Free-living nematodes from nature reserves in Costa Rica Genera *Egtitus* Thorne, 1967 and *Trachypleurosum* Andrássy, 1959 (Dorylaimida: Actinolaimidae)

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Abstract. Some actinolaimid nematode species belonging to the genera *Egtitus* Thorne, 1967 and *Trachypleurosum* Andrássy, 1959 are described or redescribed from Costa Rica. *Egtitus costaricae* sp. nov. is distinguished from the related species, *E. biformis* Andrássy, 2012*, E. neocyatholaimus* (Kreis, 1936) and *E. proximus* (Yeates, 1973), by the wide lip region (21–23 *vs* 15–17 μm) and the low number of the male supplements (6–8 *vs* 9–13). The Costa Rican specimens of *Trachypleurosum venezolanum* Coomans, Vinciguerra & Loof, 1990 correspond well with the original description. Three probable new species, *viz. Egtitus* sp. 1, *Egtitus* sp. 2 and *Trachypleurosum* sp. are also described on the basis of male specimens, but due to lack of females they are not provided with species names. In the Appendix five genera and forty-two species of free-living nematodes described as new to science from Costa Rica are listed.

Keywords. Costa Rica, description, *Egtitus,* list of new taxa, taxonomy, *Trachypleurosum.*

INTRODUCTION AND MATERIAL

It is known from the fundamental papers by Esquivel (2003) and Bongers, Esquivel and Arias (2003) that the nematode fauna of Costa Rica is very rich in genera and species. That is due to the wide range of inland and seaside ecosystems on the one hand, and to the regions being almost untouched by human influence on the other. There is hardly another country on the Globe where nature would be protected with such great care as in Costa Rica.

The above-mentioned papers report on about 20,000 nematode specimens belonging to 230 genera deposited in the Nematology Laboratory at the Universidad Nacional in Heredia, Costa Rica. Although these numbers increased considerably in the course of the subsequent years, only a small percent of the nematodes has hitherto been identified to species level. In an "Appendix" at the end of the present paper, we compiled a list of the free-living (inclusive plant-parasitic) nematode genera (5) and species (42) that have been described as new to science from Costa Rica.

In this study, we report on some actinolaimid nematodes of the Costa Rican collection belonging to the genera *Egtitus* Thorne, 1967 and *Trachypleurosum* Andrássy, 1959. We studied a total of 44 exemplars (27 females, 15 males and 2 juveniles), mounted on aluminium slides that have been collected in various protected areas of the Central American country. Unfortunately, we had only two populations that contained both female and male specimens. In the other populations, eight in number, we only found either females or males (mostly a single specimen).

As a result, we describe a new species of *Egtitus* and a known but rare species of *Trachypleurosum.* Besides, males of three further species of these genera are presented. It is not impossible that each of them represents a new species, but on the basis of one sex (or one specimen) we do not want to provide them with species names. In those populations where only females were present we could not determine them even to genus level,

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since to separate *Egtitus* and *Trachypleurosum* males are necessary.

Egtitus Thorne, 1967 contains actinolaimid nematodes mainly characterised by the absence of denticles in the dental chamber and by sexual dimorphism in the shape of the tail (long and conical in female, short and rounded in male). Quite recently, Andrássy (2012) rediagnosed the genus and listed 28 species belonging to it. *Trachypleurosum* Andrássy, 1959 also has an adenticulate stomatal chamber, but differs from *Egtitus* by having a long and conical tail in both sexes. The latter genus includes five species. As far as is known, both genera are distributed in Asia, Africa and Latin America.

Of the family Actinolaimidae six species have hitherto been recorded from Costa Rica: *Brasilaimus bidentatus* Loof & Zullini, 2000, *B. bryophilus* (Hunt, 1978) Vinciguerra, Zullini & Monteiro, 1999, *B. memorabilis* (Andrássy, 1968) Vinciguerra, Zullini & Monteiro, 1999, *B. subaquilus* Lordello & Zamith, 1957, *B. vinciguerrae* Loof & Zullini, 2000 and *Practinocephalus secundus* Andrássy, 1968.

DESCRIPTIONS

Egtitus costaricae sp. nov.

(Figures 1 A–E and 2 A–C)

Holotype female: L = 2.12 mm; a = 44; b = 4.5; c = 11.5; c' = 7.6; V = 51 %.

Paratype females (n = 10): L = 2.00–2.39 mm; a = 38–46; b = 4.3–4.7; c = 11.2–14.0; c' = 6.3–8.0; V = 51–54 %.

Paratype males (n = 7): L = 1.77–2.00 mm; a = 40–52; b = 3.8–4.3; c = 60–74; c' = 0.8–1.0.

General characters. Body nearly straight after fixation, more curved in posterior part of male, 45–62 (female) or 37–48 (male) µm wide at middle. Cuticle smooth under light microscope, 2.0–2.5 µm thick on most body and 3.0–3.5 µm thick on anterior part of the female tail. Lip region expanded, offset by a depression, 21–23 µm wide and 8–9 µm high. Lips rounded, amalgamated. Body at posterior end of pharynx 2.0–2.4 times as wide as lip region. Amphids caliciform with aperture about half the corresponding body width.

Labial and dental chambers[1] well separated, the former 12–14 µm, the latter 7–8 µm broad. Labial disc 7 µm wide. Vestibular ring corrugated. Pharyngeal denticles absent. Onchia simple, uni-tipped. Guiding ring double but thin, 7–8 µm wide, located at 16–18 µm from labial field. Odontostyle 21–24 µm long and 2.5–3.0 µm thick, about as long as labial diameter or 4.1–4.9 % of pharyngeal length, thicker than cuticle at the same level. Aperture two-fifths to almost half the stylet length. Odontophore 30–35 µm long. Pharynx 470–536 (female) or 436–470 µm (male) long, at 47–50 % expanded. Medial, conoid part of pharynx 60–70 µm long, occupying 13–15 % of total pharyngeal length. Because of the heavy muscular structure, the pharyngeal gland nuclei are difficult to discern. D = 51–52 % or at 11–12 % of total body length. AS1 nucleus invisible, AS2 = 49–52 %, PS1 = 73–75 %, PS2 = 74–77 %. Glandularium 222–258 µm long. Posterior end of pharynx with a shallow disc. Cardia conical.

Female. Reproductive system didelphic, amphidelphic. Genital branches highly and equally developed, each as long as 6.5–8.0 body widths or occupying 15–17 % of body length. Vulva a short longitudinal slit with slightly sclerotized inner lips. Vagina 18–19 µm long, 30–37 % of corresponding body diameter. Uterus packed with spermatozoa. One female with one, another with two, and a third with three uterine eggs measuring 95–110×36–46 µm; eggs 1.4–2.0 times as long as corresponding body diameter. Distance between posterior end of pharynx and vulva 1.3–1.4 times as long as pharynx. Rectum 1.2–1.6, prerectum 2.1–3.2 anal body widths long. Vulva–anus distance equal to 4.5–5.8 tail lengths. Tail 152–185 µm long, 6.8–8.7 % of entire length of body, rather uniformly tapered to its fine and sharp tip. Posterior half of tail slightly bent dorsally.

[1] See Andrássy, 2012, Fig. 1.

An aberrant female was also found in the population studied. It had a reduced anterior genital branch, more a sack, 1.8 body widths long, and a shorter tail than the other females of the same population (98 µm, c' = 5.2 *vs* 152–185 µm, c' = 6.3–7.6)

Male. Testes two, straight, moderately developed, the anterior 6–7 body widths long, or occupying 12–13 % of total body length, the posterior 7–8 body widths long, or occupying 14–15 % of total body length. Spermatozoa fusiform, 7 µm long. Spicula dorylaimoid, 40–45 µm long, distinctly longer than tail. Ventromedian supplements very small, hardly discernible, spaced, six to eight in number (6 or 8 in one male each and 7 in five males); posteriormost of them at a distance of 45–55 µm from cloaca. Series of supplements 55–70 µm long. Prerectum beginning at level of the first or second supplement. Tail conoid-rounded, 22–30 µm long, occupying 1.3–1.7 % of entire length of body.

Diagnosis and relationships. Body in male somewhat under, in female over 2 mm (on average 1.87 and 2.20 mm, respectively), the male is slimmer than the female. Other main characteristics are the broad and moderately separated lip region, medium long odontostyle equal in length to the labial diameter, broad labial chamber, pharynx expanded at its middle, rather short prerectum, short spicula, six to eight very small supplements, medium long and uniformly tapered female and short, conoid-rounded male tail.

In having a body length ranging from 2.0 to 2.4 mm and a medium long tail (equalling to 6–8 anal body widths), this new species resembles *Egtitus biformis* Andrássy, 2012, *E. neocyatholaimus* (Kreis, 1936) Thorne, 1967 and *E. proximus* (Yeates, 1973) Vinciguerra, 1988. It can easily be distinguished from them by the number of the male supplements (6–8 *vs* 10, 12–13 and 9–10, respectively) as well as by the width of the lip region (21–23 *vs* 15–17 µm, in *E. proximus* originally not given).

The overwhelming majority of *Egtitus* species inhabit Asia–Australasia (22 species), from the American continent (Central- and South America) four species have been recorded hitherto (Andrássy, 2012), while two species are known to occur in Africa. If we compare *E. costaricae* sp. nov. with the American species – *E. bryophilus* Thorne, 1967 (Puerto Rico, Peru), *E. chilenus* Andrássy, 2012 (Chile), *E. elaboratus* (Cobb, 1906) Thorne, 1967 and *E. surinamensis* (Micoletzky, 1925) Thorne, 1967 (Surinam, Guayana) – we find that it differs from *E. bryophilus* by the wider lip region (21–23 *vs* 15–17 µm), longer odontostyle (21–24 *vs* 17–19 µm) and longer female tail (c' = 6.3–8.0 *vs* 5.4–6.0), from *E. chilenus* by the broader lip region (21–23 *vs* 18–19 µm), longer tail (c' = 6.3–8.0 *vs* 4.3–5.3) and lower number of supplements (6–8 *vs* 10–11), from *E. elaboratus* by longer body (2.0–2.4 *vs* 1.7–1.8 mm) and longer tail (c' = 6.3–8.0 *vs* 4.4–5.3), and from *E. surinamensis* (incompletely described) by the longer body of male (1.8–2.0 *vs* 1.4 mm; female unknown in *surinamensis*).

Type habitat and locality. Rotten tree branch with many small basidiocarps taken close to a freshwater stream in a primary forest, 200 to 300 m above sea level, Hitoy Cerere Biological Reserve, La Amistad Caribe Conservation Area, Costa Rica. Collected in August 1998 by A. Esquivel, A. Zullini and R. Gómez.

Type specimens. Holotype female on slide No. 360.09. Paratypes: 13 females and 7 males (on the slides No. 360.07–14), deposited at the Nematology Laboratory of the Universidad Nacional in Heredia, Costa Rica.

Etymology. Named after the country where found, Costa Rica.

Egtitus sp. 1

(Figures 3 A–D)

Male (n = 3): L = 1.47–1.54 mm; a = 53–60; b = 3.9–4.5; c = 86–110; c' = 0.7–0.8.

