

## New species of *Neotropiella* Handschin, 1942 (Collembola: Neanuridae) from Brazil

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### Abstract

Three new species of *Neotropiella* Handschin, 1942 are described from Southeastern Brazil. Remarks are made in respect to the diagnosis of the genus and some of the species described up to date. The species *Neotropiella barbatae* sp. nov. and *N. macunaimae* sp. nov. belong to a complex of species with serrated chaetae. The other new species, *N. insularis* sp. nov., is the second of the genus that has bi- or trilobed vesicles on the PAO. Observations on the chaetotaxy of Abd VI of the new species can bring new insights to the taxonomy of the genus. A comparative table including all the species described to date is provided.

**Keywords** New species | taxonomy | Pseudachorutinae | Brazil | Neotropic

### 1. Introduction

The Brazilian fauna of Poduromorpha is yet to be fully discovered, as numerous families of this group of Collembola have several pantropical and endemic taxa reported from this country (Abrantes et al. 2012). This is the case for the genus *Neotropiella* Handschin, 1942, of which most of the species have been described from the Neotropics and, among the 16 described species, ten have already been recorded for Brazil (Abrantes et al. 2012). The exceptions in the genus are *N. mirabilis* (Handschin, 1929) and *N. murphyi* Massoud, 1965, which were described from Ethiopia and Malaysia, respectively.

During recent expeditions in Southeast Brazil, three new species of *Neotropiella* were found and are herein described and illustrated. Two of them, *N. barbatae* sp. nov. and *N. macunaimae* sp. nov., were collected in different mountain plateaus, at more than 2,400 m above sea level, within the soil and leaf litter of 'campos de

altitude' (also known as the Brazilian páramos). The third species, *N. insularis* sp. nov., was found in leaf litter of the Atlantic rainforest on the largest island in the seashore of the Rio de Janeiro State.

**Abbreviations used in text.** **Abd** – abdominal segment, **AM** – Amazonas State, **Ant** – antennal segment, **Cx** – coxa, **a.s.l.** – above sea level, **Fe** – femur, **FR** – France, **ICMBio** – Instituto Chico Mendes da Biodiversidade, **MG** – Minas Gerais State, **MNRJ** – Museu Nacional do Rio de Janeiro, **MT** – Mato Grosso State, **PAO** – postantennal organ, **RJ** – Rio de Janeiro State, **Scx** – subcoxa, **Tita** – tibiotarsus, **Th** – thoracic segment, **Tr** – trochanter, **VT** – ventral tube.

### 1.1. Diagnosis and remarks on the genus *Neotropiella*

The genus *Neotropiella* is characterized, according to Massoud (1967), by a trilobed apical bulb; Ant III organ composed of two tubes placed in a single groove of the tegument; maxillae without fringed or toothed lamellae; mandible with teeth; reduced eyes; PAO always present and moruliform; VT with 4+4 or more chaetae; furca always present; anal spines absent.

All the species of the genus are summarized, with their main characters, in Table 1. It can be noticed that most of them have 5+5 eyes and a mandible with up to six teeth, except for *N. denisi* (Arlé, 1939) and *N. mirabilis* (Handschin, 1929), which have 6+6 eyes and more than

ten teeth on mandible. The species with 5+5 eyes share a similar size and disposition of the ocelli, always near each other, and a reduced mandible with relatively small teeth.

In the description of *N. denisi*, the disposition of eyes is completely different from the other species of the genus, as they are more sparsely distributed, resembling, in fact, species of the genus *Arlesia* Handschin, 1942, *Brasilimeria* Stach, 1949 and *Tijucameria* Mendonça & Fernandes, 2005. In 1981, Arlé registered *N. denisi* from areas of the Amazon forest (Alto Xingu, MT) with a variation in the number of eyes, being 7+7, what we believe could well be a different species. In addition to that, the mandible of *N. denisi* presents 11–12 teeth, being two strong basal teeth and the others smaller and subequal in size. This type of mandible also resembles that of *Arlesia*, *Brasilimeria*

**Table 1.** Main characters of all known species of *Neotropiella* Handschin, 1942.

Species	Ant IV sensilla	Sensorial field (*)	Eyes per side	PAO vesicles	Mandible teeth	VT chaetae	Chaetae on each dens	Type Locality
<i>arlei</i> Najt, Thibaud & Weiner, 1990	6	–	5	25–32	4	4	6	Guyana
<i>carli</i> (Denis, 1924)	?	+(over 100)	5	65	3	?	6	Guyana
<i>denisi</i> (Arlé, 1939)	?	?	6	20–23	11–12	?	6	Brazil (RJ)
<i>digitomucronata</i> Massoud & Thibaud, 1982	?	+(76)	5	34	4	?	6	Guadalupe (FR)
<i>duranti</i> Díaz & Najt, 1995	7	+(40)	5	50–60	5	4	6	Venezuela
<i>gordae</i> Díaz & Najt, 1995	5	+(28–35)	5	26–30	4	4	6	Venezuela
<i>malkini</i> Arlé, 1981	?	+ (?)	5	80	2	?	7	Colombia
<i>meridionalis</i> (Arlé, 1939)	?	?	5	29–30	4	?	6	Brazil (RJ)
<i>minima</i> Thibaud & Oliveira, 2010	6	–	5	7–10	4	4	5–6	Brazil (AM)
<i>mirabilis</i> (Handschin, 1929)	?	?	6	80	**	?	5	Ethiopia
<i>murphyi</i> Massoud, 1965	?	?	5	70	4–5	?	6	Malaysia
<i>pedisensilla</i> Najt, Thibaud & Weiner, 1990	6	+(46)	5	20–22	4	3	6	Guyana
<i>plurichaetosa</i> Thibaud & Oliveira, 2010	6	–	5	27–36	5–6	4	5–6	Brazil (AM)
<i>quiqueoculata</i> (Denis, 1931)	?	?	5	26–36	4	?	6	Costa Rica
<i>silvestrii</i> (Denis, 1929)	?	?	5	35	4?	?	?	Cuba
<i>vanderdrifti</i> Massoud, 1963	7	–	5	18–23	6	?	6	Suriname
<i>barbatae</i> sp. nov.	6	–	5	27–29	6	4	6	Brazil (RJ)
<i>insularis</i> sp. nov.	6	+(over 140)	5	38–40	5	4	6	Brazil (RJ)
<i>macunaimae</i> sp. nov.	7	–	5	23–27	5	4	6	Brazil (MG)

