

A new cave-dwelling species of *Spelaeobochica* (Pseudoscorpiones: Bochicidae) from Brazil

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Abstract. *Spelaeobochica iuiu* sp. n. is described from Lapa do Baixão limestone cave in the municipality of Iuiu (Bahia, Brazil). It is easily distinguished from the two other species of the genus, *S. allodentatus* Mahnert 2001 and *S. muchmorei* Andrade & Mahnert 2003, by its pedipalpal measurements and proportions, but particularly by the presence of tooth-like protuberances on the pedipalpal segments. It is considered a troglobitic species.

Keywords: Karst, morphology, Neotropics, troglobitic

In Brazil, karstic areas are economically explored by several mining companies; as a consequence, many caves have disappeared with their fauna unknown or poorly studied. Different forms of anthropogenic activities such as quarrying, agriculture, waste disposal and tourism also take place in different parts of the country, which are liable to significantly affect cave communities (Ferreira & Martins 2001). Recent research documenting the cave biota of Brazil has intensified with the goal of protecting these endangered biotopes and their fauna (Souza-Silva et al. 2011).

Existing knowledge of the cave-dwelling pseudoscorpions from Brazil was summarized by Mahnert (2001), who recorded 25 species in seven families from about 100 caves, including the new genus *Spelaeobochica* and the type species *S. allodentatus* Mahnert 2001 from Bahia State. Subsequently, a second species of *Spelaeobochica*, *S. muchmorei* Andrade & Mahnert 2003, was added by Andrade & Mahnert (2003) from caves located in São Paulo State, Brazil.

The family Bochicidae ranges from Texas and Mexico to South America, from the Antilles to Venezuela, Guyana and Brazil, as well as in Europe (Spain, Portugal) (Muchmore 1998; Mahnert 2001; Zaragoza 2004; Reboleira et al. 2010).

The discovery of this new species in Bahia represents the third species of the genus *Spelaeobochica*. It inhabits the Lapa do Baixão cave (limestone karstic area), and it is highly adapted to the hypogean environment.

METHODS

Field work was performed in Lapa do Baixão cave (14°23'8.13"S, 43°37'35.06"W). The pseudoscorpions were found by visual searching of the cave floor and walls, captured with a fine brush, and placed in vials with 70% ethanol. We examined the specimens used for morphological analysis as temporary glycerine mounts in cavity slides. After examination, specimens were returned to 70% ethanol in glass vials. Measurements and drawings were made using a drawing tube with a phase contrast microscope. We studied one specimen (ISLA–846) using a scanning electron microscope. Parts of the female paratype were assembled on aluminum support stubs, placed over a film of aluminum foil with carbon tape, sputter-covered with gold (Baltec SCD 050), and observed in a LEO EVO 40 XVP scanning electron microscope (Leo Electron Microscopy). The ratios given are the length/width and length/depth for the legs. When two articles are compared, the ratio is

the length/length index, and all measurements are listed in millimeters. Terminology follows Chamberlin (1931), Harvey (1992) and Judson (2007).

The specimens are lodged in the collection of invertebrates in the Laboratory of Subterranean Ecology, Biology Department of Lavras Federal University, Minas Gerais State, Brazil (ISLA); a paratype male (ISLA845) is deposited in the Museum of Natural History of the city of Geneva (MHNG).

TAXONOMY

Family Bochicidae Chamberlin 1930
Genus *Spelaeobochica* Mahnert 2001

Type species.—*Spelaeobochica allodentatus* Mahnert 2001, by original designation.

Spelaeobochica iuiu new species
(Figs. 1–19)