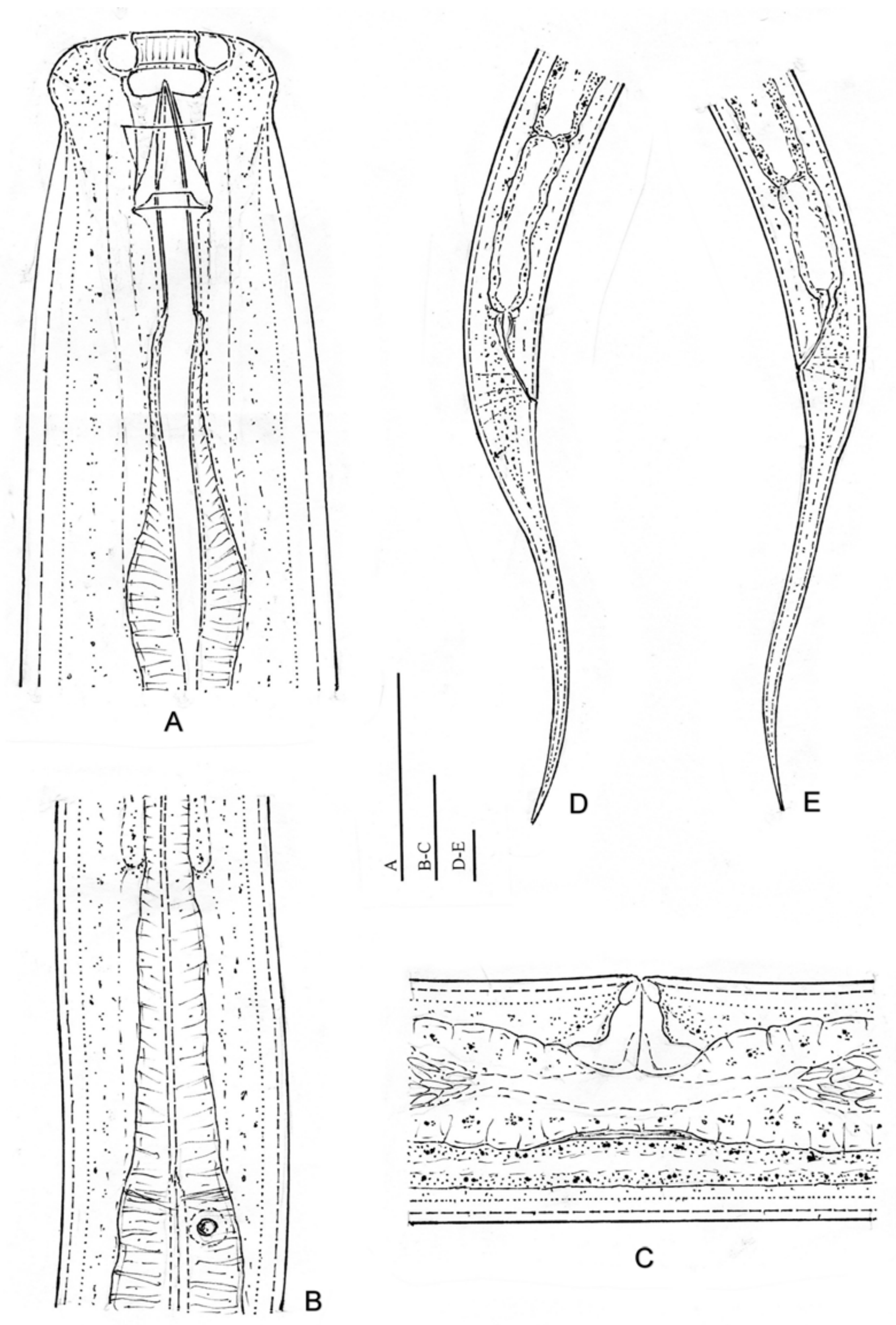

Figure 1. *Egtitus costaricae* sp. nov. A: anterior end; B: medial section of pharynx; C: vulval region; D–E: tail of females. (Scale bars = 20 µm)

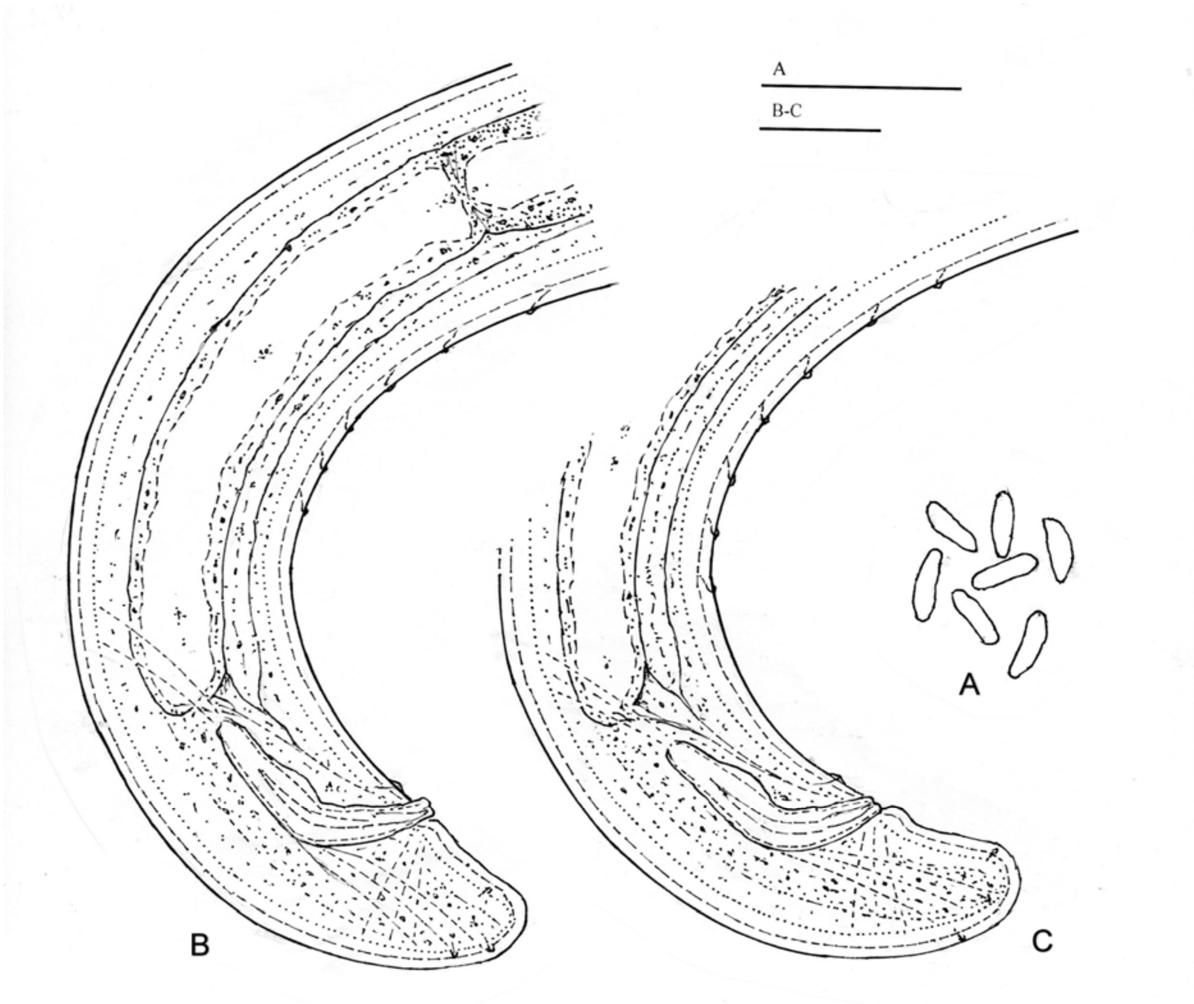

Figure 2. *Egtitus costaricae* sp. nov. A: spermatozoa; B–C: posterior end of males. (Scale bars = 20 µm)

General characters. Body C-shaped after fixation, slender, 41–48 µm wide at middle. Cuticle smooth under light microscope, only 1.5–2.0 µm thick on most body, but very thick, 5–8 µm on pre-cloacal (supplemental) region. Lip region expanded, wider than adjacent body, offset by a depression, 23–24 µm wide and 9–10 µm high. Lips rounded, completely amalgamated. Body at posterior end of pharynx 2.0–2.2 times as wide as lip region. Amphids caliciform with aperture about half the corresponding body width.

Labial and dental chambers well separated, the former 14–15 µm, the latter 7–9 µm broad; labial disc 7–8 µm wide. Vestibular ring corrugated.

Pharyngeal denticles absent. Onchia simple, uni-tipped. Guiding ring double but thin, 8 µm wide, located at 17–18 µm from oral field. Odontostyle 24–25 µm long and 3 µm thick, hardly longer than labial diameter, thicker than cuticle at the same level. Aperture nearly half a stylet length. Odontophore 32–36 µm long. Pharynx 564–630 µm long, at 43–44 % expanded, heavily muscular in posterior part. Pharyngeal gland nuclei difficult to discern. D = 45–47 % or at 11–12 % of total body length. AS nuclei inconspicuous, PS = 75–78 %. Glandularium 292–324 µm long. Posterior end of pharynx with a shallow disc. Cardia tongue-shaped.

Male. Testes two, straight, well-developed, 6.8–7.2 body widths long, or occupying 11–12 % of total body length. Spermatozoa ovoid to fusiform, 7–8 µm long, about as long as one-sixth body diameter. Spicula dorylaimoid, 52–55 µm long, distinctly longer than tail. Ventromedial supplements very small but with distinct innervations, spaced, in one male 9, in two males 11 in number; posteriormost at a distance of 50–55 µm from cloaca. Their series amounts to 75–90 µm. Prerectum long, beginning well before the row of the supplements. Tail conoid-rounded, 22–28 µm long, occupying 0.9–1.1 % of entire length of body.

Remarks. The medium-long and very slender body, expanded lip region, odontostyle with long aperture, pharynx enlarging before its middle, long prerectum, the number of supplements and the very thick cuticle on the supplemental region characterise this species.

In length of the body, width of the lip region, length of the odontostyle and number of the ventral supplements, this species fairly resembles *Egtitus itanagrus* Khan, Ahmad & Jairajpuri, 1994, but the latter is an Asian species recorded from India, Seychelles and China. If comparing the present males with the American *Egtitus* species, *viz. E. bryophilus* Thorne, 1967 (Puerto Rico, Peru), *E. chilenus* Andrássy, 2012 (Chile), *E. costaricae* sp. nov. (Costa Rica), *E. elaboratus* (Cobb, 1906) Thorne, 1967 (Hawaii) and *E. surinamensis* (Micoletzky, 1925) Thorne, 1967 (Surinam, Guayana), they differ from them by having a slenderer body, broader lip region (23–24 *vs* 15–17, 18–19 and 21–23 µm, respectively; not known in *E. surinamensis*), longer odontostyle (24–25 *vs* 17–19, 20–23, 21–24 µm, respectively; unknown in *E. surinamensis*), and a long prerectum. Not having female specimens, we decline at this time to provide this nematode with a species name.

