

Six new species of ptyctimous mites (Acari: Oribatida) from Madagascar

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ABSTRACT — Six new species of ptyctimous oribatid mites from Madagascar are described and illustrated: *Oribotritia perpusilla* **n. sp.** and *Phthiracarus ranomafanensis* **n. sp.** from Ranomafana National Park; *Euphthiracarus* (*Euphthiracarus*) *paranetron* **n. sp.** and *Atropacarus* (*Hoplophorella*) *parastenos* **n. sp.** both from Montagne d'Ambre National Park; *Phthiracarus paracrispus* **n. sp.** from Ankarafantsika National Park; *Notophthiracarus medius* **n. sp.** from Andasibe – Mantadia National Park. A comparison with the most closely related species is also presented.

KEYWORDS — Oribatid; ptyctimous mites; Euphthiracaroidea; Phthiracaroidea; new species; taxonomy; morphology; Madagascar

INTRODUCTION

Madagascar hosts some of the World's most diverse, unusual, endemic fauna and flora. This unique biodiversity and high level of endemism seem to be related to long-term isolation from neighbouring continental landmasses and the highly diverse environment. This fourth largest island in the World is classified as one of the most important biodiversity hotspots (Myers *et al.* 2000).

Dr P. Baňar (Brno, Czech Republic), in official co-operation with the University in Antananarivo (Antananarivo, Madagascar), organized the search for litter-inhabiting invertebrates, mainly different groups of insects, in the years 2010–2015 in various parts of Madagascar. Together with his collaborators Dr R. Raveloson, Dr E. M. Rabotoson and Dr L. S. Rahanitriniaina, he collected large samples of

litter invertebrates, which were kindly offered for our study. This contribution is partly a continuation of our study of ptyctimous mite fauna based on this material (Niedbała and Starý 2013; 2014a, b, c; 2015a, b, c).

Altogether another six new species of ptyctimous oribatid mites belonging to five genera and subgenera, *Oribotritia* Jacot, 1924 from the family Oribotritiidae Grandjean, 1954, *Euphthiracarus* Ewing, 1917 from the family Euphthiracaridae Jacot, 1930 and *Phthiracarus* Perty, 1841, *Notophthiracarus* Ramsay, 1966 and *Atropacarus* (*Hoplophorella*) sensu Niedbała, 1986 from the family Phthiracaridae Perty, 1841 were found in this rich material. Their descriptions are the subjects of this study.

MATERIALS AND METHODS

The soil samples were collected by using a leaf litter sifting method and were extracted using a Winkler apparatus. All of the extracted mite specimens were preserved in 85 % ethanol, then cleared on slides with 80 % lactic acid and mounted on temporary slides with glycerol. Observations, figures and measurements were made using a standard light microscope equipped with a drawing attachment. The determined materials were preserved in vials with 80 % ethanol. All measurements are given in micrometres. Specimens shorter than 600 μm are considered small, while longer than 1 mm are large. The term c_1/c_1-d_1 indicates the ratio of length of setae c_1 to the distance between setae c_1-d_1 . The terminology is based on Niedbała (2000). The types are partly deposited at the Department of Animal Taxonomy and Ecology, Poznań, Poland (DATE) and partly at the Institute of Soil Biology BC ASCR, České Budějovice in the Czech Republic (ISB).

DESCRIPTION OF NEW SPECIES

Oribotritia perpusilla n. sp. (Figures 1)

Description

Measurements of holotype — Prodorsum: length 255, width 150, height 94, setae: sensillus 101, interlamellar (*in*) 53, lamellar (*le*) 43, rostral (*ro*) 35; notogaster: length 429, width 152, height 247; notogastral setae: c_1 and h_1 38, ps_1 45; genital and aggenital plates 99×38 , anal and adanal plates 233×25 .

Medium-sized species; body colour pale yellow.

Prodorsum — with distinct, long and simple lateral carinae. Sensilli long, bent in proximal part, smooth. Other prodorsal setae short, interlamellar (*in*) and rostral (*ro*) setae erect, rough, lamellar setae (*le*) procumbent, smooth, exobothridial setae (*ex*) vestigial.

Notogaster — Notogastral setae short, $c_1/c_1-d_1=0.4$, all notogastral setae strong, rough, except filiform setae c_3 and ps_3 ; setae c_1 and c_2 remote from anterior margin, setae c_3 near the margin.

Ventral region — Setae *h* of subcapitular mentum shorter than distance between them. Anogenital cleft *trv* long. Nine pairs of genital and two pairs of equal aggenital setae present, genital setae g_{1-5} longer than setae g_{6-9} . Anal plate without setae and three pairs of adanal setae present. Distance between adanal setae ad_1 and ad_2 slightly longer than between ad_2 and ad_3 . Lyrifissures *iad* situated laterally between adanal setae ad_2 and ad_3 .

Legs — Chaetome of legs without tarsi: I: 1-3-5(2)-5(1), II: 1-4-3(1)-3(1), III: 3-2-3(1)-3(1), IV: 3-2-2(1)-3(1); all tarsi heterotridactylous.

Material examined — Holotype is deposited at DATE from locus typicus: Madagascar, Ranomafana National Park, Vatoharanana, 3. X. 2012, evergreen rain forest, latitude $21^{\circ}16'42.2''$ S, longitude $47^{\circ}26'18.2''$ E, altitude about 1000 m, sifted forest leaf litter, Winkler apparatus extraction, leg. L. S. Rahanitriniaina.

Etymology — The name of the new species *perpusillus* is Latin for "very small" and alludes to the small size of body in comparison with congeners.

Comparison — The new species differs from its congeners by the small size, the long, simple lateral carinae of the prodorsum and long, bent sensilli, absence of anal setae and presence of three pairs of adanal setae.

