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## New species of the superfamily Phthiracaroidae (Acari, Oribatida) from the Afrotropical Region

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### ABSTRACT

Five new species of ptyctimous oribatid mites are described, identified and illustrated from the Afrotropical Region: *Plonaphacarus paramachadoi* sp. n. and *Protophthiracarus turianiensis* sp. n. from the Nguru Mountains of Tanzania, *Hoplophthiracarus paratryssos* sp. n. and *Atropacarus (Atropacarus) primus* sp. n. from Ranomafana National Park in Madagascar, and *Notophthiracarus dispersus* sp. n. from Vohidrazana Forest in Madagascar. A comparison with the most closely related species is also presented.

KEY WORDS: Tanzania, Madagascar, Acari, Oribatida, Phthiracaridae, taxonomy, new species.

### INTRODUCTION

The major tropical wilderness areas represent important storehouses of biodiversity and play a vital role in climate stability. They also serve as controls against which we can measure the management of more devastated areas and biotopes. The montane forests of northeast Tanzania, which include the Usambara Mountains, and the rainforests and other forest types in Madagascar in particular, belong conclusively among such important biodiversity hotspots (Mittermeier *et al.* 1998; Araujo 2002).

The present contribution deals with the description of five new species of ptyctimous oribatid mites belonging to four different oribatid genera of the family Phthiracaridae: *Plonaphacarus* Niedbala, 1986; *Protophthiracarus* Balogh, 1972; *Hoplophthiracarus* Jacot, 1933; *Notophthiracarus* Ramsay, 1966; and *Atropacarus (Atropacarus)* Ewing, 1917. These species were found in large leaf-litter sifting samples collected by Dr P. Baňář (from Brno, Czech Republic) and Dr V. Grebennikov (from Ottawa, Canada) from various parts of the forested Usambara Mountains in northeast Tanzania as well as from many localities in Madagascar (Ewing 1917; Ramsay 1966; Balogh 1972; Niedbala 1986).

The fauna of oribatid mites from the superfamily Phthiracaroidae of the Ethiopian Region have been reviewed and discussed in detail by Niedbala (2001). In total 108 species of phthiracarid mites were recorded from the Ethiopian region, of which 73 species occur on the African mainland. Twenty-two species were recorded from Tanzania (14 endemic — 63.6%), and 20 species from Madagascar (17 endemic — 85.0%). Altogether six species from the genus *Plonaphacarus* and two species from the genus *Protophthiracarus* were previously found in soils in Tanzania, and 14 species of the genus *Notophthiracarus* were hitherto recorded from soils in Madagascar. The record of the species *Hoplophthiracarus paratryssos* sp. n. from Ranomafana National Park is the first one from this genus among the fauna of Madagascar and the record of *Atropacarus (Atropacarus) primus* sp. n., also from Ranomafana National Park, is the first record of this subgenus for the Ethiopian Region.

## MATERIAL AND METHODS

The soil and leaf litter samples were collected using a sifting method and were partly extracted by using a Winkler apparatus. All the extracted mite specimens were preserved in 85% ethanol, then cleared in 80% lactic acid on temporary cavity slides and mounted on temporary slides with glycerol. The determined material was preserved in vials with 80% ethanol. Observations, figures, and measurements were made using a standard light microscope equipped with a drawing attachment. All the measurements are given in micrometres. The terminology used is based on Niedbala (1992). Type material is deposited at the Department of Animal Taxonomy and Ecology, Poznań, Poland (DATE), the Institute of Soil Biology BC ASCR, České Budějovice, in the Czech Republic (ISB) and the Natural History Museum, Geneva, Switzerland (NHMG).

## TAXONOMY

Superfamily Phthiracaroidae  
Family Phthiracaridae Perty, 1841  
*Plonaphacarus paramachadoi* sp. n.

Figs 1–8

**Etymology:** The prefix *para* (near) is Latin and refers to the similarity of the new species with *Plonaphacarus machadoi* (Balogh, 1958).

**Description:**

**Measurements** (holotype). Prodorsum: length 252, width 202, height 91, setae: sensillus (*ss*) 53, interlamellar (*in*) 97, lamellar (*le*) 28, rostral (*ro*) 76; notogaster: length 485, width 328, height 303, notogastral setae:  $c_1$  96,  $c_1/c_1-d_1=0.7$ ,  $h_1$  and  $ps_1$  88; genitoaggenital plate  $114 \times 101$ , anoadanal plate  $202 \times 101$ .

**Integument.** Colour brown. Microsculpture of integument slightly rugged and ornamentation polygonal.

**Prodorsum** (Figs 1, 2). Lateral carinae distinct, rather short. Sigillar fields short. Posterior furrows indistinct. Sensilli club-like with elongated, dilated head, obtuse distally and covered with small spines. Interlamellar setae long, thick, erect, covered with small spines in distal half similar to notogastral setae. Lamellar setae short, spinose, smooth. Rostral setae stout, thick, erect, pointed distally and covered with small spines, remote from anterior border. Exobothridial setae vestigial.