Habitat and locality. Soil from a secondary forest, between 400 and 500 m above sea level, Barbilla Biological Reserve, La Amistad Caribe Conservation Area, Costa Rica; collected in February 2000 by A. Esquivel, I. Popovici, H. Arias and R. Gómez. (Three males on the slides No. 563.08, 563.19 and 563.22).

Egtitus **sp. 2**

(Figures 4 A–C)

One male: L = 3.02 mm; a = 60; b = 4.6; c = 102; c' = 0.7.

General characters. Body nearly straight after fixation, 50 µm wide at middle. Cuticle smooth under light microscope, thin, 2.0 µm thick on most body and 3.0 µm thick in supplement region. Lip region expanded, well offset by a deep constriction, 24 µm wide and 9 µm high, wider than adjacent body. Lips rounded, amalgamated. Body at posterior end of pharynx 2.4 times as wide as lip region. Amphids caliciform with aperture more than half the corresponding body width.

Labial and dental chambers well separated, the former 15 µm, the latter 9 µm wide; labial disc 7 µm wide. Vestibular ring corrugated. Pharyngeal denticles absent. Onchia simple, uni-tipped. Guiding ring double but thin, 9 µm wide, at 18 µm from labial field. Odontostyle 26 µm long and 3 µm thick, slightly longer than labial diameter, thicker than cuticle at the same level. Aperture two-fifths of stylet length. Odontophore 35 µm long. Pharynx 656 µm long, at 44 % expanded. Medial, conoid part of pharynx 95 µm long, occupying 14 % of pharyngeal length. Medial section 65 µm long, 10 % of neck length. Because of the heavy muscular structure, the pharyngeal gland nuclei are rather inconspicuous with exception of D nucleus which lies at 53 % of pharynx or 12 % of total body length. AS nuclei invisible, PS = 73–75 %. Glandularium 336 µm long. Posterior end of pharynx with a shallow disc. Cardia conical.

Male. Testes two, straight, well developed, the anterior 10 body widths long or occupying 18 % of total body length, the posterior 8.6 body widths long or occupying 15 % of total body length. Their germinative sections unusually long, each

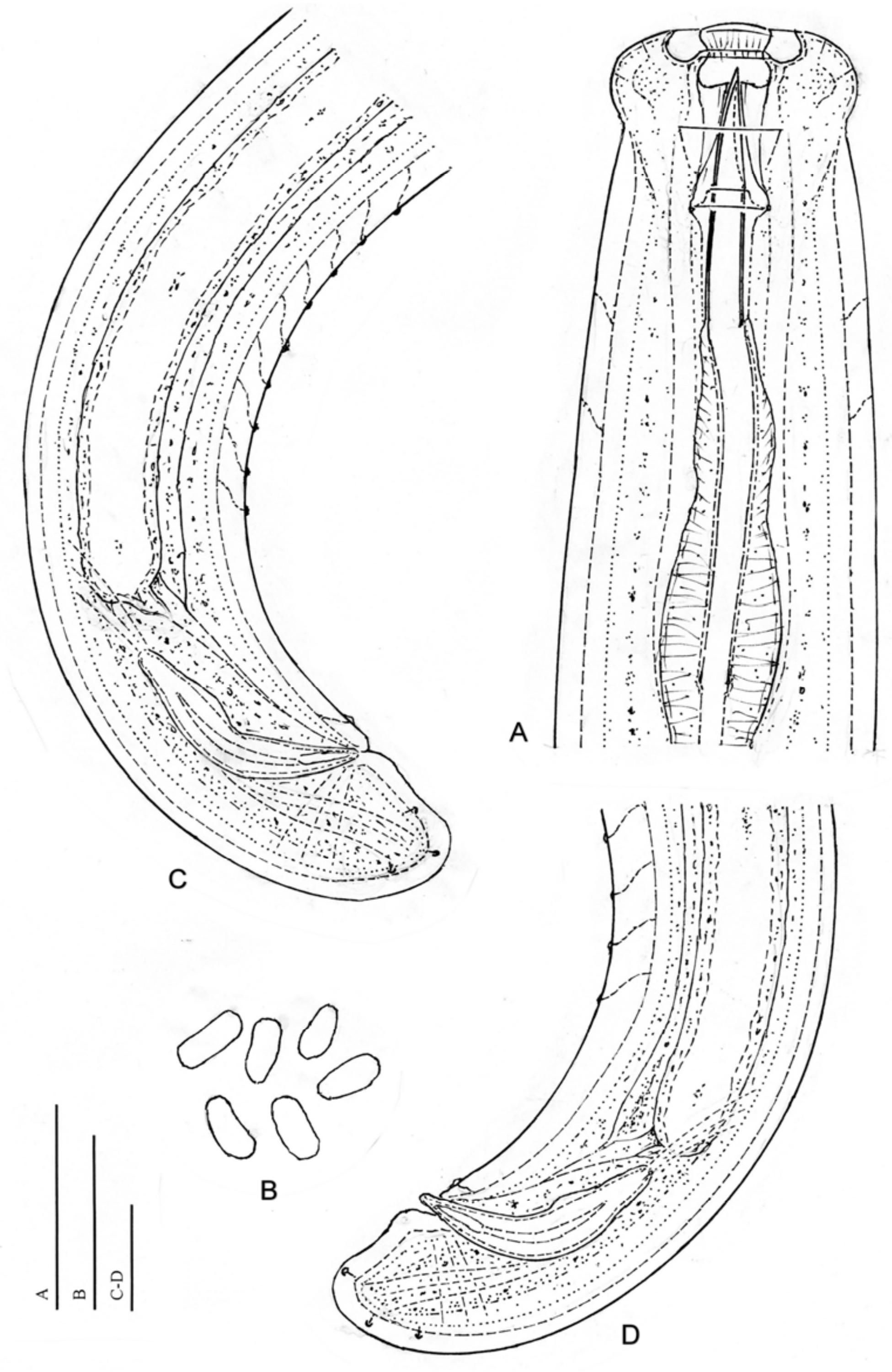

Figure 3. *Egtitus* sp. 1. A: anterior end; B: spermatozoa; C–D: posterior end of males. (Scale bars = 20 µm)

occupying 25–30 % of the testis length. Spermatozoa very numerous, ovoid, 8–10 µm long, about as long as one-fifth corresponding body diameter. Spicula dorylaimoid, 55 µm long, distinctly longer than tail. Ventromedial supplements nine, very small, spaced, 10–15 µm apart; posteriormost of them at a distance of 60 µm from cloaca. Series of supplements 105 µm long. Prerectum beginning at level of the first supplement. Tail broadly rounded, hemispheroid, 22 µm long, occupying merely 0.7 % of entire length of body.

Remarks. The long body (3 mm), broad and strongly offset lip region, medium long odontostyle, unusually long germinative section of testes, and presence of nine small supplements characterise this species. We may suppose that the female belonging to this male is longer, over 3 mm, what means, this species would be the longest representative of the genus *Egtitus*. There is a single species, *E. nudus* (Wu & Hoeppli, 1929) Thorne, 1967 which was described with body length of 2.0–3.0 mm (female) and 2.6 mm (male). Its description is however very meagre, even the number of the male supplements was not determined.

The present male probably represents a hitherto undescribed species, but on the basis of a single specimen we decline to name it.

Habitat and locality. Soil around trees on Path Palmito, 1200 to 1300 m above sea level, in a primary cloudy forest, Tapanti National Park, La Amisto Pacifico Conservation Area, Costa Rica; collected in July, 1998 by A. Esquivel, A. Zullini and R. Gómez. (One male on the slide No. 338.24).

Trachypleurosum venezolanum Coomans, Vinciguerra & Loof, 1990

(Figures 5 A–D and 6 A–C)

Females (n = 5): L = 1.88–2.05 mm; a = 36–43; b = 4.0–4.2; c = 15.0–18.4; c’ = 4.3–5.6; V = 52–54 %.

Males (n = 3): L = 1.80–1.99 mm; a = 44–49; b = 3.7–4.1; c = 16.4–20.1; c’ = 3.3–4.8.

General characters. Body of female nearly straight, that of male arcuate at posterior end, 48–56 µm (female) or 40–42 µm (male) µm wide at middle. Cuticle smooth, 2.5–3.0 µm thick on most body regions. Lip region offset by expansion, 24–28 µm wide and 9–10 µm high, lips rounded and amalgamated. Body at proximal end of pharynx 1.5–2.0 times as wide as head. Amphids caliciform with aperture one-half of corresponding body width.

Labial and dental chamber separated, the former 14–18, the latter 9–11 µm broad. Vestibular ring corrugated. No pharyngeal denticles. Onchia uni-tipped. Odontostyle slender, 25–28 µm long and 2.0–2.5 µm tick, about as long as labial diameter, as thick as or thicker than cuticle at same level. Aperture about two-fifths of stylet length. Odontophore 35–40 µm long. Guiding ring double but thin, 8 µm wide, located at 18–20 µm from oral field. Pharynx 450–492 µm long, at 48–51 % expanded; medium section 70–75 µm long, 14–16 % of pharyngeal length. Dorsal nucleus at 51–54 % of pharyngeal length or 12–14 % of total body length. Other pharyngeal nuclei rather inconspicuous, PS1-2 = 72–75 %. Glandularium 175–225 µm long. Cardia conical.

Female. Genital organ paired with equally long branches. Vulva pore-like, vagina 14–18 µm long, occupying one-third or less of corresponding body width. Uterine eggs not observed. Distance between posterior end of pharynx and vulva a little longer (1.1–1.2 times) than pharynx itself. Rectum as long as 1.2, prerectum as 2.0–2.8 anal body diameters. Vulva–anus distance equal to 6.1–7.6 tail lengths. Tail 110–133 µm long, 5.4–6.6 % of entire length of body, elongate-conical with sharp tip.

Male. Testes straight, opposed, each 4.0–5.9 body widths long or occupying 10–13 % of body length. Spermatozoa fusiform, slender, 8–10 µm long, as long as one-quarter or one-fifth body diameter. Spicula dorylaimoid, 45–50 µm long.

