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NEOCARUS CAIPORA, A NEW MITE SPECIES (PARASITIFORMES: OPILIOACARIDA: OPILIOACARIDAE) FROM BRAZILIAN AMAZON CAVES

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ABSTRACT — A new species of the genus *Neocarus* (Parasitiformes: Opilioacarida: Opilioacaridae), *Neocarus caipora* n. sp. is described and illustrated from Brazilian Amazon caves.

KEYWORDS — Neotropic; Brazil; Amazon forest; Canga; *Neocarus*

INTRODUCTION

The Opilioacarida is one of the smallest orders of mites. Only 11 genera, 38 species and one subspecies have been described so far. Of these, only two genera, but almost half of the species (17) and the unique subspecies have been described from the New World. Within that subset of taxa, most were described from North and Central America (Chamberlin and Mulaik 1942; Juvara-Bals and Baltac 1977; Vázquez and Klompen 2002, 2009). Only five species (in two genera) have been described from South America, *Neocarus platensis* Silvestri 1905 from Argentina, Uruguay and Brazil *Neocarus ojastii* Lehtinen 1980 from Venezuela, *Neocarus potiguar* Bernardi, Zacarias and Ferreira 2012, *Neocarus proteus* Bernardi, Klompen, Zacarias, and Ferreira 2013 and *Caribeacarus brasiliensis* Bernardi, Silva, Zacarias, Klompen and Ferreira 2013 from Brazil (Bernardi *et al.* 2012; Bernardi *et al.* 2013a;

Bernardi *et al.* 2013b; Hammen 1969; Lehtinen 1980; Silvestri 1905). In this study we describe a new species of *Neocarus* from North of Brazil.

MATERIALS AND METHODS

All specimens were collected by hand from caves, searching under stones, in organic matter accumulations, cracks in the soil and were stored in vials with 80 % ethanol.

Most material was studied as slide-mounted specimens. For this purpose, specimens were dissected (due to size), cleared in Nesbitt's solution and mounted on slides using Hoyer's medium (Walter and Krantz 2009).

Drawings were prepared using a Zeiss Axio-scope 3 phase contrast microscope, connected to a drawing tube; measurements are presented in

micrometers (μm) and were taken using a Nikon Eclipse 90i automated DIC microscope.

The nomenclature of setae and other morphological characters follows Grandjean (1936), van der Hammen (1969, 1977) and Vázquez and Klompen (2002, 2009).

Specimens are deposited at the Mite Reference Collection, Department of Entomology and Acarology, Escola Superior de Agricultura "Luiz de Queiroz" (MZLQ), Universidade de São Paulo, Piracicaba-SP, Brazil; Collection of Subterranean Invertebrates (ISLA), Section of Zoology, Department of Biology, Universidade Federal de Lavras, Lavras-MG, Brazil; and Ohio State University Acarology Collection (OSAL), Museum of Biological Diversity, Columbus, OH, USA.

RESULTS

Neocarus caipora n. sp. Bernardi, Klompen and Ferreira (Figures 1-5)

Differential diagnosis

The new species and *Neocarus potiguar* are the only ones in the genus with triangular male genital valves (these valves are rectangular or weakly curved in other congeners), and just one pair of lateral seta on acrotarsus II-IV (Figures 1-2). However, in *N. caipora* n. sp. the female lacks pre-genital setae (present in *N. potiguar*) and the number of the *ch*-type setae on the palp tarsus is less than in *N. potiguar* (12 – 14 vs. 25 – 27).

N. potiguar and *N. caipora* are currently the only species in South America with curved dorsal and apically pectinate lateral setae on ambulacra II - IV. This character is shared with some North American species, such as *Neocarus texanus* Chamberlin and Mulaik 1942, *N. siankaanensis* Vázquez and Klompen 2002, *N. bajacalifornicus* Vázquez and Klompen 2002 and *N. veracruzensis* Vázquez and Klompen 2009 (Figure 2).