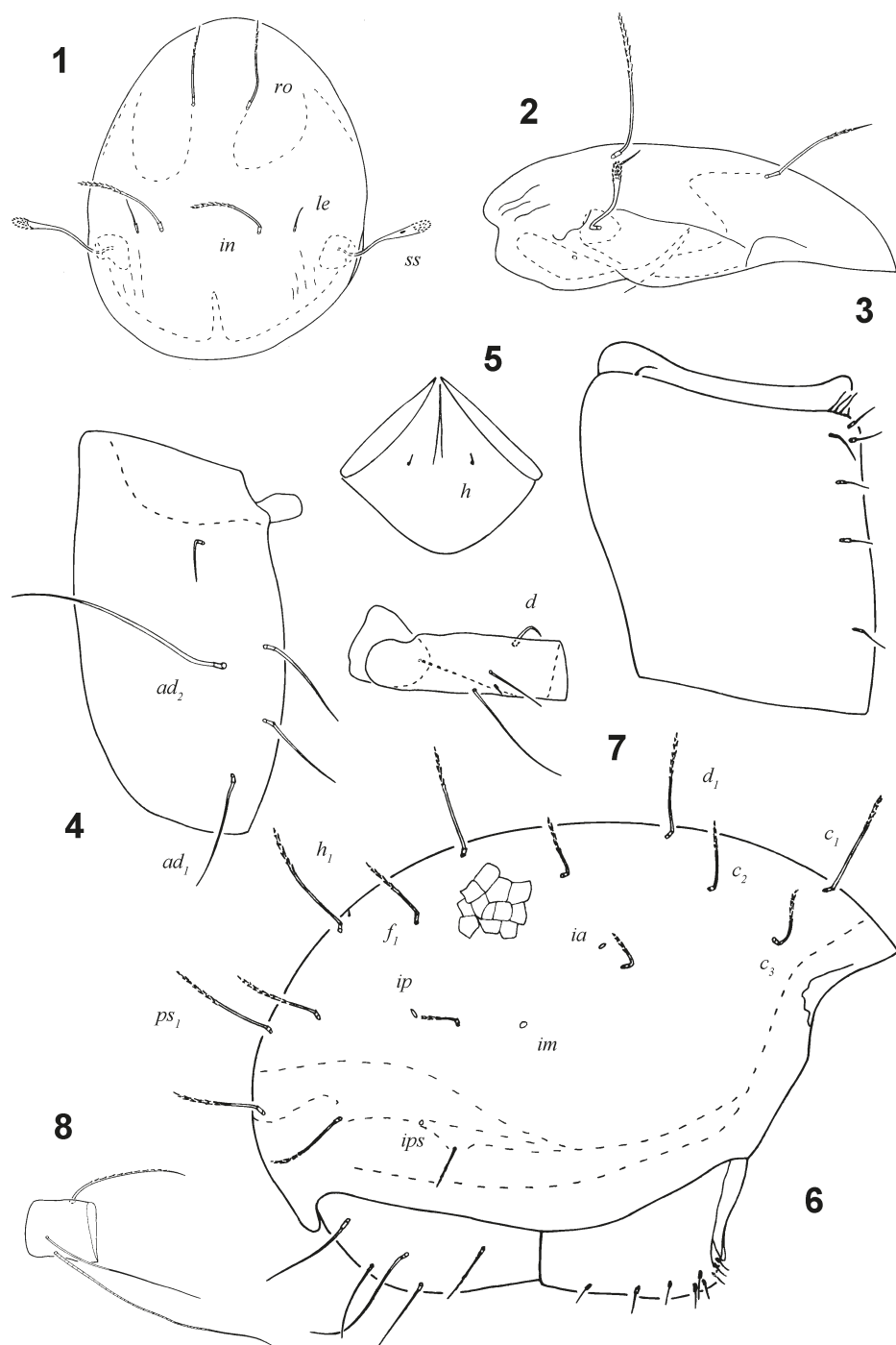
**Notogaster** (Fig. 6). Notogastral setae of medium length,  $c_1 < c_1-d_1$ , thick, covered with spines in distal half. Setae  $c_1$  and  $c_3$  slightly remote from anterior margin, setae  $c_2$  far from border. Vestigial setae  $f_1$  located slightly anterior of setae  $h_1$ . Four pairs of lyrifissures *ia*, *im*, *ip* and *im* present.

**Ventral region** (Figs 3–5). Setae *h* of mentum (Fig. 5) minute. Formula of genital setae 4+2:3. Anoadanal plates with five pairs of well-developed setae, setae  $ad_2$  the longest and bent distally, anal setae shorter than  $ad_1$  and  $ad_2$ , but longer than  $ad_3$ , adanal setae rough, anal setae smooth.

**Legs** (Figs 7, 8). Chaetome of legs of “complete type”, setae *d* of femora I remote from distal end of article.

**Holotype:** TANZANIA: Nguru Mts., Turiani, 4.xi.2010, 06°04'29"S 37°32'19"E, 1277 m, deciduous forest on steep slope, leaf litter sifting, leg. V. Grebennikov, TAN-009 (DATE).