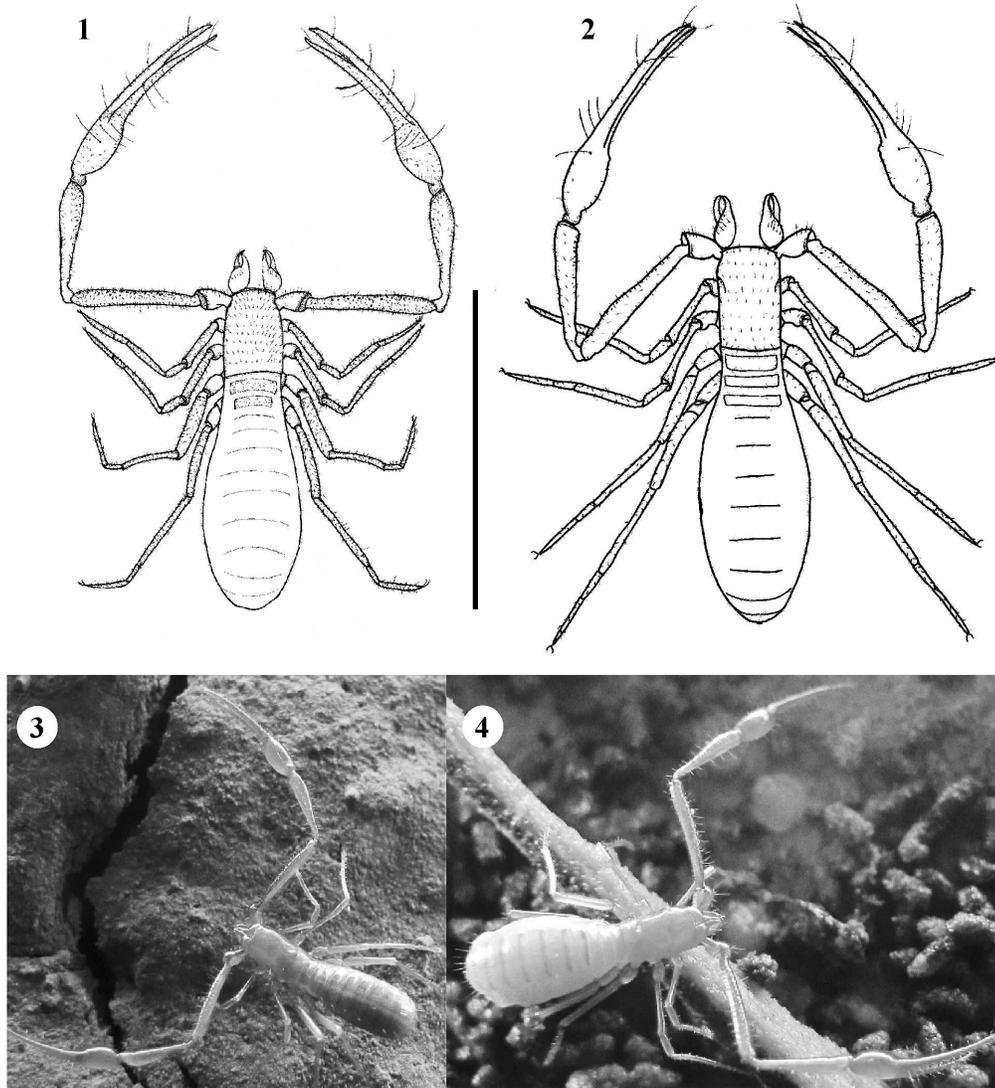
Material examined.—BRAZIL: *Bahia*: holotype female (slightly damaged, distal third of the left palpal finger missing), Lapa do Baixão cave, Iuiu (14°23'8.13"S, 43°37'35.06"W), 8 June 2010, R.L. Ferreira (ISLA–844). Paratypes: 2 males, same locality, 8 June 2010, R.L. Ferreira (1 each ISLA–846; MHNG–845); 1 female, same locality, 8 June 2010, (ISLA–842); 1 tritonymph, 20 July 2007, R.L. Ferreira (ISLA–843).

Etymology.—The specific name *iuiu* is treated as a noun in apposition; in Portuguese, it refers to the name of the municipality that the specimen inhabits.

Diagnosis.—The new species is characterized by the slender pedipalps (femur 7.8–8.3 times, patella 5.6–6.6 times, chela 6.1–6.9 times as long as broad), by the finely granulate pedipalps and, particularly, by the presence of tooth-like protuberances on femur and patella, and the presence of one tooth-like protuberance on medial side of chelal hand near the base of the fixed finger.

Description of adults.—Pedipalps, carapace, chelicerae, first coxae, and first abdominal segments reddish brown; other parts of the body yellowish brown. Tergites and sternites with light sclerotization along anterior margin. Vestitural setae smooth, delicate, and long.

Carapace: 1.6 times longer than broad, broadest near middle, then slightly narrowed to base, anterior margin smoothly rounded, without epistome, a broad reticulate transverse band near posterior margin; without eyes; 60 setae



Figures 1–4.—*Spelaeobochica iuiu* new species: 1. Habitus of male paratype; 2. Habitus of female holotype (scale bar 4.5 mm); 3, 4. Photographs of living specimens.

(6 setae on anterior margin and 6 on posterior margin), the range for paratypes is 50–60 setae.

Chelicera (Figs. 5, 15, 16): with 10 (11 on ♂) dorsal and 3 lateroventral setae on hand, fixed finger with 9 small teeth, (♂: 8–6), movable finger with 5 acute teeth, (♀ and ♂: 4) and a large, laterally displaced subterminal tooth, which is continuous with the remaining teeth; galea simple, slender and acute; subgaleal seta reaching end of galea; serrula exterior with 27 blades (♀: 28, ♂: 27–30), serrula interior with 23 blades (♀: 18, ♂: 22–23); rallum (Fig. 6) of 4 apically dentate blades, the two distal blades closely set.