DESCRIPTIONS OF THE NEW SPECIES

Chelicera — (Figure 3). Basal segment (115 – 134 μm) with 1 and fixed digit (201 – 214 μm) with 3

setae. Setae *ch1*" and *ch2*" smooth, *cht* and *ch2'* lightly barbed (only visible at high magnification). Dorsal (*id*) and antiaxial lyrifissure (*ia*) well developed. Fixed digit with 1 tooth, movable digit (63 – 68 μm) with 1 tooth and a well developed terminal hook. Movable digit with two ventral denticles in the basal portion. A third, but small and weakly visible denticle was observed only in 3 females. One or two rounded membranous processes present in middle of the anterolateral portion. Internal surface of movable digit with a small sensillum.

Subcapitulum — (Figures 4A-C). All 4 pairs of paralabial setae present: *pl1* small, conical; With's organ (*pl2*) membranous and barbed marginally; rutella (*pl3*) with one distinct row of 5 teeth, inserted dorso-lateral; *pl4* very small, inserted dorsal. With 4 circumbuccal (*cb*), and 5 – 10 median and subcapitular setae. Seta *vm1* in all adults with rounded tip and robust, similar to circumbuccal setae. Females with one, rarely two (N=1), additional pairs of median setae with rounded tips (indicated by arrows in Fig. 4A). All setae in the median area of the subcapitulum in males show a fine, attenuated tip. Canals (*ogl1* and *ogl2*) on lateral lips distinct.

Palp — (Figures 4D-F). Trochanter with 2-4 ribbed, tapering (= *r*-type) and rarely 1 papilliform (= *p*-type) setae (just observed in one male); femur with 7 – 12 *r*, 6 – 12 papilliform (= *p*-type) setae; genu with 21 – 31 *r* and 5 – 10 *p*-type setae. Tibia and tarsus partially fused. Tibia with 19 – 26 smooth (*s*-type) and 21 – 34 *r*-type setae. Palp tarsus with lyrifissures *ia* and *iπ*. Tarsal setation including 2 *sm2*, 5 *d* (leaf-like), 12 – 14 *ch*, 9 – 11 *sm*, 5 *v* and 3 *s* setae. Sexual differentiation indistinct or absent. Pretarsus in shape of a pair of well developed sessile claws. Total length of palp in adults 476 – 553 μm .

Idiosoma — (Figure 5). Color light with dark blue patches. Body sometimes with a brownish background resulting from ingested food. Dorsal shield with 108 – 139 ribbed setae and two pairs of eyes. One pair of lyrifissures present. Rostrum rounded. Dorsal portion of idiosoma between the shield and the preanal segment without setae, but with numerous lyrifissures arranged in transverse rows. Preanal segment with 1 dorsal and 2 latero-ventral setae; anal plates in adults each with 9 – 10

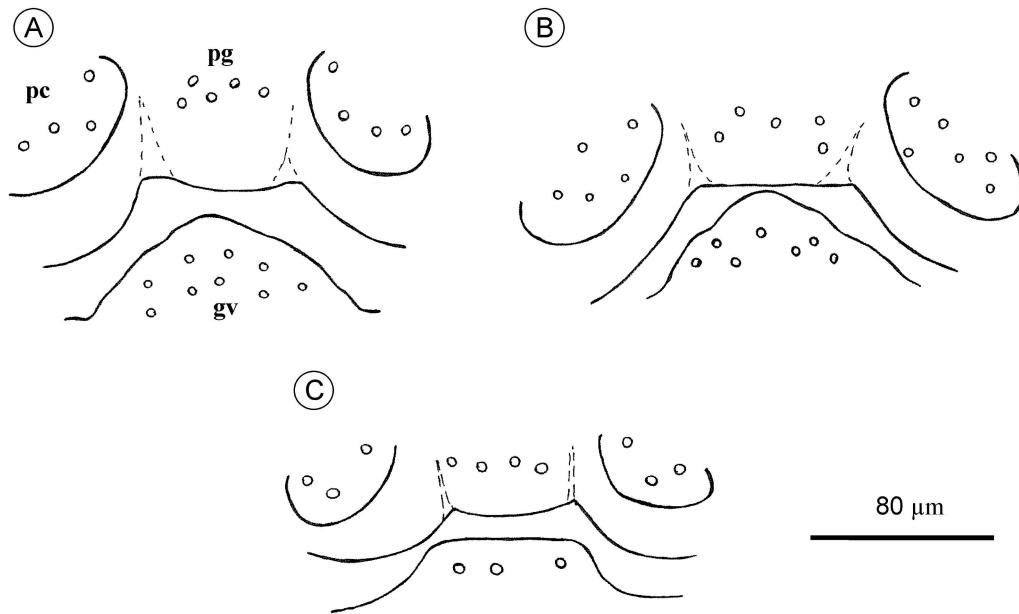


FIGURE 1: Schematic representation of the male genital area in *Neocarus* species: A – *Neocarus caipora* n. sp.; B – *Neocarus potiguar*; C – *Neocarus calakmulensis*. Abbreviations: pc, pregenital capsules; pg, pregenital area; gv, genital valve.