Euphthiracarus (Euphthiracarus) paranetron n. sp. (Figures 2)

Description

Measurements of holotype — Prodorsum: length 218, width 149, height 94; prodorsal setae: sensillus (*ss*) 68, interlamellar (*in*) and rostral (*ro*) 91, lamellar (*le*) 76, exobothridial (*ex*) 29; notogaster: length 414, width 262, height 257; notogastral setae: c_1 56, $c_1/c_1-d_1=0.5$, h_1 and ps_1 53; genitoaggenital region 132×53 ; anoadanal region 202×43 .

Medium-sized species. Colour yellow. Surface of body reticulate.

Prodorsum — with two pairs of parallel lateral carinae. Sensilli (*ss*) rather long, with elongated, rough, spindle-shaped head. Prodorsal setae long, erect, attenuate; relative lengths of prodorsal setae $in=ro>le>ss>ex$.

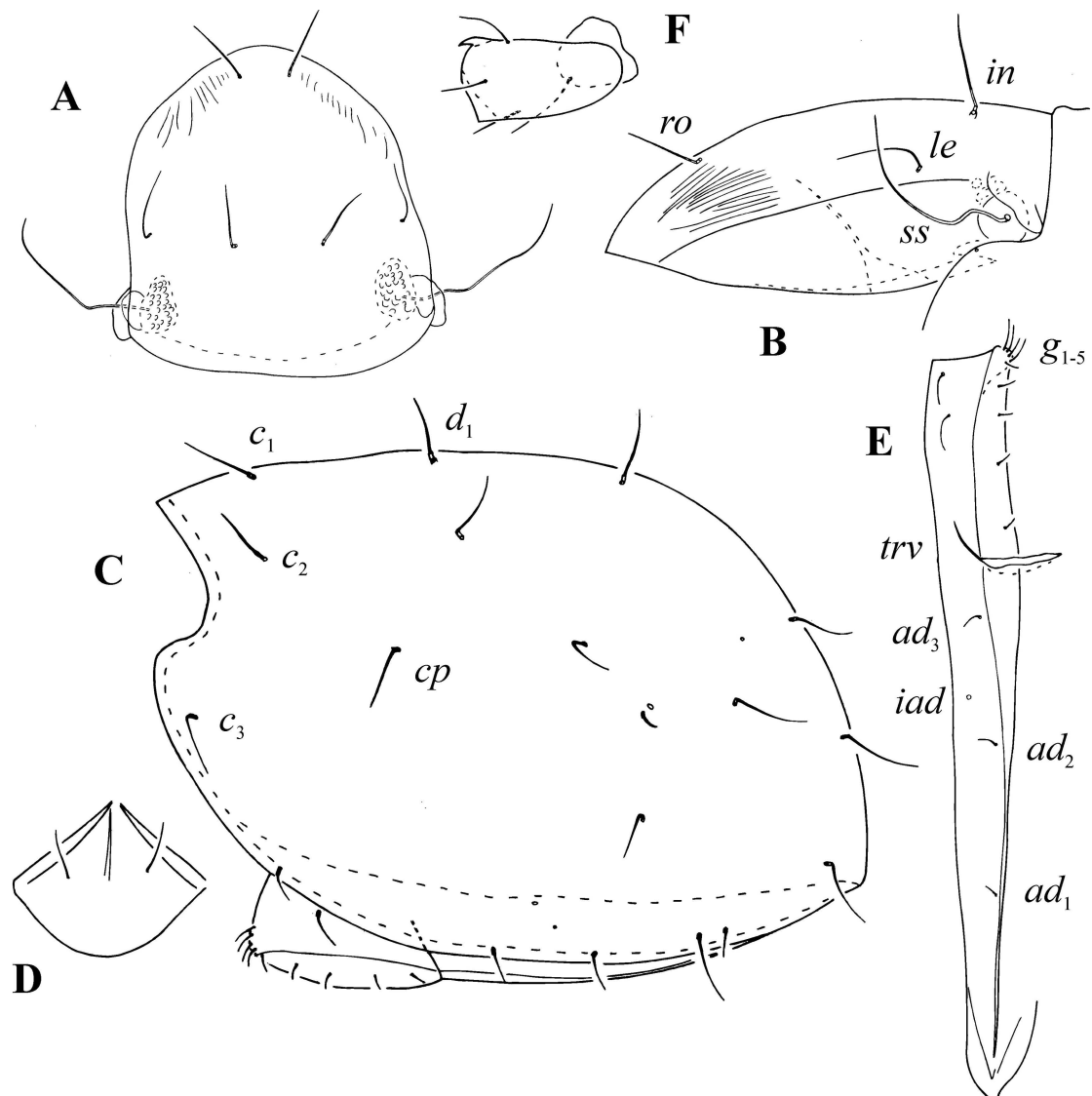


FIGURE 1: *Oribotritia perpusilla* n. sp. (holotype): A – prodorsum, dorsal view; B – prodorsum, lateral view; C – opisthosoma, lateral view; D – mentum of subcapitulum; E – right side of ventral plates; F – trochanter and femur of leg I.