**Paratypes:** 20 specimens, same locality data as Holotype, (10 DATE, 5 ISB and 5 NHMG).



Figs 1–8. *Plonaphacarus paramachadoi* sp. n. holotype: (1) prodorsum, dorsal view; (2) prodorsum, lateral view; (3) right genitoaggenital plate; (4) right anoadanal plate; (5) mentum of subcapitulum; (6) lateral view of opisthosoma; (7) trochanter and femur of leg I; (8) tibia of leg IV.

Remarks: The new species is similar to *Plonaphacarus machadoi* (Balogh, 1958) by the shape and length of setae, location of vestigial setae  $f_1$  and presence of four pairs of lyrifissures. *P. paramachadoi* is distinguished from *P. machadoi* by the absence of alveoles on body, location of rostral setae (far from anterior part of rostrum) and minute setae  $h$  of infracapitular mentum (Balogh 1958).

***Hoplophthiracarus paratryssos* sp. n.**

Figs 9–16

Etymology: The prefix *para* (near) is Latin and refers to the similarity of the new species to *Hoplophthiracarus tryssos* Niedbala, 2004.

*Measurements* (holotype). Prodorsum: length 217, width 151, height 101, setae:  $ss$  20,  $in$  71,  $le$  28,  $ro$  30,  $ex$  25; notogaster: length 424, width 273, height 252, notogastral setae:  $c_1$  56,  $c_1/c_1-d_1=0.6$ ,  $h_1$  and  $ps_1$  25; genitoaggenital plate  $96 \times 71$ , anoadanal plate  $162 \times 78$ .

Description:

*Integument*. Colour white-yellow. Surface of body covered with fine punctation.

*Prodorsum* (Figs 9, 10). Distinct lateral carinae and sigillar fields. Sensilli short with thin pedicel and swollen head, rounded in lateral aspect and fusiform in dorsal aspect. Prodorsal setae short, fine, attenuate, interlamellar setae distinctly longer than lamellar and rostral setae.

*Notogaster* (Fig. 14). Fifteen pairs of short, fine and attenuate setae. Setae  $c_2$  more remote from anterior border than setae  $c_1$  and  $c_3$ . Vestigial setae  $f_1$  situated anteriorly of  $h_1$ , setae  $f_2$  situated anteriorly above  $h_3$ . Two pairs of lyrifissures  $ia$  and  $im$  present.

*Ventral region* (Figs 11–13). Setae  $h$  of mentum (Fig. 13) as long as distance between them. Arrangement of genital setae: 4+2:3. Anoadanal plates with rather long, fine setae, similar in length except short  $ad_3$  setae.

*Legs* (Figs 15, 16). Chaetome of legs of “incomplete type”, femora of legs I with three setae, setae  $d$  remote from distal end of segment.

Holotype: MADAGASCAR, Ranomafana National Park, 14.iv.2011, 21°15'46.1"S 47°25'13.1"E, 983 m, sifting sample of forest leaf litter, Winkler apparatus extraction, leg. L.S. Rahanitrianiaina and R. Raveloson, MAG-021 (DATE).

