TAXONOMY AND NOMENCLATURE

Two new cave-dwelling genera of short-tailed whip-scorpions from Brazil (Arachnida: Schizomida: Hubbardiidae)

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ABSTRACT. Two new genera of short-tailed whip-scorpions are described based on material from Brazilian iron ore and canga caves in the Carajás region, Pará, Brazil. Naderiore gen. nov. with a single species N. carajas sp. nov. and also monotypic Cangazomus gen. nov. (type species C. xikrin sp. nov.). The relationships of the two new genera with previously described genera are discussed. Naderiore most closely resembles Adisomus Cokendolpher & Reddell, 2000, Piaroa Villarreal, Tourinho & Giupponi, 2008 and Calima Moreno-González & Villarreal, 2012, and can be distinguished from them by Dm₁ modified as macrosetae in the male flagellum. Cangazomus most closely resembles Naderiore, Adisomus Cokendolpher & Reddell, 2000, and Piaroa Villarreal, Tourinho & Giupponi, 2008. It differs from all of them by the presence of two pairs of ramified spermatotheal lobes, each composed of a differentiated stalk and distoterminal ramified bulbs, chitinized arch without anterior branch and notched lateral tip, pedipalps unarmed and not sexually dimorphic, and the male flagellar setae Dm₁ as a microsetae.

KEY WORDS. Canga cave, Cangazomus, Iron ore cave, Naderiore, neotropics, taxonomy.

The low diversity of Schizomida, 258 species according to Harvey (2007), especially in the Neotropical region, is not surprising in view of the small size of these arachnids (usually 2-7 mm of total length) and their cryptic habits, which are poorly known. Studies on South American schizomids have intensified in the 21st century. A review of schizomids recorded on this continent can be found in Armas (2010) where 34 described species in nine genera are cited. Additionally, the author mentions that there are at least 11 undescribed species and three undescribed genera in South America. Since then, two genera and 13 species have been described, most of them from Colombia (Armas & Delgado-Santa 2012a, b, Moreno-González & Villarreal 2012, Villarreal & García 2012, Delgado-Santa & Armas 2013, Santos et al. 2013, Villarreal et al. 2014, Moreno-González et al. 2014), resulting in 47 described species on South America. This number is probably an underestimate of the true diversity of Schizomida, considering that the region of Manaus (Amazonas, Brazil), the only area reasonably well sampled, harbors seven species.

The following factors have contributed to the poor knowledge of this group in South America: first, there are only a few South American specialists in the group, and arachnologists from the Neotropics began to collect and describe new taxa from the region only in the 21st century; second, Winkler and Kempson apparatus (but see Ads et al. 1999) have not been widely used to collect arachnids in the Amazonian and Andean regions. As a result, suitable habitats there such as leaf litter, forest canopy and caves have been poorly sampled. In more recent years, Rolando Teruel and Luis de Armas have described a large number of new species from Central America, particularly from the Caribbean region. It is expected that the number of described species in South America will increase exponentially when the group receives more attention from researchers and is collected more intensively. This has already happened in other parts of the world during the last 40 years (Harvey 2007: fig. 2). More research in this group is needed to clarify the relationships among the many monotypic genera that have been proposed and to generate phylogenetic hypotheses (see Moreno-González & Villarreal 2012).

In this contribution, two new genera and two new species of short-tailed whip-scorpions (schizomids) are described based on material collected from Iron ore and Canga caves of Serra dos Carajás, Pará, Brazil, elevating the number of South American genera to 11, and the number of described species to 49. The relationships of the two new genera with those previously described are discussed.

