period (October until March). According to Köppen's climate classification system, the local climate is "Aw", with dry winter and an average annual rainfall of 640 mm³ (Alvares et al. 2013). The Serra do Ramalho region is inserted in the Caatinga domain (the only Brazilian semi-arid biome), with transitional areas to the Cerrado (Brazilian Savanna) (Cole 1960).

Field sampling

The specimens were collected in Lapa dos Peixes cave as part of an extensive invertebrate survey. The holotype was gathered on September 7, 2023, by R.L. Ferreira, while the paratype was collected on June 3, 2024. Both specimens were gathered using fine brushes moistened with

ethanol and preserved in vials containing 70% ethanol.

Analysis and preparation

The specimens were analyzed using a Zeiss Axio Scope A1 optical microscope, with image analysis conducted through the ZEN 2012 software. Illustrations of the specimens' bodies and appendages were created using a drawing tube attached to an Olympus BX40 optical microscope with phase contrast capabilities. Kaiser's glycerol gelatin was applied as the mounting medium to ensure stability during both observation and illustration processes. Photographs of structures and appendages were taken using a Zeiss Axio Zoom V16, with image capture facilitated by the ZEN 2.1 software. These images were subsequently vectorized using Inkscape 1.1 software (Montesanto 2015; available at inkscape.org). Further examination of the paratypes was performed with a Hitachi TM4000 scanning electron microscope (SEM). The holotypes and paratypes of both species have been deposited in the Coleção de Invertebrados Subterrâneos de Lavras (ISLA).

3. Results

Family Chernetidae Menge, 1855

Subfamily Chernetinae Menge, 1855

Tribe Chernetini Menge, 1855

Ceriochernes sp1

Material Examined. Holotype male (ISLA 125649), preserved in ethanol: Brazil, Serra do Ramalho, Bahia, Lapa dos Peixes (13° 49' 22.1" S 43° 57' 25.2" W), September 7, 2023, collected by R.L. Ferreira. Paratype female (ISLA 125650), same data as the holotype, except it was collected on June 3, 2024.

Etymology.

Diagnosis. *Ceriochernes* sp1 differs from other species of the genus by hexagonal reticulate epicuticle; carapace 0.080 mm longer than wide; presence of modified leaf-shaped setae, filamentous setae and other branched setae; cheliceral chaetotaxy with 8 setae; hand and finger of the chela with equivalent proportions. Trichobothria: *st* closer to *t* than to *sb* and *b*; *ist* proximal to *it*; *ist* adjacent to *est*; *esb* slightly distal to *eb*; *et* and *it* adjacent and opposite.

Description. Body and Legs, orange-brown; pedipalps darker orange-brown; chelicerae almost translucent orange-brown. Entire body covered by a reticulated epicuticle with a hexagonal shape, resembling a beehive.

Carapace: 0.080 mm longer than wide (paratype 0.041mm wide than longer); showing a difference between ocular width and posterior width of 0.197 (0.302) mm; without ocular apparatus; Two transverse grooves, in the medial and posterior position; 48 modified setae, leaf-like, (of these, 9 on lateral margins, 11 between the first and second groove and 4 between the last groove and the posterior margin.)

Coxas: Intercoxal tubercle absent, the palpal coxae with reticulate epicuticle, with 17 setae, 7 modified setae closer to the margin, 10 filamentary in the internal portion, has reticulate epicuticle; coxae of the legs, without reticulated epicuticle, with only filamentary setae, chaetotaxy I–IV: 13(14):16(17):20:28(29).

Tergites: Divided horizontally except for I and XI. All setae modified. Chaetotaxy I–XI: 4:4:4:5:4:4:6:6:6:7.



Figure 1: Figure 7. New species' habitus.

Sternite: Covered with reticulate epicuticle of hexagonal shape. Granular integument resembles scales. Chaetotaxy II–XII: 44:21:8:13:14:13:12:11:8:3:4 (anal). Modified setae smaller than those on tergites. Segments II, III, and the two central setae of segment V are filamentous. Female genital operculum with (35)38 setae in the anterior region and 20(22) along the posterior margin.

Chelicera: Hand with 7 setae and movable finger with 1, sbs, bs, bs1 and bs2 are branched; ls long, es short. Fixed finger with 8 teeth, pointed and facing backwards (the first three distal ones smaller and spaced apart); movable finger without teeth; galea with bifid tip and a subdistal ramus; external serrula with 19 blades, Internal serrula with four distal blades (the first elongated and three rounded), bearing small spine-like projections, followed by a continuous, uniform structure resembling a veil; rallum with 3 blades, the third most distal blade is larger and serrated, the others smooth.