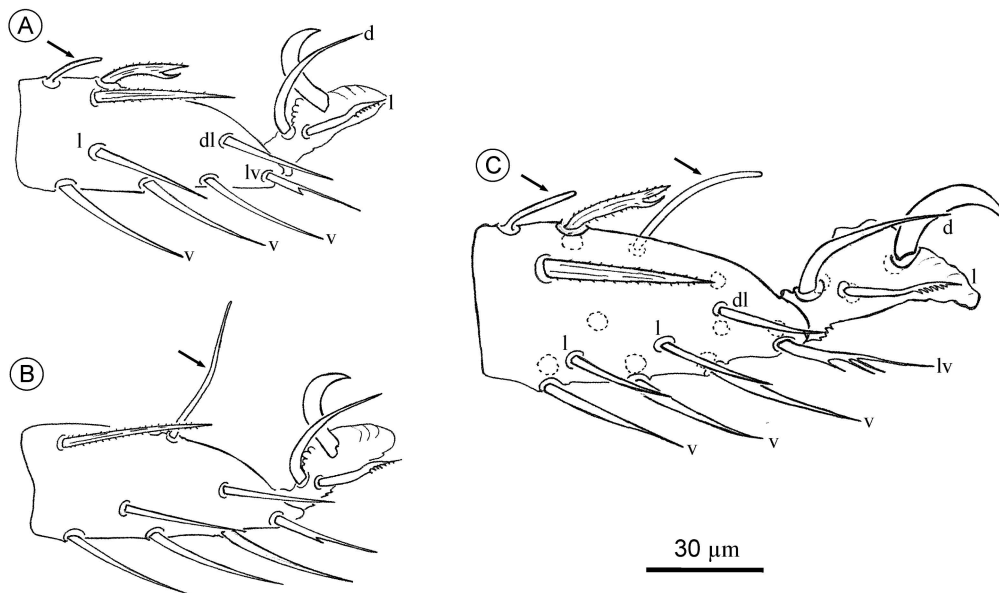


FIGURE 2: Acrotarsus II, *Neocarus caipora* n. sp. (A - B) and *Neocarus texanus* (C), female; A, C – posterolateral view; B – anterolateral view. Abbreviations: v, ventral seta; l, lateral seta; vl, ventro-lateral seta; ld laterodorsal seta; d, dorsal seta. Sensillae are indicated by an arrow.