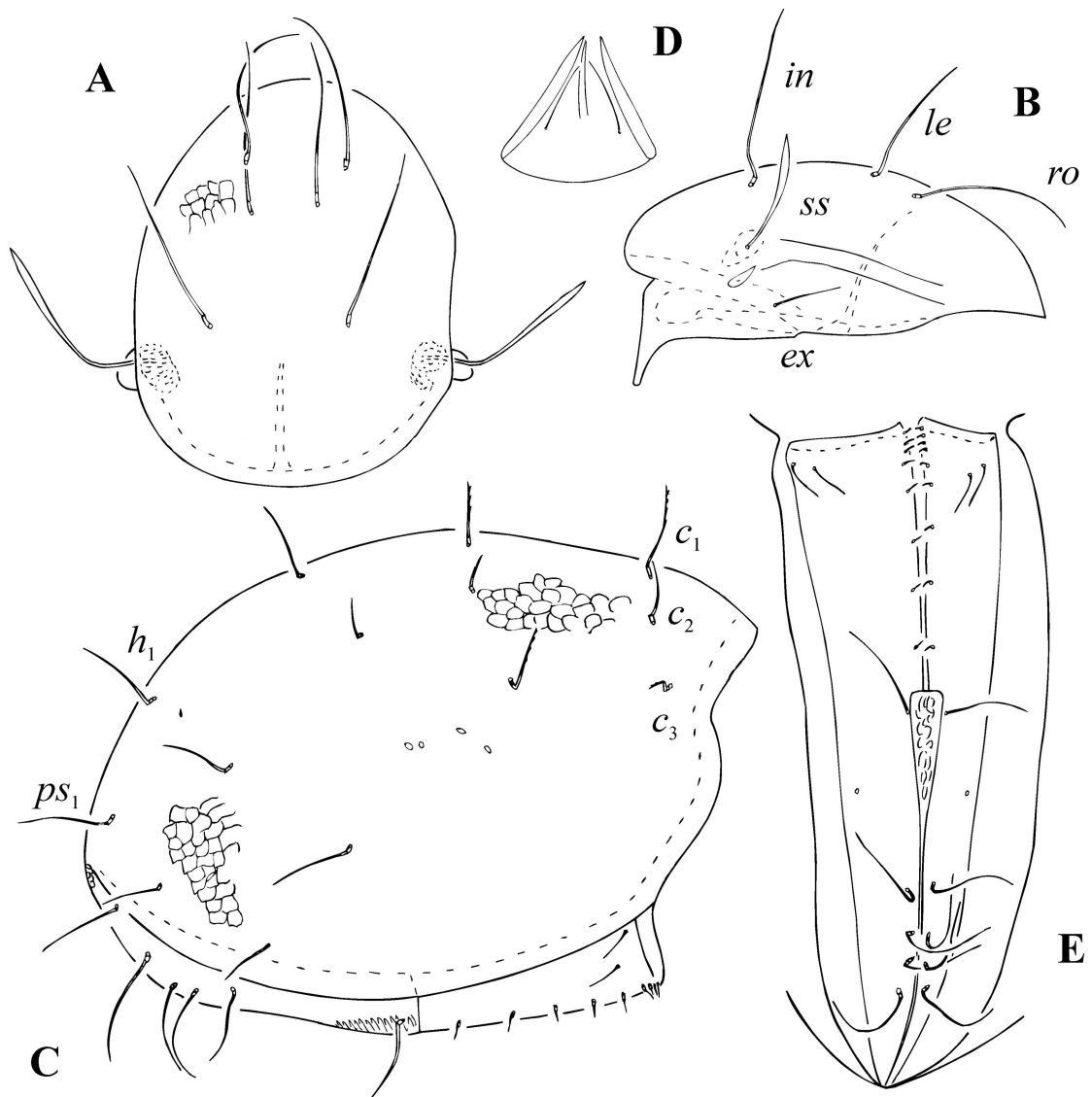


FIGURE 2: *Euphthiracarus paranetron* n. sp. (holotype): A – prodorsum, dorsal view; B – prodorsum, lateral view; C – opisthosoma, lateral view; D – mentum of subcapitulum; E – ventral side.

Notogaster — with relatively short ($c_1 < c_1 - d_1$), rigid notogastral setae covered sparsely with spines; notogastral setae c_{1-3} remote from anterior margin, setae c_1 and c_2 further removed than c_3 .

Ventral region — Setae h of subcapitular mentum longer than distance between them. Nine pairs of genital setae with formula 8: 1, two pairs of rather long aggenital setae. Anal setae an_1 and an_2 shorter, slender and thinner than adanal setae ad_1 and ad_2 . Lyrifissures iad situated between adanal setae ad_2 and anal setae an_3 .

Legs — Chaetome of legs without tarsi: I: 1-3-5 (2)-5(1), II: 1-3-2(1)-4(1), III: 2-2-2(1)-2(1), IV: 2-1-1(1)-2(1), all tarsi monodactylous.

Material examined — Holotype is deposited at DATE from locus typicus: North Madagascar, Montagne d'Ambre National Park, circuit Ampijoroana, 7. I. 2015, evergreen rain forest, latitude 12°31'28" S, longitude 49°09'52" E, altitude 950 m, sifted forest leaf litter sample under *Pandanus* sp. tree, Winkler apparatus extraction, leg. P. Baňář and E. M. Rabotoson.

Etymology — The prefix *para* is Latin meaning "near" and refers to the similarity of the new species with the species *Euphthiracarus netron* Niedbala et Starý, 2014.

Comparison — The new species is distinguishable from the similar *E. netron* Niedbala et Starý, 2014 by the reticulation of body surface (versus punctuation of surface), presence of two pairs of lateral carinae of prodorsum (versus one pair), slightly different shape of sensilli, with head like elongated spindle (versus short spindle), longer exobothridial setae ex , longer than distance between setae le and ro (versus shorter than $le-ro$), longer setae h of mentum than distance between them (versus setae h shorter), arrangement of genital setae: 8: 1 (versus arrangement 7: 2) (Niedbala and Starý 2014b).

***Phthiracarus paracrispus* n. sp.
(Figures 3)**

Description

Measurements of holotype — Prodorsum: length 283, width 202, height 101; prodorsal setae: sensillus (ss) 66, interlamellar (in) 126, lamellar (le)

101, rostral (ro) 68, exobothridial (ex) 58; notogaster: length 581, width 379, height 328; notogastral setae: c_1 152, $c_1/c_1-d_1=1.1$, h_1 and ps_1 94.

