

**SUPPLEMENTARY DESCRIPTION OF *INDORIBATES (HAPLOZETES) MINUTUS* (TSENG, 1984) AND *MULIERCULA FEMOROSERRATA* (PÉREZ-ÍÑIGO ET BAGGIO, 1980) COMB. N. (ACARI, ORIBATIDA, ORIPODOIDEA)**

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**ABSTRACT:** Two oripodoid oribatid mites, *Indoribates (Haplozetes) minutus* (Tseng, 1984) and *Muliercula femoroserrata* (Pérez-Íñigo et Baggio, 1980) comb. n., are redescribed on the basis of specimens from Brazil. *Indoribates (H.) minutus* is recorded for the first time in the Neotropical region. The recombination of two scheloribatid species, *Schelorbitates femoroserratus* Pérez-Íñigo et Baggio, 1980 and *S. orixaensis* Badejo, Woas et Beck, 2002, as *Muliercula femoroserrata* (Pérez-Íñigo et Baggio) comb. n. and *M. orixaensis* (Badejo, Woas et Beck) comb.n., is proposed. An identification key to known species of the genus *Muliercula* is given.

**KEY WORDS:** Oribatida, Oripodoidea, *Indoribates (Haplozetes) minutus* (Tseng), *Muliercula femoroserrata* (Pérez-Íñigo et Baggio), new record, new combination, key, Brazil

### INTRODUCTION

This work is a part of our continuing study of the Brazilian oribatid mite fauna (Ermilov *et al.* 2014). The present study includes the data on supplementary description of two oripodoid species (Acari, Oribatida, Oripodoidea), *Indoribates (Haplozetes) minutus* (Tseng, 1984) and *Muliercula femoroserrata* (Pérez-Íñigo et Baggio, 1980) comb. n. The original descriptions of both species are brief and incomplete, therefore the main goal of our paper is to redescribe and illustrate *I. (H.) minutus* and *M. femoroserrata* based on material from Brazil.

*I. (H.) minutus* was described by Tseng (1984) from Taiwan; it was earlier known only in that country. Hence, this species is recorded for the first time in the Neotropical region. *M. femoroserrata* was described by Pérez-Íñigo and Baggio (1980) as *Schelorbitates femoroserratus* from Brazil. The recombination of this species as well as the other Brazilian scheloribatid species, *S. orixaensis* Badejo, Woas et Beck, 2002, is presented (see *Remarks* section).

In addition, an identification key to known species of the genus *Muliercula* is given below.

### MATERIAL AND METHODS

The collection locality and habitat of the new species are given in the “*Material examined*” sections. Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. Notogastral width

refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu–tibia–tarsus. General terminology used in this paper follows that of Grandjean (summarized by Norton and Behan-Pelletier 2009). Drawings were obtained through a drawing tube mounted on a Carl Zeiss transmission light microscope “Axioskop-2 Plus”.