Tergites: undivided, chaetotaxy: 6: 6: 6: 6: 9: 10: 9: 9: 9: 7: 6 [♂: 6: 5–6: 6–7: 6–8: 8–9: 8–10: 8–9: 9–10: 9–11: 7: 6–7; ♀: 6: 4: 6: 8: 8: 9: 11: 12: 7: 6]. Pleural membranes smoothly, longitudinally striate; manducatory process acute, with 2 apical marginal and 1–2 discal setae, 1 short (sub-oral) seta on palpal coxa; palpal coxa laterally scaly and sculptured, with numerous tiny pores, 6–8 long setae, coxae with numerous tiny pores (number decreasing from I to IV), I with 4–5 setae, II 4–5, III 4, IV 4–6.

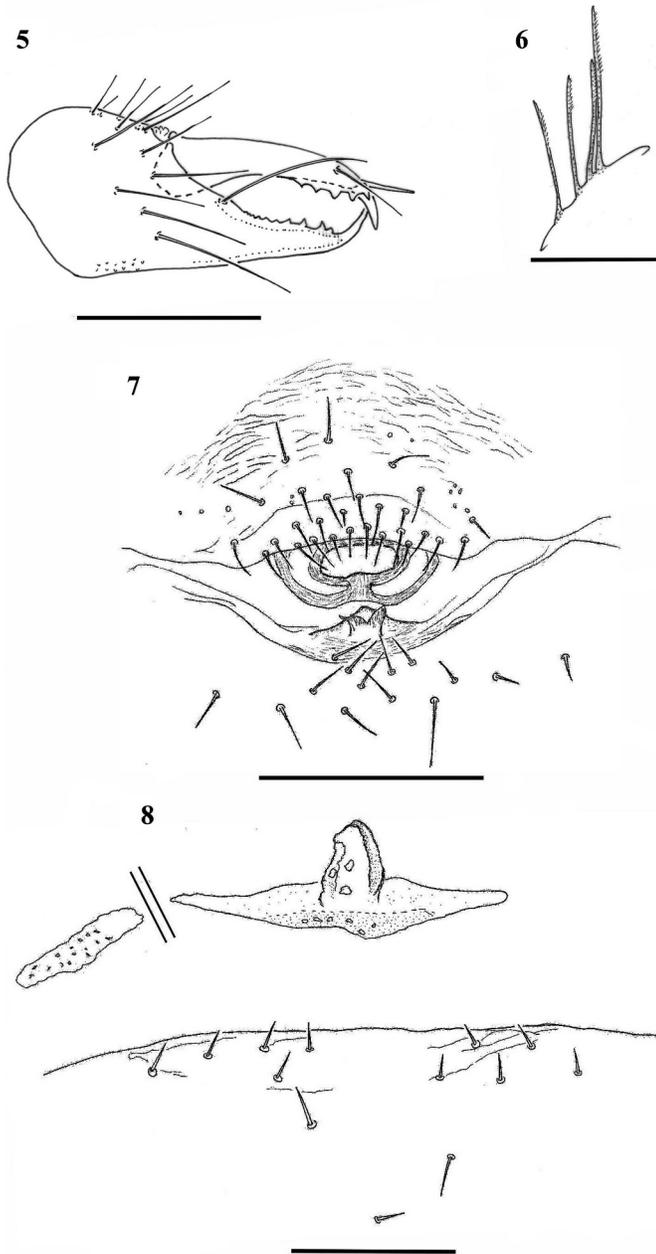
Genital operculum of females (Fig. 8): 12 marginal and discal short setae (♀: 13), median cribrate plate sclerotized, with a median finger-like prolongation, lateral cribrate plates elongate.

Chaetotaxy of female sternites: III with 14 marginal setae (♀: 16) and 3 suprastigmal setae on each side, IV: 7–8 + 2×2, V–VII: 11–12, VIII–X: 11, XI: 6, slit-like pores present. Anal cone of all specimens with 2 pairs of short setae.

Genital operculum of males: (Fig. 7) with 17–18 marginal short setae and approximately 11 longer discal setae, sternite II medially somewhat furrowed with tiny pores.

Chaetotaxy of male sternites: III: 5–7 marginal longer setae, 7 median discal setae + 6 setae on sternite (2 suprastigmal setae on each side), IV: 9–10, V: 10, VI: 9–11, VII: 11, VIII: 11–12, IX: 11, X: 10–11, XI: 6.