Species of medium size; colour greyish.

Prodorsum — with median and lateral fields distinct long and narrow. Lateral carinae long, exceeds the sinus. Posterior furrows not visible. Sensilli (ss) long, thin, smooth, enlarged in their proximal third and ending in a point. Interlamellar (in) and lamellar (le) setae fine, smooth, semi-erect; rostral setae (ro) curved and directed downwards; exobothridial setae (ex) rather long, almost as long as ss and ro ; relative length of prodorsal setae $in > le > ro = ss > ex$.

Notogaster — with fine, rather long notogastral setae ($c_1 > c_1 - d_1$); setae c_1 and c_3 slightly remote from anterior notogastral margin, setae c_2 far from the margin. Vestigial notogastral setae f_1 located posteriorly of h_1 setae; two pairs of lyrifissures ia and im present.

Ventral region — Setae h of subcapitular mentum shorter than distance between them. Genitoaggenital plate with 9 genital setae with formula: 7(4+3): 2. Anoadanal plates with five pairs of well-developed setae; anal setae considerably longer than adanal setae, adanal setae ad_1 and ad_3 short, ad_2 minute.

Legs — Chaetome of legs complete; setae d of femora I thin, remote from distal end of article.

Material examined — Holotype is deposited at DATE from locus typicus: Madagascar, Ankarafantsika National Park, 23. IV. 2011, lowland forest, latitude 16°18'05,9" S, longitude 46°49'06,4" E, altitude 71 m, sifted sample of forest litter, Winkler apparatus extraction, leg. L. S. Rahanitriniaina and R. Raveloson;

Etymology — The prefix *para* is Latin meaning "near" and refers to the similarity of the new species with *P. crispus* Hammer, 1972.

Comparison — The new species is similar to *P. crispus* Hammer, 1972 in the characters of prodorsum, especially in the shape of sensilli. It is distinguishable by longer notogastral setae c_1 ; $c_1 > c_1 - d_1$, (versus $c_1 < c_1 - d_1$); notogastral setae c_1 and c_3 slightly remote from anterior margin, setae c_2 far from margin (versus c_3 almost near margin and c_1 and c_2

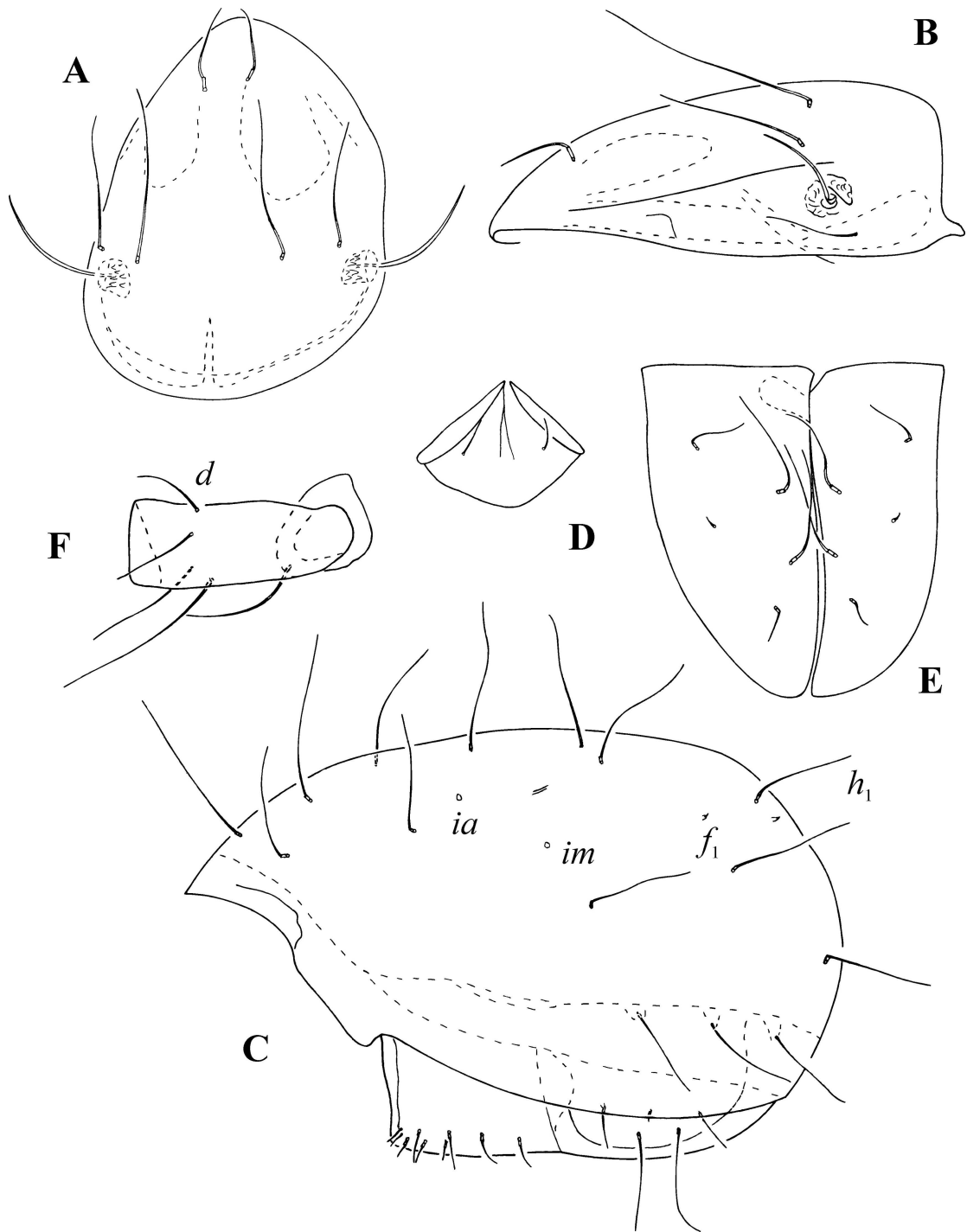


FIGURE 3: *Phthiracarus paracrispus* n. sp. (holotype): A – prodorsum, dorsal view; B – prodorsum, lateral view; C – opisthosoma, lateral view; D – mentum of subcapitulum; E – anoadanal plates; F – trochanter and femur of leg I.