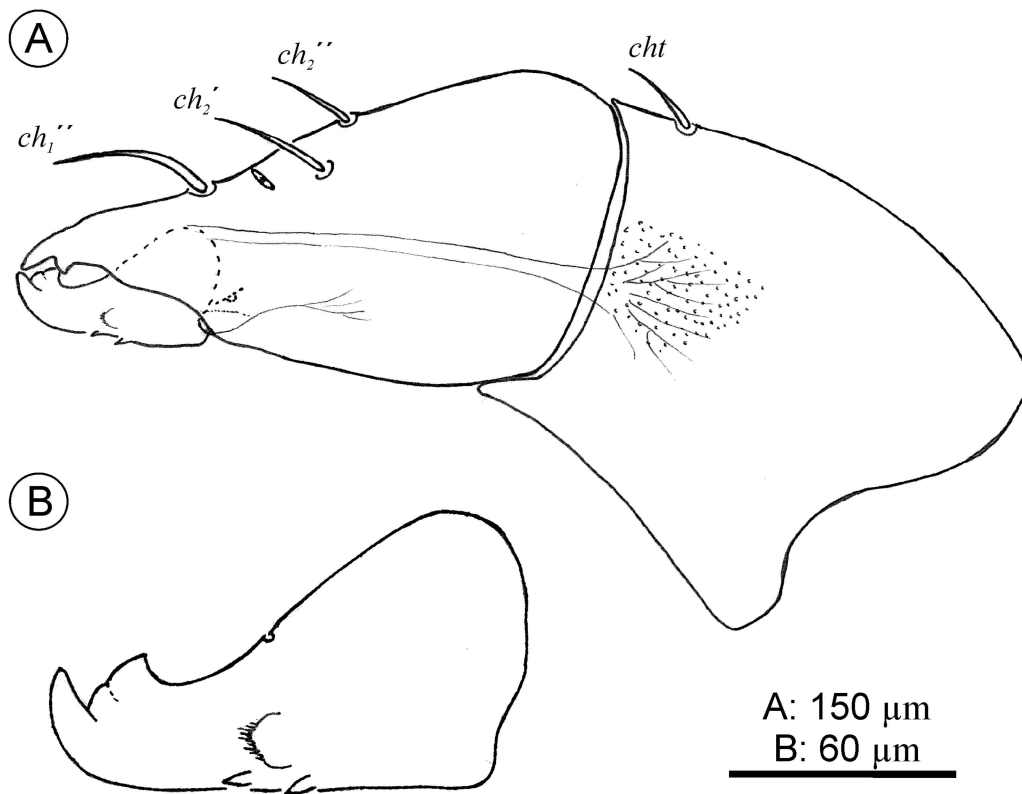


FIGURE 3: *Neocarus caipora* n. sp. (Female): A – Lateral view of chelicerae; b – Detail of the movable digit of chelicerae.

