Acta Zoologica Academiae Scientiarum Hungaricae 59(4), pp. 337–345, 2013

CONTRIBUTION TO THE KNOWLEDGE OF PTYCTIMOUS MITES (ACARI: ORIBATIDA) FROM MADAGASCAR

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Three new species of ptyctimous oribatid mites, *Oribotritia mahunkai* sp. n., *Protophthiracarus mahunkai* sp. n. and *Atropacarus (Hoplophorella) mahunkai* sp. n., collected in various localities in Madagascar, are described and figured. The species found are representatives of three different genera, whereas one of them belongs to the superfamily of Euphthiracaroidea, family Oribotritiidae Grandjean, 1954, and the other two to the superfamily of Phthiracaroidea, family Steganacaridae Niedbała, 1986 from the Euptyctima group.

Key words: oribatid mites, Phthiracaroidea, Euphthiracaroidea, new species, Mahunka.

INTRODUCTION

Present paper includes descriptions of three new species of ptyctimous mites named in honour of Prof. Sándor Mahunka (1937–2012), who was an admirable person, a brilliant and respected zoologist, highly acclaimed world class specialist on taxonomy and systematics of soil acariform mites, with special emphasis on Acarida, Tarsonemida and Oribatida. He has published more than 530 original scientific papers frequently dealing with the mite fauna of tropical and subtropical countries. With its enormously rich soil mite fauna, and high species and genus level endemism (Niedbała 2001, Schatz 2004), his favorite country, from this perspective, was Madagascar representing an important biodiversity hotspot. In his series of papers (Mahunka 1983, 1993, 1996, 1997, 1999, 2009*a*, *b*, 2010, 2011), he described many new ptyctimous mite species from different localities of Madagascar. His list of mite species recorded from this landmass (Mahunka 2002) contains 166 species, 105 genera and subgenera and 41 families of oribatids, including 22 species of Phthiracaroidea and 15 species of Euphthiracaroidea. Altogether, 44 species of ptyctimous mites have been recorded from Madagascar so far: 27 species belonging to the superfamily Phthiracaroidea and 17 species to Euphthiracaroidea. The scientific legacy and impact of Prof. S. Mahunka's papers to our knowledge on soil mites is enormous and will inspire and influence generations of future acarologists, soil zoologists and ecologists.

MATERIAL AND METHODS

Dr. P. Baňař (Brno, Czech Republic) collected samples by sifting soil and litter samples from various parts of Madagascar during his expeditions in the years 2010–2012, and kindly provided us this material.

Mites were extracted from soil samples by using modified Winkler-extractors. Assorted mite specimens were preserved in 80% ethanol, mounted and cleared with 85% lactic acid for temporary slides and transferred to slides with glycerol for microscopic observation. Observations, determination, measurements, and illustrations were made using a standard light microscope equipped with a drawing attachment. All measurements are given in micrometres. Terminology used was derived from Niedbała (2000).

Type material is partly deposited at the Department of Animal Taxonomy and Ecology, Poznaň, Poland (DATE), at the Institute of Soil Biology BC ASCR, České Budějovice, Czech Republic (ISB), and at the Natural History Museum, Genève, Switzerland (NHMG).

Oribotritia mahunkai sp. n.
(Figs 1A-F)

Diagnosis – Two pairs of lateral carinae on prodorsum, dorsally marked stronger than ventrally. Sensilla short, dilated medially. Notogastral setae short, rigid, except filiform setae c_3 and p_3.

Aggenital setae ag_1 considerably shorter than setae ag_2. One pair of minute anal setae and three pairs of longer adanal setae; distance between setae ad_1 and ad_2 is longer than between setae ad_2 and ad_3; lyrifissures *iad* situated laterally at level of ad_2 setae.