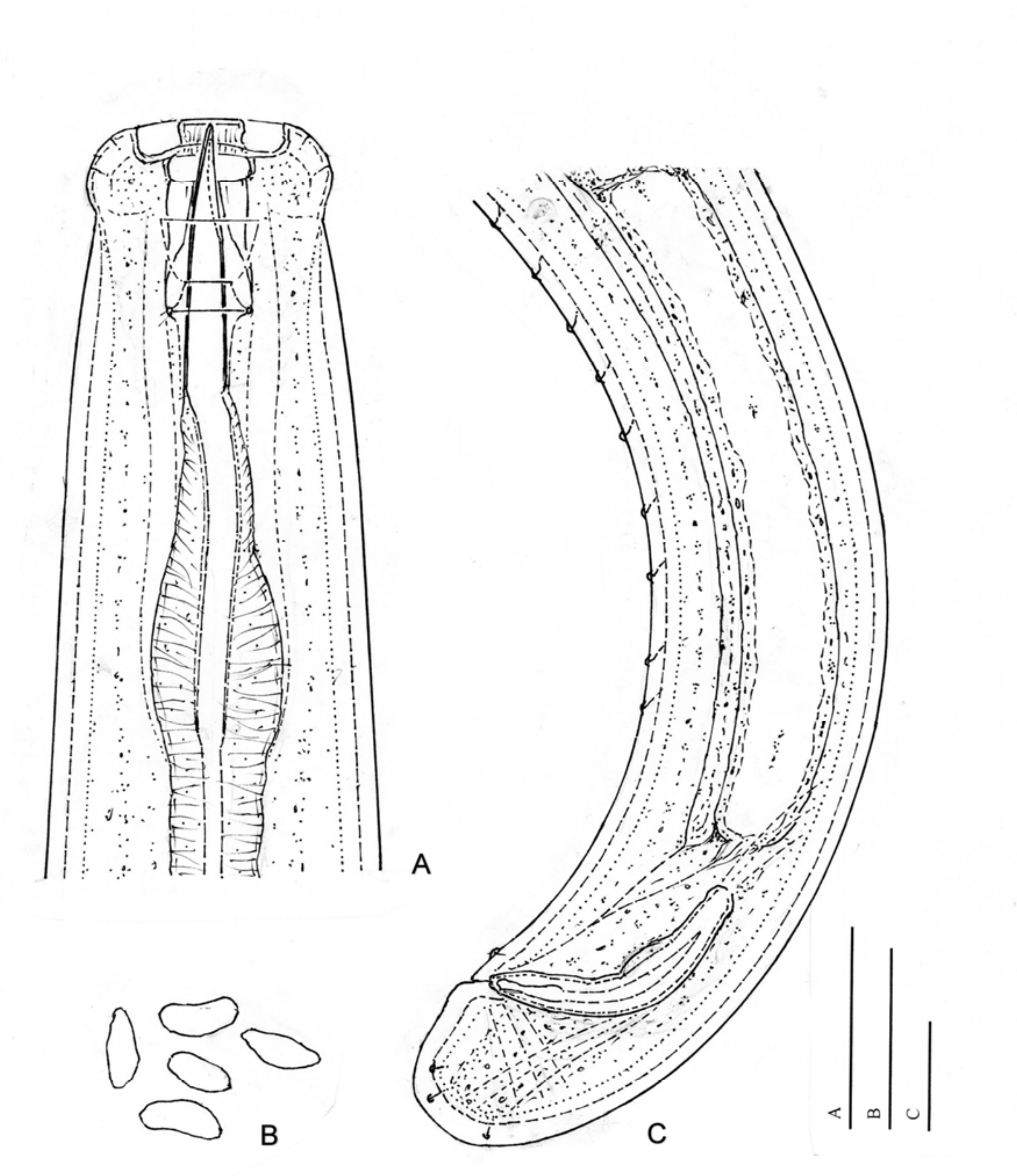

Figure 4. *Egtitus* sp. 2. A: anterior end; B: spermatozoa; C: posterior end of male. (Scale bars = 20 μm)

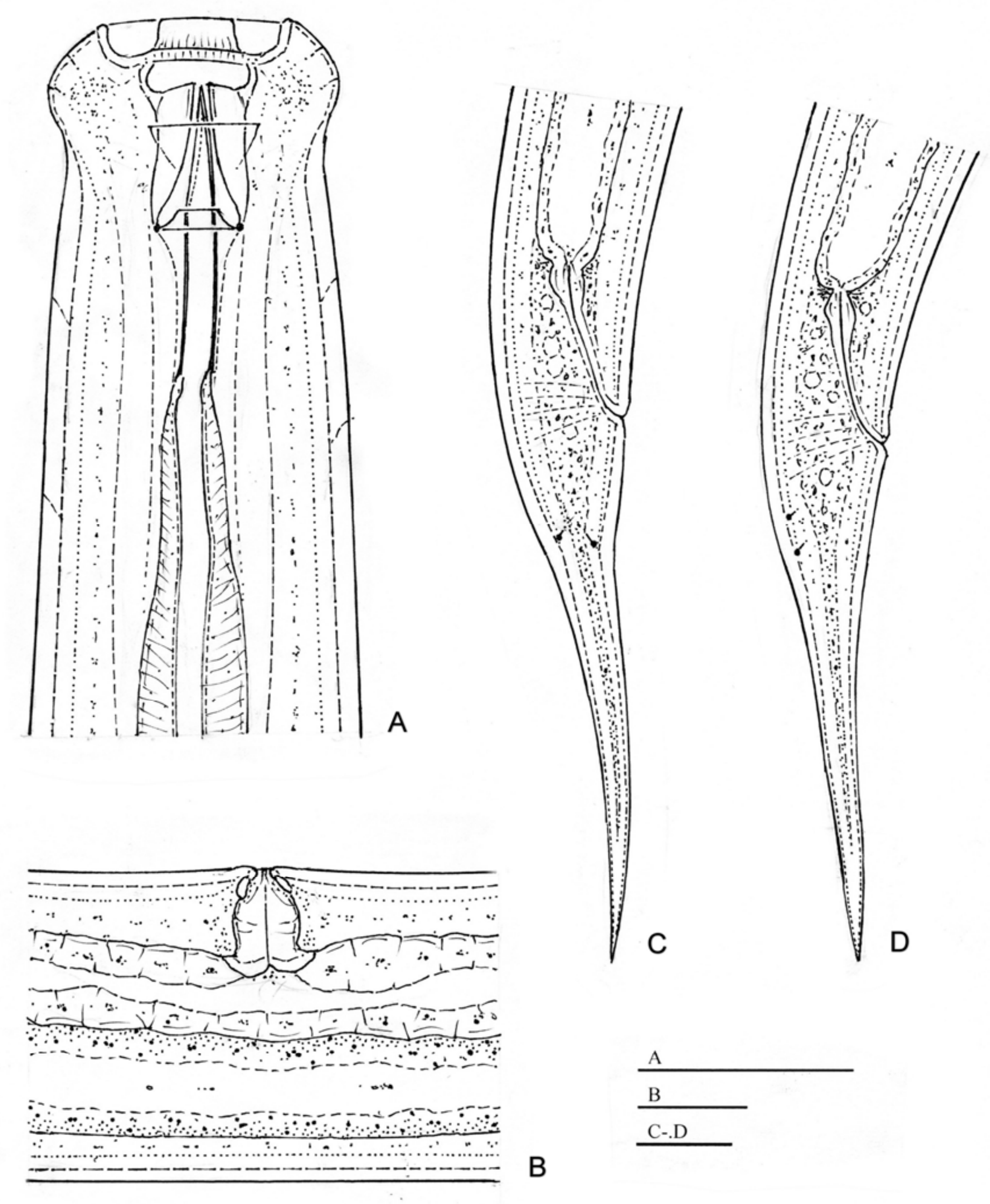

Figure 5. *Trachypleurosum venezolanum* Coomans, Vinciguerra & Loof, 1990. A: anterior end; B: vulval region; C–D: tail of females. (Scale bars = 20 µm)

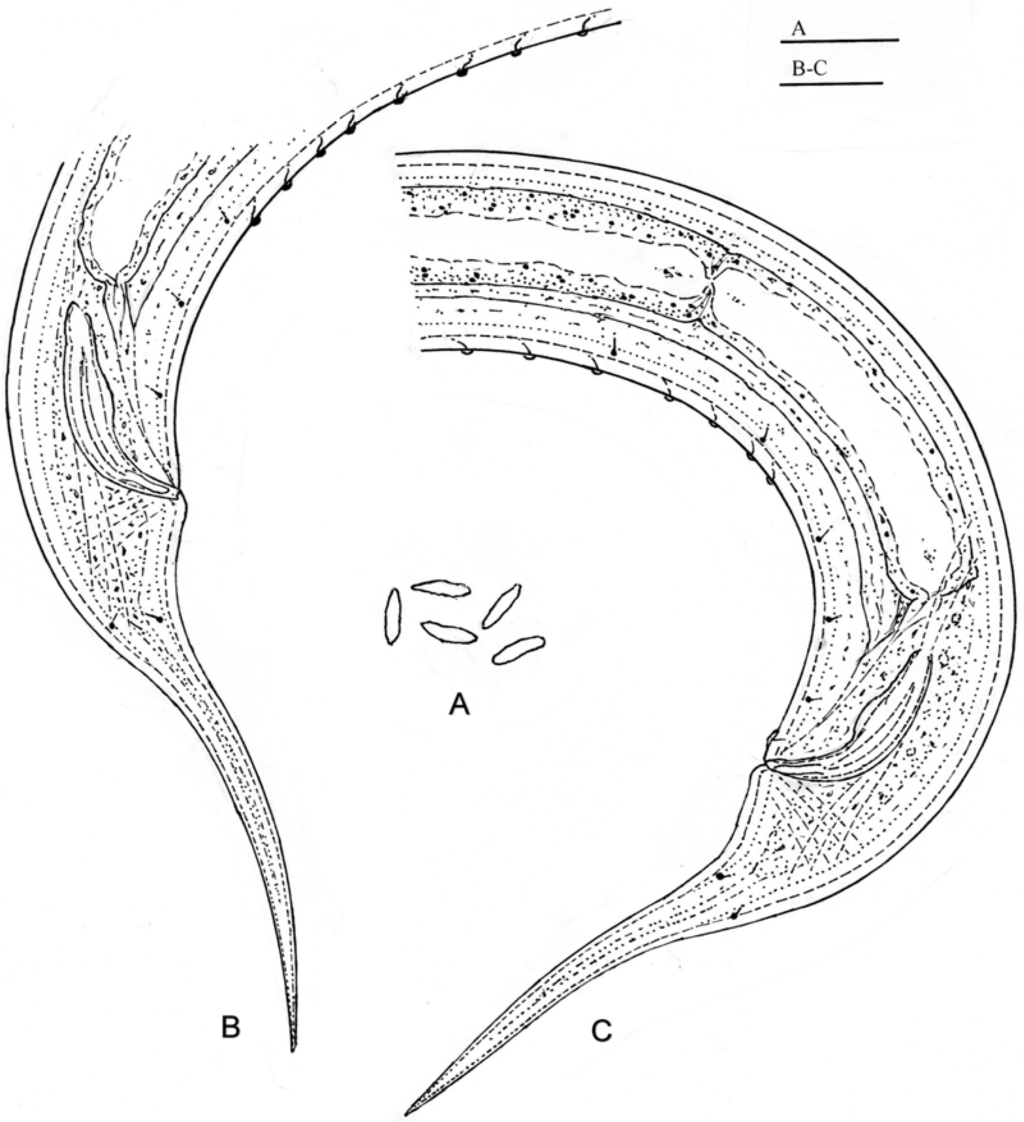

Figure 6. *Trachypleurosum venezolanum* Coomans, Vinciguerra & Loof, 1990. A: spermatozoa; B–C: posterior end of males. (Scale bars = 20 µm)

Ventromedian supplements 7–8, small, rather evenly spaced, their series extending 85–114 µm. Posteriormost supplement at a distance of 55 to 70 µm from cloaca. Prerectum beginning in range of supplements, at level of the 4^{th} or 5^{th} supplement. Tail 96–110 µm long, similar to that of female, occupying 4.8–6.2 % of total length of body.