slightly remote from margin); vestigial notogastral setae f_1 located posterior of h_1 (versus anterior of h_1); setae h of subcapitular mentum shorter than distance between them (versus, longer of distance); formula of genital setae 7(4+3): 2, versus: 7(4+2): 3; adanal setae ad_2 minute (versus ad_2 rather long, similar in the length to other adanal setae); chaetome of legs complete (versus chaetome of legs incomplete) (Hammer 1972).

***Phthiracarus ranomafanensis* n. sp.**
(Figures 4)

Description

Measurements of holotype: Prodorsum: length 364, width 273, height 136; prodorsal setae: sensillus (ss) 45, interlamellar (in) 94, lamellar (le) 53, rostral (ro) 76, exobothridial (ex) 43; notogaster: length 515, width 454, height 485; notogastral setae: c_1 61, $c_1/c_1-d_1=0.4$, h_1 and ps_1 30; genitoaggenital plate 151×126 , anoadanal plate 227×111 .

Medium-sized species; colour light brown.

Prodorsum — with distinct sigillar fields. Lateral carinae absent. Sensilli (ss) short, club-shaped with rounded head. Other prodorsal setae fine, attenuate, $in > ro > le > ex$, rostral setae (ro) procumbent.

Notogaster — with 15 pairs of fine, attenuate and very short notogastral setae, setae c_1 shorter than half of distance between setae c_1-d_1 . Setae c_1 and c_2 remote from anterior margin of notogaster, setae c_3 situated near this margin. Vestigial setae f_1 located anterior of h_1 setae (left side of holotype) or at the level of h_1 setae (right side of holotype). Four pairs of lyrifissures ia , im , ip and im present.

Ventral region — Setae h of subcapitular mentum slightly longer than distance between them. Formula of genital setae 4: 5. Anoadanal plates with 5 pairs of very short setae, adanal setae ad_1 the longest. Adanal setae situated near paraxial border of plates, adanal setae ad_1 at the level of anal setae an_1 and adanal setae ad_2 at the level of anal setae an_2 .

Legs — Chaetome of legs of "complete type"; setae d of femora I long, robust and slightly remote from distal end of article.

Material examined — Holotype is deposited at DATE from locus typicus: Madagascar, Ranomafana National Park, 15. IV. 2011, secondary forest, latitude $21^\circ 13' 03.6''$ S, longitude $47^\circ 22' 02.9''$ E, altitude 1198 m, Amboditanimena village environs, sifted sample of forest litter, Winkler apparatus extraction, leg. P. Baňář and R. Raveloson.

Etymology — This new species is named after Ranomafana National Park.

Comparison — The new species has the arrangement of genital setae similar to that of some South African species of the genus *Phthiracarus* such as *P. densus* Niedbala, 2006, *P. endroedii* (Mahunka, 1984) (Niedbala 2006). It is easily distinguishable from its congeners by the unusual arrangement of adanal setae situated near paraxial borders, adanal setae ad_1 and ad_2 at the level of anal setae an_1 and an_2 , very short and fine notogastral setae, and by the presence of four pairs of notogastral lyrifissures.

***Notophthiracarus medius* n. sp.**
(Figures 5)

Description

Measurements of holotype — Prodorsum: length 232, width 162, height 86; length of prodorsal setae: sensillus (ss) 114, interlamellar (in) 116, lamellar (le) 15, rostral (ro) 48, exobothridial (ex) 18; notogaster: length 460, width 323, height 288; notogastral setae: c_1 109, $c_1/c_1-d_1=0.8$, h_1 106, ps_1 96; genitoaggenital plate 114×86 , anoadanal plate 185×96 .

Measurement of paratype — Prodorsum: length 187, height 76; notogaster: length 359, height 202.

Species of medium size. Body colour brown.

Prodorsum — Surface of prodorsum reticulate but in posterior part with small irregular alveoles connected with weak lines. Lateral carinae distinct and long. Sigillar fields poorly marked, median longer than laterals. Sensilli (ss) long, bacilliform, without head, curved, covered with small spines, similar in shape to notogastral setae. Interlamellar setae (in) robust, erect, covered with distinct spines in distal half, similar to notogastral setae. Lamellar setae (le) thick, short, rostral setae (ro)