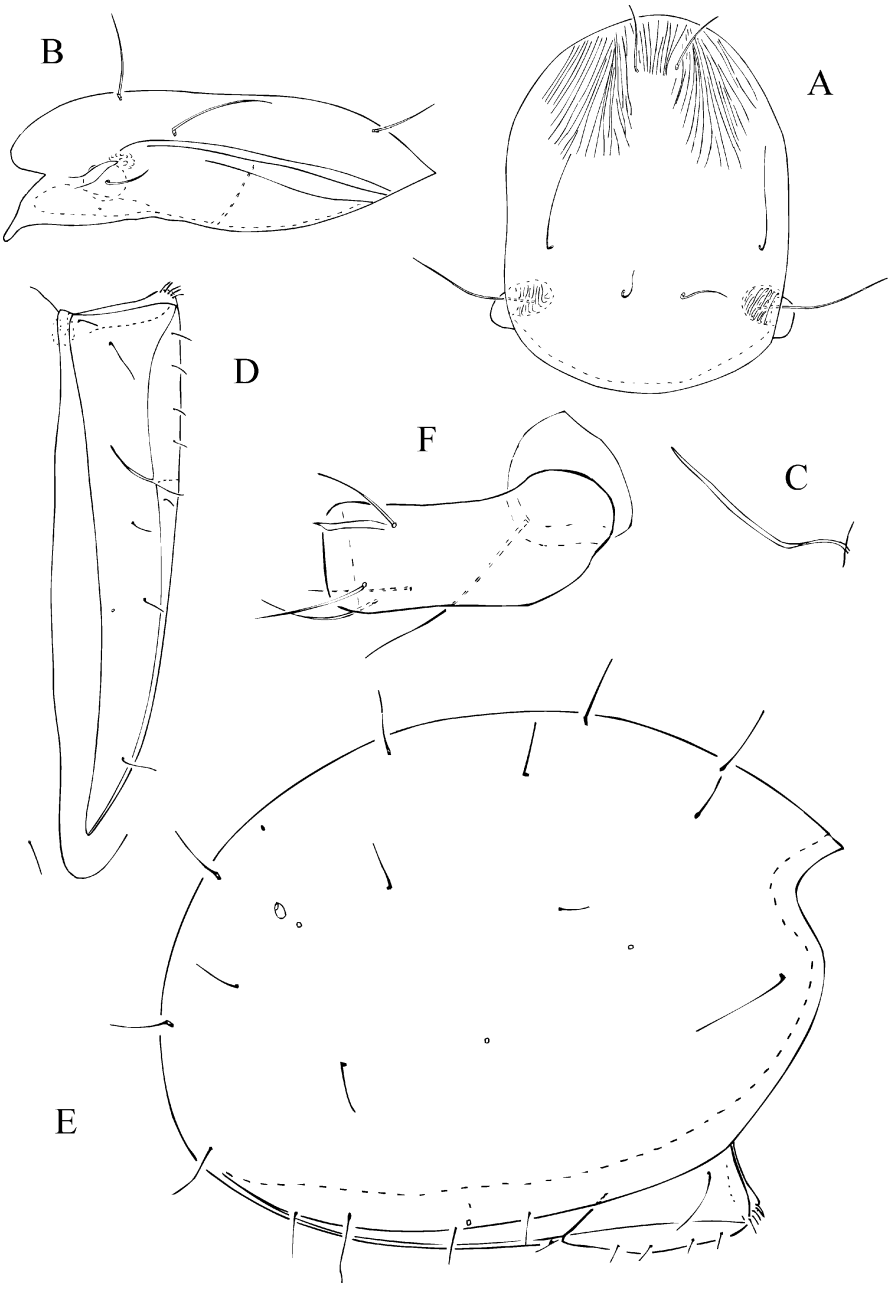
Measurements of holotype – Rather large species, prodorsum length 439, width 343, height 146, sensillum 73, setae: interlamellar 94, lamellar 111, rostral 76; notogaster: length 808, width 586, height 545, setae c_1 83, c_1/c_1-d_1= 0.5, h_1 76, p_1 68; genital and aggenital plates 207 × 116, anal and adanal plates 404 × 101.

Description – Colour light to dark brown. Body surface finely porose.