### SUPPLEMENTARY DESCRIPTION

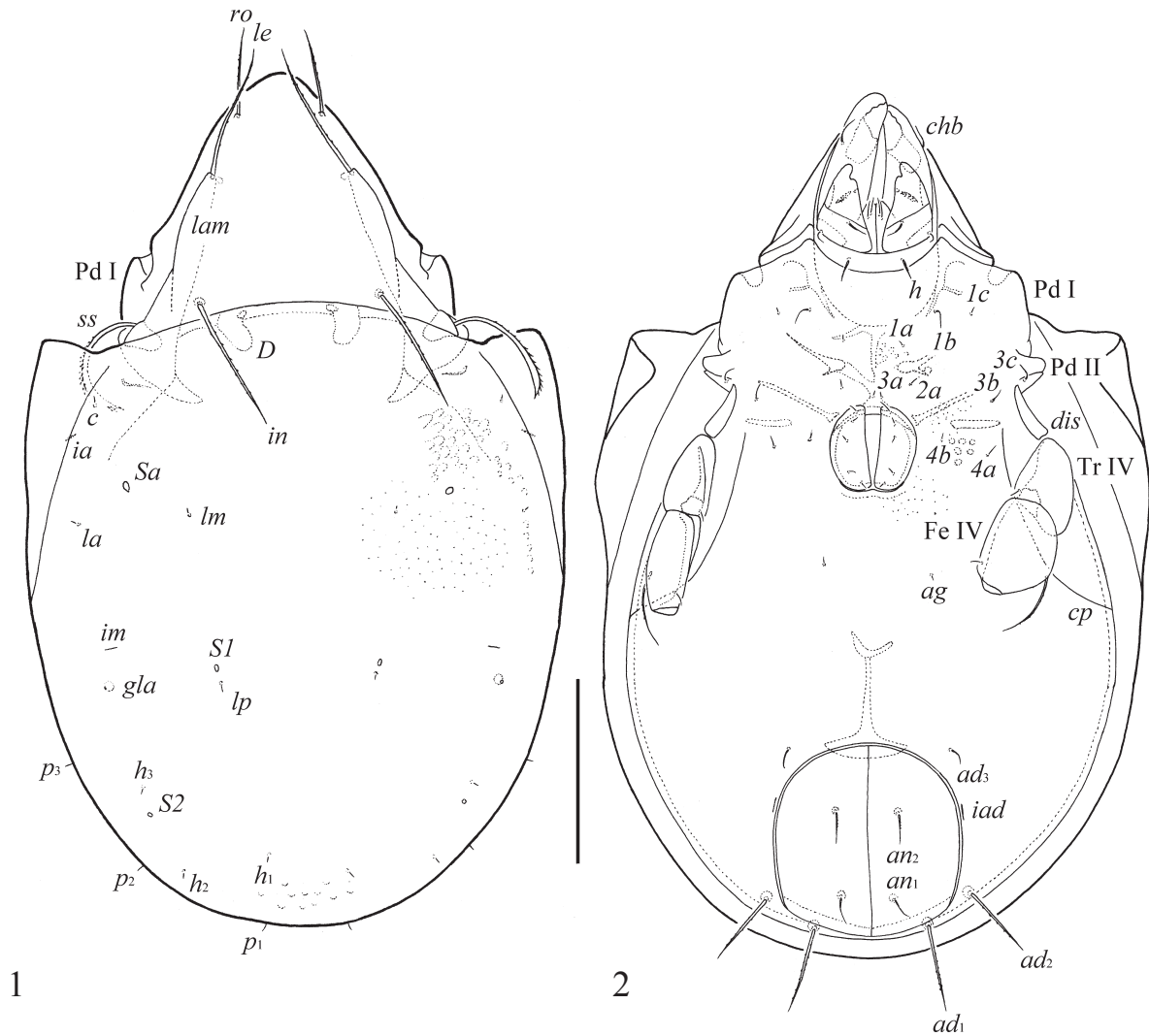
#### *Indoribates (Haplozetes) minutus* (Tseng, 1984)

Figs 1–15

**Description.** *Measurements* (for 11 specimens: six females and five males). Body length: 398–581; notogastral width (without pteromorphs): 232–348. Females larger than males: 498–581 × 298–348 versus 398–481 × 232–298.

*Integument.* Body color yellowish brown. Body surface microgranulate; granules rounded, very small (less than 1), well visible under high magnification. Lateral parts of prodorsum between tutorial and acetabula I and II indistinctly reticulate.

*Prodorsum.* Rostrum widely rounded. Lamellae (*lam*) located dorso-laterally, interrupted in basal part, slightly longer than half of prodorsum length (measured in lateral view). Translamellar line absent. Sublamellar lines (*slam*) short, strong.



Figs 1–2. *Indoribates (Haplozetes) minutus* (Tseng, 1984), adult: 1 — dorsal view; 2 — ventral view (legs except basal parts of legs IV not illustrated). Scale bar 100  $\mu$ m.

Sublamellar porose areas (*Al*) oval (12–16  $\times$  8–10). Tutoria (*tu*) distinct, long. Rostral (*ro*, 45–53), lamellar (*le*, 69–82) and interlamellar (*in*, 77–94) setae setiform, barbed. Bothridial setae (*ss*, 94–106) with long stalk and shorter, slightly dilated unilaterally, ciliate head. Exobothridial setae (*ex*, 4) thin, smooth. Porose areas *Ad* not found.

**Notogaster.** Anterior notogastral margin slightly convex medially. Dorsophragmata (*D*) of medium size, elongated longitudinally, rounded distally. Ten pairs of notogastral setae short (4), thin, smooth. Four pairs of sacculi (*Sa*, *S1*, *S2*, *S3*) with small, oval channels. Setae *lp* inserted posteriorly to *S1*. Lyrifissures (*ia*, *im*, *ip*, *ih*, *ips*) and opisthonotal gland openings (*gla*) distinct.

**Gnathosoma.** Subcapitulum longer than wide (114–118  $\times$  90). Subcapitular setae setiform; *h* (24–28) barbed, *a* (24–28) and *m* (12–14) sparsely barbed. Two pairs of adoral setae (*or*<sub>1</sub>, *or*<sub>2</sub>, 20)

thickened, densely bilaterally barbed. Palps (length 69) with setation 0–2–1–3–9(+ $\omega$ ). Sole-nidion attached to eupathidium (*acm*), both located on dorsal tubercle. Chelicerae (length 135–139) with two barbed setae; *cha* (45–53) longer than *chb* (28–32). Trägårdh's organ (*Tg*) long, tapered.