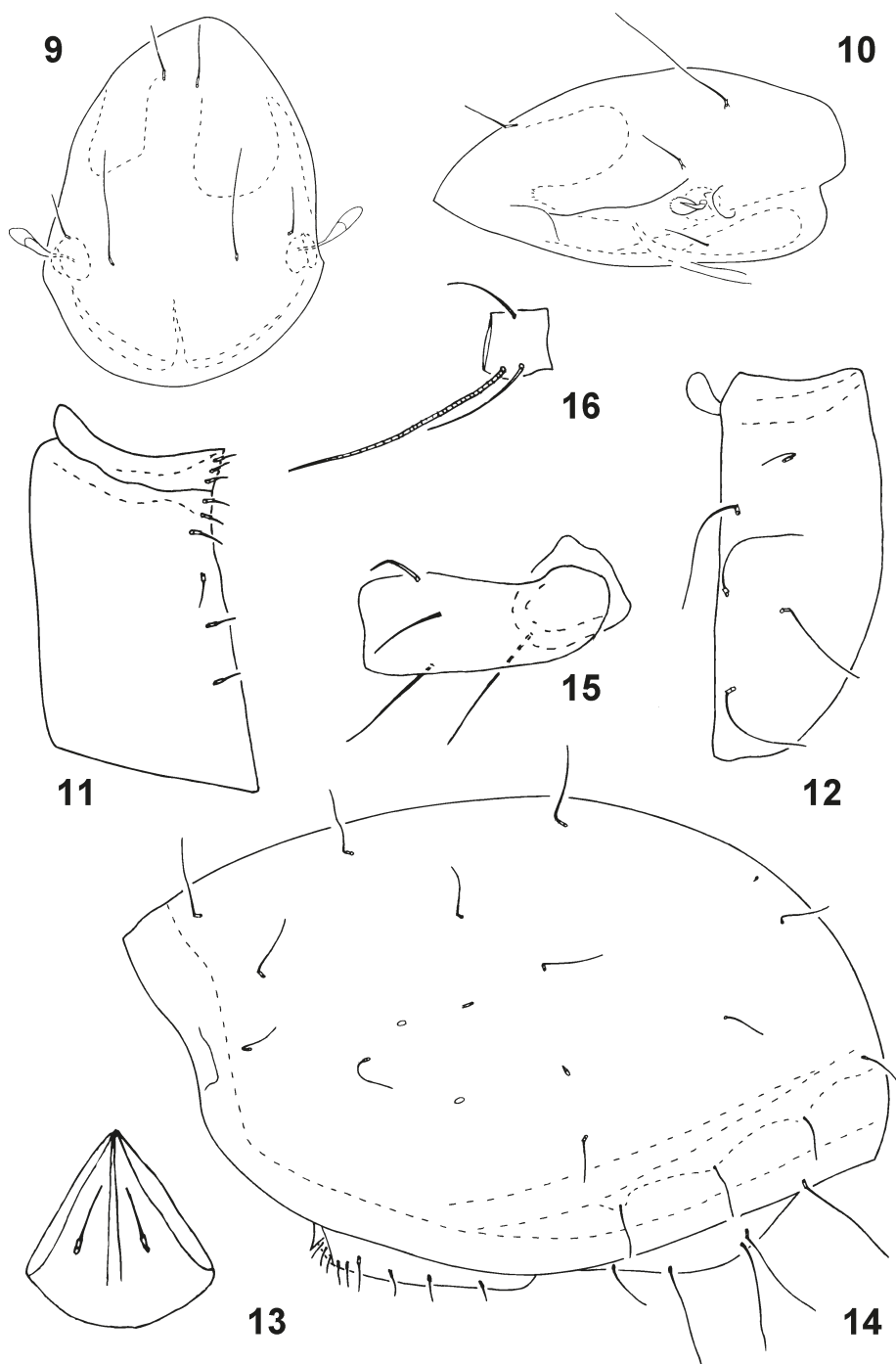
Remarks: The new species is distinguishable from congeners by the presence of smooth, attenuate setae on its body. It is similar to the Brazilian species *Hoplophthiracarus tryssos* Niedbala, 2004 in size of body, length of lateral carinae on the prodorsum, and size and length of notogastral setae, but is distinguishable by the differences in length of the interlamellar and lamellar setae, longer setae on the anoadanal plates, and especially by the unusual position of vestigial setae  $f_2$  and the different arrangement of genital setae 4+2:3 (three setae in progenital position), versus 4:5 (five setae in progenital position in *H. tryssos*) (Niedbala 2004).

***Protrophthiracarus turianiensis* sp. n.**

Figs 17–24

Etymology: The name refers to the type locality in the vicinity of Turiani town in the Nguru Mountains.

*Measurements* (holotype). Prodorsum: length 480, width 328, height 247; setae:  $ss$  126,  $in$  96,  $le$  51,  $ro$  81; notogaster: length 949, width 687, height 646; notogastral setae:  $c_1$



Figs 9–16. *Hoplophthiracarus paratryssos* sp. n. holotype: (9) prodorsum, dorsal view; (10) prodorsum, lateral view; (11) right genitoaggenital plate; (12) left ano-adanal plate; (13) mentum of subcapitulum; (14) lateral view of opisthosoma; (15) trochanter and femur of leg I; (16) tibia of leg IV.

152,  $c_1/c_1-d_1=0.6$ ,  $h_1$  159, and  $ps_1$  180; genitoaggenital plate  $278 \times 167$ ; anoadanal plate  $268 \times 167$ .

**Description:**

*Integument.* Colour light brown. Surface of body alveolate and covered with strong sculpture.

*Prodorsum* (Figs 17, 18). Distinct median crista. Strong hump present above the bothridium which continues in lateral carinae. Posterior furrows feeble. Sigillar fields not visible because of strong integument. Sensilli long, thin, without head, with feeble spines at tip. Interlamellar setae fairly long, thick, covered with small spines at distal end. Lamellar setae spiniform, rough. Rostral setae thick, obtuse, rough, curved inwards. Exobothridial setae vestigial.

*Notogaster* (Fig. 23). Setae fairly long ( $c_1 < c_1-d_1$ ), thick, covered with small spines at distal end, some setae with spines on one side, some setae with spines on both sides. Setae of row  $c$  remote from anterior margin,  $c_2$  and  $c_3$  more remote than setae  $c_1$ . Vestigial setae  $f_1$  and all lyrifissures not visible because of strong sculpture.

*Ventral region* (Figs 19–22). Genitoaggenital plates with nine pairs of setae with formula:  $5(4+1):4$ . Anoadanal plates each with five short, rough setae, adanal setae  $ad_2$  the longest and thickest, setae  $an_2$  longer than setae  $ad_1$  and  $an_1$ , setae  $ad_3$  the shortest.

*Legs* (Fig. 24). Formulae of setae and solenidia of “complete type”. Setae  $d$  on femora I slightly remote from distal end of article.