Prodorsum (Figs 1A, B) with two pairs of lateral carinae, dorsally well marked, ventrally weaker, shorter and convergent in proximal part. Sensilla (Fig. 1C) rather short, rigid, smooth, slightly dilated medially; interlamellar and rostral setae short, erect, rough; lamellar setae procumbent, filiform; exobothridial setae vestigial.

Notogaster (Fig. 1E) with short, rigid setae, except for slightly longer and filiform setae c_3 and p_3. Setae c_1 and c_2 remote from anterior margin, setae c_3 near the margin. Opening of opisthosomal gland, five lyrifissures and two vestigial setae present and positioned as normal for the genus.

Ventral region (Fig. 1D). Setae *h* of mentum considerably longer than distance between them. Genital plates with nine pairs of setae, setae $g_{1–5}$ smaller and distanced from setae $g_{6–9}$; two pairs of aggenital setae present, setae ag_1 considerably shorter than setae ag_2. Anogenital cleft *trv* rather long. One pair of minute anal setae and three pairs of longer adanal setae present; distance between setae ad_1 and ad_2 longer than between setae ad_2 and ad_3. Lyrifissures *iad* situated laterally at the level of setae ad_2.



Figs 1A–F. *Oribotritia mahunkai* sp. n.: A = prodorsum, dorsal view, B = prodorsum, lateral view, C = sensillum, D = right ventral side, E = opisthosoma, lateral view, F = trochanter and femur of leg I.

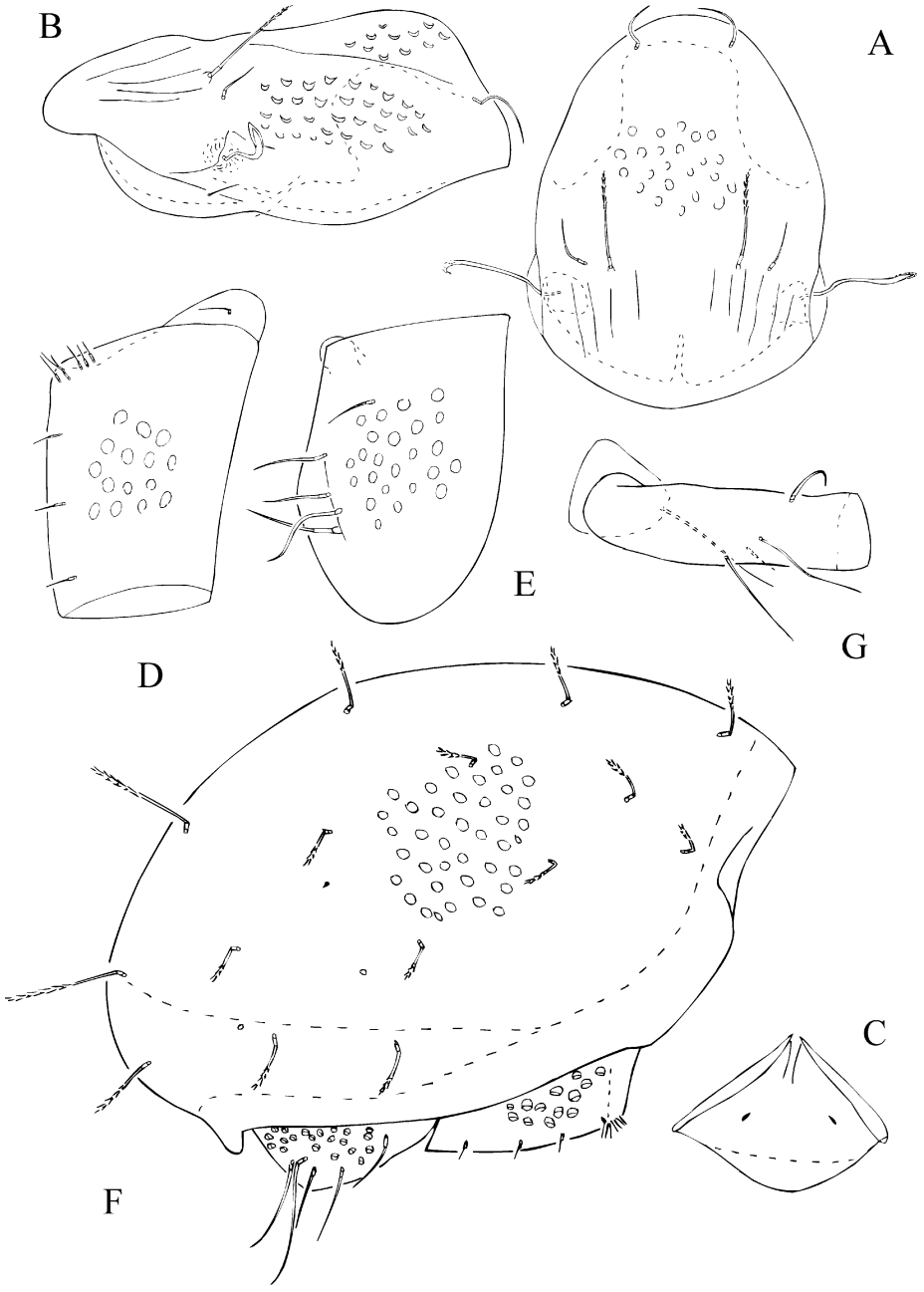
Legs (Fig. 1F). Chaetome of legs (without tarsi): I: 1–4–5(2)–5(1), II: 1–4–4(1)–3(1), III: 3–2–3(1)–3(1), IV: 3–2–2(1)–3(1); tarsi heterotridactylous.