MATERIAL AND METHODS

The type material is deposited in the Museu Paraense Emílio Goeldi (MPEG, curator A. B. Bonaldo) and in the Museu de Zoologia da Universidade de São Paulo (MZSP, curator R.
Sex flagella (Figs. 1-3, 7-8). Chitinized arch in the spermathecae (Fig. 17) and Vm
slightly marked terminal bulbs (Fig. 17), chitinized arch with an
of two pairs of spermathecal lobes almost straight with distinct
XII, and (5) absence of a single well developed accessory teeth in
the male flagellum, (3) absence of gonopod in the spermathecae,
(only some
female flagellum, (2) male flagellum sub-rhomboidal shaped
sharing with them the following characters: (1) four-segmented
Giupponi, 2008 and
Cokendolpher & Reddell, 2000,
and

Abbreviations: (AB) anterior branch, (AMN) anteromedian notch, (AMP) anterome-
dian process, (DO) duct openings, (GOP) glandular openings, (IA)
internal angle, (PB) posterior branch, (LT) lateral tip.

The illustrations of the chelicerae and spermathecae are based on photographs taken with a Zeiss Axioskop 50
microscope, integrated with the Carl Zeiss photo software Zen Lite, using the edition software Inkscape version 0.48.4 (www.
ingraph.org). Z-axis photographs were created with a Leica
M125 stereo scope with trinocular tube, integrated to the Leica
microscope, integrated with the Carl Zeiss photo software Zen

Description. Male holotype (homeomorphic). Coloration
(in ethanol); general dorsal coloration pattern light brownish-
gold. Stubs were photographed under a ZEISS DSM 940 Scanning
Electron Microscope at the Centro de Microscopia Eletrônica
of the Instituto de Biociencias (Universidade de São Paulo). The gen-

Type species. Naderiore carajas sp. nov., by monotypy.

Diagnosis. Naderiore most closely resembles Adisosmus
Cokendolpher & Reddell, 2000, Piaroa Villarreal, Tourinho & Giupponi, 2008 and Calima Moreno-González & Villarreal, 2012,
sharing with them the following characters: (1) four-segmented
female flagellum, (2) male flagellum sub-rhomboidal shaped
(only some Piaroa species), (3) absence of dorsal eminences on
the male flagellum, (3) absence of gonopod in the spermathecae,
(4) absence of posterodorsal abdominal process on the segment
XII, and (5) absence of a single well developed accessory teeth in
the chelicerae. Naderiore differs from all of them by the presence
of two pairs of spermathecal lobes almost straight with distinct
slightly marked terminal bulbs (Fig. 17), chitinized arch with an
anteriorly notched LT (Fig. 17), male heteromorphic pedipalp
patella armed with a ventral spur (Figs. 14-15), and the setae
Dm1 modified as macrosetae on the male flagellum (Fig. 1).
It may also be differentiated from Calima by the presence of
chitinized arch in the spermathecae (Fig. 17) and Vm2 in both
sexes flagella (Figs. 1-3, 7-8).

Etymology. “Naderiore” is a noun from Carajás indigenous
people that means “brother”. Gender masculine.

Remarks. A significant character of the genus is the presence of Dm1 modified as macrosetae in the male flagellum (Fig. 1), a
unique condition among the Neotropical species of Hubbardiinae.

Naderiore carajas sp. nov.
Figs. 1-3, 7-8, 12-17, 25

Diagnosis. Total length 3.7-3.9 mm (flagellum not includ-
ed). Without eyespots. Male abdomen not elongated, without
posterodorsal abdominal process on segment XII. Male flagellum
rhomboidal 1.6 times longer than wide, and 5 times longer than
pedicel length (Figs. 1-3). Spermathecae with two pairs of lobes,
whose distal circular bulbs are slightly marked and roughly so
thick as the stalk, medial lobes shorter than lateral ones, both
with numerous duct openings over surface (Fig. 17); chitinized
arch with AB and PB incomplete, IA rounded and LT sharp with
an anterior notch (Fig. 17).