**Epimeral and lateral podosomal regions.** Apodemes 1, 2, 3 and sejugal apodemes distinct. Epimeral setal formula: 3–1–3–2. All setae thin, slightly barbed; *1b*, *3b*, *3c* (20–24) longer than *4a* (16–18) and *1a*, *1c*, *2a*, *3a*, *4b* (8–12). Setae *1c* inserted near *1b*. Pedotecta I (*Pd I*) large, concave (in dorsal view) and scale-like (in lateral view); pedotecta II (*Pd II*) smaller, trapezoid, bifurcate anteriorly (in ventral view) and scale-like (in lateral view). Discidia (*dis*) elongated, weakly triangular. Circumpedal carinae (*cp*) distinct.

**Anogenital region.** Five pairs of genital (*g*<sub>1</sub>, 16–20, *g*<sub>2</sub>–*g*<sub>5</sub>, 12–16), one pair of aggenital (*ag*,



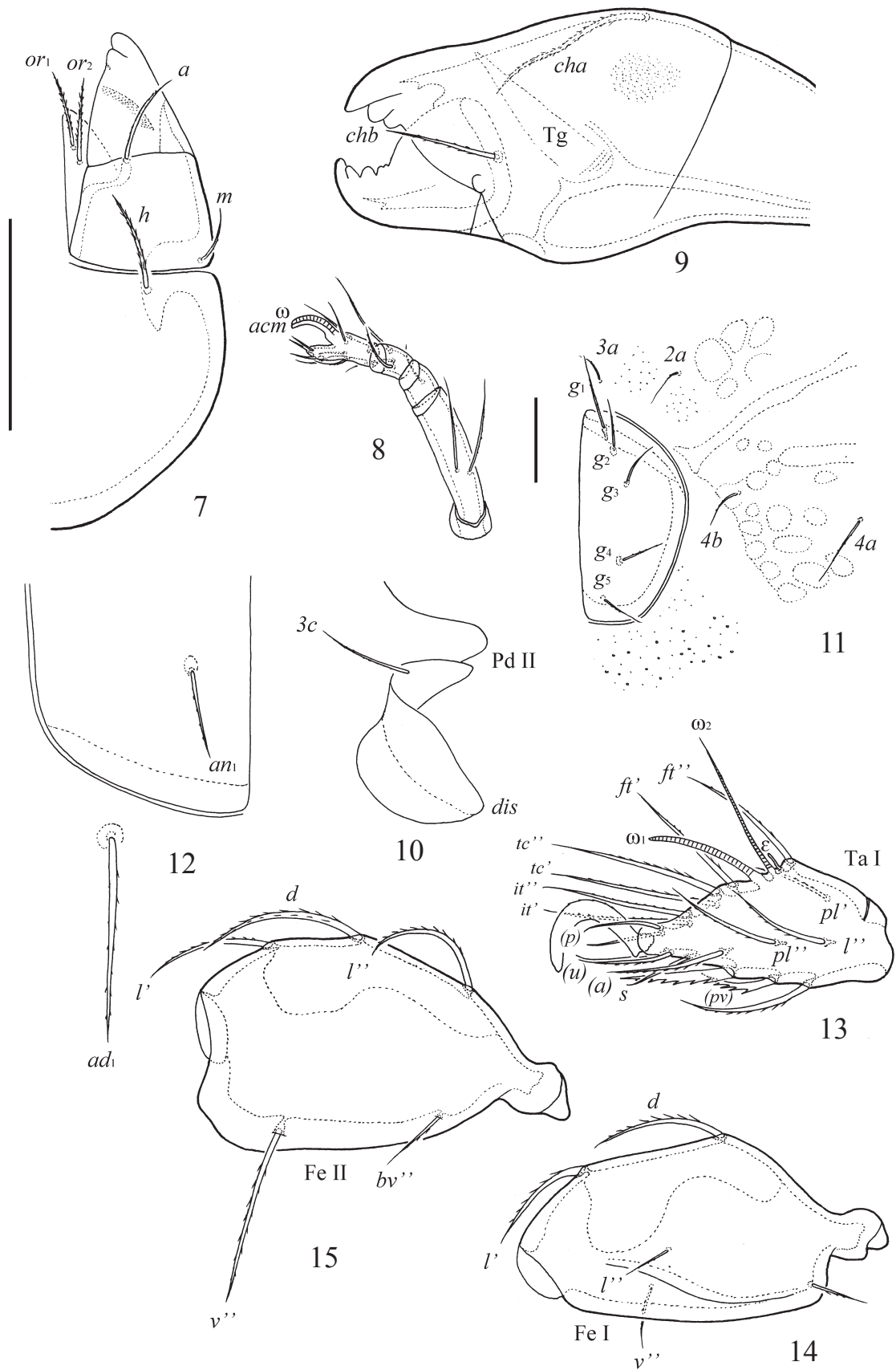
Figs 3–6. *Indoribates (Haplozetes) minutus* (Tseng, 1984), adult: 3 — lateral view of anterior part of body (legs I, II except basal parts not illustrated); 4 — posterior view; 5 — rostral seta; 6 — bothridial seta. Scale bars 100  $\mu$ m (3, 4), 20  $\mu$ m (5, 6).