Material examined. Holotype and eight paratypes: MAG-034, ABT/13/2011/, Madagascar, Ambohitantely Species Reserve, 20.IV.2011, GPS-coordinates 18°11′22,4″S, 47°17′38,9″E, altitude 1631 m, secondary forest, sifted sample of forest litter and fern residues, leg. L. S. Rahanitriniaina, and R. Raveloson, one paratype: MAG-038, ABT/18/2011/, Madagascar, Ambohitantely Species Reserve, 20.IV.2011, 18°11′43,1″S, 47°17′16,1″E, altitude 1613 m, secondary forest, sifted sample of forest litter, leg. L. S. Rahanitriniaina, and R. Raveloson, seven paratypes: MAG-031, ABT/08/2011/, Madagascar, Ambohitantely Species Reserve, 19.IV.2011, 18°11′51,8″S, 47°17′03,5″E, altitude 1533m, forest edge, sifted sample of forest litter, leg. P. Baňař, and R. Raveloson, one paratype: MAG-035, ABT/15/2011/, Madagascar, Ambohitantely Species Reserve, 20.IV.2011, 18°11′31,0″S, 47°17′33,3″E, altitude 1630 m, secondary forest, sifted sample of forest litter, leg. L .S. Rahanitriniaina, and R. Raveloson, 15 paratypes: MAG-036, ABT/16/2011/, Madagascar, Ambohitantely Species Reserve, 20.IV.2011, 18°11′43,5″S, 47°17′23,1″E, altitude 1636 m, secondary forest, sifted sample of forest litter, leg. L. S. Rahanitriniaina, and R. Raveloson, 12 paratypes: MAG-037, ABT/17/2011/, Madagascar, Ambohitantely Species Reserve, 20.IV.2011, 18°11′43,1″S, 47°17′19,3″E, altitude 1636 m, secondary forest, sifted sample of forest litter, leg. L. S. Rahanitriniaina, and R. Raveloson, 10 paratypes: MAG-014, ABT/10/2011/, Madagascar, Ambohitantely Species Reserve, 19.IV.2011, 18°11′39,2″S, 47°17′12,6″E, altitude 1674 m, sifted sample of plant residues under *Pandanus* sp., leg. L. S. Rahanitriniaina and R. Raveloson. Holotype and 18 paratypes are deposited at DATE, 18 paratypes are deposited at NHMG, and 18 paratypes at ISB.