Description. Male holotype (homeomorphic). Coloration
(in ethanol); general dorsal coloration pattern light brownish-
orange (Fig. 25); pedipalps, chelicerae, leg I and propeltidium
slightly darker. Prosoma. Propeltidium long (1.2 mm), anterior
process with only one seta followed by three pairs of dorso-sub-
median setae. Eyespot absent. Anterior sternum with 11 (9+2)
setae; posterior sternum with 7 setae. Metapeltidium entire.
Pedipalp (Fig. 14). Trochanter with mesal spur, with an anteri-
ori-projected sharp frontal process; femur without spurs; patella
without a ventromesal curved spur; tibia without spurs. Femur,
ecal surface with four setae near the ventral margin (Fe1, Fe2,
Fv1 and Fv2). Chelicerae (Fig. 16). Fixed finger (Fig. 16: bottom)
with two small teeth between two large outer teeth. Movable
finger (Fig. 16: top): serrula composed of 18 hyaline teeth; guard
tooth present, lamella present, accessory tooth absent. Setae:
G1 = 3 setae, G2 = 1, G3 = 4, G4 = 2, G5 = 8, G6 = 1; setae G1 with
spicules on their base. Opisthosoma. Tergite I with two pairs
and tergite II with three pairs of anterior microsetae. Tergites I-VII each
with one pair of dorso-submedian setae; VIII-IX each with one
pair of dorso-submedian setae and one pair of distolateral setae;
X-XI narrow, each with one pair of lateral setae and five ventral
setae; XII with one pair of dorso-median setae, two pairs of lateral
and four pairs of ventral setae. Segments X-XII not elongated.
Posterodorsal abdominal process of segment XII absent. Legs:
anterior dorsal margin of femur IV produced at about 90 degrees
angle, about three times as long as high. Flagellum (Figs. 1-3).

Dorsoventrally flattened, bulb sub-rhomboidal, 1.6 times longer
than wide, with short pedicel (1/5 total length). Setation: Vm, at
same level of Vm, but distal to Dm,; pair DI, (microsetae) prox-
imal to Vm,; pair Vm, proximal to DI, level; pair Dm, between
Dm, and DI,; DI, positioned slightly distal to VI,; Vm, proximal
to Dm, level, closer to VI, than to VI,; VI, proximal to DI, level,
and distal to Dm, level. Setae pair Dm, modified as macrosetae.
With distolateral microsetae patches composed of four microsetae

TAXONOMY
Hubbardiidae Cook, 1899
Hubbtiinae Cook, 1899
Naderiore gen. nov.
Figs. 1-3, 7-8, 12-17, 25

Type species. Naderiore carajas sp. nov., by monotypy.

Diagnosis. Naderiore most closely resembles Adisosmus
Cokendolpher & Reddell, 2000, Piaroa Villarreal, Tourinho & Giupponi, 2008 and Calima Moreno-González & Villarreal, 2012,
sharing with them the following characters: (1) four-segmented
female flagellum, (2) male flagellum sub-rhomboidal shaped
(only some Piaroa species), (3) absence of dorsal eminences on
the male flagellum, (3) absence of gonopod in the spermathecae,
(4) absence of posterodorsal abdominal process on the segment
XII, and (5) absence of a single well developed accessory teeth in
the chelicerae. Naderiore differs from all of them by the presence
of two pairs of spermathecal lobes almost straight with distinct
slightly marked terminal bulbs (Fig. 17), chitinized arch with an
anteriorly notched LT (Fig. 17), male heteromorphic pedipalp
patella armed with a ventral spur (Figs. 14-15), and the setae
Dm1 modified as macrosetae on the male flagellum (Fig. 1).
It may also be differentiated from Calima by the presence of
chitinized arch in the spermathecae (Fig. 17) and Vm2 in both
sexes flagella (Figs. 1-3, 7-8).
from the same level of Vm₃ to slightly anterior to Vl₁. With one pair of shallow dorso-submedian depressions at same level of Dl₁, located at approximately half of the flagellum length, without any dorsal swelling. With several glandular openings (GOP) (see Figs. 12-13) and many grooves radiating from a central pore (see Santos & Pinto-da-Rocha 2009) on lateral and dorso-subapical regions; with several pores (without radiating striated grooves) on central ventral region.