Holotype: TANZANIA: Nguru Mts., Turiani, 30.x.2010,  $06^\circ 06' 24''$ S  $37^\circ 33' 26''$ E, 677 m, deciduous forest on steep slope, leaf litter sifting, leg. V. Grebennikov, TAN-008 (DATE).

Paratypes: 4 specimens, same locality data as holotype (DATE); 4 specimens: TANZANIA: Nguru Mts., Turiani, 4.xi.2010,  $06^\circ 04' 29''$ S  $37^\circ 32' 19''$ E, 1277 m, deciduous forest on steep slope, leaf litter sifting, leg. V. Grebennikov, TAN-009 (3 ISB and 1 NHMG).

**Remarks:** The new species is distinguishable from congeners by the combination of the following characters: strong median crista of prodorsum, bacilliform, long, thin sensilli without head, setae of row  $c$  on notogaster remote from anterior margin, but setae  $c_1$  less remote than setae  $c_2$  and  $c_3$ .

***Notophthiracarus dispersus* sp. n.**

Figs 25–31

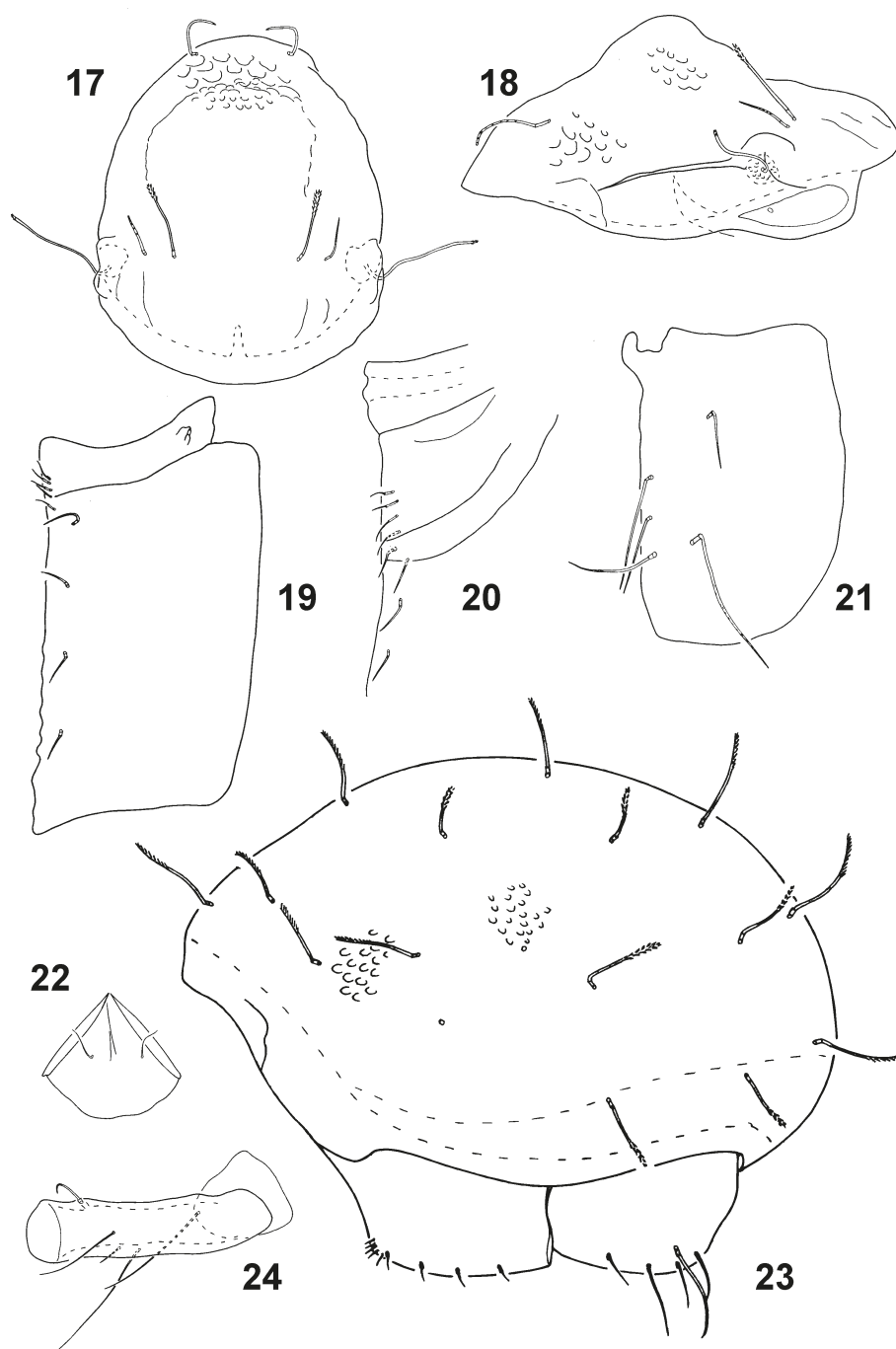
**Etymology:** From the Latin *dispersus* (rare, sparsely) and alludes to the sparse distribution of cilia on the interlamellar and notogastral setae.