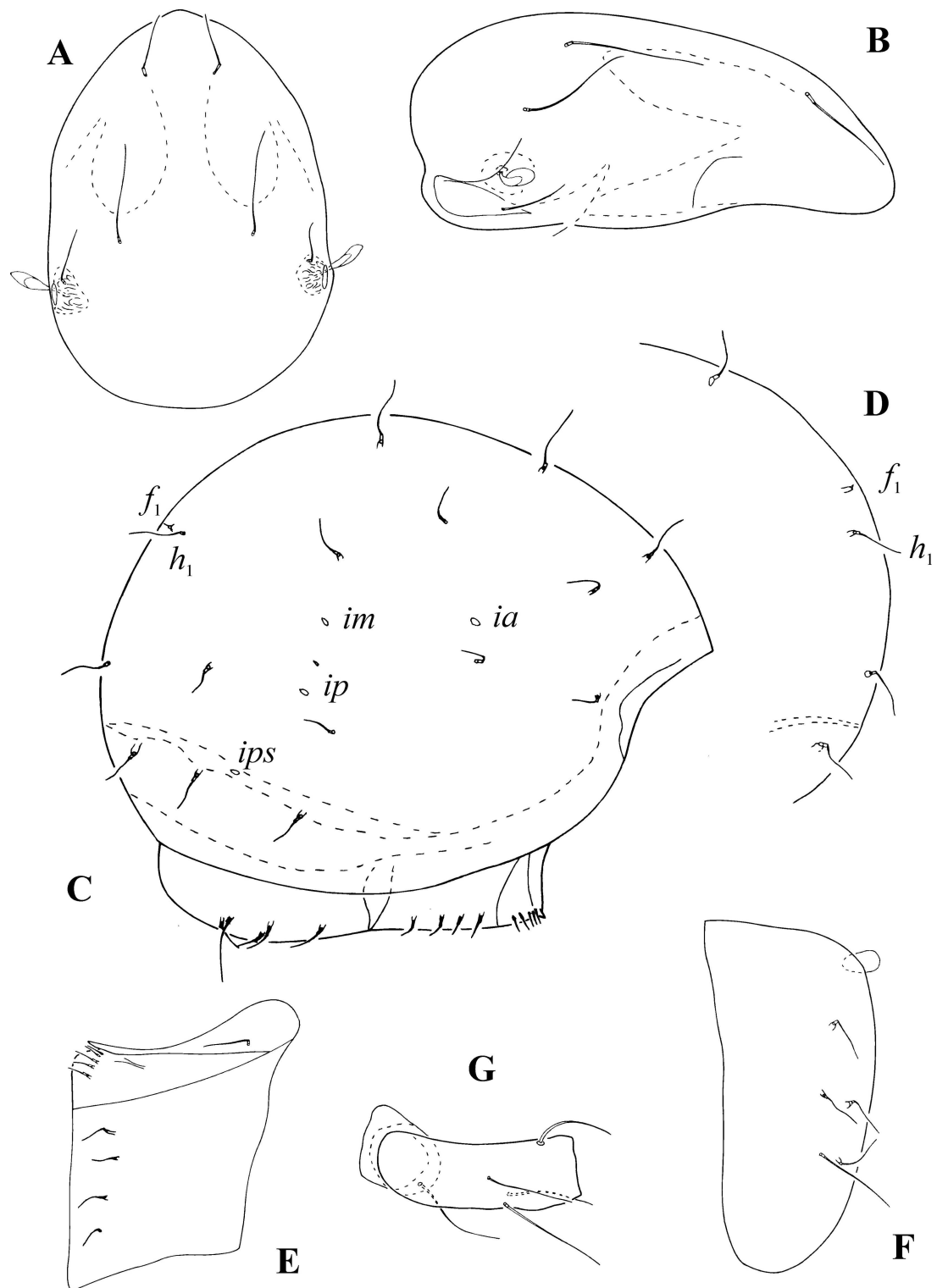


FIGURE 4: *Phthiracarus ranomafanensis* n. sp. (holotype): A – prodorsum, dorsal view; B – prodorsum, lateral view; C – opisthosoma, lateral view; D – left side of posterior part of notogaster; E – left genitoaggenital plate; F – right anoadanal plate; G – trochanter and femur of leg I.