Remarks. The genus *Trachypleurosum* Andrássy, 1959 contains five species: *T. conforme* (Schneider, 1935) Andrássy, 1959, *T. venezolanum* Coomans, Vinciguerra & Loof, 1990, *T. indicum* Khan, Ahmad & Rahaman, 1991, *T. karnatakum* Khan & Jairajpuri, 1994 and *T. balforum* Bloemers, Ahmad, Wanless & Hodda, 1995 (see also Table 1). Two of them *(T. indicum* and *T. karnatakum)* were reported from Asia (India), other two *(conforme* and *balforum)* from Africa (Ivory Coast and Cameroon, resp.) and one *(venezolanum)* is known from Central- and South America (Costa Rica and Venezuela). The present species, *T. venezolanum* differs from *T. karnatakum* and *T. balforum* by the larger body (1.7–2.3 *vs* 1.2–1.5 mm), from *T. indicum* by the longer odontostyle (25–31 *vs* 18–21 µm), and from *T. conforme* by the lower number of supplements (7–10 *vs* 15).

In morphological and morphometric structures, the present specimens well correspond to the type ones described by Coomans, Vinciguerra and Loof (1990) from Venezuela. Only the two males from Cocos Island have a thinner cuticle (1.4–1.7 *vs* 2.5–3.0 µm) and a narrower lip region (21–22 *vs* 24–28 µm), but in other respects they also agree with the typical specimens.

Habitat and locality: (1) Mosses from tree trunks, 100 to 200 m above sea level, primary forest, Agujas Biological Station, Path Real, Osa Conservation Area, Costa Rica (five females, one male and two juveniles, on slides No. 225.01–03); collected in November 1997 by A. Esquivel and T. Bongers. (2) Mosses from trunks, between 10 and 100 m above sea level, Cocos Island (Isla del Coco, an uninhabited island in the Pacific Ocean approximately 550 km from the shore of Costa Rica) (two males, on the slide No. 576.02); collected in 2000 by A. Alvarado.

Trachypleurosum sp.

(Figures 7 A–C)

One male: L = 1.85 mm; a = 38; b = 4.3; c = 20.8; c' = 3.3.

General characters. Body C-shaped after fixation, 48 µm wide at middle. Cuticle smooth, 2.0–2.5 µm thick on most regions, but 5 µm thick at level of the supplements. Lip region 15 µm wide, moderately separated by a slight constriction. Body at proximal end of pharynx three times as wide as lip region. Labial chamber 9, dental chamber 6, labial disc 5 µm broad. Odontostyle 18 µm long and 2 µm thick, thicker than cuticle at same level. Odontophore 35 µm long. Guiding ring 6 µm wide, at a distance of 13 µm from oral field. Pharynx 430 µm long, at 52 % expanded, its median section cca 60 µm long. D = 54 %, PS = 74–75 %. Glandularium 197 µm long.

Male. Diorchic, each testis 4.6 body widths long or occupying 12 % of body length. Spermatozoa fusiform, small, 4.5–5.0 µm long, only about one-tenth as long as corresponding body diameter. Spicula 45 µm long. Ventromedian supplements 10, distinct. Prerectum beginning well anterior to the row of supplements. Tail 80 µm, 4.8 % of entire length of body, slightly dorsally bent.

*Remarks***.** The single male specimen observed differs from the other Costa Rican congener, *Trachypleurosum venezolanum* Coomans, Vinciguerra & Loof, 1990 by the much narrower lip region (15 *vs* 24–28 µm), less spacious labial chamber (9 *vs* 14–18 µm broad), shorter odontostyle (18 *vs* 25–28 µm), longer prerectum of male, smaller spermatozoa (4–5 *vs* 8–10 µm) and more numerous supplements (10 *vs* 7–8).

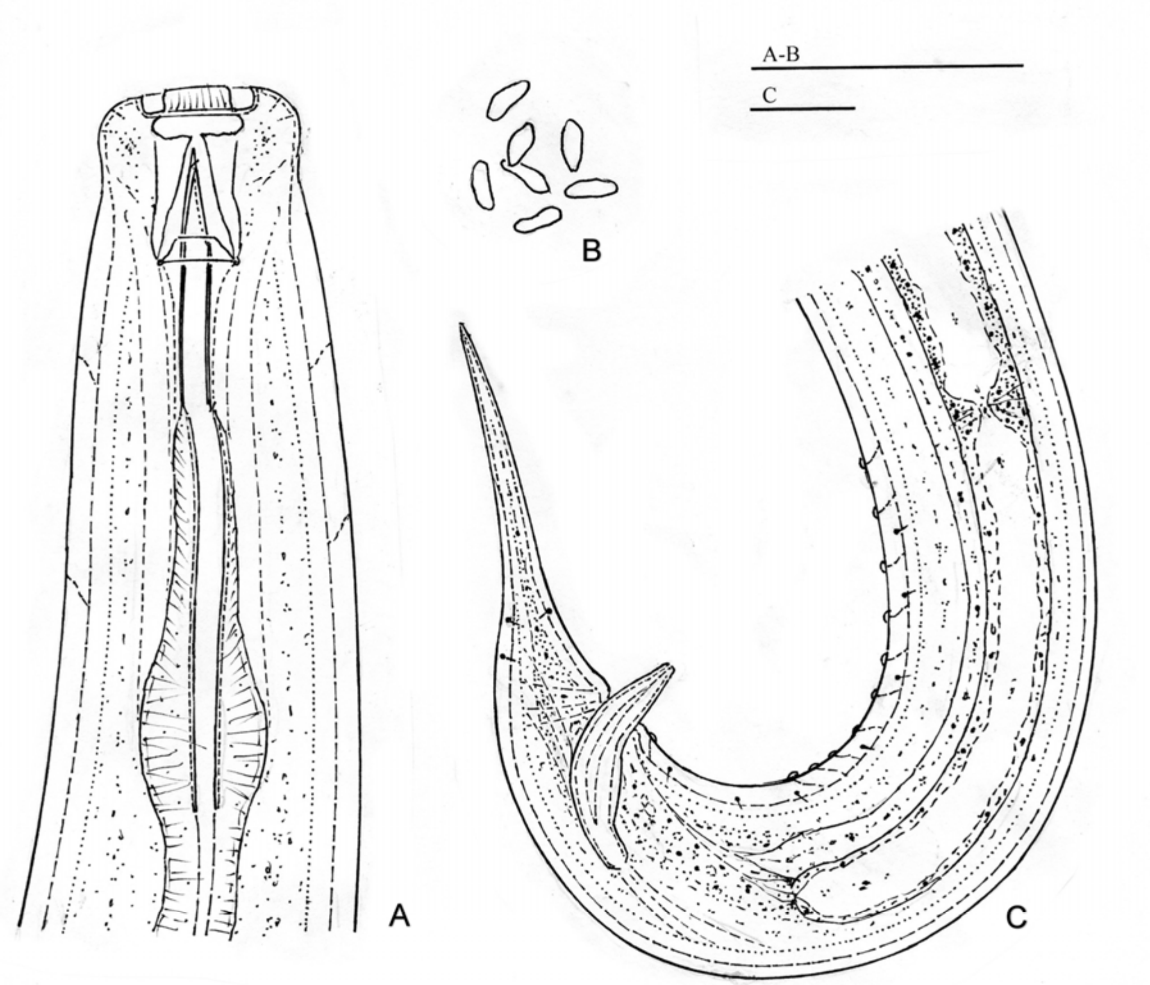

Figure 7. *Trachypleurosum* sp. A: anterior end; B: spermatozoa; C: posterior end of male. (Scale bars = 20 µm)

The present species differs also from the four other representatives of the genus in having a narrow lip region (15 *vs* 18–28 µm) and a short odontostyle (18 *vs* 20–31 µm). It is likely new to science, but a single specimen is not enough to handle it as such.

Habitat and locality. Mosses in the vicinity of a stream, primary forest, Hitoy Cerere Biological Reserve, La Amistad Caribe Conservation Area, Costa Rica; collected in August 1998 by A. Esquivel, A. Zullini and R. Gómez. (One male on the slide No. 356.07.)

Table 1. Main morphometric characters of *Trachypleurosum* species

	L	a	b	c	c'	V	Lip w.	Odont.	Tail	Spic.	Suppl.
balforum ♀ ♂	1.2–1.5 1.1–1.6	26–35 26–41	3.3–3.5 3.2–3.9	10–12 10–14	4.8–5.2 3.6–4.8	50–54	21–23	22–25	110–134 116–133	38–41	7–9 spaced
conforme	2.1 2.3	36 54	4.0 4.6	18 20	3.9 3.2	54	18	24	118 110	50	15 spaced
indicum	1.6–2.0 1.5–1.6	36–44 38–43	3.7–4.7 3.7–4.1	11–15 12–13	4.3–6.1 3.8–4.6	49–54	18–21	18–21	122–156 106–133	37–45	7–9 spaced
karnatakum	1.4 1.5–1.6	37 39–41	3.5 3.5–3.9	11 14	5.5 4.0	52	20–22	21–23	127 101–111	41–42	9 spaced
venezolanum	1.7–2.3 1.6–2.2	30–51 41–53	3.5–4.3 3.6–4.7	13–19 14–23	3.8–5.6 2.5–4.8	51–55	23–28	25–31	110–149 84–143	43–52	7–10 spaced
Range	1.2–2.3	26–51	3.3–4.7	10–19	3.8–6.1	49–55	18–28	18–31	110–156	37–52	7–15

APPENDIX
New genera and species of free-living nematodes described from Costa Rica

A) ***Genera***

Ecanema Ahmad & Shaheen, 2005 – Nordiidae
Inbionema Loof & Zullini, 2000 – Nordiidae
Parapalus Loof & Zullini, 2000 – Paraxonchiidae
Pseudaphelenchus Kanzaki, Giblin-Davis, Scheffrahn, Center & Davies, 2009 – Aphelenchoididae
Scalpelus Ahmad, 2004 – Qudsianematidae

B) ***Species***

ARAEOLAIMIDA

Leptolaimidae

Paraplectonema americanum Zullini, Loof & Bongers, 2002
Paraplectonema loofi Holovachov & Boström, 2004

Aphanolaimidae

Anonchus pulcher Zullini, Loof & Bongers, 2002

Chronogastridae

Chronogaster costaricae Zullini, Loof & Bongers, 2002

RHABDITIDA

Cephalobidae

Eucephalobus iaculocaudatus Boström & Holovachov, 2011

Osstellidae

Deficephalobus mirabilis Holovachov, Esquivel & Bongers, 2005

Bunonematidae

Rhodolaimus arboreus Holovachov, Esquivel & Bongers, 2003

APHELENCHIDA

Aphelenchoididae

Pseudaphelenchus yukiae Kanzaki, Giblin-Davis, Scheffrahn, Center & Davies, 2009

TYLENCHIDA

Telotylenchidae

Paratrophurus costaricensis López-Chaves, 1986

Pratylenchidae

Pratylenchus gutierrezi Golden, López-Chaves & Vilchez-Rojas, 1992

Hoplolaimidae

Helicotylenchus stylocercus Siddiqi & Pinochet, 1979
Rotylenchus phaliurus Siddiqi & Pinochet, 1979

Meloidogynidae

Meloidogyne arabicida López-Chaves & Salazar-Figueroa, 1989
Meloidogyne salasi López-Chaves, 1984

ENOPLIDA

Pelagonematidae

Thalassogenus brzeskii Loof & Zullini, 2000

Onchulidae

Limonchulus costaricanus Holovachov, Winiszewska, Sturhan, Esquivel & Wu, 2008

MONONCHIDA

Mononchidae

Mononchus laminatus Zullini, Loof & Bongers, 2002

Anatonchidae

Miconchus gomezi Zullini, Loof & Bongers, 2002

DORYLAIMIDA

Dorylaimidae

Calcaridorylaimus andrassyi Ahmad & Shaheen, 2004
Laimydorus esquiveli Ahmad & Shaheen, 2004
Laimydorus tropicus Ahmad & Shaheen, 2004
Prodorylaimus paraobesus Ahmad & Shaheen, 2004

Thornenematidae

Coomansinema brevicauda Ahmad & Shaheen, 2004

Actinolaimidae

Brasilaimus bidentatus Loof & Zullini, 2000
Brasilaimus vinciguerrae Loof & Zullini, 2000
Egtitus costaricae sp. nov.