Palps: Trochanter 0,17 (0.15) mm times wider than long, with a rounded (ventral) protuberance; femur 0.43 (0.43) mm times longer than wide, with internal margin convex, like an arch; patella 0.31 (0.38) mm times longer than wide, most proximal part thin, and the distal part in oval shape; hand similar size to the fingers, with modified leaf-shaped setae; fingers with filamentous setae, without reticulated epicuticle; chela with some bifid and branched setae; movable finger slightly curved inwards like an arch, with 51(48) teeth, facing backwards, with pointed apex, 2 smaller accessory teeth, located distally in the external lateral region; fixed finger straight with 43(45) homogeneous teeth in the shape of a trapezoid, with pointed apex, and 5 accessory teeth located distally in the external lateral region. Trichobothria: *st* closer to *t* than to *sb* and *b*, *ist* proximal to *it*, *ist* adjacent to *est*, *esb* slightly distal to *eb*, *et* and *it* are adjacent and opposite. Well-developed venom apparatus on the mobile finger.

Leg I: Arolium smaller than the claw; tarsus with predominant of modified setae, filamentous setae on the internal part and around the most distal tip; tibia with a single seta on the distal part; femur and patella (not fused), with only modified setae; trochanter with modified setae only on the outer part and completely granulated (thorn-like granules).

Leg IV: Arolium smaller than the claw; tarsus with predominant of modified setae, filamentous setae on the internal part and around the most distal tip; tibia with 3 filamentous setae on the internal part, femur and patella (fused) with filamentous and modified setae distributed around the limb; trochanter with filamentous setae on the internal part and two modified setae on the outer part.

Measurements (mm): Female holotype (Paratypes in parenthesis): body length 2.23 (2,50); carapace 0.70/0.62(0,764/0,805). Chelicera 0.23/0.10(0.29/0.14). Pedipalp: trochanter 0.39/0.22(0.45/0.30); femur 0.63/0.20(0.68/0.24); patella 0.55/0.23(0.65/0.27); hand (with pedicel) 0.54/0.36(0.62/0.42); chela (with pedicel) 1.13/0.36(1.25/0.42); chela (without pedicel) 1.085/0.36(1.20/0.42); movable finger length 0.60(0.66). Leg I: trochanter 0.16/0.12 (0.17/0.13); femur 0.21/0.14 (0.20/0.14); patella 0.20/0.12 (0.30/13); tibia 0.32/0.10 (0.34/0.10); tarsus 0.35/0.07 (0.40/0.07). Leg IV: trochanter 0.25/0.13 (0.21/0.13); femur + patella 0.53/0.12 (0.60/0.13); tibia 0.50/0.11 (0.51/0.11); tarsus 0.36/0.08 (0.40/0.07)