Pedipalps: (Figs. 9, 10, 11, 17; see Table 1 for measurements and proportions). Trochanter finely granulate, indistinct hump present; femur with a distinct tubercle on lateral side near end, with a series of tooth-like small protuberances, finely granulate, patella with a medial protuberance near end of



Figures 5–8.—*Spelaeobochica iuiu* new species: 5. Left chelicera of female holotype (scale bar 0.3 mm); 6. Rallum of female holotype (scale bar 0.1 mm); 7. Genital operculum of male paratype (scale bar 0.25 mm); 8. Genital operculum of female holotype and one median and one lateral cribrate plate (scale bar 0.1 mm).

pedicel, with a few tooth-like protuberances on medial side and mediolaterally finely granulate, hand with pedicel very finely granulate in distal half, on medial side near base of fixed finger with a tooth-like protuberance. Fixed finger (holotype: distal third of the left palpal finger missing) with about 75–78

broad, acute, densely set teeth, in distal half of finger 8–9 antiaxial accessory teeth present, 19–22 paraxial accessory teeth; with total of 27–30 accessory teeth. Movable finger with 73–79 teeth, movable finger with 5–6 (right)/4–8 (left) antiaxial and 13–16 (right)/11–13 (left) paraxial accessory teeth (partly in two series), with total of 15–21 accessory teeth. Venom apparatus well developed in both fingers, venom duct long, nodus ramosus slightly distal to *ist*, respectively *st*. Trichobothrial pattern: *ib* in distal half of hand dorsum; *ist* slightly distal of *est*, *est* is proximate compared to *st* on movable finger, *isb* in basal position much nearer to *esb* than to level of *sb*, *it* indistinctly distal of *et*; *b-sb-st-t* almost equidistant.

Leg I (Fig. 12): see Table 1 for measurements and proportions.

Leg IV (Figs. 13, 19): see Table 1 for measurements and proportions. Subterminal setae finely dentate apically (Fig. 14); arolia undivided and shorter than smooth claws.

Description of tritonymph.—Paler than adult (whitish coloration) with the fingers of pedipalps and chelicerae light red. Vestitural setae smooth, delicate, and long.

Carapace: 1.5 times longer than broad; with 40 setae (6 setae on anterior margin and 6 on posterior margin).

Chelicerae: 8 acuminate dorsal and 2 lateroventral setae on hand, fixed finger with 9 rounded teeth, movable finger with 4 rounded teeth and a large, laterally displaced subterminal tooth, similar to adults; galea slender; acute; subgaleal seta reaching end of galea; serrula exterior with 25 blades, serrula interior with 18 blades; rallum of 4 apically dentate blades (with the same aspect of the rallum of adults).

Tergites undivided, chaetotaxy: 4: 4: 6: 6: 6: 6: 9: 9: 9: 6: 6. Pleural membranes smoothly, longitudinally striate; manducatory process acute, with 2 apical marginal and 1–2 discal setae, 1 short seta on palpal coxa; palpal coxa laterally scaly, sculptured, with tiny pores, 6 long setae (shorter than in adults), coxae also with tiny pores (number decreasing from I to IV), I with 4 setae, II 3, III 3, IV 4.

Sternites chaetotaxy: 4: 7: 6: 9: 10: 10: 11: 11: 11: 6. Anal cone with 2 pairs of short setae.

Pedipalps: see Table 1 for measurements and proportions. Trochanter slightly and finely granulate (granulation less than adult), indistinct hump present; femur with a distinct tubercle on lateral side near end, with some subtle tooth-like very small protuberances, patella with a medial protuberance near pedicel ending, with a few small tooth-like protuberances on medial side and mediolaterally finely granulate, on medial side near base of fixed finger with a tooth-like protuberance. Trichobothria *sb* and *ist* absent; fixed finger with 47 teeth, 3 antiaxial and 10 paraxial accessory teeth, movable finger with 46 teeth, antiaxial accessory teeth lacking, 7 paraxial accessory teeth.

Leg I: see Table 1 for measurements and proportions. Basitarsus and telotarsus with a less visible suture line.

Leg IV: see Table 1 for measurements and proportions. Subterminal setae similar to adults. Basitarsus and telotarsus with a less visible suture line.

KEY TO SPECIES OF *SPELAEOBOCHICA*

1. Rallum of 4 dentate blades, eyeless, but with two tiny, lateroventral tubercles on each side of carapace. Pedipalps: femur 4.2 times longer than broad; chela with pedicel 4.1 times. Leg IV: femur+patella 3.8 times longer than deep *S. allodentatus*

Table 1.—Measurements (mm) and proportions (length/breadth) of body parts of *Spelaeobochica iuiu* new species.