Qudsianematidae

Scalpelus loofi Ahmad, 2004

Aporcelaimidae

Makatinus macrostylus Shaheen & Ahmad, 2004

Paraxonchiidae

Parapalus arboricola Loof & Zullini, 2000

Crateronematidae

Chrysonema inbionis Ahmad & Shaheen, 2005
Sicorinema esquiveli Loof & Zullini, 2000

Nordiidae

Actinolaimoides ecae Shaheen & Ahmad, 2004
Ecanema ecae Ahmad & Shaheen, 2005
Inbionema biforme Loof & Zullini, 2000
Oriverutus belloi Liébanas, Esquivel & Peña-Santiago, 2011
Oriverutus tropicus Ahmad & Shaheen, 2003

Longidoridae

Xiphinema costaricense Lamberti & Tarjan, 1974

Leptonchidae

Tyleptus bongersi Loof & Zullini, 2000
Xiphinemella monohystera Loof & Zullini, 2000

Tylencholaimidae

Pachydorylaimus holovachovi Esquivel, Guerrero, Peña-Santiago & Powers, 2007
Pachydorylaimus schizodontus Loof & Zullini, 2000

Encholaimidae

Echinodorus saccatus Shaheen & Ahmad, 2004

PUBLICATIONS CONTAINING DESCRIPTIONS OF NEW NEMATODE TAXA FROM COSTA RICA

AHMAD, W. (2004): *Scalpelus loofi* gen. n., sp. n. (Nematoda: Dorylaimida) from Costa Rica. *Journal of Nematode Morphology and Systematics,* 7: 85–90.

AHMAD, W. & SHAHEEN, A. (2003): Two new species of the genus *Oriverutus* Siddiqi, 1971 (Nematoda: Dorylaimida) from Central America. *Journal of Nematode Morphology and Systematics,* 5: 183–190.

AHMAD, W. & SHAHEEN, A. (2004): Five new and two known species of the family Dorylaimidae (Nematoda: Dorylaimida) from Costa Rica. *Nematology,* 6: 567–584.

AHMAD, W. & SHAHEEN, A. (2005): A new and a known species of the genus *Chrysonema* Thorne, 1929 (Nematoda: Dorylaimida) from Costa Rica. *Nematologia Mediterranea,* 33: 55–60.

AHMAD, W. & SHAHEEN, A. (2005): *Ecanema ecae* gen. n., sp. n. (Nematoda: Dorylaimida) from Costa Rica. *Nematology,* 7: 381–385.

BOSTRÖM, S. & HOLOVACHOV, O. (2011): Two new species of *Eucephalobus* Steiner, 1936 and one new species of *Pseudacrobeles* Steiner, 1938 (Rhabditida: Cephalobidae) with mucronate tail. *Journal of Nematode Morphology and Systematics,* 14: 91–104.

ESQUIVEL, A., GUERRERO, P., PEÑA-SANTIAGO, R. & POWERS, T. (2007): Freeliving dorylaimid nematodes from natural reserves in Costa Rica. The genus *Pachydorylaimus* Siddiqi, 1983. *Nematropica,* 37: 317–333.

GOLDEN, A.M., LÓPEZ-CHAVES, R. & VÍLCHEZ-ROJAS, H. (1992): Description of *Pratylenchus gutierrezi* n. sp. (Nematoda: Pratylenchidae) from coffee in Costa Rica. *Journal of Nematology,* 24: 298–304.

HOLOVACHOV, O. & BOSTRÖM, S. (2004): Morphology and systematics of the superfamilies Leptolaimoidea Örley, 1880 and Camacolaimoidea Micoletzky, 1924 (Nematoda: Plectida). *Journal of Nematode Morphology and Systematics,* 7: 1–49.

HOLOVACHOV, O., ESQUIVEL, A. & BONGERS, T. (2003): Free-living nematodes from nature reserves in Costa Rica. 5. Bunonematoidea (Rhabditida). *Nematology,* 5: 665–676.

HOLOVACHOV, O., ESQUIVEL, A. & BONGERS, T. (2005): The genus *Deficephalobus* De Ley & Coomans, 1990 (Cephalobina: Osstellidae) from nature reserves in Costa Rica. *Nematology,* 7: 469–477.

HOLOVACHOV, O., WINISZEWSKA, G., STURHAN, D., ESQUIVEL, A. & WU, J (2008): New genus, three new and two known species of the family Onchulidae Andrássy, 1964 with notes on systematics and biology of the family. *Journal of Nematode Morphology and Systematics,* 11: 1–30.

KANZAKI, M., GIBLIN-DAVIS, R.M., SCHEFFRAHN, R.H., CENTER, B. & DAVIES, K.A. (2009): *Pseudaphelenchus yukiae* n. gen., n. sp. (Tylenchina: Aphelenchoididae) associated with *Cylindrotermes macrognathus* (Termitidae: Termitinae) in La Selva, Costa Rica. *Nematology,* 11: 869–881.

LAMBERTI, F & TARJAN, A.C. (1974): *Xiphinema costaricense* n. sp. (Longidoridae, Nematoda), a new species of dagger nematodes from Costa Rica. *Nematologia Mediterranea,* 1: 1–11.

LIÉBANAS, G., ESQUIVEL, A. & PEÑA-SANTIAGO, R. (2011): Free-living dorylaimid nematodes from nature reserves in Costa Rica. The genus *Oriverutus* Siddiqi, 1971. Species with specialised uterus. *Nematology,* 13: 307–318.

LOOF, P.A.A. & ZULLINI, A. (2000): A new species of the genus *Thalassogenus* Andrássy, 1973 and the systematic position of the genus (Nematoda: Oncholaimina). *Annales Zoologici (Warszawa),* 50: 263–266.

LOOF, P.A.A. & ZULLINI, A. (2000): Freeliving nematodes in nature reserves of Costa Rica. 1. Dorylaimina. *Nematology,* 4, 605–633.

LÓPEZ-CHAVES, R. (1984): *Meloidogyne salasi* sp. n. (Nematoda: Meloidogynidae), a new parasite of rice (*Oryza sativa* L.) from Costa Rica and Panama. *Turrialba,* 34: 275–286.

LÓPEZ-CHAVES, R. (1986): Nematodos asociados al arroz en Costa Rica. *Paratrophurus costaricensis* sp. n. *Nematropica,* 16: 177–184.

LÓPEZ-CHAVES, R. & SALAZAR-FIGUEROA, L. (1989): *Meloidogyne arabicida* sp. n. (Nemata: Heteroderidae) nativo de Costa Rica: un nuevo y severo patógeno del cafeto. *Turrialba,* 39: 313–323.

SHAHEEN, A. & AHMAD, W. (2004): Three new and known species of Dorylaimida (Nematoda) from Costa Rica. *International Journal of Nematology,* 14:177–185.

SIDDIQI, M.R. & PINOCHET, J. (1979): *Helicotylenchus stylocercus* n. sp. and *Rotylenchus phaliurus* n. sp. (Nematoda: Hoplolaimidae) from Costa Rica. *Journal of Nematology,* 11: 333–338.

ZULLINI, A., LOOF, P.A.A. & BONGERS, T. (2002): Free-living nematodes from nature reserves in Costa Rica. 2. Mononchina. *Nematology,* 4: 1–23.

ZULLINI, A., LOOF, P.A.A. & BONGERS, T. (2002) Free-living nematodes from nature reserves in Costa Rica. 3. Araeolaimida. *Nematology,* 4: 709–724.

GENERAL REFERENCES

ANDRÁSSY, I. (1959): Neubenennungen einiger homonymer Nematoden-Gattungen. *Nematologica,* 4: 223–226.

ANDRÁSSY, I. (2012): On the *"Paractinolaimus"* genus group (Nematoda: Actinolaimidae), with description of five new and two rare species of *Egtitus* Thorne, 1967. *Journal of Natural History,* 45: 453–494.

BLOEMERS, G.F., AHMAD, W., WANLESS, F.R. & HODDA, M.E. (1995): *Trachypleurosum balforum* sp. n. (Nematoda: Actinolaimidae) from Cameroon, with a diagnostic compendium of the genus. *Afro-Asian Journal of Nematology,* 5: 198–203.

BONGERS, T., ESQUIVEL, A. & ARIAS, H. (2003): Preliminary results of the Costa Rican nematode inventory. *Journal of Nematode Morphology and Systematics,* 6: 91–94.

COBB, N. A. (1906): Freeliving nematodes inhabiting the soil about the roots of cane, and their relation to root diseases. *Bulletin of Hawaiian Sugar Planters' Association, Division of Pathology and Physiology,* 5: 163–195.

COOMANS, A., VINCIGUERRA, M.T. & LOOF, P.A.A. (1990): Status of the genera *Paractinolaimus* Meyl, 1957, *Trachypleurosum* Andrássy, 1959 and *Trachactinolaimus* Andrássy, 1963 (Nematoda: Actinolaimidae) with description of *Trachypleurosum venezolanum* n. sp. *Revue de Nématologie,* 13: 143–154.

ESQUIVEL, A. (2003): Nematode fauna of Costa Rican protected areas. *Nematropica,* 33: 131–145.

KHAN, Z. & JAIRAJPURI, M.S. (1994): *The actinolaims, predatory soil nematodes from India.* Aligarh, pp. 137.

KHAN, Z., AHMAD, W. & RAHAMAN, P.F. (1991): A new species of the rare nematode genus *Trachypleurosum* Andrássy, 1959 (Nematoda: Actinolaimidae) from India. *Nematologica,* 37: 376–381.

KHAN, Z., AHMAD, W. & JAIRAJPURI, M.S. (1994): Three new species of actinolaim nematodes from India. *Nematologica,* 40: 494–502.

KREIS, H. A. (1936): Süsswasser-Nematoden aus der Umgebung von Madras (Indien). *Revue suisse de Zoologie,* 43: 641–645.