Measurements (MZSP-65721). Pedipalp: trochanter 0.50; femur 0.62; patella 0.59; tibia 0.55; tarsus 0.25; total 2.37. Leg I: trochanter 0.33; femur 1.19; patella 1.45; tibia 1.01; basitarsus 0.36; telotarsus 0.60; total 4.94. Leg II: 0.20; 0.93; 0.55; 0.50; 0.42; 3.13. Leg III: 0.23; 0.72; 0.30; 0.35; 0.56; 0.44; 2.60. Leg IV: 0.30; 1.18; 0.56; 0.81; 0.72; 0.46; 4.03. Total length: 4.00. Propeltidium 1.25 long. Prosoma: 1.56 long. Opisthosoma: 2.20 long (flagellum excluded). Flagellum 0.41 long/0.15 wide.

Variation (male paratypes). Propeltidium 1.02-1.47 long; femur I 1.08-1.25; patella I 1.15-1.90 long; femur IV 1.02-1.35, 2.3-4.3 longer than wide. Anterior sternum 11-13 (9+2 to 11+2) setae. Paratypes with one or two setae on anterior process, a variation hitherto unreported in Hubbardiinae. Ventrally, patella with discrete (like females) to pronounced knob in heteromorphic males (Fig. 15) (MZSP-68883, MZSP-68907, MZSP-68871).

Female paratype (MZSP-65722). Coloration (in ethanol) and setation as in male except for: pedipalpal trochanter rounded, without frontal process, not projected anteriorly. Pedipalp patella without a ventral spur. Anterior sternum with 13 (11+2) setae, posterior sternum with 5 setae. Propeltidium with two setae on the anterior process, both located near each other at the same level. Flagellum (Figs. 7-8) four-segmented. Segment II with Dm₁, Vm₁, and Vm₃, all at the same level. Segment III with Dm₁ (microsetae) proximal to Vm₁. Segment IV with Vl₁ at same level of Vm₁ and Dl₁; Dm₄ between Dl₁ and Dl₂; Vl₂ proximal to Dl₁; and distal to Dm₄; Vm₄ (microsetae) proximal to Dl₁ and slight distal to above Vl₄. Apex of the flagellum with several glandular openings appearing as many grooves radiating...
from a central pore. **Spermathecae** (Fig. 17) consist of two pairs of almost straight lobes, with their apex anteriorly directed, whose distal circular bulbs are slightly marked and roughly so thick as the stalk; median lobes slightly thinner and shorter than lateral ones, both with cylindrical stalks covered with numerous DO over surface. Chitinized arch incomplete, AB and PB open, LT sharp and short with an anterior notch, IA rounded, without AMN and AMP.

Measurements (MZSP-68883). Pedipalp: trochanter 0.65; femur 0.50; patella 0.50; tibia 0.45; tarsus 0.25; total 2.35. Leg I: trochanter 0.30; femur 1.12; patella 1.27; tibia 0.95; basitarsus 0.32; telotarsus 0.50; total 4.40. Leg II: 0.27; 0.80; 0.67; 0.47; 0.42; 0.62; 3.27. Leg III: 0.22; 0.80; 0.45; 0.50; 0.45; 0.4; 2.87. Leg IV: 0.27; 1.15; 0.50; 0.75; 0.65; 0.62; 3.85. Total length: 3.65. Propeltidium: 1.02 long. Prosoma: 1.32 long. Opisthosoma: 2.32 long (flagellum excluded). Flagellum 0.32 long.

Variation (females). Propeltidium 1.16-1.20 long; femur I 1.075; patella I 1.21-1.23 long; femur IV 1.00-1.03, 2.28-2.44 longer than wide. With one or two setae on anterior process.