12–16), two pairs of anal ( $an_1$ ,  $an_2$ , 20–28) and three pairs of adanal ( $ad_1$ , 45–61;  $ad_2$ , 41–57;  $ad_3$ , 16–20) setae setiform, slightly barbed. Lyrifissures *iad* located close to and parallel anal plates.

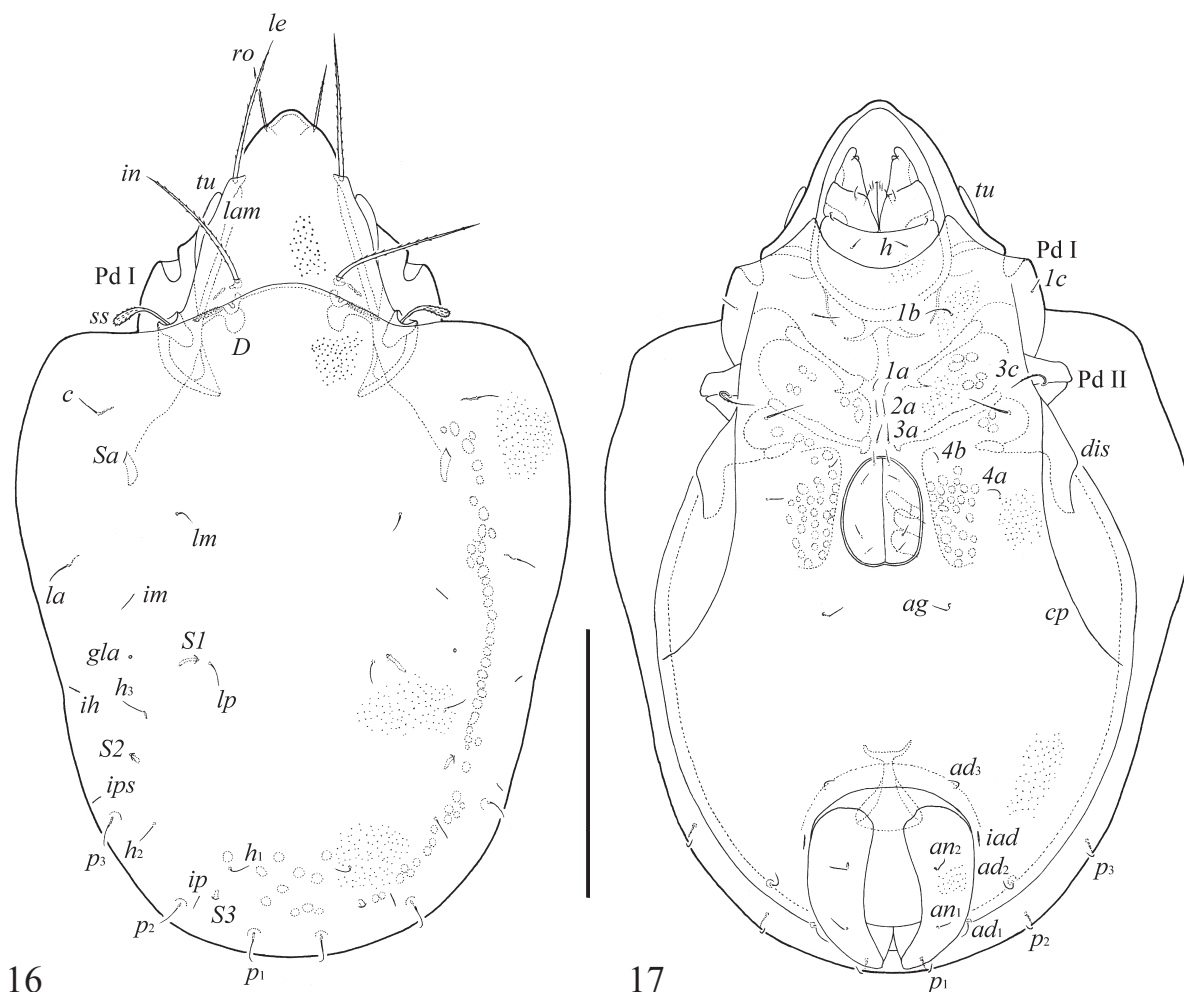
**Legs.** Monodactylous, leg claws with several minute barbs on dorsal side. Ventral side of femora without teeth. Generally, morphology of leg segments, setae and solenidia typical for *Haplozetes* (for example, Beck 1964; Bayartogtokh 2000). Formulae of leg setation and solenidia: I (1–5–3–4–19) [1–2–2], II (1–5–3–4–15) [1–1–2],