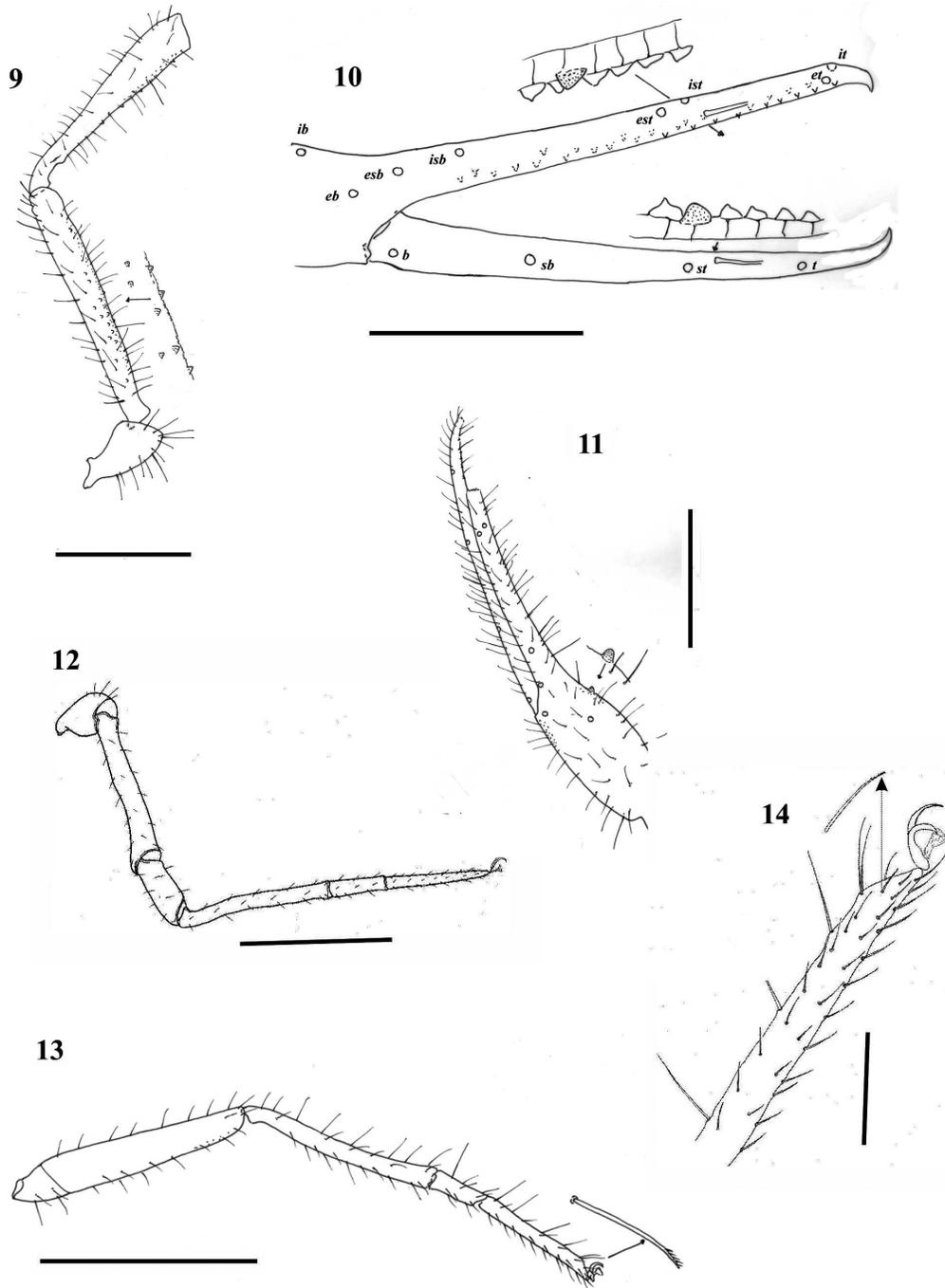
	♀ holotype	♂ paratypes	♀ paratype	tritonymph paratype
Body	5.17	4.47–4.34	5.29	3.2
Carapace	1.44/0.95 1.5×	1.40/0.85–1.32/0.84 1.6×	1.48/1.00 1.5×	0.95/0.65 1.5×
Pedipalp				
Trochanter	0.81/0.39 2.1×	0.67/0.39–0.60/0.37 1.7–1.6×	0.80/0.41 2.0×	0.41/0.32 1.3×
Femur	2.16/0.28 7.8×	2.08/0.25–2.00/0.24 8.3×	2.20/0.28 7.9×	1.32/0.20 6.6×
Patella	2.00/0.34 5.9×	1.92/0.29–1.80/0.30 6.6–6.0×	2.00/0.36 5.6×	1.16/0.24 4.8×
Hand with pedicel	1.17/0.53 2.2×	1.16/0.50–1.08/0.45 2.3–2.4×	1.20/0.48 2.5×	0.77/0.38 2.0×
Finger length	2.13	2.08–1.96	2.28	1.36
Finger/hand with pedicel	1.8×	1.8×	1.9×	1.8×
Chela with pedicel	3.21 6.1×	3.12–2.96 6.2–6.6×	3.32 6.9×	2.08 5.5×
Leg I				
Femur	0.99/0.18 5.5×	0.95/0.21–0.90/0.16 4.5–5.6×	1.04/0.18 5.8×	0.58/0.11 5.3×
Femur/patella	2.3×	2.4–2.3×	2.4×	2.2×
Patella	0.43/0.16 2.8×	0.40/0.19–0.39/0.15 2.1–2.6×	0.44/0.15 2.9×	0.26/0.12 2.2×
Tibia	0.95/0.10 9.2×	0.89/0.11–0.80/0.09 8.0–8.9×	0.94/0.10 9.4×	0.52/0.08 6.5×
Basitarsus	0.33/0.09 3.9×	0.30/0.10–0.28/0.08 3.0–3.5×	0.33/0.09 3.7×	0.18/0.07 2.6×
Telotarsus	0.62/0.07 8.3×	0.61/0.09–0.55/0.07 6.8–7.9×	0.59/0.07 8.4×	0.38/0.06 6.3×
Basitarsus/telotarsus	1.9×	2.0×	1.8×	2.1×
Leg IV				
Femur+patella	1.63/0.27 6.1×	1.52/0.30–1.48/0.24 5.1–6.2×	1.60/0.38 4.2×	1.00/0.19 5.3×
Tibia	1.35/0.14 9.6×	1.28/0.14–1.16/0.17 9.1–6.8×	1.32/0.10 13.2×	0.81/0.09 9.0×
Basitarsus	0.37/0.13 2.9×	0.35/0.13–0.35/0.10 2.7–3.5×	0.36/0.09 4.0×	0.22/0.08 2.8×
Telotarsus	0.87/0.09 9.3×	0.84/0.11–0.80/0.09 7.6–8.9×	0.89/0.08 11.1×	0.54/0.08 6.8×
Basitarsus/telotarsus	2.4×	2.4–2.3×	2.5×	2.5×