MICOLETZKY, H. (1925): Zur Kenntnis tropischer, freilebender Nematoden aus Surinam, Trinidad und Ostafrika. *Zoologischer Anzeiger,* 64: 1–28.

SCHNEIDER, W. (1935): Freilebende Nematoden. *In: Voyage de Ch Alluaud et P. A. Chappuis en Afrique occidentale française (Dec. 1930–April 1930). Archiv für Hydrobiologie,* 28: 1–20.

THORNE, G. (1967): *Nematodes of Puerto Rico: Actinolaimoidea new superfamily with a revision of its genera and species, with addenda to Belondiroidea (Nemata, Adenophorea, Dorylaimida).* Technical Papers of University Puerto Rico No. 43, pp. 48.

WU, H.W. & HOEPPLI, R.J.C. (1929): Free-living nematodes from Fookien and Chekiang. Teil III. *Archiv für Schiffs- und Tropenhygiene,* 3: 35–43.

YEATES, G. W. (1973): Taxonomy of some soil nematodes from the New Hebrides. *New Zealand Journal of Sciences,* 15: 673–697.

Opusc. Zool. Budapest, 2012, 43(1): 97–99

Earthworm species, a searchable database

CS. CSUZDI[1]

Abstract. The first earthworm species named was *Lumbricus terrestris* Linnaeus, 1758. Since then, there were some 6000 earthworm (Oligochaeta: Megadrili) species names described, from which *ca*. 3000–3500 are valid. In order to help the orientation in such a huge amount of data a web-based database was created. Each record contains the basic data of the species names described; i.e. family, genus, specific epithet, author, year, reference to the original description and optionally the valid combination of the species name and deposition of type specimens. The database is searchable by every field mentioned and the resulted list can be arranged alphabetically.

Keywords. Oligochaeta, Megadrili, earthworms, species database.

The first earthworm named was *Lumbricus terrestris* Linnaeus, 1758. We had to wait until 1826 when the next work describing new earthworm species has been published (Savigny 1826) and by the 1870's the number of described earthworm species names hardly reached 100.

The intensive research on earthworms begun with the work of Rosa (1882), Beddard (1883), Benham (1886) and Michaelsen (1889), and, with more or less intensity, continues today, and now the described species names slightly exceed 6000 (Fig. 1).

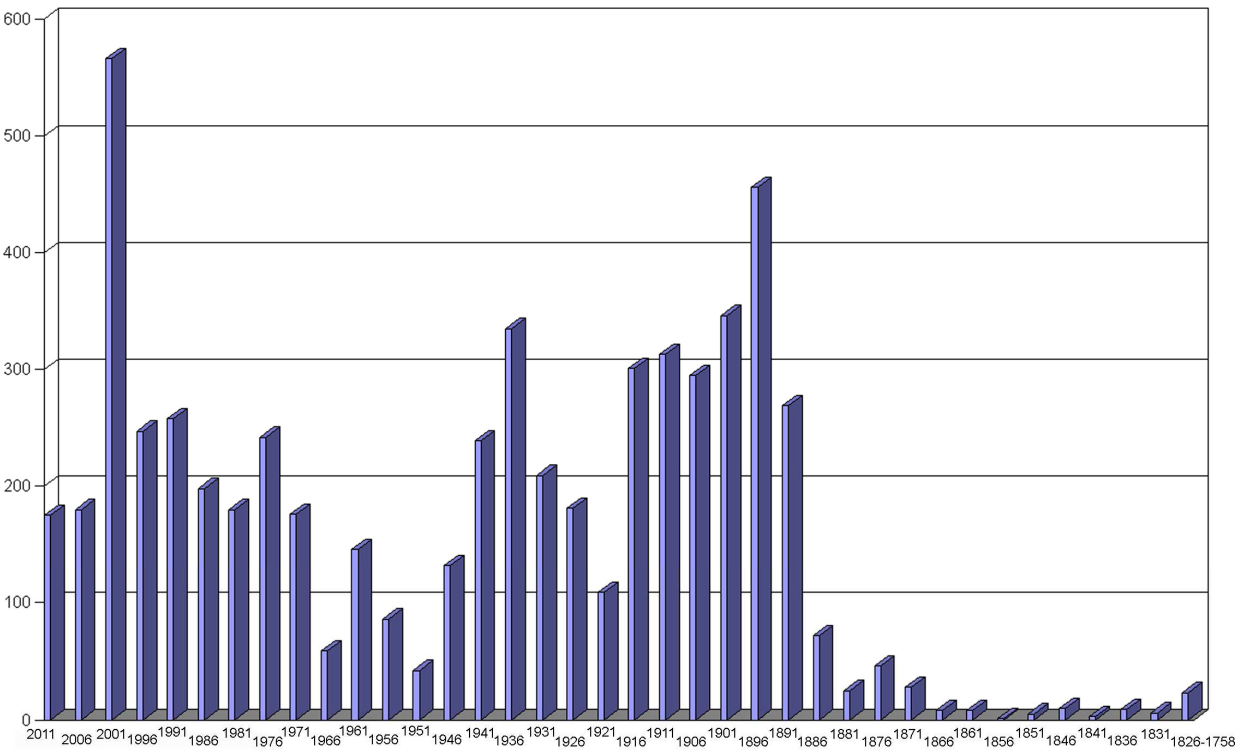

Figure 1. Number of earthworm species described in five years' periods from 1826 to the present

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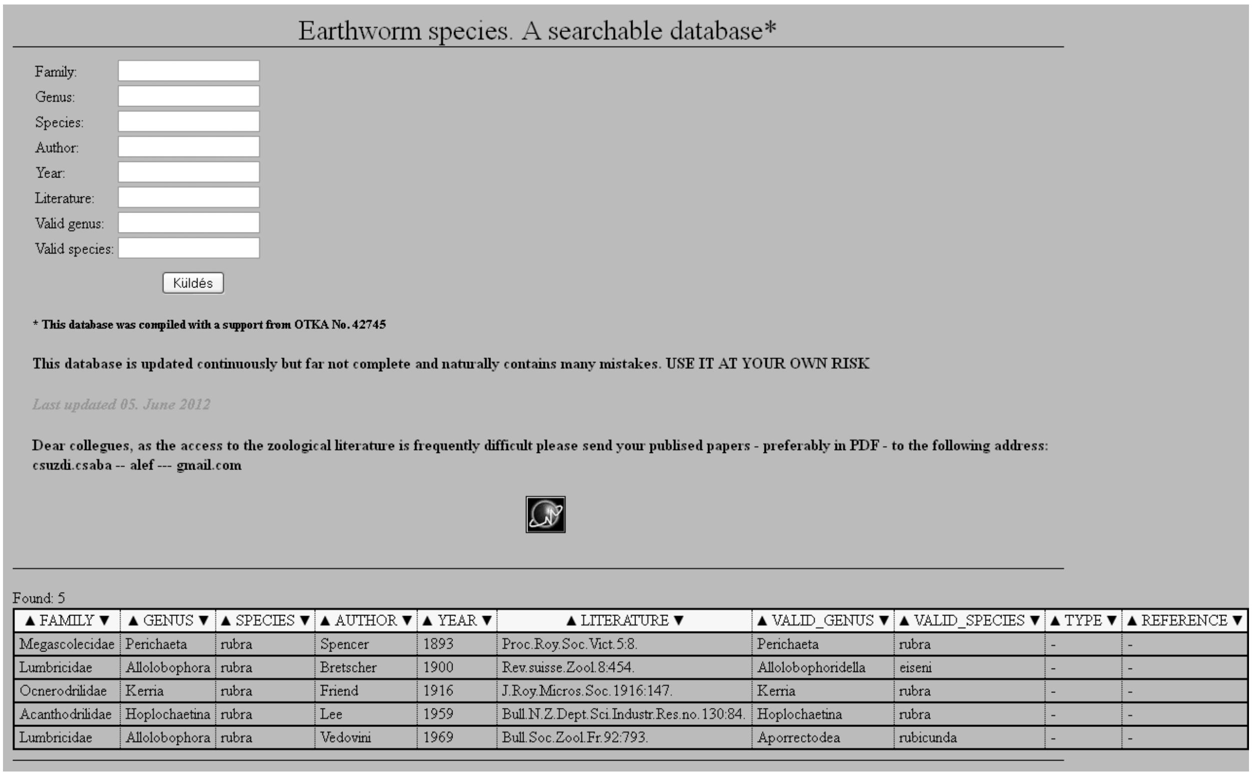
However, because of the possible large number of synonymous names the number of valid species is much lower. Zicsi (1982) analyzing the lumbricid species names described until 1971 concluded, that from the 561 names 271 were synonyms and only 290 (51.7%) valid. If we accept that the ratio of the synonymous names is more or less the same in other families as well then the valid number of earthworm species can be estimated between 3000 and 3500.

The last comprehensive book on earthworms (Michaelsen 1900) contains only *ca*. 1250 species names, therefore in order to help the orientation among the described earthworm species Reynolds and Cook (1976, 1981, 1989, 1992) published the Nomenclatura Oligochaetologica series. In the meantime, the present author, together with Prof. András Zicsi, working on a large earthworm material collected in West Africa, realized the need of an up to date list of the described species in the different earthworm families. Continuing the work done on lumbricid earthworms (Zicsi 1982) we have started to set up a cardfile system of the earthworm species names described in the other families as well.

The paper-based cardfile-system was first converted to an MS FoxPro database and used on personal computers, and later on it was made online and available to the public on the web site http://earthworm.uw.hu (Fig. 2).


Earthworm species. A searchable database*

Family:
Genus:
Species:
Author:
Year:
Literature:
Valid genus:
Valid species:
Küldés

* This database was compiled with a support from OTKA No. 42745

This database is updated continuously but far not complete and naturally contains many mistakes. USE IT AT YOUR OWN RISK

Last updated 05. June 2012

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Found: 5

▲ FAMILY ▼	▲ GENUS ▼	▲ SPECIES ▼	▲ AUTHOR ▼	▲ YEAR ▼	▲ LITERATURE ▼	▲ VALID_GENUS ▼	▲ VALID_SPECIES ▼	▲ TYPE ▼	▲ REFERENCE ▼
Megascolecidae	Perichaeta	rubra	Spencer	1893	Proc.Roy.Soc.Vict.5:8.	Perichaeta	rubra	-	-
Lumbricidae	Allolobophora	rubra	Bretscher	1900	Rev.suisse.Zool.8:454.	Allolobophoridella	eiseni	-	-
Ocnerodrilidae	Kerria	rubra	Friend	1916	J.Roy.Micros.Soc.1916:147.	Kerria	rubra	-	-
Acanthodrilidae	Hoplochaetina	rubra	Lee	1959	Bull.N.Z.Dept.Sci.Industr.Res.no.130:84.	Hoplochaetina	rubra	-	-
Lumbricidae	Allolobophora	rubra	Vedovini	1969	Bull.Soc.Zool.Fr.92:793.	Aporrectodea	rubicunda	-	-

Figure 2. Screen-shot of the database's home-page

The database presently consists of 6021 name records and is not considered complete. It might contain several duplicated records and misspellings. The valid name field is the most incomplete and it gives only an orientation on the present combination of the names. It is more reliable in case of Lumbricidae and Acanthodrilidae (Benhamiinae) and absolutely not in other families.