**Description:**

*Measurements* (holotype). Prodorsum: length 525, width 353, height 227, setae:  $ss$  114,  $in$  353,  $le$  43,  $ro$  51,  $ex$  38; notogaster: length 1010, width and height 687, notogastral setae:  $c_1$  252,  $c_1/c-d_1=1.3$ ,  $c_2$  227,  $c_3$  45,  $h_1$  227,  $h_2$  151,  $h_3$  62,  $ps_1$  247, and  $ps_2$  202; genitoaggenital and anoadanal plates  $313 \times 151$ .

*Integument.* Colour reddish brown. Surface of body covered with dispersed small, rounded and deep concavities.

*Prodorsum* (Figs 25, 26). Feeble, short median crista. Lateral carinae well developed, long. Sigillar fields very narrow, median trapezoid distally and longer than laterals. Sensilli of medium length, bacilliform, covered with small spines in distal half. Interlamellar setae rigid, similar to notogastral setae, covered sparsely with small spines. Rostral setae and lamellar setae spiniform. Exobothridial setae the shortest.



Figs 17–24. *Protophthiracarus turianiensis* sp. n. holotype: (17) prodorsum, dorsal view; (18) prodorsum, lateral view; (19) left genitoaggenital plate; (20) paraxial fragment of left genitoaggenital plate; (21) left anoadanal plate; (22) mentum of subcapitulum; (23) lateral view of opisthosoma; (24) trochanter and femur of leg I.



*Notogaster* (Fig. 30). Notogastral setae rigid and of different lengths, dorsal setae longer than laterals, ( $c_1 > c_1 - d_1$ ), setae  $c_1$  and  $ps_1$  the longest, setae  $c_3$  and  $h_3$  the shortest. All notogastral setae sparsely covered with small spines in distal half. Setae  $c_{1-3}$  remote from anterior margin, setae  $c_2$  considerably more remote than setae  $c_1$  and  $c_3$ . Vestigial setae  $f_1$  not visible because of strong sculpture. Two pairs of lyrifissures  $ia$  and  $im$  present.

*Ventral region* (Figs 27–29). Setae  $h$  of mentum (Fig. 29) considerably longer than distance between them. Formula of genital setae: 5:4. Anoadanal plates with five pairs of rigid, rough setae, adanal setae  $ad_1$  and  $ad_2$  longer than anal setae, situated near to paraxial border, adanal setae  $ad_3$  the shortest.

*Legs* (Fig. 31). Chaetome of legs complete. Setae  $d$  on femora I slightly remote from anterior end of article and bifurcated distally.

Holotype: MADAGASCAR: Beforona commune, Vohidrazana forest, 6.vi.2012, semi-deciduous forest, 18°58'30.6"S 48°30'53.4"E, 1130 m, sifting of leaf litter sample, Winkler apparatus extraction, leg. L.S. Rahanitriniaina and E.M. Rabotoson, MAG-153 (DATE).

Remarks: The new species can be distinguished from congeners by the combination of the following characters: small median crista of prodorsum, rigid interlamellar and notogastral setae sparsely covered with spines, bacilliform and ciliate sensilla, formula of genital setae 5:4, adanal setae  $ad_1$  and  $ad_2$  situated near paraxial border and bifurcate setae  $d$  on femora of legs I.

### *Atropacarus (Atropacarus) primus* sp. n.

Figs 32–41

*Etymology*: From the Latin *primus* (first), referring to the first find of species of the subgenus *Atropacarus* in the Afrotropical Region.

*Description*:

*Measurements* (holotype). Prodorsum: length 520, width 328, height 252, setae:  $ss$  172,  $in$  169,  $le$  101,  $ro$  51,  $ex$  63; notogaster: length 1030, width 606, height 616, notogastral seta  $c_1$  and  $h_1$  233,  $c_1/c_1 - d_1 = 1.1$ ,  $ps_1$  164; genitoaggenital region  $253 \times 215$ , anoadanal region  $367 \times 215$ .