\* Approximate number of chaetae on sensorial field.

\*\*According to Massoud (1967) the mandible is 'finement dentelée' (with fine teeth) and very similar to *N. denisi* (Arlé, 1939).

and *Tijucameria*. Unfortunately the type material of this species was lost and could not be checked.

According to Massoud (1967) the species *N. mirabilis* is, in many aspects, very similar to *N. denisi*, as it also has 6+6 eyes disposed sparsely and a finely toothed mandible, although in the original description (Handschin 1929) there is no drawing of the mandible. A striking difference between them was the fact that *N. mirabilis* has Abd VI hidden under the fifth, while in *N. denisi* it is not.

The combination of characters of the two species mentioned above may indicate that a revision is needed in respect to their position within the subfamily Pseudachorutinae, as they almost certainly do not belong to *Neotropiella*. In this sense, the diagnosis of the genus *Neotropiella* could be redefined more precisely in respect to the number of eyes and mandible teeth, being restricted to only 5+5 eyes and less than 10 teeth on mandible.

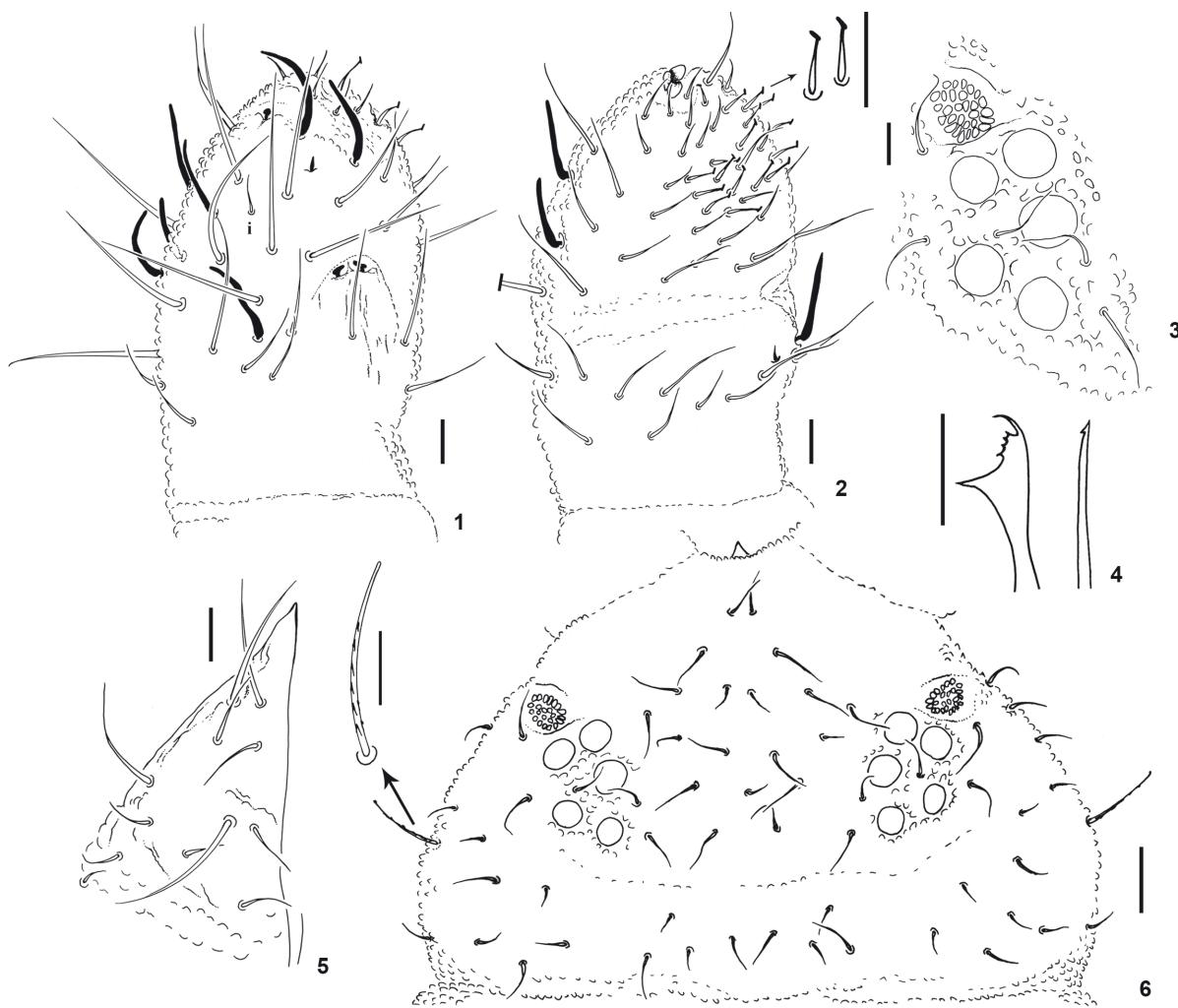
## 2. Results

### 2.1. Species descriptions

#### *Neotropiella barbatae* sp. nov. (Figs 1–11)

**Type material:** 2191 CM/MNRJ (26.X.2011): 1 specimen (young female); 2323 CM/MNRJ (26.III.2012): 1 specimen (female); 2329 CM/MNRJ (26.III.2012): 1 specimen (female). **Type locality:** Parque Nacional de Itatiaia/ICMBio, Itatiaia municipality, Rio de Janeiro State, Brazil. About 2.400m a.s.l. Soil and leaf-litter of 'campos de altitude', a high altitude ecosystem that belongs to the Atlantic Forest biome. Local coordinates 22°22'58.26"S, 44°40'0.49"W. Queiroz, G.C. leg.

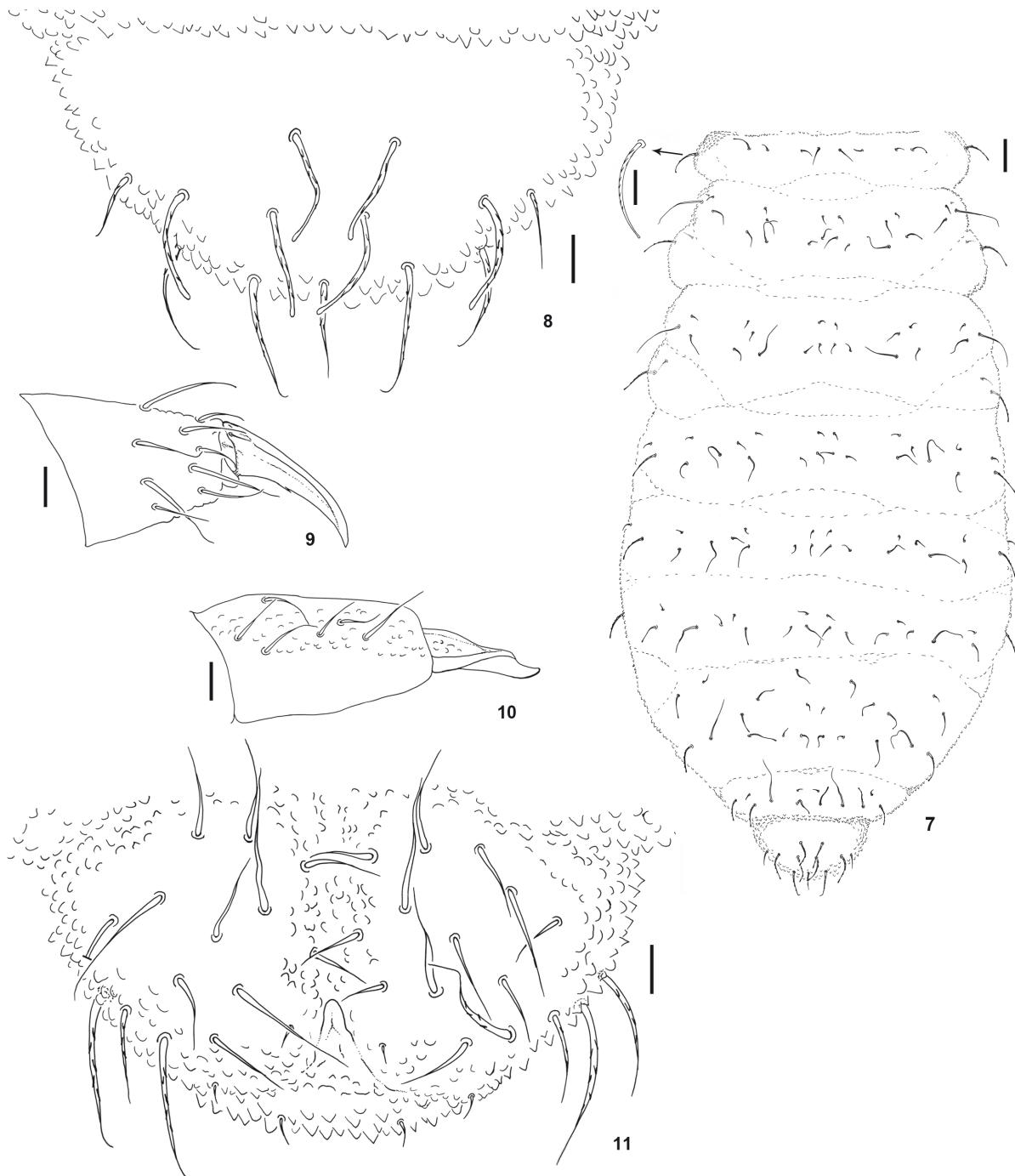
**Description.** Habitus typical of the genus. Body length of holotype (female): 1.15 mm; body length range of paratypes: 0.8–0.95 mm. Color in ethanol: black, dark pigment.



**Figures 1–6.** *Neotropiella barbatae* sp. nov. (1) Dorsolateral view of Ant III–IV, (2) Ventrolateral view of Ant III–IV with detail of bent-tip chaetae, (3) Ocular plate and PAO, (4) Mandible and maxille, (5) Labium, (6) Head chaetotaxy with detail of lateral serrated mesochaetae. Scale bars = 10 µm (1–5 and detail of 6), 30 µm (6).