Type material: Male holotype (Gruta S11D-33; 6°24’41"S 50°20’38"W), Floresta Nacional de Carajás, Canaã dos Carajás, Pará, Brazil, R. Andrade leg., 23.viii-02.ix.2007 (MZSP-65721). Paratypes: Floresta Nacional de Carajás, Parauapebas, Pará, Brazil: (Gruta N1-75), 2007, leg. R. Andrade, 1 female (MZSP-65722); idem, (Gruta N4WS-04; 6°04’23"S 50°11’44"W), 10-19.v.2011, leg. R. Andrade, 1 female (MZSP-65723); idem, (Gruta N4WS-08, 6°05’23"S 50°11’42"W), 10-19.v.2011, leg. R. Andrade, 1 male (MZSP-65724); idem, (Gruta N4WS-32, 6°04’05"S 50°11’33"W), 18.xi-01.xii.2010, leg. R. Andrade, 1 male (MZSP-65725); idem, (Gruta N4WS-75, 6°04’29"S 50°11’23"W) 18.xi-01.xii.2010, leg. R. Andrade, 2 males (MZSP-65726); idem, (Gruta N4WS-
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75; 6°04’28.7”S 50°11’23.1”W), 18.ix-01.xii.10, leg. R. Andrade et al., 2 males (MZUSP-69601); idem, (N3-037; 6°02’46.4”S 50°13’15.2”W), 05-17/III/2013, leg. F. V. Freitas et al., 1 male (MZSP-68904); idem, (N3-037; 6°02’46.4”S 50°13’15.2”W), 03-17/IV/2013, leg. F. V. Freitas et al., 1 male (MZSP-68874); idem, (N3-074; 6°02’36.6”S 50°13’51.0”W), 02-23/08/2013, leg. F. V. Freitas et al., 2 males (MZSP-68907); idem, (N3-074; 6°02’36.6”S 50°13’51.0”W), 5-17/III/2013, leg. F. V. Freitas et al., 1 male, 1 female (MZSP-68883). Floresta Nacional de Carajás, Canaã dos Carajás, Pará, Brazil: (Gruta S11-23, 6°25’25”S 50°18’00”W), 24.ii-4.iii.2010,
leg. R. Andrade, 1 male (MZSP-65728); idem, (Gruta S11D-116, 6°25’19”S 50°19’00”W), 14-19.xii.2011, leg. R. Andrade, 1 male (MZSP-65731).

Etymology. Named after the Carajás Formation, located in northern South America. The Carajás Formation is a banded iron-formation (BIF) that covers the banded iron formation (BIF), where is located canga caves where the specimens were collected. The name is treated as a noun in apposition.

**Cangazomus** gen. nov.
Figs. 4-6, 9-11, 18-20, 26
urn:lsid:zoobank.org:act:6D708F82-68AB-4E75-BF57-53F4BB43BEA6

Type species. *Cangazomus xikrin* sp. nov., by monotypy.

Diagnosis. *Cangazomus* gen. nov. most closely resembles *Naderiogen. nov.*, *Adisomus* Cokendolpher & Reddell, 2000, and *Piaroa* Villarreal, Tourinho & Giupponi, 2008, sharing with them the following characters: (1) four-segmented female flagellum, (2) male flagellum sub-rhomboidal shaped (only some *Piaroa* species), (3) absence of dorsal eminences on the male flagellum, (3) absence of gonopod in the spermathecae, (4) presence of chitinized arch in the spermathecae, (5) absence of posterodorsal abdominal process on the segment XII, and (6) absence of a single well-developed accessory teeth in the chelicerae. *Cangazomus* differs from all of them by the presence of two pairs of ramified spermathecal lobes, each composed of a differentiated stalk and distoterminal ramified bulbs (Fig. 20), chitinized arch without AB and notched LT (Fig. 20), pedipalps unarmed and not sexually dimorphic (Fig. 18), and the male flagellar setae Dm, as microsetae (Figs. 4-6).

Etymology. In reference to the *canga*, ferruginous breccias that covers the banded iron formation (BIF), where is located the cave from the type locality, and *zodus*, part of the name *Schizomus*. Gender masculine.

Remarks. The spermathecal lobes with ramified bulbs displayed by *Cangazomus xikrin* (Fig. 20) are a very novel condition among the Neotropical genera of Hubbardiidae; among the New World four-segmented genera, the North American genus *Hubbardia* Reddell & Cokendolpher, 1995, and the Caribbean genus *Luisarmasius* Reddell & Cokendolpher, 1995 share both an apparently similar spermathecal morphology, having spermathecae composed of more than three lobes in each side (Reddell & Cokendolpher 1995: 75, 81); however, the presence of multiple spermathecal lobes is a very distinct condition, compared with the presence of two pairs of lobes, each with ramified bulbs, exhibited by *C. xikrin* (Fig. 20). For this reason, we believe this character represent a synapomorphy for the genus.