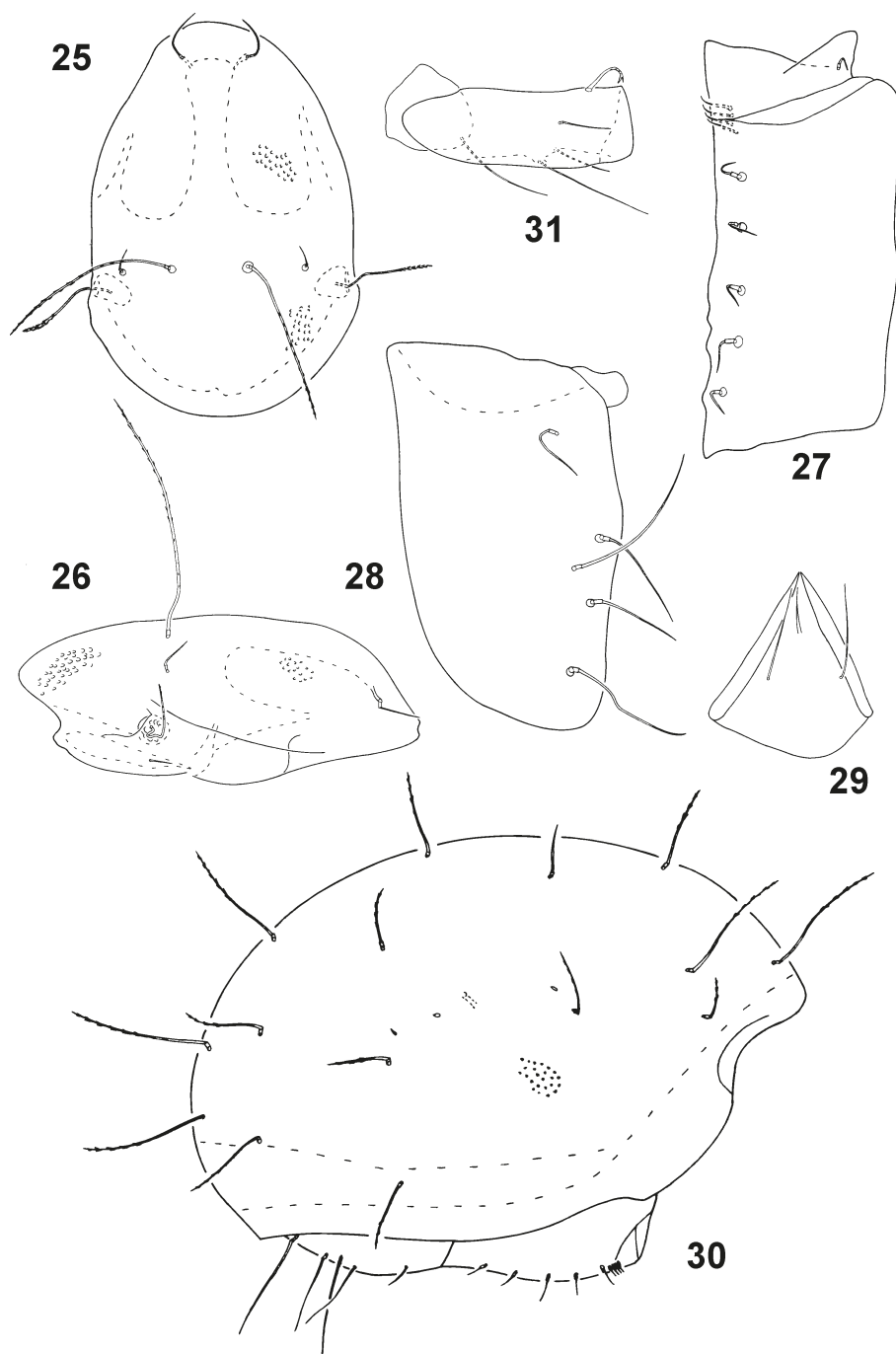
*Integument*. Colour yellow. Body surface punctated with feeble cavities on borders of body and on ventral plates.

*Prodorsum* (Figs 32, 33). Median crista prominent. Lateral carinae reach sinus. Posterior furrows distinct. Median sigillar field long, narrow, slightly broader anteriorly, longer than laterals. Sensilli long, filiform, rough, without head. Interlamellar and lamellar setae long, robust, covered with small spines at distal end, similar in shape to notogastral setae. Rostral setae short, spiniform, rough, directed inward. Exobothridial setae of medium length.