Ratio head diagonal: antenna = 1:0.83. Ant I with 7 chaetae. Ant II with 12 chaetae. Ant III and IV fused dorsally, ventral separation marked. Sensory organ of Ant III with two small club-shaped sensilla bent towards each other and underneath a cuticular fold; two longer and subcylindrical guard sensilla, two are

weakly differentiated from ordinary chaetae; ventral microsensillum present (Fig. 1). Ant IV with trilobed apical bulb and six sensilla; dorsolateral microsensillum present; subapical organite round; with 18–20 ventral chaetae with bent tips interspersed with other ordinary chaetae, but not forming a sensorial field (Fig. 2).



**Figures 7–11.** *Neotropiella barbatae* sp. nov. (7) Dorsal chaetotaxy of body with detail of lateral serrated mesochaetae of Scx I of leg I. Scale bars = 30 µm (body); detail of chaetae is 10 µm. (8) Dorsal chaetotaxy of Abd VI, (9) Tita of leg I, (10) Dens and mucro, (11) Anal valves. Scale bars = 10 µm.

Eyes 5+5, with a strongly pigmented eye patch. PAO moruliform, slightly larger than ocellus A, bearing 27–29 vesicles (Fig. 3). Maxillae styliform with a small apical hook and no lamellae; minute mandible (not longer than 10 µm) with two strong teeth, being one apical and one basal, interpolated with at least four smaller teeth (Fig. 4). Buccal cone typical of the genus. Labium bearing chaetae A–G (Fig. 5).

Dorsal chaetotaxy composed of micro (10–13 µm) and mesochaetae (20–25 µm); sensilla long (50–55 µm). Sensillar formula by half tergum: 022/111110. All the lateral and some of the dorsal mesochaetae of the last segments of the abdomen are clearly furnished with ‘serrations’, which are, in fact, small scale-like pointed teeth, and have a clavate apex (details in Figs 6 and 7). The lateral mesochaetae of head and body tend to be slightly longer than dorsal mesochaetae (about 30–35 µm). Ratio micro: mesochaetae: sensilla = 1 : 2 : 4. Chaetotaxy of head and body as in Fig. 6 and 7, respectively. Th I with 4+4 chaetae. Abd III and IV presents, laterally, one small smooth chaetae and one serrated mesochaetae. All dorsal chaetae of Abd VI are serrated, but only 3+3 are clavated and serrated; one unpaired chaetae in the third row of chaetae (Figs 7 and 8).

Chaetotaxy of legs I–III as follows: Scx I – 1, 2, 2; Scx II – 0, 2, 2; Cx – 3, 7–8, 7; Tr – 6, 5, 5; Fe – 12, 11, 10; Tita – 19, 19, 18. The Scx I of leg I has one serrated mesochaetae, while Scx I of legs II and III present one serrated mesochaetae and one smooth microchaetae (Fig. 7). Tenent hair on tibiotarsi slightly clavated, almost indistinguishable; unguis with one median inner tooth (Fig. 9). Ventral tube with 4+4 chaetae. Tenaculum with three teeth on each ramus. Abdominal segments II–V ventrally with, respectively, 3+3, 9–10+9–10, 8–9+8–9 and 5+5 chaetae. Furca fully developed: manubrium with 9+9 ventral chaetae; dens with 6+6 chaetae; mucro separated from dens with two lamella tapering before the apex, which is thickened and slightly hooked (Fig. 10). Each anal valve with 14–15 chaetae, of which two distal chaetae and one distal-lateral chaetae are serrated (one specimen was asymmetric and had one additional distal lateral chaetae on one side), and 2 chaetae hr; Abd VI with 2 setulae in the ventral side (Fig. 11).

**Etymology.** From the Latin *barbatus*, which can mean bearded or ragged, uneven, rugged. A reference to the serration of mesochaetae, especially the lateral ones, on the body of the new species.

**Discussion.** As the first species of the genus possessing well developed serrations on the chaetae, as well as a clavated apex, on the body chaetotaxy, *N. barbatae* sp. nov. can be readily distinguished from its congeners. In addition, the new species presents a group of different ventral chaetae with bent tips on Ant IV.

### *Neotropiella macunaimae* sp. nov. (Figs 12–22)

**Type material:** 2158 CM/MNRJ (27.VII.2011): 1 specimen on slide (young female); 2235 CM/MNRJ (25.XI.2011): 1 specimen on slide (female); 2350 CM/MNRJ (11.IV.2012): 2 specimens on slides (females); 2357 CM/MNRJ (11.IV.2012): 1 specimen on slide (young female); 2358 CM/MNRJ (11.IV.2012): 1 specimen on slide (female); 2360 CM/MNRJ (11.IV.2012): 7 specimens (4 in ethanol, 3 females on slides); 2361 CM/MNRJ (11.IV.2012): 2 specimens (1 in ethanol, 1 male on slide). **Type locality:** Parque Nacional do Caparaó/ICMBio, Alto Caparaó municipality, Minas Gerais State, Brazil. About 2.700 m a.s.l.. Soil and leaf-litter of ‘campos de altitude’, a high altitude ecosystem that belongs to the Atlantic Forest biome. Local coordinates 20°26'32.09"S, 41°48'8.22"W. Queiroz, G.C. leg.