**Cangazomus xikrin** sp. nov.
Figs. 4-6, 9-11, 18-20, 26
urn:lsid:zoobank.org:act:FBD18CDD-CF9E-472C-AF7F-9A548419FF82

Diagnosis. Total length 2.85-3.20 mm (flagellum not included). Without eyesposts. Male abdomen not elongated, without posterodorsal abdominal process on segment XII. Male flagellum rhomboidal 1.8 times longer than wide, and 4 times longer than pedicel length (Figs. 4-6). Spermathecae with two pairs of ramified lobes, each composed of a differentiated stalk and distoterminal ramified bulbs, lateral lobes composed by at least four ramifications and medial ones with at least two ramifications (Fig. 20); chitinized arch without AB, PB incomplete, IA rounded and LT sharp without an anterior notch (Fig. 20).

Description. Male holotype. Coloration (in ethanol): general dorsal coloration pattern light brownish-orange (Fig. 26); pedipalps, chelicerae, and propeltidium slightly darker. Legs and venter much paler than dorsum. **Prosembla.** Propeltidium long (1.17 mm), anterior process with only one seta followed by three pairs of dorso-submedian setae. Eyespot absent. Anterior sternum with 14 setae (12+2); posterior sternum with six setae. Metaepisternum entire. **Pedipalp** (Fig. 18). Trochanter with mesal spur, with a short frontal process; femur, patella and tibia without spurs. Femur, ectal surface with four setae near the ventral margin (Fe1, Fe2, Fv1 and Fv2).

**Chelicerae** (Fig. 15). Fixed finger (Fig. 15: bottom) with two smaller teeth between two large outer teeth. Movable finger (Fig. 15: top): serrula composed of 9 hyaline teeth; guard tooth present, lamella present, accessory tooth absent. Setae: G1 = 3 setae, G2 = 3, G3 = 3, G4 = 2, G5 = 7, G6 = 1; setae G1 with spicules on their base. **Opisthosoma.** Tergite I with two pairs and tergite II with three pairs of anterior microsetae. Tergites I-VII each with one pair of dorso-submedian setae; VIII-IX each with one pair of dorso-submedian setae and one pair of distolateral setae; X-XI narrow, each with one pair of lateral setae and five ventral setae; XII with one pair of dorso-submedian setae, two pairs of lateral setae and four pairs of ventral setae. Segments X-XII not elongated. Posterodorsal abdominal process of segment XII absent. Legs: Anterior dorsal margin of femur IV produced at about 90 degrees angle, 2.1 times as long as high. **Flagellum** (Figs. 4-6). Dorsoventrally flattened, bulb sub-rhomboidal, 1.7 times longer than wide, with short pedicel (1/5 total length). Setation: Vm, at same level of Dm, and Vm; pair Dl (microsetae) proximal to Vm; pair Vm at same level of Dl level; pair Dm (microsetae) at same level of Dl; Dl positioned slightly distal to Vl; Vm proximal to Dm level, closer to Vl than to Vl; Vl proximal to Dl level, and distal to Dm level. With distolateral microsetae patches composed of three microsetae from the same level of Vm to slightly anterior to Vl. With one pair of separated oval shaped and deep dorso-submedian depressions at same level of Dl (microsetae), located at approximately half of the flagellum length, without any dorsal swelling. With several glandular openings (GOP) (see Fig. 11) appearing as many grooves radiating from a central pore (see Santos & Pinto-da-Rocha 2009) on lateral and dorso-median to subapical region; without pores on central ventral region.