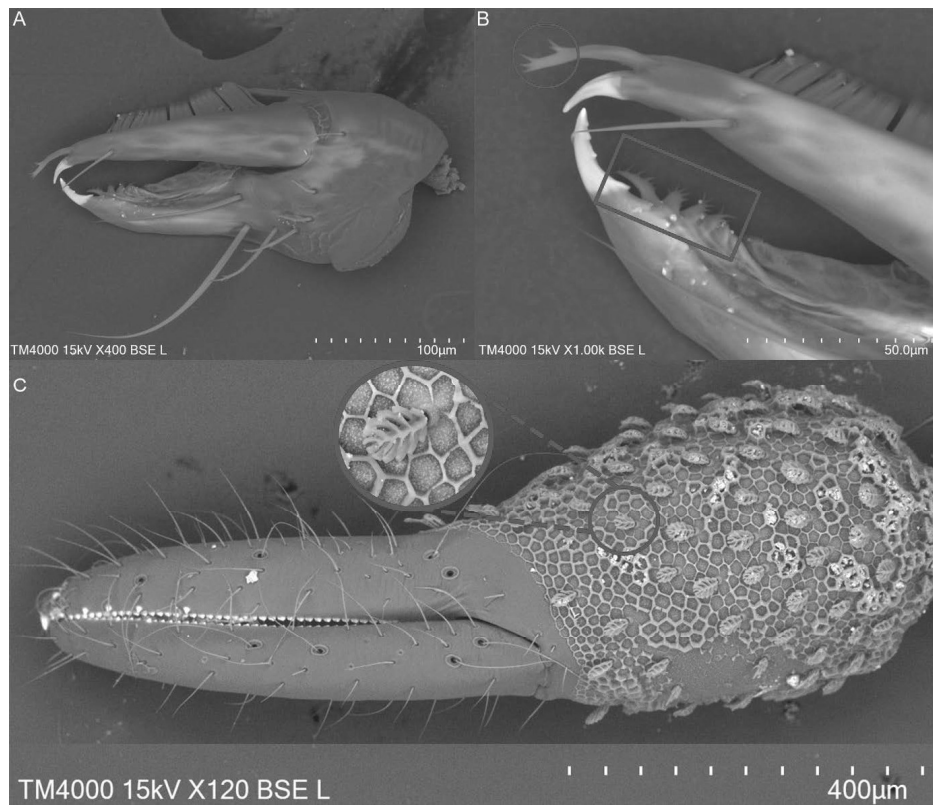


Figure 2: *Ceriochernes sp1* female paratype A) Right chelicera, dorsal view B) Detail of left chela, showing galea branching, and internal serrula C) Left chela, external view, highlighting modified setae and reticulated epicuticle.

4. Discussion

The genus *Ceriochernes* comprises eight known species worldwide, distributed across four countries. *Ceriochernes detritus* Beier, 1937, the first species described for the genus, is found in the Philippines and differs from the newly described species in several characteristics: the setae are not modified into leaf-like shapes, the chelicera has a rallum with three smooth setae (two short and one long), the galea has 3 to 6 lateral branches, the tergite has divided segments except for the last one, and it is further distinguished by the number of teeth on the chelae (48 on the fixed finger and 48 on the movable finger).

Ceriochernes besucheti Beier, 1973, from Sri Lanka, differs by the shape of the carapace (0.12 mm longer than wide), the short setae that are not modified into leaf-like shapes, the galea with 6 to 7 lateral branches in the chelicera, the tergite entirely divided, and in the chelae, the fingers are slightly shorter than the palm (without a pedicel).

In Nepal, three species occur: *Ceriochernes martensi* Beier, 1974, distinguished by its reticulated epicuticle (without an hexagonal pattern), almost invisible ocular marks, and two transverse sulci on the carapace, with the sub-basal sulcus close to the posterior margin. The chelicera has 5 setae, and the tergite has divided segments except for the last one. *Ceriochernes nepalensis* Beier, 1974, differs by its reticulated epicuticle (without an hexagonal pattern), short and thick setae, and the chelicera with 5 setae. In the chelae, the fingers are shorter than the palm (without a pedicel). *Ceriochernes vestitus* Beier, 1974, is distinguished by the reticulated epicuticle (without an hexagonal pattern),

two transverse sulci on the carapace, with the sub-basal sulcus near the posterior margin, and the shape of the carapace (0.05 mm longer than wide). The chelicera has 5 setae.

In Brazil, three species have already been described: *C. brasiliensis*, which differs in the shape of the carapace (0.12 mm longer than wide), the chelicera with 7 setae, the tergite with divided segments except for the last one, and in the chelae, the fingers are almost the same size as the palm (without a pedicel). *C. foliaceosetosus*, differs by the shape of the carapace (0.05–0.06 mm longer than wide), the external serrula of the chelicera with 17 lamellae, the cheliceral setae with 6–7 setae, the galea branched with 5 lateral branches, the tergite with divided segments except for the last one, and the number of teeth on the chelae (35 to 40 teeth on both the fixed and movable fingers). The fingers are slightly shorter than the palm (without a pedicel), and there are differences in certain body proportions. *C. amazonicus* Mahner, 1985, differs in the flattened vestiture setae, the chelicera with 7 setae, the galea branched with 6 apical branches, the female genital operculum with 30 setae, and the tergite entirely divided.

Although the descriptions of these species are older and not very detailed, they exhibit several characteristics that differ significantly from *Ceriochernes sp1* nov., confirming it as a new species of the genus. A future revision of the genus would be essential to clarify gaps in the current knowledge of the group, along with molecular analyses to better understand the genus' distributio.

5. Conclusão

The description of this new species increases the number of species in the genus *Ceriochernes* to nine, four of which are found in Brazil. Furthermore, by incorporating several previously unillustrated characters in the descriptions of other species within the genus, this work serves

as a model for future descriptions of new species that may be discovered. Finally, this new species confirms the taxonomic diversity and consequent significance of the Água Clara system, the richest hotspot of tropical subterranean biodiversity.

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