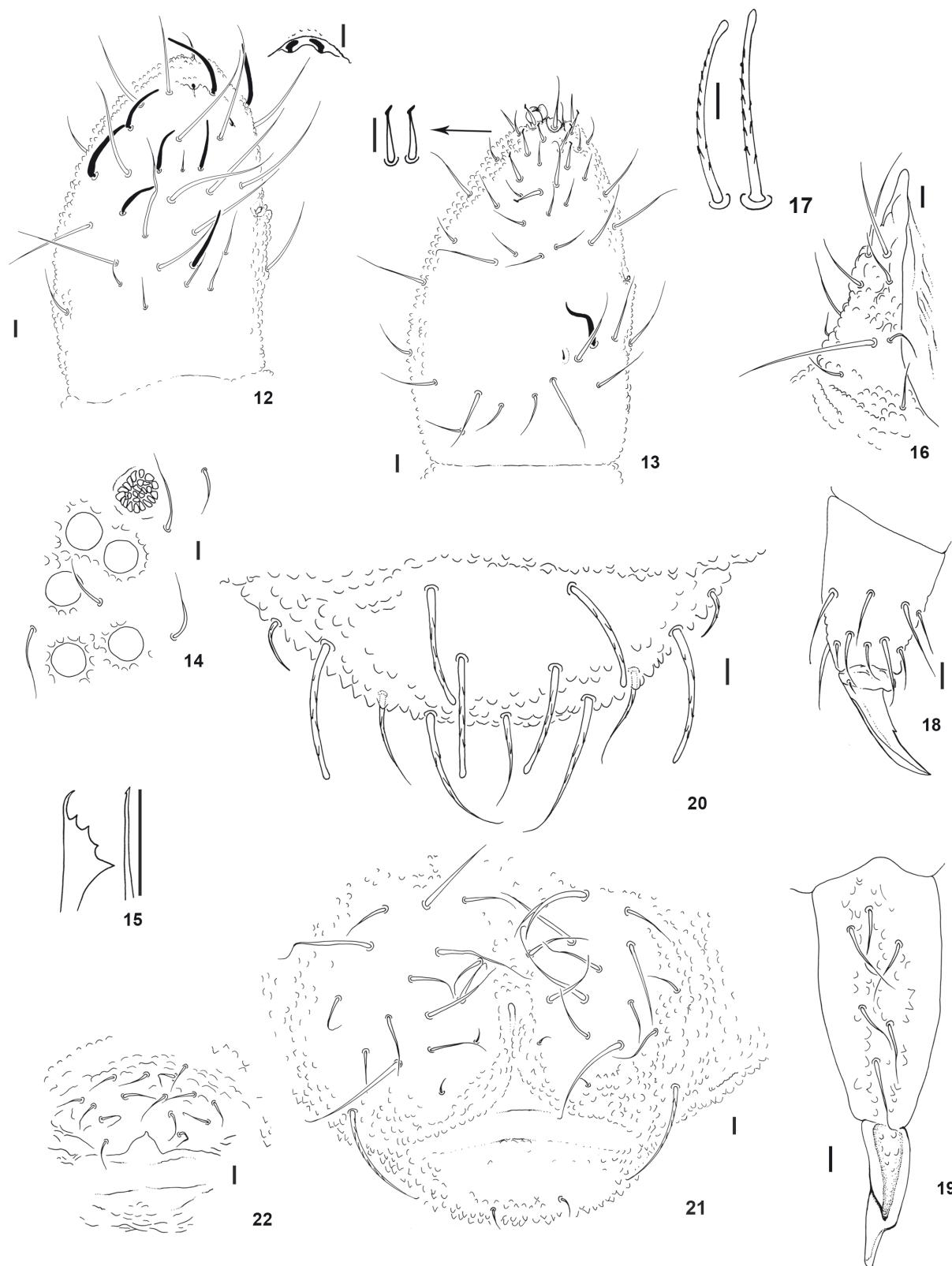
**Description.** Habitus typical of the genus. Body length of holotype (female): 2.23 mm; body length range of paratypes: 0.8–2.23 mm. Color in ethanol: black, dark pigment.

Ratio head diagonal: antenna = 1:0.70. Ant I with 7 chaetae. Ant II with 12 chaetae. Ant III and IV fused dorsally, ventral separation marked. Sensory organ of Ant III with two small club-shaped sensilla bent towards each other and underneath a fold of the integument; two longer and subcylindrical guard sensilla; ventral microsensillum present (Fig. 12). Ant IV with trilobed apical bulb and seven sensilla, three are weakly differentiated from ordinary chaetae; dorsolateral microsensillum present; subapical organite round; 7–8 ventral chaetae with bent tips interspersed with other ordinary chaetae (Fig. 13).

Eyes 5+5, with strongly pigmented eye patch. PAO moruliform, slightly larger than ocellus A, bearing 23–27 vesicles (Fig. 14). Maxillae styliform with a small apical tooth and no lamellae; minute mandible (not longer than 10 µm) with two strong teeth, the apical and the basal, interpolated with three smaller teeth (Fig. 15). Buccal cone typical of the genus. Labium bearing chaetae A–G (Fig. 16).

Dorsal chaetotaxy of the body just like *N. barbatae* sp. nov. (see Fig. 7). Ratio micro: mesochaetae: sensilla = 1: 2: 4. Lateral serrated mesochaetae have a strongly clavated apex (Fig. 17). All dorsal chaetae of Abd VI are serrated, but only 3+3 are strongly clavated and serrated; one unpaired chaetae in the third row of chaetae.