Comparison – The new species is characterised by the presence of lateral carinae, which are dorsally well marked, ventrally weaker, shorter, and convergent in proximal part; the aggenital setae ag_1 are considerably shorter than setae ag_2 and the lyrifissures *iad* are situated laterally at the level of ad_2 setae. The closest related *Oribotritia striata* Mahunka, 2009 has got a similar construction of lateral carinae, shape and length of prodorsal and notogastral setae, presence of one pair of anal and three pairs of adanal setae but is distinguishable by the longitudinal striation on the prodorsum and notogaster, presence of three pairs of aggenital setae and the lyrifissures *iad* are situated laterally and posteriorly of ad_2 setae.

Protophthiracarus mahunkai sp. n.
(Figs 2A-G)

Diagnosis – Cuticle of body deeply concave. Prodorsum with strong median crista. Median sigillar field of prodorsum large, lateral parts very short. Notogastral setae short sparsely barbed in distal half. Four pairs of notogastral lyrifissures present. Setae *h* of mentum minute. Adanal setae ad_2 situated near anal setae.



Figs 2A–G. *Protophthiracarus mahunkai* sp. n.: A = prodorsum, dorsal view, B = prodorsum, lateral view, C = mentum of infracapitulum, D = left genitoaggenital plate, E = left anoadanal plate, F = opisthosoma, lateral view, G = trochanter and femur of leg I.

Measurements of holotype – Prodorsum length 303, width 202, height 141, sensillum 68, setae: interlamellar 64, lamellar 35, rostral 48, exobothridial 23; notogaster: length 606, width 313, height 364, c_1 68, h_1 101, p_1 111, $c_1/c_1 - d_1 = 0.6$; genitoaggenital plate 146 × 106 anoadanal plate 166 × 101.

Description. Colour brown. Cuticle well sculptured with very distinct, deep rounded concavities.

Prodorsum (Figs 2A, B) with strong median crista; sigillar fields abnormal, median large, laterals parts very short, rounded; posterior furrows present; lateral carinae absent. Sensilla with short, narrow pedicel, enlarged towards distal end and fusiform, rough head. Interlamellar setae short, strong, thick and covered sparsely by barbs at distal half, similar to notogastral setae; lamellar setae shorter, spiniform, rough; exobothridial setae distinct, needle-like; rostral setae, spiniform, rough, curved and directed inward.

Notogaster (Fig. 2F) with 15 pairs of thick, short setae sparsely barbed at distal half, median setae even in shape of aspergillum, shorter than dorsal setae, especially h_1 and p_1. Setae c_1 and c_3 remote from anterior border, setae c_2 far from border. Vestigial setae f_1 not visible because of strong sculpturing. Four pairs of lyrifissures *ia*, *im*, *ip* and *ips* present.

Ventral region (Figs 2C,D,E). Setae *h* of mentum minute. Genitoaggenital plates with nine pairs of genital setae with arrangement: 4+2: 3. Anoadanal plates each with five rough setae, adanal setae ad_2 situated near anal setae, setae ad_3 smallest.