III (2–3–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Famulus ( $\epsilon$ ) short, thin, straight, indistinctly dilated distally, inserted posteriorly to solenidium  $\omega_2$ . Setae barbed (except smooth *s* on tarsus I and *p*). Solenidia  $\omega_1$  on tarsus I,  $\omega_1$ ,  $\omega_2$  on tarsus II and  $\sigma$  on genua III thickened, blunt-ended, other solenidia thinner, setiform.

**Material examined.** Eleven specimens: Brazil, 22°57'S, 43°09'W, Rio de Janeiro, Morro do Leme, Forte Duque de Caxias, 91 m a.s.l., Atlantic



Figs 7–15. *Indoribates (Haplozetes) minutus* (Tseng, 1984), adult: 7 — left half of subcapitulum, ventral view; 8 — palp; 9 — chelicera (posterior part not illustrated); 10 — pedotectum II, discidium and epimeral seta 3c; 11 — left genital plate and part of epimeral region; 12 — posterior part of right anal plate and adanal seta ad1; 13 — tarsus I, left, antiaxial view; 14 — femur I, left, antiaxial view; 15 — femur II, left, antiaxial view. Scale bars 50  $\mu\text{m}$  (7, 9, 13–15), 20  $\mu\text{m}$  (8, 10–12).



Figs 16–17. *Muliercula femoroserrata* (Pérez-Íñigo et Baggio, 1980), adult: 16 — dorsal view; 17 — ventral view (legs not illustrated). Scale bar 200  $\mu$ m.

forest, soil litter, unknown date and collector (collection of the Tyumen State University, Tyumen, Russia).

**Remarks.** The specimens of *I. (H.) minutus* from Brazil are similar in general appearance to those from Taiwan according to the original description (Tseng 1984). We have not found any morphological differences.

***Muliercula femoroserrata*  
(Pérez-Íñigo et Baggio, 1980) comb. n.**

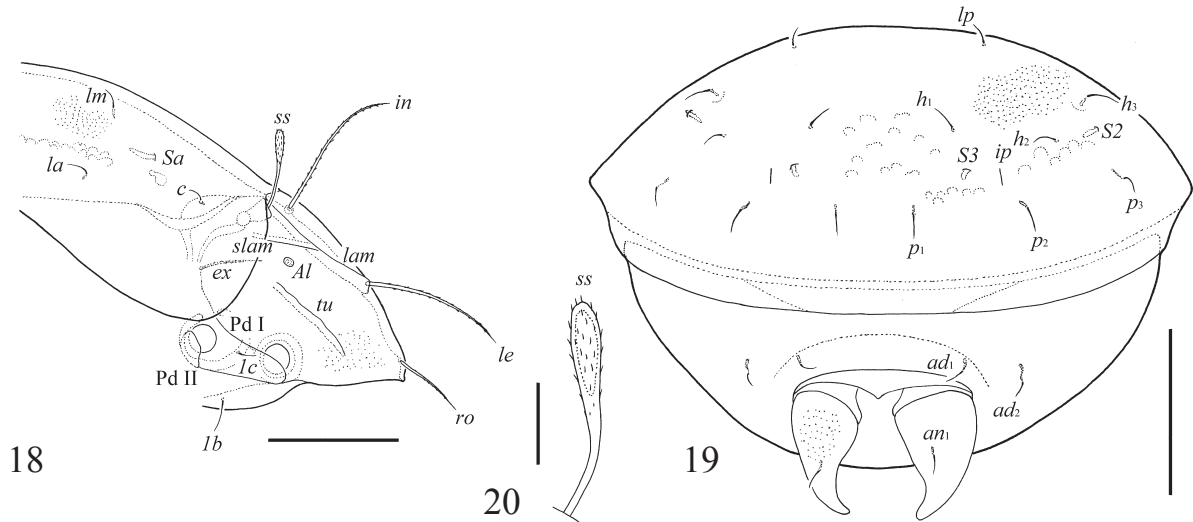
Figs 16–28

**Description.** *Measurements* (for seven specimens: three females and four males). Body length: 614–780; notogastral width (without pteromorphs): 365–481. Females larger than males: 697–780  $\times$  431–481 versus 614–630  $\times$  365.

*Integument.* Body color dark brown. Body surface weakly microfoveolate; foveoles small (less than 1), rounded.