Chaetotaxy of legs I–III as follows: Scx I – 1, 2, 2; Scx II – 0, 2, 2; Cx – 3, 8, 7; Tr – 5, 5, 5; Fe – 12, 11, 10; Tita – 19, 19, 18. The Scx I of leg I presents one serrated mesochaetae, while Scx I of legs II and III present one serrated mesochaetae and one smooth microchaetae. Tenent hair on tibiotarsi slightly clavated, almost indistinguishable; unguis with one median inner tooth (Fig. 18). Ventral tube with 4+4 chaetae. Tenaculum with three teeth on each ramus. Abdominal segments II–V ventrally with, respectively, 3+3, 9–10+9–10,



**Figures 12–22.** *Neotropiella macunaimae* sp. nov. (12) Dorsal view of Ant III–IV with detail of Ant III organ, (13) Ventral view of Ant III–IV with detail of bent-tip chaetae, (14) Ocular plate and PAO, (15) Mandible and maxillae, (16) Labium, (17) Detail of lateral mesochaetae of Scx I of leg I (left) and of the head (right), (18) Tita of leg III, (19) Dens and mucro, (20) Dorsal chaetotaxy of Abd VI, (21) Anal valves, (22) Genital plate of female. Scale bars = 10  $\mu$ m.

8–9+8–9 and 5+5 chaetae. Furca present: manubrium with 9–10+9–10 ventral chaetae; dens with 6+6 chaetae; mucro separated from dens with two lamella tapering before the apex, which is thickened and slightly hooked (Fig. 19). Dorsal chaetotaxy of Abd VI as in Fig. 20. Each anal valve with 14–15 chaetae, of which only one distal-lateral chaetae is clearly serrated, and 2 chaetae hr; Abd VI with 2 setulae in the ventral side (Fig. 21). Genital plate of female as in Figure 22.

**Etymology.** After the book Macunaíma, written by the Brazilian author Mário de Andrade in 1928. The book narrates a surreal and comic story about the homonymous character, Macunaíma, and represents the multicultural aspects of brazilian life.

**Discussion.** This new species is very similar to *N. barbatae* sp. nov. concerning many aspects, such as dorsal chaetotaxy, number of chaetae on dens, mucro shape, but specially the serrated and clavated chaetae and also the presence of bent-tip chaetae ventrally on Ant IV. Nevertheless, the serrated chaetae of *N. macunaimae* sp. nov. tend to have a more clavated apex and also a lesser number of bent-tip chaetae on Ant IV – eight instead of 20 in *N. barbatae* sp. nov. In addition, their mandibles are different, as *N. barbatae* sp. nov. has four tiny teeth between the basal and the apical teeth, while *N. macunaimae* sp. nov. has only three relatively larger teeth between the apical and basal teeth. In the anal valves of *N. barbatae* sp. nov., two clearly serrated chaetae are present in its distal part and one distal lateral serrated chaetae, while in *N. macunaimae* sp. nov. only the distal lateral chaetae are serrated.

These species belong to a complex of species with serrated chaetae which are well distributed, at least in Southeastern Brazil, as other specimens with this character have already been collected by our group in different localities of the region. However, due to the small number of specimens they could not be described.

### *Neotropiella insularis* sp. nov. (Figs 23–36)

**Type material:** 1973 CM/MNRJ (24.vii.2009): 20 specimens (3 in ethanol, 17 on slides: 6 males, 2 females and 9 juveniles). **Type locality:** Ilha Grande, Angra dos Reis municipality, Rio de Janeiro State, Brazil. About 200m a.s.l.. Leaf-litter of Atlantic rainforest. Local coordinates 23°10'53.52"S, 44°14'42.23"W. Rodrigues, J. & Mattos, I. leg.

**Description.** Habitus typical of the genus. Body length of holotype (female): 3.5 mm; body length range of paratypes: 2.5–3.8 mm. Color in ethanol: dark blue to dark purple.

Ratio head diagonal: antenna = 1:1.3. Ant I with 9 chaetae. Ant II with 12 chaetae. Ant III and IV fused

dorsally, ventral separation marked. Sensory organ of Ant III with two small club-shaped sensilla bent towards each other; two longer and subcylindrical guard sensilla; ventral microsensillum present. Ant IV with trilobed apical bulb and six sensilla, two are weakly differentiated from ordinary chaetae; dorsolateral microsensillum present; subapical organite round (Fig. 23). Ventral side of Ant IV with about 140 small chaetae, forming a sensorial field that covers almost the whole extension of the segment (Fig. 24).