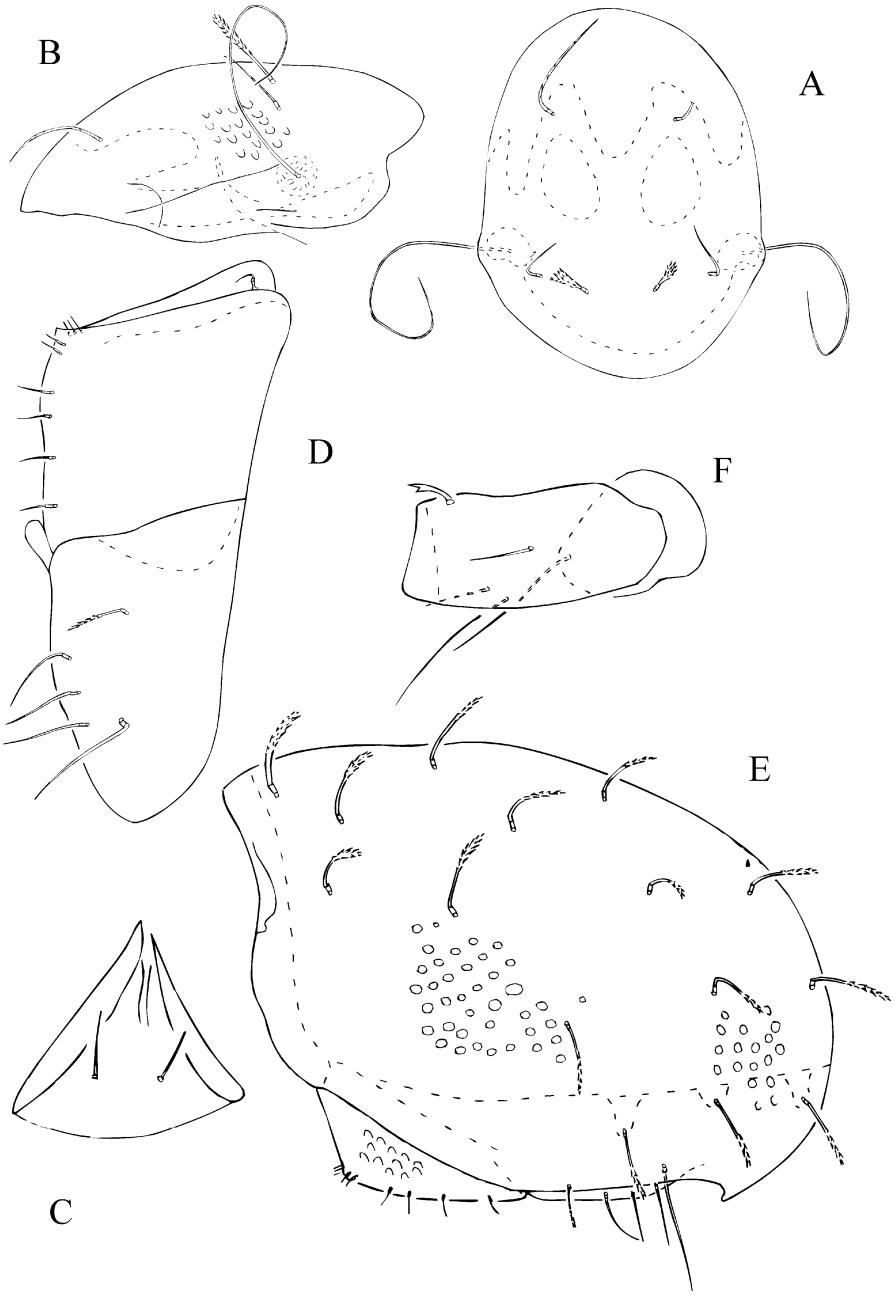
Legs (Fig. 2G). Formulae of setae and solenidia of "complete type". Setae *d* of femora I remote from distal end of article.

Material examined. Holotype: MAG–037, ABT/17/2011/, Madagascar, Ambohitantely Species Reserve, 20.IV.2011, 18°11′43,1″S, 47°17′19,3″E, altitude 1636 m, secondary forest, sifted sample of forest litter, leg. L. S. Rahanitriniaina, and R. Raveloson. Holotype is deposited at DATE.

Comparison – The new species is closely alike to *Protophthiracarus araios* Niedbała, 2001 by the shape of sensilla, length and shape of notogastral setae, directed inward rostral setae and length and position of anal and adanal setae. However, it is distinguishable by presence of longer interlamellar setae covered with spines in distal half (versus rough setae), arrangement of notogastral setae c_1 and c_3 remote from anterior margin (versus setae c_1 remote from margin and setae c_3 situated on margin), number (4) and position of lyryfissures (versus 3 pairs of lyrifissures).