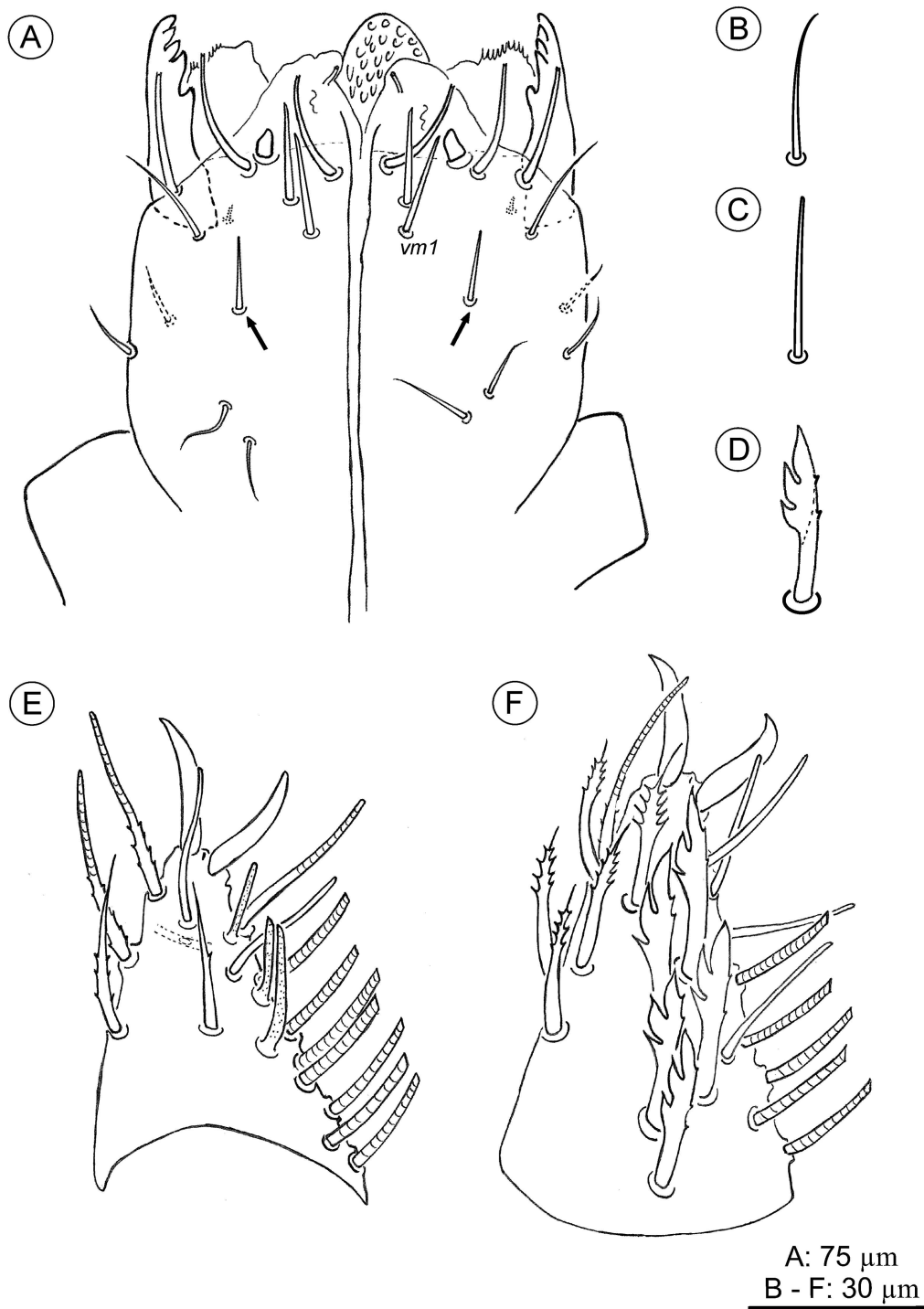


FIGURE 4: *Neocarus caipora* n. sp. (Female): A – Ventral view of subcapitulum; B – Detail of a seta with a fine tip; C – Detail of a seta with a rounded tip, found only in females (arrows in Fig. A); D – Detail of *d*-type (foliate) seta on palp tarsus; E and F – Ventral (E) and dorsal (F) view of the palp tarsus.