*Prodorsum.* Rostrum weakly protruding, narrowly rounded. Lamellae located dorso-laterally, longer than half of prodorsum length (measured in lateral view). Translamellar line absent, but unclear V-shaped structure visible. Prolamellar lines and lateral keel-shaped ridges absent. Sublamellar lines distinct, long. Sublamellar porose areas small, rounded (8–10) or oval (8–10  $\times$  6–8). Tutorsia strong, long. Rostral (57–65), lamellar (110–123) and interlamellar (135–147) setae setiform, barbed. Bothridial setae (61–73) clavate, with long stalk and shorter, elongated, rounded distally, barbed head. Exobothridial setae (45–53) setiform, barbed. One pair of elongated, narrow porose areas *Ad* located posterolateral to interlamellar setae, visible in dissected specimens.

*Notogaster.* Anterior notogastral margin convex medially. Dorsophragmata of medium size, slightly elongated longitudinally, rounded distally. Ten pairs of notogastral setae short (18–22), thin,



Figs 18–20. *Muliercula femoroserrata* (Pérez-Íñigo et Baggio, 1980), adult: 18 — lateral view of anterior part of body (gnathosoma and legs I, II not illustrated); 19 — posterior view; 20 — bothridial seta. Scale bars 100 µm (18, 19), 20 µm (20).

Table 1.  
Leg setation and solenidia of *Indoribates (Haplozetes) minutus* (Tseng, 1984)  
same data for *Muliercula femoroserrata* (Pérez-Íñigo et Baggio, 1980)

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ <sub>1</sub> , φ <sub>2</sub>	(ft), (tc), (it), (p), (u), (a), s, (pv), v'*, (pl), l'', ε, ω <sub>1</sub> , ω <sub>2</sub>
II	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv), ω <sub>1</sub> , ω <sub>2</sub>
III	l', v'	d, l', ev'	l', σ	l', (v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv)
IV	v'	d, ev'	d, l'	l', (v), φ	ft'', (tc), (p), (u), (a), s, (pv)

\* — seta v' absent in *I. (H.) minutus*.

Roman letters refer to normal setae (ε to famulus), Greek letters to solenidia. Single prime (') marks setae on anterior and double prime (') setae on posterior side of the given leg segment. Parentheses refer to a pair of setae.

slightly barbed. Four pairs of sacculi with elongated and straight channels. Lyrifissures (except *ia*) and opisthotal gland openings distinct.

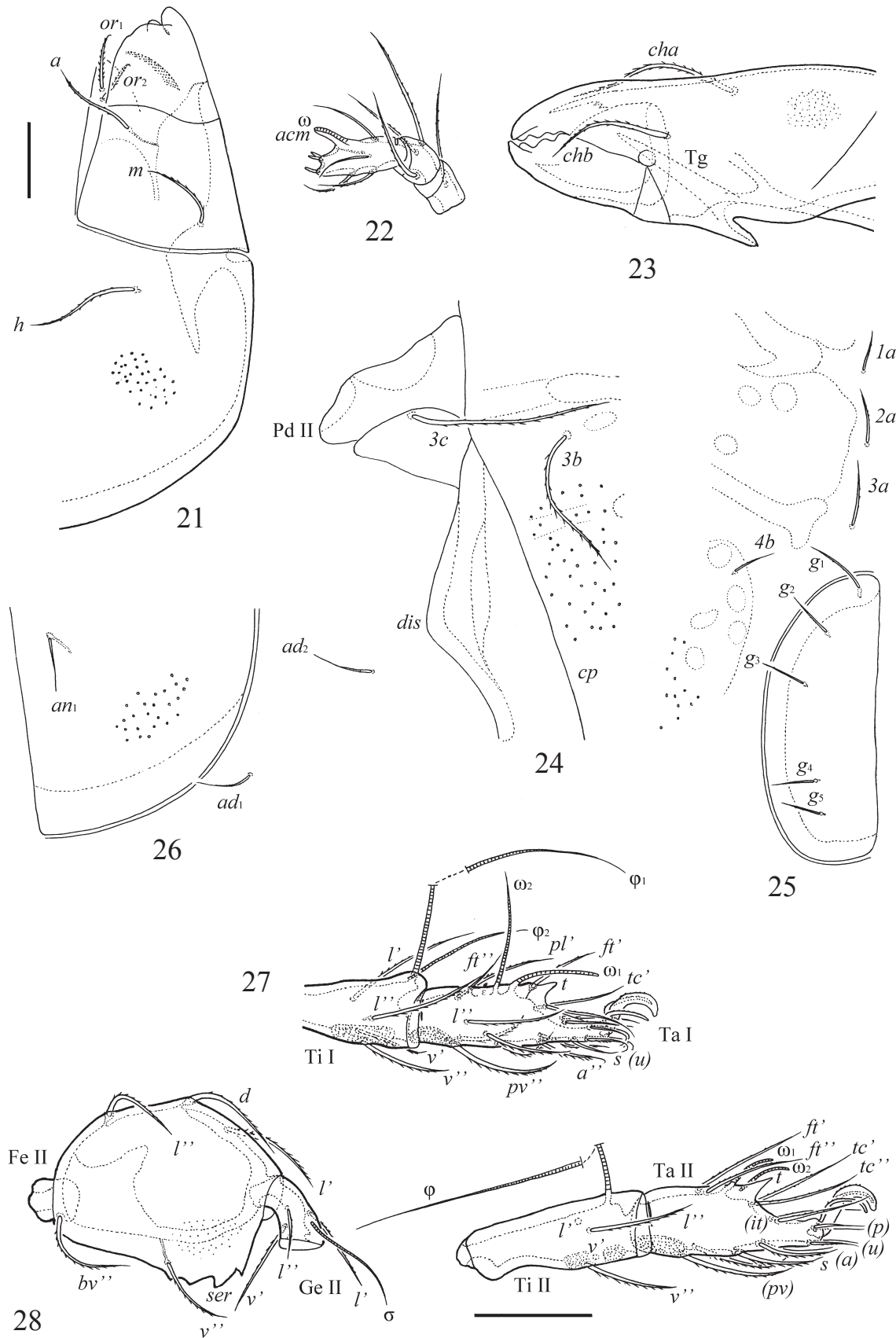
**Gnathosoma.** Subcapitulum longer than wide (135–147 × 90–98). Subcapitular setae setiform, barbed; *h* (30–32) longer than *a* (26–28) and *m* (22–24). Two pairs of adoral setae (16–18) thickened, densely bilaterally barbed. Palps (length 90) with setation 0–2–1–3–9(+ω). Solenidion attached to eupathidium, both located on dorsal tubercle. Chelicerae (length 147) with two barbed setae; *cha* (49–53) longer than *chb* (32–36). Trägårdh's organ long, tapered.