Atropacarus (Hoplophorella) mahunkai sp. n.
(Figs 3A–F)

Diagnosis. Cuticle of body covered by deep concavities. Sigillar fields of prodorsum joined. Sensilla of whip-like shape. Notogastral setae short, thick, densely ciliate. Setae *d* of femora I bifurcate.



Figs 3A–F. *Atropacarus* (*Hoplophorella*) *mahunkai* sp. n.: A = prodorsum, dorsal view, B = prodorsum, lateral view, C = mentum of infracapitulum, D = left genitoaggenital and anoadanal plates, E = opisthosoma, lateral view, F = trochanter and femur of leg I.

Measurements of holotype. Specimens of this species are relatively small. Prodorsum length 147, width 104, height 68, sensillum 99, setae: interlamellar 38, rostral 45, lamellar 28; notogaster: length 255, width 172, height 159, setae: c_1 and p_1 33, h_1 35; genitoaggenital plate 66 × 63, anoadanal plate 86 × 61.

Description – Colour brown. Surface of body covered with deep, round concavities.

Prodorsum (Figs 3A,B) with long lateral carinae, median and lateral sigillar fields joined, median with deep incision, longer than lateral fields. Sensilla long, filiform whip-shaped, rough. Interlamellar setae thick covered with dense cilia in distal half; lamellar and rostral setae strong, rough, rostrals directed inward; exobothridial setae simple, smooth.

Notogaster (Fig. 3E) with 15 pairs of setae thick, short (c_1/c_1-d_1=0.5) densely covered with small spines in distal half, ventral setae slightly dilated; setae c_2 and c_3 remote from anterior border, setae c_1 near the border. Vestigial setae f_1 slightly anterior to setae h_1. Two pairs of lyrifissures *ia* and *im* visible.

Ventral region (Figs 3C,D). Setae *h* of mentum slightly longer than distance between them. Arrangement of genital setae: 4+2: 3. Anoadanal plates with spiniform anal and ad_1 setae similar in length, setae ad_2 the longest and thickest but similar in shape to anal setae, setae ad_3 the shortest but similar to notogastral setae, covered with small cilia in distal half.

Legs (Fig. 3F). Chaetome of legs of "incomplete type", setae of genua IV absent, setae *d* of femora I bifurcate and slightly remote from distal end of article.

Material examined. Holotype: MAG-081, Madagascar, RNF/15/2011/ Ranomafana National Park, 16.IV.2011, 21°15′06.6″S, 47°24′31.0″E, altitude 1197 m, sifted sample of forest litter, leg. R. Raveloson, and L. S. Rahanitriniaina, two paratypes: MAG-080, Madagascar, RNF/14/2011/ Ranomafana National Park, 16.IV.2011, 21°15′08.4″S, 47°24′33.1″E, altitude 1182 m, sifted sample of forest litter, leg. R. Raveloson, and L. S. Rahanitriniaina, two paratypes: MAG-022, Madagascar, RNF/12/2011/ Ranomafana National Park, 15.IV.2011, 21°15′51,3″S, 47°24′09,1″E, altitude 1118 m, sifted sample of forest litter, leg. P. Baňař and R. Raveloson. Holotype and 2 paratypes are deposited at DATE, one paratype is deposited at NHMG, and one paratype at ISB.

Comparison – The new species is easily distinguishable by the deep concavities on the surface of body, the thick, short and densely cilitate notogastral setae, and especially by the joined sigillar fields of prodorsum, the whip-like shaped sensilla and the bifurcated setae *d* of femora I.

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Acknowledgements – We would like to thank Dr. P. Baňař (Brno, Czech Republic) renowned entomologist, specialist on soil Heteroptera, for collecting soil samples from Madagascar and the anonymous referees for constructive criticism of the manuscript. The study was partly supported by the Academy of Sciences of the Czech Republic, Research Plan No. AV0Z60660521.

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Revised version received April 4, 2013, accepted July 2, 2013, published November 15, 2013