Measurements – (male holotype). Pedipalp: trochanter 0.37; femur 0.32; patella 0.52; tibia 0.37; tarsus 0.20; total 1.80. Leg I: trochanter 0.25; femur 0.97; patella 1.12; tibia 0.80; basitarsus 0.27; telotarsus 0.45; total 3.87. Leg II: 0.15; 0.47; 0.65; 0.45; 0.35; 0.32; 2.40. Leg III: 0.25; 0.60; 0.32; 0.40; 0.37; 0.35; 0.45;
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2.30. Leg IV: 0.25; 0.87; 0.42; 0.62; 0.57; 0.25; 3.10. Total length: 2.12. Propeltidium: 1.17 long. Prosoma: 1.27 long. Opisthosoma: 1.57 long (flagellum excluded). Flagellum 0.32 long/0.17 wide.

Variation (male paratypes). Propeltidium 0.81-0.94 long; femur I 0.75-0.93; patella I 0.91-1.13 long; femur IV 0.83-0.91, 2.2-2.4 longer than wide. Paratypes with one or two setae on anterior process; two small dorso-submedian depressions slightly deeper than holotype in some specimens.

Figures 21-26. Photographs of habitat and live schizomids: (21) view of plateau at Carajás region, limit between canga and ombrophilous vegetation types; (22-23) entrance region of a canga cave; (24) invertebrate manual collecting on ground of the interior of a canga cave; (25) live male of Naderiore carajas gen. nov., sp. nov. on ground; (26) live female of Cangazomus xikrin gen. nov., sp. nov. on ground. Photos: (21-24) Renata de Andrade, (25) Igor Cizauskas, (26) Marcus Oliveira.
Female paratype (MZSP-65734): Coloration (in ethanol) and setation as in male except for: pedipalp trochanter rounded, without frontal process, not projected anteriorly. Flagellum (Figs. 9-10) four-segmented. Segment II with Dm₁, Vm₁, and Vm₂ all at the same level. Segment III with Dm₁ (microsetae) proximal to Vm₁. Segment IV with Vl₁ at same level of Vm₁ and Dl₁; Dm₄ between Dl₁ and Dl₂; Vl₁ proximal to Dl₁ and distal to Dm₂; Dl₄ (microsetae) proximal to Dl₁ and slightly distal to above Vl₁, between the level of Dm₄ and Dl₁. Apex of the flagellum with several glandular openings appearing as many grooves radiating from a central pore. Spermathecae (Fig. 20) consist of two pairs of lobes, with their apex anteriorly directed and a distinguishable stalk; median lobes shorter than lateral ones, with one pair of terminal bulbs (bifurcation); lateral lobes with at least four to five buls; chitinized arch without AB, PB incomplete, 1A rounded and LT sharp and short, without an anterior notch (Fig. 20).

Measurements (MZSP-65734). Pedipalp: trochanter 0.31; femur 0.38; patella 0.35; tibia 0.30; tarsus 0.19; total 1.54. Leg I: trochanter 0.25; femur 0.84; patella 0.98; tibia 0.69; basitarsus 0.25; telotarsus 0.40; total 3.40. Leg II: 0.13; 0.59; 0.34; 0.36; 0.31-0.33; 0.31; 2.00. Leg III: 0.13; 0.50; 0.24; 0.25; 0.31; 0.31; 1.70. Leg IV: 0.23; 0.85; 0.38; 0.56; 0.50; 0.38; 2.90. Total length: 3.20. Propeltidium: 0.94 long. Prosoma: 1.20 long. Opisthosoma: 1.70 long (flagellum excluded). Flagellum 0.24 long.

Variation (female paratypes). Propeltidium 0.88-0.95 long; femur 1.081-0.84; patella 1.96-0.98 long; femur IV 0.84-0.85, 2.20-2.30 longer than wide.