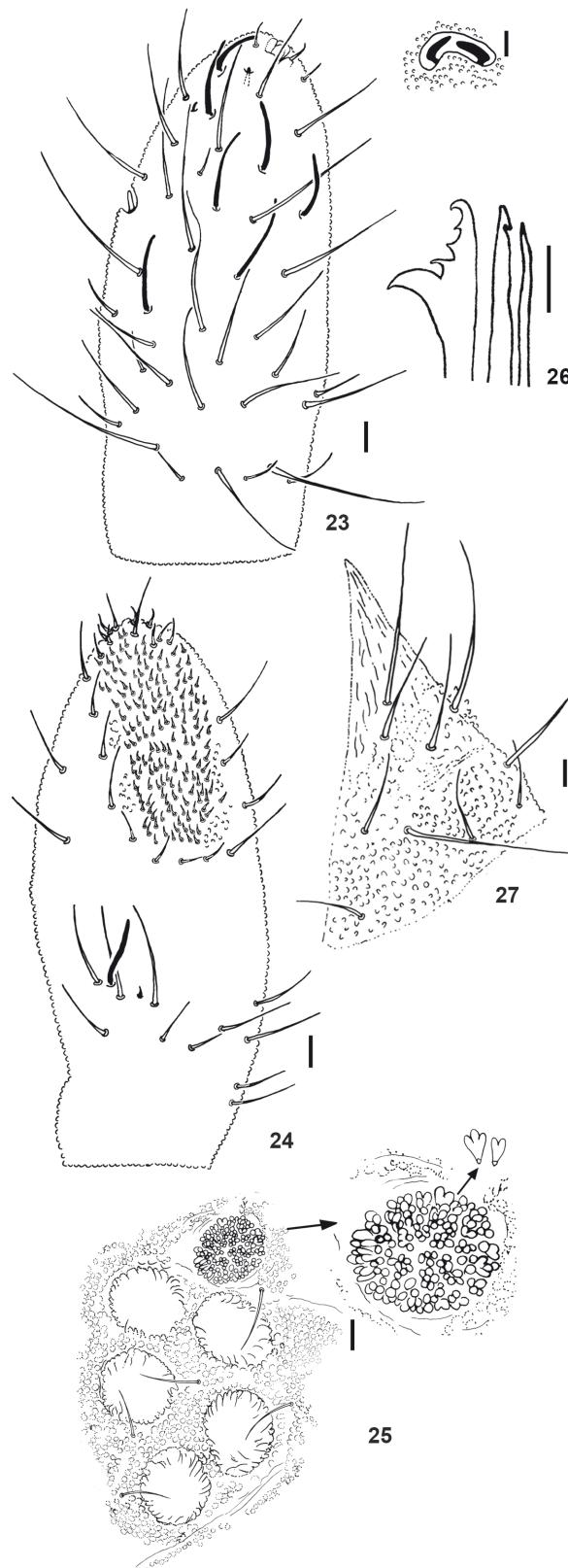
Eyes 5+5, with strongly pigmented eye patch. The eyes have a unique shape, with a pleated edge. PAO moruliform, slightly larger than ocellus A, bearing 38–40 vesicles; each vesicle with a bi- or trilobed apex (Fig. 25). Maxillae styliform with two lamella and a small apical hook; mandible with five teeth, the basal being strong and the four others smaller (Fig. 26). Buccal cone typical of the genus. Labium bearing chaetae A–G (Fig. 27).

Dorsal chaetotaxy composed only of smooth microchaetae (15–18) and long sensilla (120–125 $\mu$ m). Sensillar formula by half tergum: 022/111110. Ratio microchaetae: sensilla = 1: 7. Chaetotaxy of head and body as in Fig. 28. Th I with 4+4 chaetae. Abd VI with two unpaired chaetae (Fig. 29).

Chaetotaxy of legs I–III as follows: Scx I – 1, 2, 2; Sex II – 0, 2, 2; Cx – 3, 8, 7; Tr – 5, 5, 5; Fe – 12, 11, 10; Tita – 19, 19, 18. Pointed tenent hair on tibiotarsi; unguis with one inner basal tooth (Fig. 30). Some males presented one differentiated chaetae on Cx of legs I and III, the first being of peculiar shape and the second with a bisected apex (Figs 31 and 32). Ventral tube with 4+4 chaetae. Tenaculum with three teeth on each ramus. Furca present: manubrium with 15–16+15–16 ventral chaetae; dens with 6+6 chaetae; mucro separated from dens with a greatly developed and enlarged lamella tapering before the apex, which is elongated and slightly hooked (Figs 33 and 34). Each anal valve with 14–15 chaetae, one being distal-lateral, and 2 chaetae hr; Abd VI with 2 setulae in the ventral side. Genital plate of male and female as in Figs 35 and 36, respectively.

**Etymology.** After the Latin *insula*, meaning island, as it has been collected on the largest island of the Rio de Janeiro coast, called 'Ilha Grande' ('Big Island').

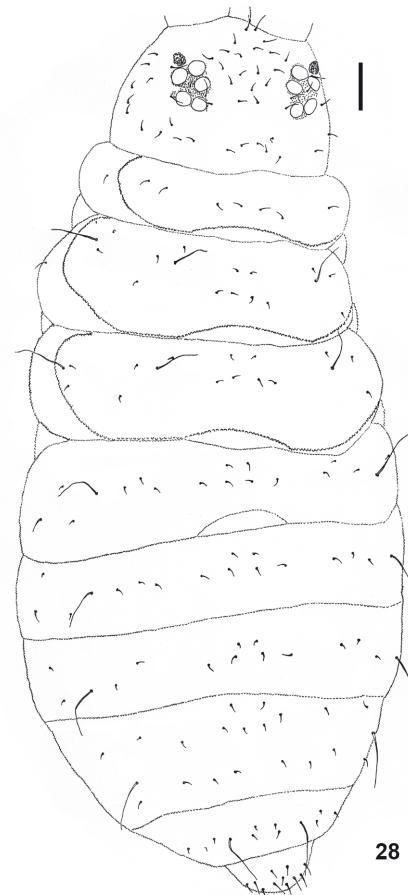
**Discussion.** Due to the combination of sensorial field on Ant IV, bi- and trilobed vesicles on the PAO and the unique mandible, *N. insularis* sp. nov. can be well distinguished from its congeners. Only six species present a sensorial field on Ant IV (see Table 1), although, only *N. carli* (Denis, 1924) and *N. digitomucronata* Massoud & Thibaud, 1982 have a well-developed sensorial field with over 70 small chaetae, such as *N. insularis* sp. nov. with about 140 chaetae. In respect to the PAO vesicles, *N. insularis* sp. nov. is the second of the genus that