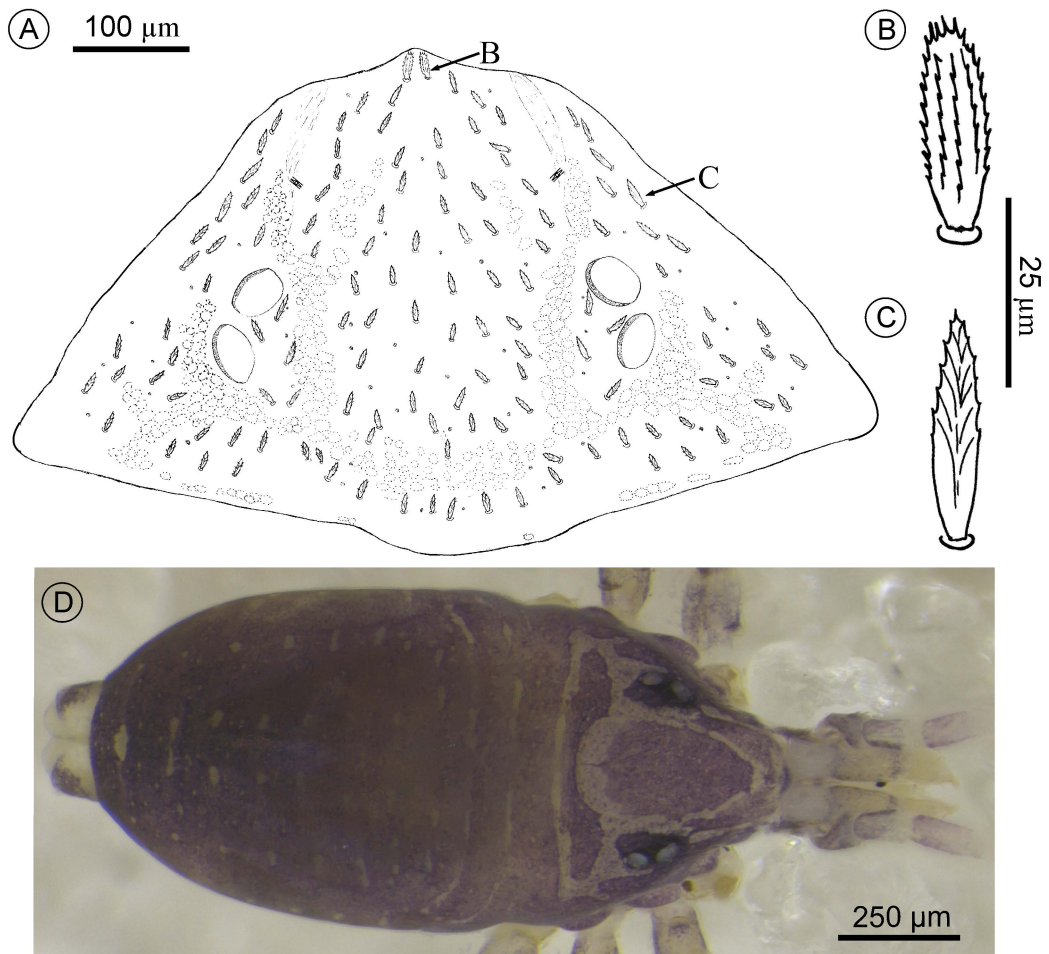


FIGURE 5: *Neocarus caipora* n. sp. A – View of male prodorsal region; B and C – Detail of setae on prodorsal region; D – Dorsal view of female.