- Rallum of 4–6 dentate blades, eyeless, without tubercles on each side of carapace, pedipalps and legs much more slender. Leg IV femur+patella greater than 4.0 times longer than deep 2
2. Rallum of 4 dentate blades. Medial side of hand near base of fixed finger with a tooth-like protuberance. Pedipalps: femur 7.8–8.3 longer than broad; chela with pedicel 6.1–6.9 times longer than broad. Leg IV: femur+patella 4.2–6.2 times longer than deep *S. iuiu*
- Rallum of 6 dentate blades. Medial side of hand near base of fixed finger without a tooth-like protuberance. Pedipalps: femur 12.5 times longer than broad; chela with pedicel 8.6 times longer than broad. Leg IV: femur+patella 9.5 times longer than deep *S. muchmorei*

Habitat.—The Lapa do Baixo cave comprises the only known locality of this species. The cave was not totally explored since part of its inner chambers becomes flooded during rainy periods. However, the known conduits extend over 500 meters. The specimens were restricted to the inner portions of the cave in a conduit that becomes partially submerged during the rainy season; they were found walking freely on the floor and walls, both covered by a layer of fine silty sediment. During the first incursion to the cave (20 July 2007), we found only one tritonymph; three years later (8 June 2010), we found a total of 10 specimens (all adults). Potential prey include mites, springtails, juvenile crickets (*Endecous* sp.,

Phalangopsidae) and diplopods (Polydesmida, Oniscodesmidae). The only known entrance to the cave is located at the bottom of a subsidence sinkhole, which receives epigeal water, especially during strong rain. The external area is severely impacted, mainly by human activities such as agriculture and extensive breeding of cattle and goats. Fortunately, the cave has not been visited by anyone except the research team.

Discussion.—The new species displays the main characters of the genus *Spelaeobochica*: 4–6 setae in rallum, high number of setae on the cheliceral hand, venom apparatus well developed in both chelal fingers, distal position of trichobothrium *ib*, presence of accessory teeth on the chelal fingers,