**Epimeral and lateral podosomal regions.** Apodemes 1, 2, 3 and sejugal apodemes distinct. Epimeral setal formula: 3–1–3–2. All setae setiform, barbed; *3c* (49–53) longer than *3b* (41–45), *1b* (28–32), *3a* (18–20), *1c*, *2a*, *4a* (14–16) and *1a*, *4b* (10–12). Pedotecta I large, concave (in dorsal view) and scale-like (in lateral view); pedotecta II

smaller, trapezoid, bifurcate anteriorly (in ventral view) and scale-like (in lateral view). Discidia elongated, weakly triangular. Circumpedal carinae distinct.

**Anogenital region.** Four or five pairs of genital (*g*<sub>1</sub>, 14–18, *g*<sub>2</sub>–*g*<sub>5</sub>, 10–12), one pair of aggenital (16–18), two pairs of anal (18–20) and three pairs of adanal (18–20) setae thin, slightly barbed. Lyrifissures *iad* located close and parallel to anal plates.

**Legs tarsi** with strong medial claw and two thinner, lateral claws; all with several minute barbs on dorsal side. Dorsal side of tarsi I, II with tooth (*t*). Ventral side of femora II serrate (*ser*), with four to five teeth. Generally, morphology of leg segments, setae and solenidia typical for *Muliercula* (for example, Coetzer 1968; Badejo et al. 2002). Formulae of leg setation and solenidia: I (1–5–3–4–20) [1–2–2], II (1–5–3–4–15) [1–1–2], III (2–3–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in



Figs 21–28. *Muliercula femoroserrata* (Pérez-Íñigo et Baggio, 1980), adult: 21 — left half of subcapitulum, ventral view; 22 — tarsus, tibia and genu of palp; 23 — chelicera (posterior part not illustrated); 24 — pedotectum II, discidium and epimeral setae  $3b$  and  $3c$ ; 25 — right genital plate and part of epimeral region; 26 — posterior part of left anal plate and adanal setae  $ad_1$  and  $ad_2$ ; 27 — tarsus and anterior part of tibia I, right, antiaxial view; 28 — leg II, left, antiaxial view. Scale bars 20  $\mu$ m (21–26), 50  $\mu$ m (27, 28).

Table 1. Famulus short, thin, straight, indistinctly dilated distally, inserted posteriorly to solenidion  $\omega_2$ . Setae barbed (except smooth *s* on tarsus I and *p*). Solenidia  $\omega_1$  on tarsus I,  $\omega_1$ ,  $\omega_2$  on tarsus II and  $\sigma$  on genua III thickened, blunt-ended, other solenidia thinner, setiform.