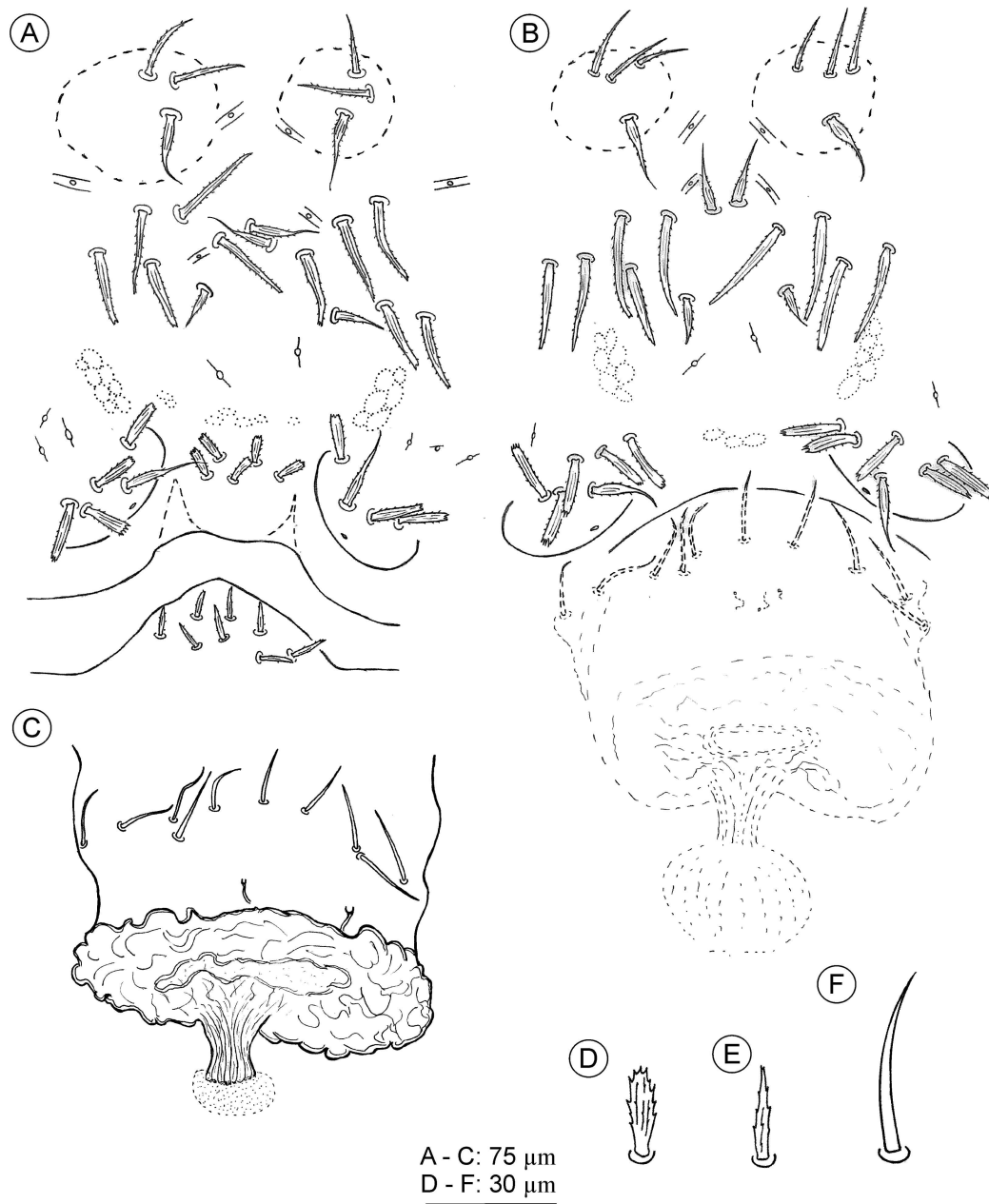


FIGURE 6: *Neocarus caipora* n. sp.: A – View of male sternitogenital region; B – View of female sternitogenital region; C – View of invaginated ovipositor; D – Male pre-genital seta; E – Male genital seta; F – Female genital seta.

stout, ribbed setae.

Sternitogenital region — (Figure 6). Sternapophyses with two setae, one small seta at the tip and one long and barbed seta positioned more basal. Sternal verrucae in adults each with 1 long, tapering (*St1*), and 2-3 smaller setae. Remaining sternal area with 2 pairs of tapering (*St2* and *St3*) and 3-4 pairs of long, ribbed setae, and 3 pairs of lyrifissures (two pairs very large, the third smaller; all different in shape and size from "standard" opisthosomal lyrifissures). Setae *St2* slightly longer than *St3*. Pregenital capsules each with 1 long tapering seta (*St5*) and 4-5 ribbed setae. Pregenital and genital area in male with, respectively, 4-8 ribbed, stout setae and 5-8 tapering and ribbed setae. In females, pregenital area nude and genital area with 8-12 smooth and pointed setae. Ovipositor consisting of a tube-like structure. A single pair of gland-like structures in its median portion, and apex convex.

Legs — (Figure 2). Leg I longer than others (leg I, 3210 – 3225 μm ; leg II, 1581 – 1777 μm ; leg III 1539 – 1762 μm ; leg IV, 2366 – 2796 μm). Telotarsus I has a highly modified group of dorsal setae located in the apical portion, close to the tarsal claws, homologous to the Haller's organ of ticks (Moraza 2005). Basitarsus I carries just two types of setae, 1) smooth and 2) tapering and barbed. All other leg segments carry three types of setae arranged in distal to basal lines: 1) tapering and barbed, 2) papilliform and 3) smooth seta.

Acrotarsus of leg II with a dorsal bifurcate seta and two smooth sensilla (one long and other small) resembling solenidia (Figure 2). Acrotarsi of legs III-IV carry just 3 long, barbed and tapering setae dorsally. Additionally, acrotarsi II-IV carry 3 pairs of smooth ventral setae, 1 pair of lightly barbed ventrolateral setae (positioned distally), 1 pairs of smooth lateral setae and 1 pair of smooth laterodorsal setae (positioned distally). Pretarsi in all instars with one pair of claws and 2 pairs of setae, one pair long and curved, and other smaller and apically pectinate. Pretarsal ambulacrum rounded and smooth. Coronidia limited to basitarsi II-IV.

Material examined — Holotype; 1♀(MZLQ) from Canãa dos Carajas, Gruta Cav11-S11 (06°24'38.3"S 50°19'38.7"W), 19 III 2010, Andrade

R *col.* Paratypes; Brazil, Pará State: 6♀1♂(ISLA) from Parauapebas, Gruta Cav34-S11 (06°24'08.8"S 50°22'56"W), 22 X 2010, Andrade R *col.*; 1♂(MZLQ) from Parauapebas, Gruta Cav3-S11 (06°24'41.3"S 50°20'04.5"W), 22 X 2010, Andrade R *col.*; 1♀(MZLQ) from Parauapebas, Gruta Cav3-S11 (06°24'41.3"S 50°20'04.5"W), 31 V 2010, Andrade R *col.*; 1♀(MZLQ) from Parauapebas, Gruta S11-D11 (06°24'20.5"S 50°21'56"W), 25 V 2010, Andrade R *col.*; 1♀(MZLQ) from Canãa dos Carajás, Gruta 11 D11 (06°24'38.3"S 50°19'38.7"W), 19 III 2010, Andrade R *col.*; 1♀(MZLQ) from Canãa dos Carajás, Gruta S11-D19 (06°24'14.6"S 50°22'13.4"W), 19 X 2010, Andrade R *col.*; 1♀1♂(OSAL) from Canãa dos Carajás, Gruta S11-D18 (06°24'10.5"S 50°22'24.8"W), XII 2011, Andrade R *col.*; 1♀(ISLA) from Canãa dos Carajás, Gruta S11-D106 (06°23'49.6"S 50°17'06.5"W), 14 XII 2011, Andrade R *col.*; 1♀(ISLA) from Parauapebas, Gruta S11-D11 (06°24'39.9"S 50°20'03.1"W), 25 V 2010, Andrade R *col.*; 1♀(ISLA) from Parauapebas, Gruta S11-D11 (06°24'39.9"S 50°20'03.1"W), 22 III 2010, Andrade R *col.*; 3♀(OSAL) from Parauapebas, Gruta Cav24-S11 (06°24'20.5"S 50°21'56"W), 25 V 2010, Andrade R *col.*; 3♀(MZLQ) from Parauapebas, Gruta N5SM2-096 (06°08'03.3"S 50°08'09.1"W), 29 IX 2010, Zampaulo RA *col.*