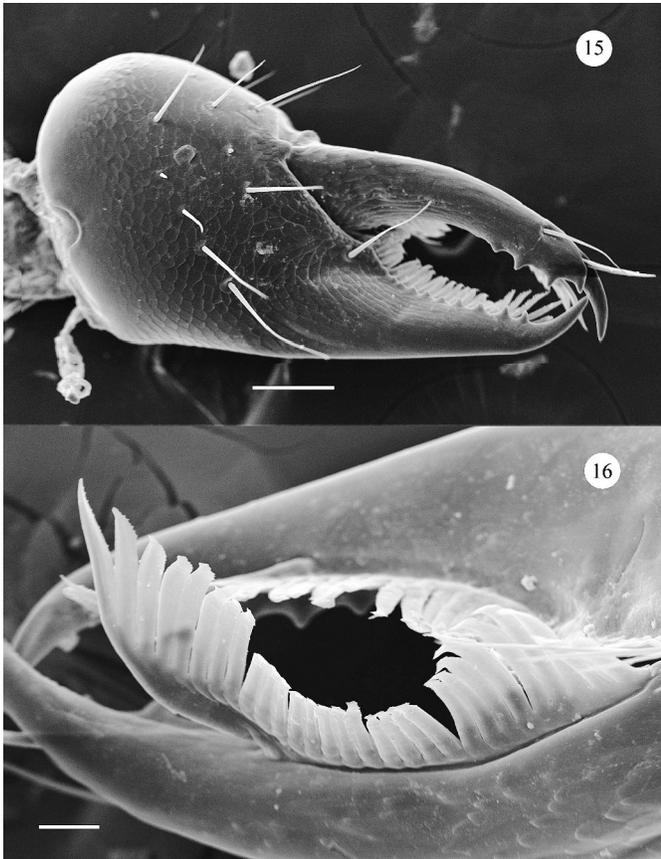


Figures 9–14.—*Spelaebochica iuiu* new species: 9. Left pedipalp of female holotype, small protuberances magnified (scale bar 1.00 mm); 10. Right chela of holotype lateral view, marginal tooth rows omitted, replaced by detail drawings (scale bar 1.0 mm); 11. Left chela of female holotype in dorsal view, tooth-like protuberance magnified (scale bar 1.0 mm); 12. Leg I of female holotype (scale bar 1.00 mm); 13. Leg IV of female holotype (scale bar 1.0 mm); 14. Detail of telotarsus of leg IV showing subterminal seta (scale bar 0.25 mm).

and the presence of a distinct tubercle on the palpal femur. Two species have been previously described in this genus, *S. muchmorei* from caves of São Paulo (Mahnert 2001) and *S. allodentatus* from Bahia (Gruta do Impossível, Palmeiras) (Andrade & Mahnert 2003) (Fig. 20). *Spelaebochica iuiu* can be easily distinguished from those species by the presence of tooth-like protuberances on the pedipalps and by its measurements. It is distinctly smaller than *S. muchmorei* (e.g., femur length 2.76–3.32 mm vs 2.0–2.16 mm)

with stouter pedipalps (e.g., femur 12.5–13.3 times as long as broad vs 7.8–8.3 times), but it is distinctly larger than *S. allodentatus* (e.g., femur length 0.95–0.97 mm vs 2.0–2.16 mm) with more slender pedipalps (e.g., femur 4.2 times as long as broad vs. 7.8–8.3 times). Furthermore, the pedipalps are smooth in *S. allodentatus*, but granulate in *S. iuiu*.

Until 2008, all natural cavities in the Brazilian territory were protected by law. Unfortunately, the national legislation was