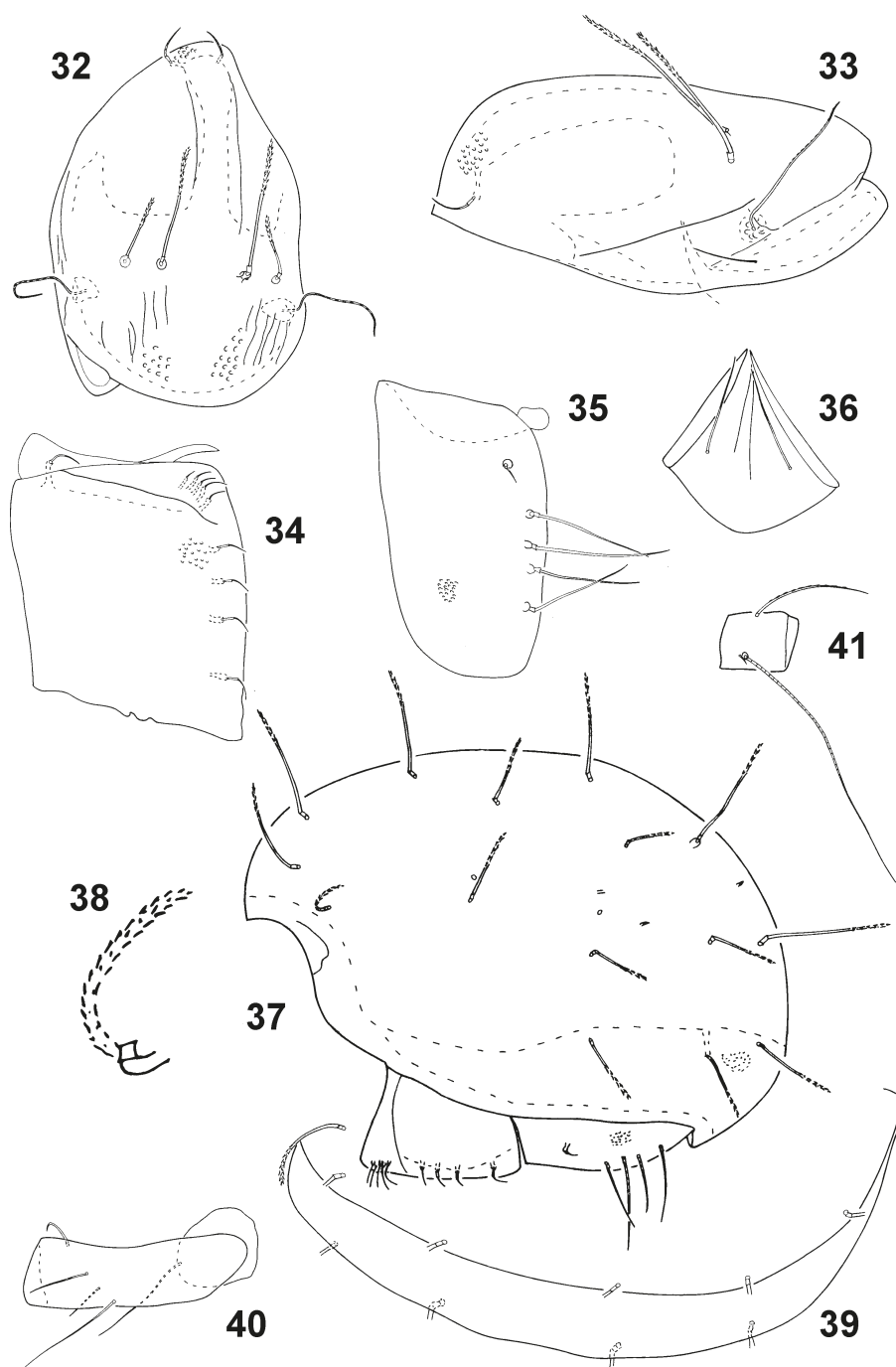
*Notogaster* (Figs 37–39). Two median cristae along the dorsal part; 15 pairs notogastral setae of medium length ( $c_1 > c_1 - d_1$ ), robust, covered with small spines at distal end, only shortest setae  $c_3$  are wholly ciliated, setae  $c_1$  located far from anterior border, setae  $c_2$  remote, setae  $c_3$  near the border. Vestigial setae  $f_1$  posterior of setae  $h_1$ . Two pairs of lyrifissures  $ia$  and  $im$  present.

*Ventral region* (Figs 34–36). Arrangement of genital setae: 4:5. Anoadanal plate with five pairs of rough setae, four pairs arranged at paraxial border of plate and small setae  $ad_3$  remote from border, setae  $ad_2$  thickest and longest.

*Legs* (Figs 40–41). Chaetome of legs complete. Setae  $d$  on femora I slightly remote from distal end of article.



Figs 25–31. *Notophthiracarus dispersus* sp. n. holotype: (25) prodorsum, dorsal view; (26) prodorsum, lateral view; (27) left genitoaggenital plate; (28) right anoadanal plate; (29) mentum of subcapitulum; (30) lateral view of opisthosoma; (31) trochanter and femur of leg I.



Figs 32–41. *Atropacarus (Atropacarus) primus* sp. n. holotype: (32) prodorsum, dorsal view; (33) prodorsum, lateral view; (34) right genitoaggenital plate; (35) right ano-adanal plate; (36) mentum of subcapitulum; (37) lateral view of opisthosoma; (38) seta  $c_3$ ; (39) median cristae of notogaster; (40) trochanter and femur of leg I; (41) tibia of leg IV.

Holotype: MADAGASCAR: Ranomafana National Park, Vatoharanana, 4.x.2012, evergreen rain forest, 21°17'33.6"S 47°25'57.6"E, 1163 m, leaf litter sifting sample, Winkler apparatus extraction, leg. L.S. Rahanitriniaina, MAG-209 (DATE).

Paratype: MADAGASCAR: Ranomafana National Park, 1.x.2012, evergreen rain forest, 21°15'10.3"S 47°25'01.2"E, 1077 m, leaf litter sifting sample, Winkler apparatus extraction, leg. L.S. Rahanitriniaina, MAG-207 (ISB).

Remarks: Specimens of this species are relatively large. This is the first species of the subgenus *Atropacarus* found in the Afrotropical Region. This species is unique among its consubgenera by the two median cristae of the notogaster and also by the shortest setae  $c_3$ , which are wholly ciliated, while the other longer setae are covered with small spines only in the distal end.

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