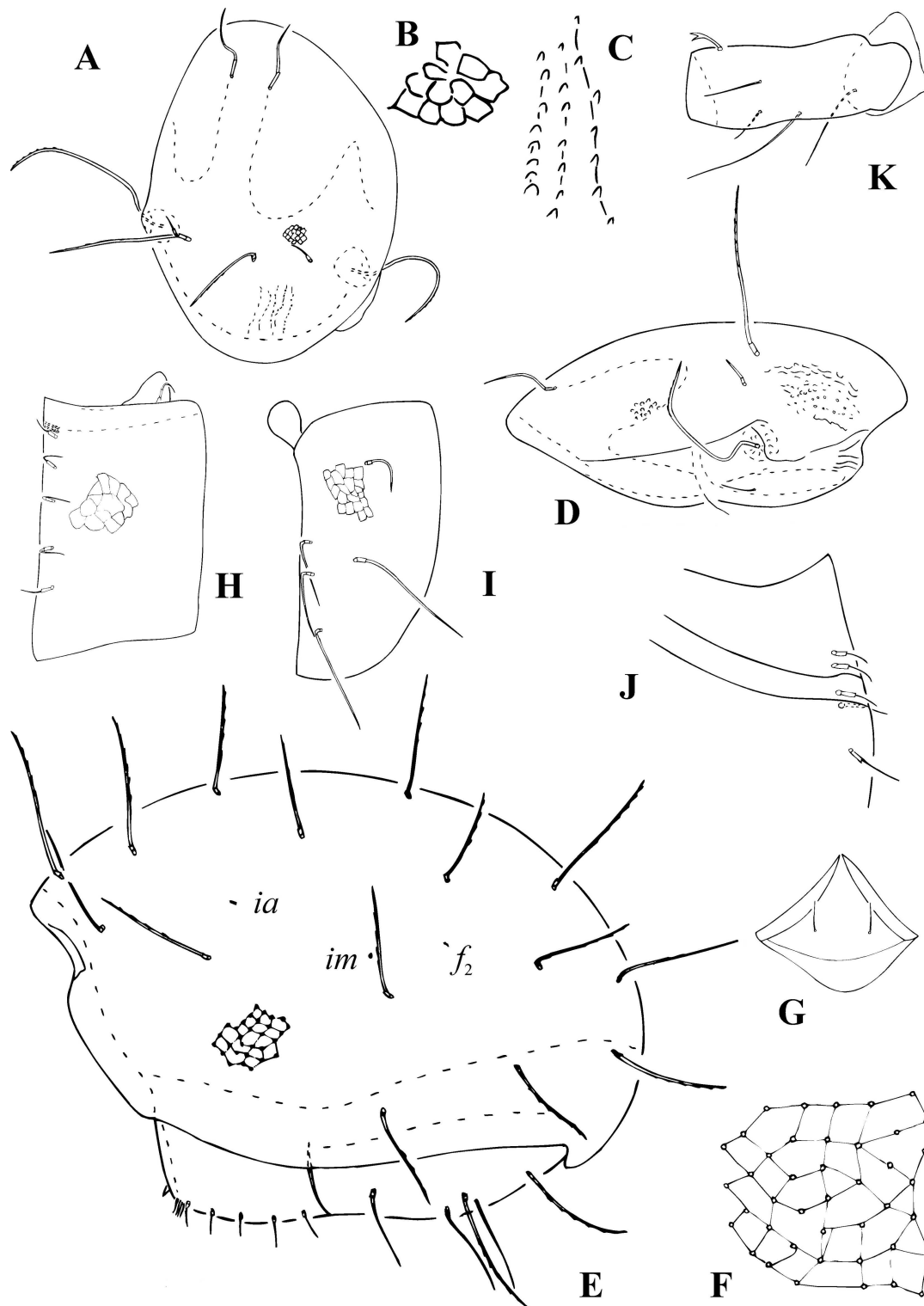


FIGURE 5: *Notophthiracarus medius* n. sp. (holotype): A – prodorsum, dorsal view; B – fragment of surface of median part of prodorsum; C – fragment of surface of posterior part of prodorsum; D – prodorsum, lateral view; E – opisthosoma, lateral view; F – fragment of surface of notogaster; G – mentum of subcapitulum; H – left genitoaggenital plate; I – left anoadanal plate; J – anterior part of paraxial margin of right genitoaggenital plate; K – trochanter and femur of leg I.

spiniform, rough; relative length of prodorsal setae: $in > ss > ro > ex > le$.

Notogaster — Surface of notogaster covered with small alveoles connected with weak lines, resembling reticulation. Notogastral setae robust, bacilliform of medium length ($c_1 < c_1 - d_1$), their distal half covered with small spines. Notogastral setae c_1 and c_3 situated close to anterior margin of notogaster, setae c_2 remote far from this margin. Vestigial notogastral setae f_1 not visible, vestigial setae f_2 and two pairs of lyrifissures ia and im present but hardly perceptible.

Ventral region — Setae h of subcapitular mentum shorter than distance between them. Surface of genitoaggenital and anoadanal plates reticulated. Formula of minute genital setae: 5: 4. Anoadanal plates each with 5 pairs of setae, two pairs of anal setae thinner and three pairs of adanal setae thicker, adanal setae ad_1 and ad_2 longest.

Legs — Setation of complete type. Setae d on femora I bifurcate and situated at distal end of article.

Material examined — Holotype is deposited at DATE from locus typicus: Central Madagascar, Andasibe – Mantadia National Park, Mantadia, circuit Rianaso, path to Chute sacrée, 29. I. 2015, evergreen rain forest, latitude 18°50'07" S, longitude 48°26'22" E, altitude about 1000 m, sifted sample of leaf litter, Winkler apparatus extraction, leg. P. Baňař and E. M. Rabotoson, and one paratype is deposited at ISB from the same locality.

Etymology — The specific name of the new species *medius* is Latin for "intermediate", "between" and refers to the similarity of the new species to two *Notophthiracarus* species *N. lineatus* Niedbała et Starý, 2015 and *N. reticulatus* Niedbała et Starý, 2014.

Comparison — The new species is similar to *N. lineatus* in the shape of the notogastral surface, which is covered by small foveolae connected with weak lines. It is also similar to *N. reticulatus* in the overall image of reticulation on the surface of notogaster. New species is distinguishable from *N. lineatus* by bacilliform shape of sensilli (versus dilated distally), longer adanal setae ad_3 (versus minute

adanal setae) and bifurcated setae d of femora I (versus not bifurcate). The new species is distinguishable from *N. reticulatus* also by bacilliform sensilli (versus dilated head of sensilli), erect interlamellar setae (in) and minute lamellar setae (le) shorter than rostral setae (ro), (versus almost procumbent interlamellar setae (in) and lamellar setae (le) longer than rostral (ro) ones, by setae h of mentum shorter than distance of their insertion points $h < h - h$ (versus longer setae that distance of their insertions, $h > h - h$; by adanal setae ad_2 of anoadanal plates, which are remote from paraxial margin of plates (versus location of adanal setae ad_2 near paraxial margin). (Niedbała and Starý 2014c, 2015b).

Atropacarus (Hoplophorella) paratenos n. sp. (Figures 6)

Description

Measurements of holotype — Prodorsum: length 190, width 139, height 71; length of prodorsal setae: sensillus (ss) 35, interlamellar (in) and exobothridial (ex) 18, lamellar (le) 13, rostral (ro) 20; notogaster: length 374, width 227, height 222; length of notogastral setae: c_1 71, $c_1/c_1 - d_1 = 0.8$, h_1 94, ps_1 83; genitoaggenital plate 114×71 , anoadanal plate 104×63 .

Species of rather small size; colour yellow; surface of body covered with deep rounded foveoles, in anterior part of notogaster with irregular margin.

Prodorsum — with small median crista. Lateral carinae short, posterior furrows distinct. Sigillar fields feeble, median ones narrow and longer than laterals. Sensilli (ss) rather short, with narrow pedicel and club-shaped, distally rounded head covered with small cilia. Other prodorsal setae minute, needleform, similar in length, $ss > ro > in = ex > le$.

Notogaster — with needleform, attenuate and smooth notogastral setae, most of them characteristically bent, medium in the length ($c_1 < c_1 - d_1$); notogastral setae c_1 and c_3 slightly remote from anterior notogastral margin, setae c_2 far from the margin. Vestigial setae and lyrifissures not visible.