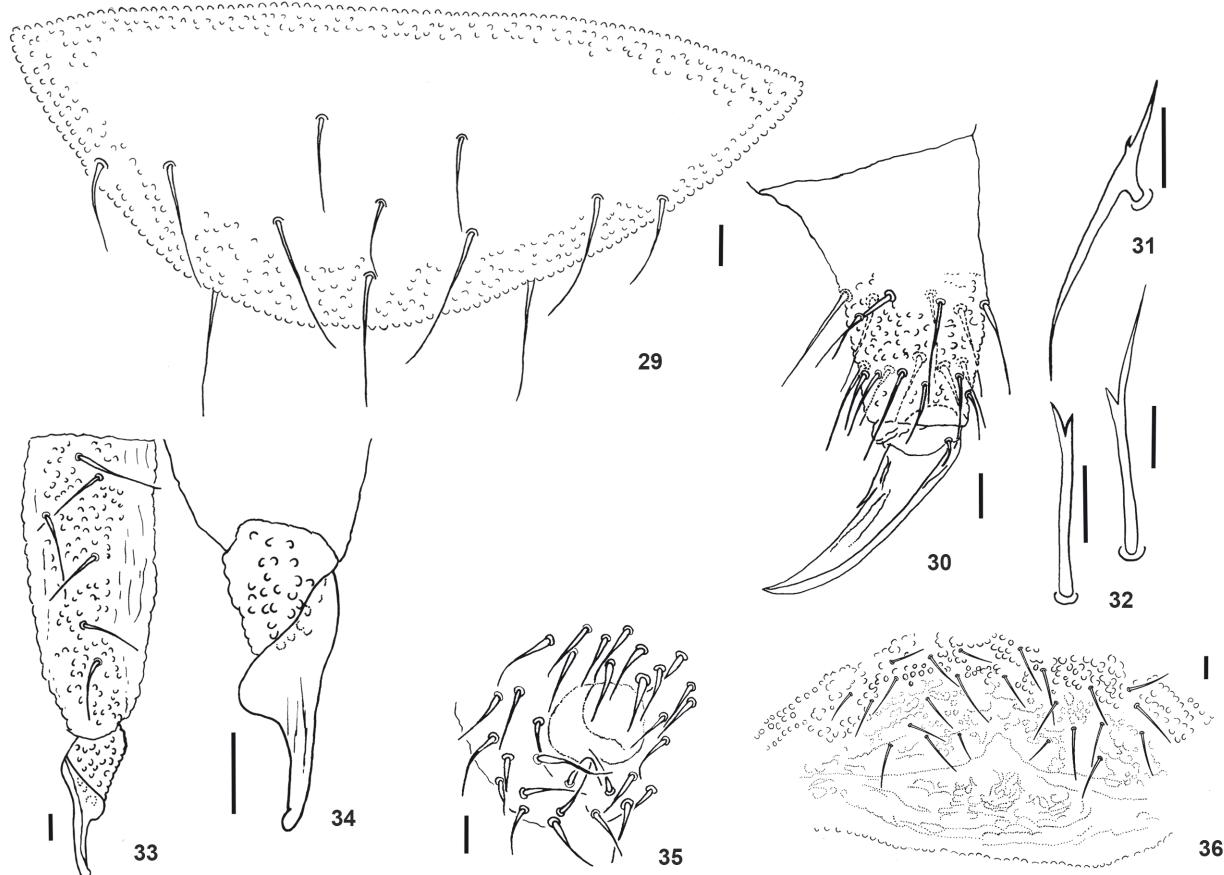
**Figures 23–27.** *Neotropiella insularis* sp. nov. (23) Dorsal view of Ant III–IV with detail of Ant III organ, (24) Ventral view of Ant III–IV, (25) Ocular plate and PAO with detail of PAO and its vesicles, (26) Mandible and maxillae, (27) Labium. Scale bars = 10 µm.

presents bi- or trilobed vesicles, together with *N. gordae* Díaz & Najt, 1995, despite the different number of vesicles, 38–40 and 26–30 in *N. insularis* sp. nov. and *N. gordae*, respectively. These two species also differ in the number of sensilla on Ant IV (6 in *N. insularis* sp. nov. and 5 in *N. gordae*) and mandible teeth (5 in *N. insularis* sp. nov. and 4 in *N. gordae*).

It is worth mentioning that the number and disposition of dorsal chaetae on Abd VI might become a good character to distinguish species of *Neotropiella*, as great differences can be seen between the species described here. The first two species, *N. barbatae* sp. nov. and *N. macunaimae* sp. nov., have only one unpaired chaetae in the third row of chaetae, while *N. insularis* sp. nov. has two unpaired chaetae in the second and third row of chaetae (see Figs 8 and 29). As, for the formerly described species, no drawings or specification of the dorsal chaetotaxy of Abd VI are given in their description, it is not possible to establish further correlations within the species of *Neotropiella* in this respect.



**Figure 28.** *Neotropiella insularis* sp. nov. Dorsal chaetotaxy of head and body. Scale bar = 120 µm.



**Figures 29–36.** *Neotropiella insularis* sp. nov. (29) Dorsal chaetotaxy of Abd VI, (30) Tita of leg II, (31) Modified chaetae of Cx on leg I of male, (32) Modified chaetae of Cx on leg III of two different male specimens, (33) Dens and mucro, (34) Mucro, (35) Male genital plate, (36) Female genital plate. Scale bars = 10 µm.

### 3. Acknowledgements

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