Type material: Male holotype (Gruta N4E-72, 6°01′58″S 50°09′14″W), Floresta Nacional de Carajás, Parauapebas, Pará, Brazil, 24-30.vii.2009, leg. R. Andrade (MZSP-65733). Paratypes: Floresta Nacional de Carajás, Parauapebas, Pará, Brazil: (Gruta N4E-72, 6°01′58″S 50°09′14″W), Floresta Nacional de Carajás, Parauapebas, Pará, Brazil, 24-30.vii.2009, leg. R. Andrade, 1 male (MZSP-65732); idem, (Gruta N4E-72, 6°01′58″S 50°09′14″W), 19.i-iii.2010, leg. R. Andrade, 1 female (MZSP-65734); idem, (Gruta N4E-62, 6°02′02″S 50°09′14″W), 24-30.vii.2009, leg. R. Andrade, 1 female (MZSP-65735); idem, (Gruta N4E-85, 6°02′04″S 50°09′27″W), 18.viii-03.ix.2009, leg. R. Andrade, 1 male (MZSP-65736); idem, (Gruta N4E-77, 6°01′59″S 50°09′04″W), 19.ii-iii-2010, leg. R. Andrade, 1 male (MZSP-65737); idem, (Gruta N4E-89, 6°02′00″S 50°09′08″W), 19.ii-4.iii-2010, leg. R. Andrade, 1 male (MZSP-65738); idem, (Gruta N4E-93, 6°02′24″S 50°09′32″W), 19.ii-4.iii-2010, leg. R. Andrade, 1 male (MZSP-65739); Floresta Nacional de Carajás, Canaã dos Carajás, Pará, Brazil: (Gruta S11D-05, 6°24′04″S 50°21′01″W), 13-30.i.2010, leg. R. Andrade, 1 male (MZSP-65740); idem, (Gruta S11D-17, 6°23′57″S 50°21′24″W), 13-30.i.2010, leg. R. Andrade, 1 male (MZSP-65741); idem, (Gruta S11Cav-24, 6°24′22″S 50°21′58″W), 22-28.ix.2010, leg. R. Andrade, 1 male (MPEG).

Etymology. Named after the Xikrin, an indigenous tribe located about one hundred kilometers from Parauapebas, the city close to the caves where the specimens were collected. The name is a noun in apposition.

Natural history of \textit{N. carajas} sp. nov. and \textit{C. xikrin} sp. nov.

The specimens of both species were found in several iron ore and 	extit{canga} (ferruginous breccias) caves, from the entrance (photic zone) to the aphytic zone, on the ground, in areas with high moisture, under boulders, between roots, leaf litter, and in some cases near bat guano. The caves in the Serra dos Carajás, located in Eastern Amazonia (state of Pará), are composed of banded iron-formation – (BIF) from the Neoarchean. A large number of caves have been recorded in the area (more than 1,500 known caves, according to data from \textit{C. xikrin} sp. nov. Serra dos Carajás comprises a set of isolated plateaus (Fig. 21), most of which are located in the Carajás National Forest, a federally protected area that is used for different purposes, including the operation of iron ore mines. The caves where the two species described here were found are situated on scarp in different landscapes, including the edges of ponds, scarp at the top of the plateaus, and the colluvial foot slopes of ridges. The caves have developed in the inner part of the \textit{canga}, within the iron ore, and at contact points between them (\textit{Piló} et al. 2015). Savannah vegetation has grown on these iron crusts and particularly on top of ranges, and is surrounded by Ombrophylous Forest; in low areas out of the Carajás National Forest an altered landscape can be found. The xerophytic savannah vegetation is a singular ecosystem in the Amazon, and is known for its high level of endemism (\textit{Campos} & \textit{Castilho} 2012). Most caves are small (< 30 m long) and shallow; the trophic resources include vegetal debris, roots, and feces of vertebrates such as bats and anurans. Neither one of the two new species displays the features of typical troglobitic schizomids (e.g. elongated pedipalps, pale integument) found, for instance, in some \textit{Protoschizonium} Rowland, 1975 or \textit{Agastoschizomus} Rowland, 1971 (both \textit{Protoschizomidae}) and \textit{Rowlandius} Reddel & Cokendolpher, 1995 (\textit{Hubbardiidae}). However, it should be noted that not all troglobiotic species have troglomorphic traits (\textit{Siet} 2008). Further studies should be conducted in epigean environments to confirm the degree of association of this species with hypogean habitats (see \textit{Santos} et al. 2013). One possible troglomorphic trait, absence of eyespots, is also found in many epigean species. Only a phylogenetic hypothesis may help to determine whether such trait has evolved in response to the cave environment.

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