**Material examined.** Seven specimens: Brazil, 23°33'S, 46°39'W, São Paulo, Parque Trianon, 852 m.a.s.l., Atlantic forest, soil litter, unknown date and collector (collection of the Tyumen State University, Tyumen, Russia).

**Remarks.** At present, *M. femoroserrata* is recorded only from Brazil. Our specimens of this species are similar in general appearance to those according to the original description (Pérez-Íñigo and Baggio 1980). However, they are distinguishable from the latter by the presence of microfoveolate integument. Clearness of microfoveoles strongly varies (very distinct, visible under low magnification,  $\times 400$ , to indistinct, visible only under high magnification,  $\times 1000$ ). Original figures and description of *M. femoroserrata* specifies that authors studied specimens under low magnification, therefore we believe, they could not observe the microfoveoles.

*M. femoroserrata* and *M. orixaensis* were described from Brazil as *Schelorbates femoroserratus* Pérez-Íñigo et Baggio, 1980 (Pérez-Íñigo and Baggio 1980) and *S. orixaensis* Badejo, Woas et Beck, 2002 (Badejo et al. 2002). *Muliercula*-species distinguishes from *Schelorbates*-species mainly by the presence of tutoria on lateral sides of prodorsum (versus absent). Both species, *S. femoroserratus* and *S. orixaensis*, with tutoria, therefore their inclusion in the genus *Schelorbates* is incorrect. Hence, the following taxonomic proposals are proposed: *Muliercula femoroserratus* (Pérez-Íñigo et Baggio) comb. n. and *M. orixaensis* (Badejo, Woas et Beck) comb. n.

**KEY TO KNOWN SPECIES OF MULIERCULA**

- 1. Bothridial setae capitate or globose ..... 2
- Bothridial setae lanceolate, fusiform or clavate ..... 4
- 2. Lamellae with protruding cusps; lamellar setae inserted on lamellae before the lamellar cusps; body size: 270  $\times$  166 ..... *Muliercula discrepans* (Balogh, 1959) (see Balogh 1959). Distribution: Angola.
- Lamellae without cusps; lamellar setae inserted on the lamellae tips ..... 3
- 3. Sacculi *Sa* and *S<sub>1</sub>* clearly elongated; bothridial setae globose, with stalk shorter than head; ante-

rior part of prodorsum foveolate; body size: 284–317  $\times$  178–191 ..... *Muliercula longisacculus* (Mahunka, 1984) (see Mahunka 1984). Distribution: Tanzania.

— Sacculi *Sa* and *S<sub>1</sub>* nearly rounded; bothridial setae capitate, with stalk not shorter than head; anterior part of prodorsum not foveolate; body size: 284–302  $\times$  164–184 ..... *Muliercula bilineata* Mahunka, 1986 (see Mahunka 1986). Distribution: Tanzania.

4. Bothridial setae lanceolate or fusiform ..... 5

— Bothridial setae clavate ..... 6

5. Bothridial setae fusiform, with very short stalk (clearly shorter than large head); tutoria long, reaching the insertions of rostral setae; body size: 324–435  $\times$  201–231 ..... *Muliercula ngoyensis* Coetzer, 1968 (see Coetzer 1968). Distribution: South Africa.

— Bothridial setae lanceolate, with very long stalk (strongly longer than small head); tutoria short, clearly not reaching the insertions of rostral setae; body size: 438–586  $\times$  266–367 ..... *Muliercula inexpectata* Badejo, Woas et Beck, 2002 (see Badejo, Woas and Beck 2002). Distribution: Nigeria.

6. Lamellar cusps with lateral tooth; body size: 443–519  $\times$  321–360 ..... *Muliercula orixaensis* (Badejo, Woas et Beck) comb. n. (see Badejo, Woas and Beck 2002). Distribution: Brazil.

— Lamellar cusps without lateral tooth ..... 7

7. Lamellae narrow; ventral sides of femora II serrate; body size: 559–780  $\times$  365–481 .... *Muliercula femoroserrata* (Pérez-Íñigo et Baggio, 1980) comb. n. (see Pérez-Íñigo and Baggio 1980). Distribution: Brazil.

— Lamellae wide; ventral sides of femora II smooth ..... 8

8. Prodorsum surface with specific freckle-like pitted areas; tarsi and tibiae with conspicuous spur-like structures; body size: 319–354  $\times$  191–204 ..... *Muliercula spora* Coetzer, 1968 (see Coetzer 1968). Distribution: South Africa.

— Prodorsum surface without specific freckle-like pitted areas; tarsi and tibiae without spur-like structures; body size: 349–371  $\times$  211–231 ..... *Muliercula muliercula* Coetzer, 1968 (see Coetzer 1968). Distribution: South Africa.

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