Ventral region — setae h of subcapitular mentum considerably longer than distance between them.

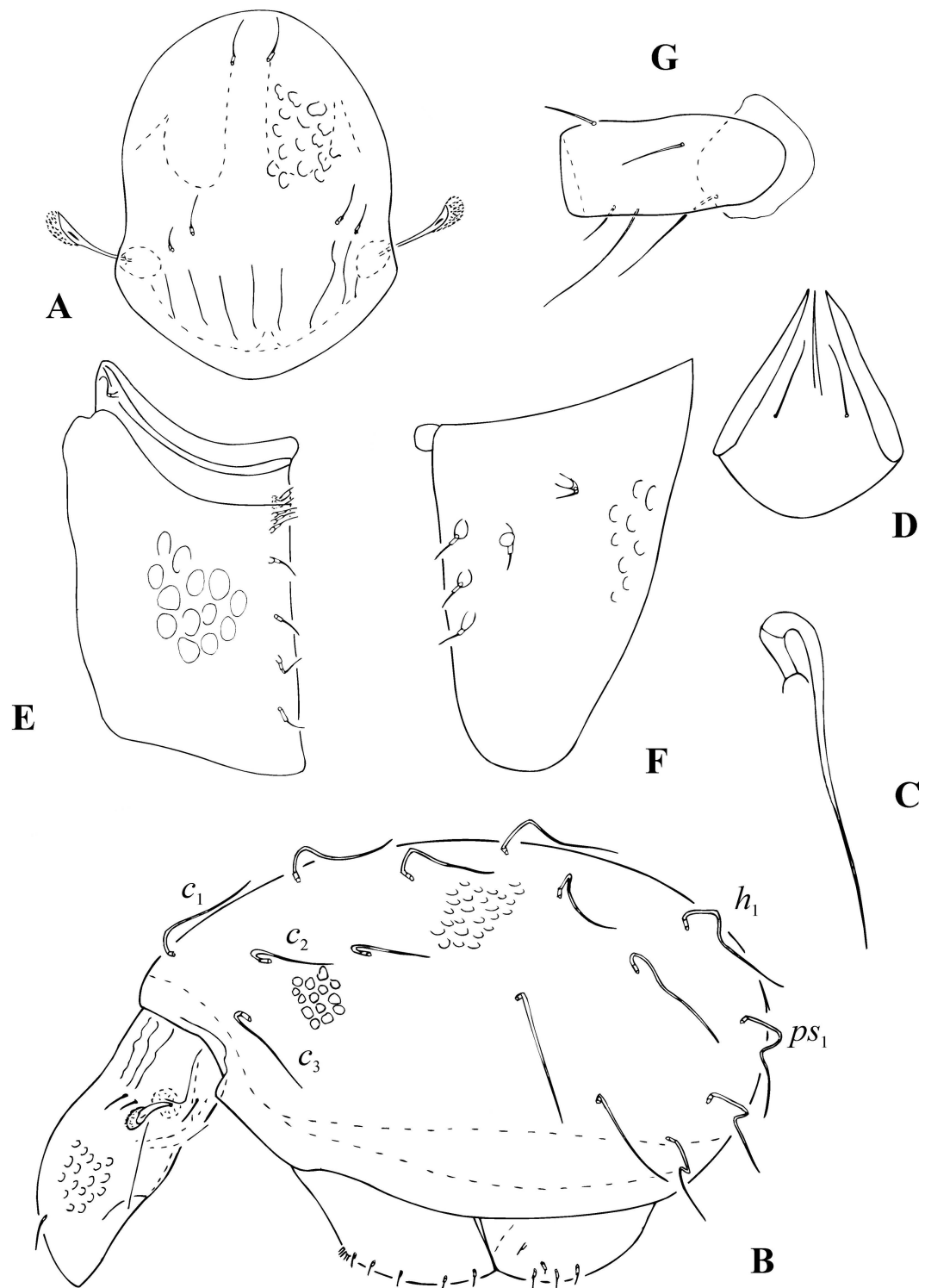


FIGURE 6: *Atropacarus* (*Hypophorella*) *parastenos* n. sp. (holotype): A – prodorsum, dorsal view; B – lateral view of body; C – seta c_1 ; D – mentum of subcapitulum; E – right genitoaggenital plate; F – left anoadanal plate; G – trochanter and femur of leg I.

Formula of minute genital setae: 6(4+2): 3. Anoadanal plates with minute, needleform setae similar in length; adanal setae *ad*₃ situated in the middle of plates.

Legs — Formulae of setae and solenidia of "complete type"; setae *d* on femora I needleform and situated at distal end of article.

Material examined — Holotype is deposited at DATE from locus typicus: North Madagascar, Montagne d'Ambre National Park, circuit Sommet, 12. I. 2015, evergreen rain forest, latitude 12°31'52" S, longitude 49°10'17" E, altitude 1169 m, sifted of *Pandanus* sp. litter sample, Winkler apparatus extraction, leg. P. Baňář and E. M. Rabotoson.

Etymology — The prefix para is Latin meaning "near" and refers to the similarity the new species with *A. (H.) stenos* Niedbała et Starý, 2014.

Comparison — The new species is slightly similar to *A. (H.) stenos* Niedbała et Starý, 2014 from Tanzania in the shape of the sensilli and shape and length of prodorsal, genital, anal and adanal setae. The new species is distinguishable from *A. (H.) stenos* by the absence of powerful median crista of prodorsum and anterior cowl of notogaster, curved notogastral setae, longer setae *h* of the mentum (versus shorter setae) and setae *d* of femora I situated at distal end of article (versus remote from distal end) (Niedbała and Starý 2014a).

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