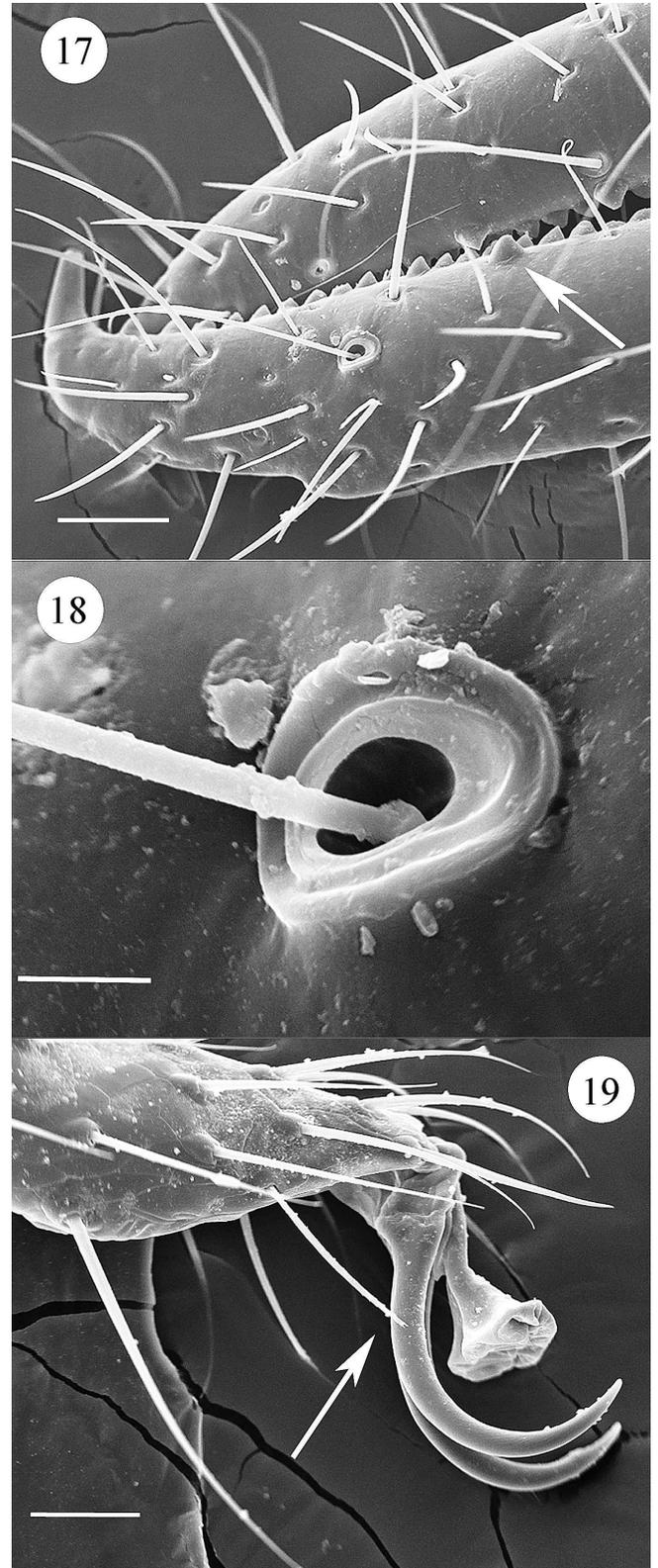


Figures 15–16.—*Spelaebochica iuiu* new species, scanning electron microscope images: 15. Left chelicera of female paratype (scale bar 0.1 mm); 16. Detail of serrula exterior on left chelicera of female paratype (scale bar 0.03 mm).

altered after this date. Nowadays, many different anthropogenic activities (especially mining) occur in karst areas, and caves all over the country are being damaged. Therefore, government officials created categories (based on biological and geological parameters) to define the “status” of each cave intending to determine which could be sacrificed and which should be preserved. To assure the complete conservation of a cave in Brazil, it is necessary from a biological point of view to prove the occurrence of at least one endemic troglotic species. Approximately 30 caves have been surveyed by biologists in the state of Bahia (Pinto-da-Rocha 1995). Our research team went to eight cavities near Lapa do Baixão cave, and found no specimens of *S. iuiu*. This strongly suggests that the species is endemic to Lapa do Baixão cave. Furthermore, the description of *S. iuiu*, besides contributing to the knowledge of pseudoscorpion diversity in the Neotropics, ensures the protection of the cave.

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Figures 17–19.—*Spelaebochica iuiu* new species, scanning electron microscope images: 17. Left chela of female paratype, arrow indicating accessory tooth (scale bar 0.04 mm); 18. Detail of trichobothria of female paratype (scale bar 0.02 mm); 19. Detail of leg IV of female paratype, arrow pointing to subterminal setae (scale bar 0.04 mm).

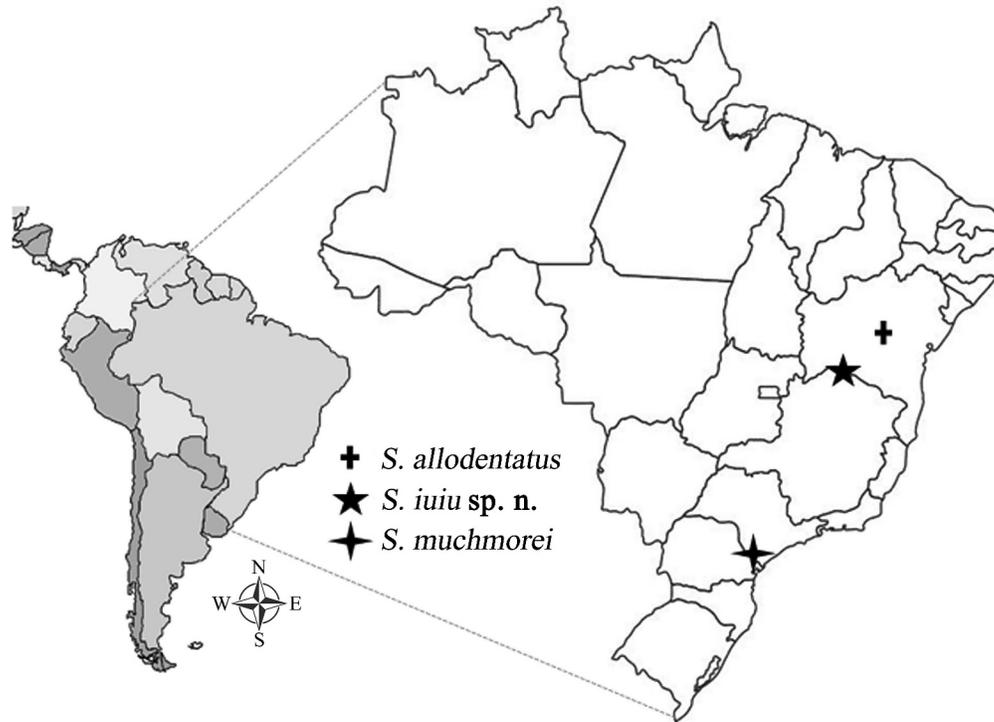


Figure 20.—Distribution map of *Spelaeobochica* in Brazil.

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