Etymology — Caipora is a creature present in common Brazilian folklore, with an origin in the indigenous culture of the "tupi-guarani". The word "caipora" is derived from the tupi language word caapora, and means "inhabitant of the forests".

Ecology remarks — All specimens used in the present work were collected in the south east of Pará State, Brazil, in 2010 and 2011. Sampling was carried out in epigeal habitats, but principally in caves in an environment of ferruginous outcrops regionally known as "Cangas". This region is surrounded by the Amazon Forest domain, but the vegetation which grows in these iron outcrops is strikingly different, consisting mostly of open grasslands, containing herbaceous plants and sparsely distributed trees. Recent subterranean biodiversity surveys showed a high species richness and a great number of endemic species (Ferreira pers. obs.). The region contains important iron ore deposits and is under consideration for intense mineral explo-

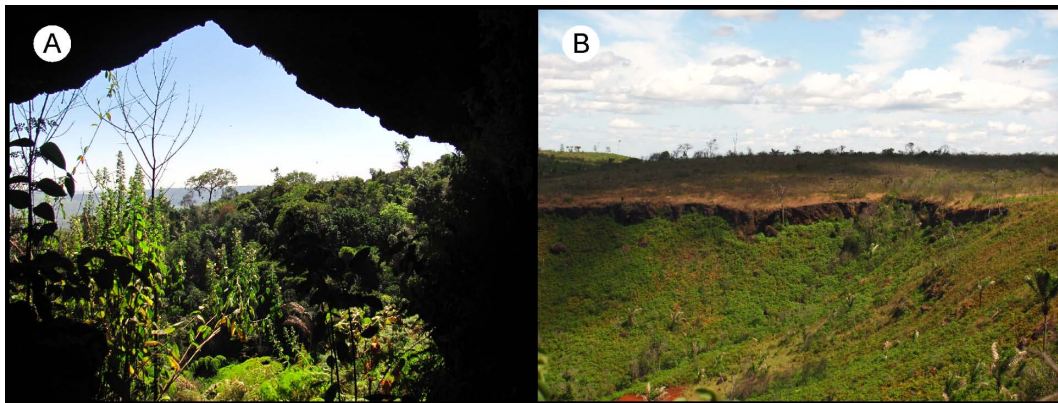


FIGURE 7: View of the dense Amazon forest (A) surrounding ferruginous outcrops with open grasslands (B).

ration, threatening those habitats (Figure 7).

An important observation made during the biological survey was the presence of two species of Opilioacaridae in the same site (cave) and sometimes next to each other, sharing the same microhabitat (under rocks and in litter on soil). This unusual mix seems to confirm that Opilioacaridae are not very aggressive and/or territorial. Previous observations by Vázquez and Palácios-Vargas (1988) and Klompen (2000) showed similar lack of aggression. Aggregation behavior in Brazilian *Neocarulus* species was already noted by Bernardi *et al.* (2012). Another factor facilitating coexistence may be body size, since adult *N. caipora* are significantly smaller than the adults of the *Caribeacarus brasiliensis* Bernardi *et al.* 2013 found in the same area. Adult *N. caipora* are similar in size to nymphal (deutonymph and tritonymph) *C. brasiliensis*, which may avoid competition between adults.

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