The database can be searched by every field i.e. family, genus, specific epithet, author, year, reference to the original description and optionally the valid combination of the species name and deposition of type specimens. By simple keywords the records beginning with the given keyword can be selected. If one wants to find all records containing the key-word a percent sign (%) should be used before and after the key-word. For example searching the term %*Csuzdi*% in the author field will select all the species names described by Csuzdi, Zicsi and Csuzdi or Csuzdi and Pavlíček etc. Similarly searching %*rubra*% in the species field will results in listing *Perichaeta rubra* Spencer, 1893; *Allolobophora rubra* Bretscher, 1900; *Kerria rubra* Friend, 1916; *Hoplochaetina rubra* Lee, 1959 and *Allolobophora rubra* Vedovini, 1969.

The database is updated continuously and the valid name field is also maintained. However, the lack of up-to date revisions of such huge families like Megascolecidae or Lumbricidae makes this task very difficult. E. g. Qiu & Bouché (1998) listed 63 lumbricid genera and subgenera many of them were of doubted validity (Csuzdi & Zicsi 2003) and surely poly- or paraphyletic (Briones *et al.* 2009). Therefore in most cases the valid names presented represent the present author's view of earthworm taxonomy, however, all comments from the oligochaetologist community are most welcome.

REFERENCES

BEDDARD, F. E. (1883): Note on some earthworms from India. *Annals and Magazine of Natural History*, (5)12: 213–224.

BENHAM, W. B. (1886): Studies on earthworms. *Quarterly Journal of Microscopical Science* 26: 213–302.

BRIONES, M. J. I., MORÁN, P. & POSADA, D. (2009): Are the sexual, somatic and genetic characters enough to solve nomenclatural problems in lumbricid taxonomy? *Soil Biology & Biochemistry*, 41: 2257–2271.

CSUZDI, CS. & ZICSI, A. (2003): *Earthworms of Hungary* (Annelida: Oligochaeta, Lumbricidae). Hungarian Natural History Museum, Budapest, pp. 271.

MICHAELSEN, W. (1889): Oligochaeten des Naturhistorischen Museums in Hamburg I. *Mitteilungen aus dem Naturhistorischen Museum in Hamburg*, 6(2): 1–17.

MICHAELSEN, W. (1900a): *Oligochaeta.* In: Das Tierreich X. Friedländer & Sohn, Berlin, pp. 575.

QIU, J-P. & BOUCHE, M. B. (1998): Liste classée des taxons valides de Lombriciens (Oligochaeta: Lumbricoidea) après l'etude des trios cinquième d'entre-eux. *Documents pedozoologiques & integrologiques*, 4: 181–200.

REYNOLDS, J. W. & COOK, D. G. (1976): *Nomenclatura oligochaetologica. A catalogue of names, descriptions and type specimens of the Oligochaeta*. University of New Brunswick, Fredericton, New Brunswick, pp. 217.

REYNOLDS, J. W. & COOK, D. G. (1981): *Nomenclatura oligochaetologica. Supplementum primum. A catalogue of names, descriptions and type specimens of the Oligochaeta*. University of New Brunswick, Fredericton, New Brunswick, pp. 39.

REYNOLDS, J. W. & COOK, D. G. (1989): *Nomenclatura oligochaetologica. Supplementum secundum. A catalogue of names, descriptions and type specimens of the Oligochaeta*. New Brunswick Museum Monographic Series (Natural Science) No. 8. pp. 37.

REYNOLDS, J. W. & COOK, D. G. (1993): *Nomenclatura oligochaetologica. Supplementum tertium. A catalogue of names, descriptions and type specimens of the Oligochaeta*. New Brunswick Museum Monographic Series (Natural Science) No. 9. pp. 33.

ROSA, D. (1882): Descrizione de due nuovi Lumbrici. *Atti della Reale Accademia delle Scienze di Torino*, 18: 169–173.

SAVIGNY, J.C. (1826): In G. Cuvier: Analyse des Travaux de l'Academie royale des Sciences, pendant l'année 1821, partie physique. *Mémoires de l'Académie des Sciences de l'Institut de France Paris,* 5: 176–184.

ZICSI, A. (1982): Verzeichnis der bis 1971 beschriebenen und revidierten Taxa der Familie Lumbricidae (Oligochaeta). *Acta zoologica hungarica*, 28: 421–454.

A new species of *Aleurodamaeus* from Ethiopia, with remarks on the taxonomic status of *Aleurodamaeus (Trichodamaeus)* Mahunka, 1984 (Acari: Oribatida: Aleurodamaeidae)

S. G. ERMILOV[1] AND L. B. RYBALOV[2]

Abstract. A new oribatid mite species, *Aleurodamaeus recenfesevpi* sp. nov., is described from moss and litter of the Ethiopian Cholomu forest. This species is similar to *A. australis* Woas, 1992 from South Africa in having long notogastral setae and the absence of scalps. However, it can be clearly distinguished from the latter by body size, specific cerotegumental ornamentation on the notogaster and epimeral setal formula. The subgenus *Aleurodamaeus (Trichodamaeus)* Mahunka, 1984 is recognized as a junior synonym of the genus *Aleurodamaeus*.

Keywords. Oribatid mites, new species, *Aleurodamaeus*, taxonomic status, *Aleurodamaeus (Trichodamaeus)*, synonym.

INTRODUCTION

The small oribatid mite genus *Aleurodamaeus* Grandjean, 1954 (Oribatida, Aleurodamaeidae) comprises five species: *A. africanus* Mahunka, 1984 from Tanzania, *A. australis* Woas, 1992 from South Africa, *A. cephalotes* (Berlese, 1916) from eastern Africa, *A. hungaricus* Paschoal & Johnston, 1985 from Hungary and *A. setosus* (Berlese, 1883) from the southern Palearctic region.

At present, the oribatid mite fauna of Ethiopia is poorly known, and only one species of *Aleurodamaeus* namely *A. africanus*, has been recorded in this country (Ermilov *et al.,* 2012).

In the course of taxonomic studies of the Ethiopian oribatid mites, collected in 2011 by the second author, we found a new representative of the genus *Aleurodamaeus* which is described below as *Aleurodamaeus recenfesevpi* sp. nov.

MATERIAL AND METHODS

The collection locality and habitat of the new species are given in the "*Material examined*" section. Specimens were studied in lactic acid, mounted on temporary cavity slides for the duration of the study, then stored in vials in 70% alcohol. All body measurements are presented in micrometers (μm). Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate to avoid discrepancies caused by different degrees of notogastral distension. Notogastral width refers to the maximum width in dorsal aspect.

General terminology used in this paper follows that of Norton & Behan-Pelletier (2009). Formulae for leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulae for leg solenidia are given in square brackets according to the sequence genu–tibia–tarsus.

TAXONOMY

Aleurodamaeus recenfesevpi sp. nov.

(Figsures 1–14)

Diagnosis. Body size 547–664 × 348–381. Scalps absent. Notogastral cerotegument represented by five longitudinal ridge-like structures.

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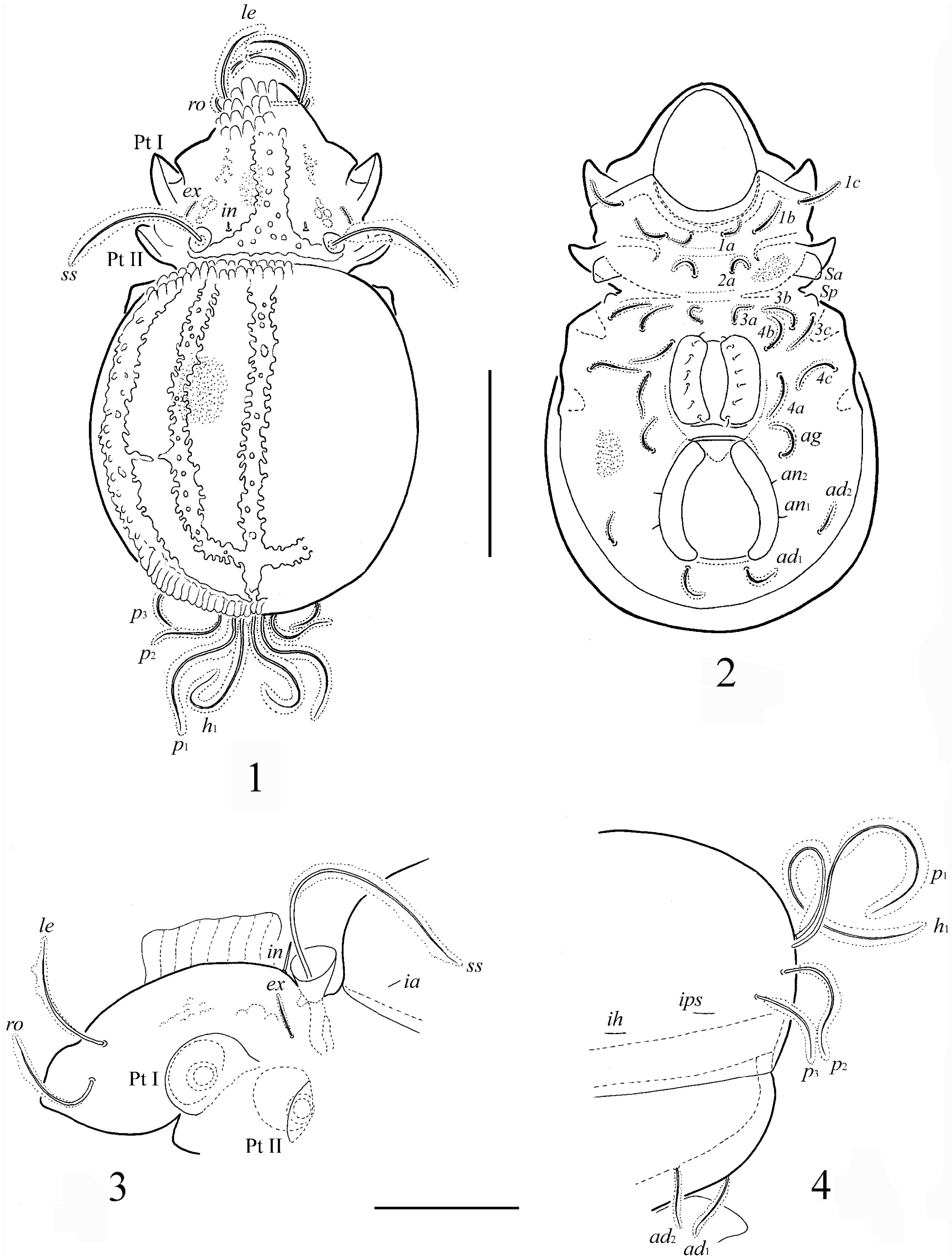


Figures 1–4. *Aleurodamaeus recenfesevpi* sp. nov. 1 = Dorsal view of body, 2 = ventral view of body, legs not shown, 3 = lateral view of prodorsum, legs not shown, 4 = lateral view of posterior part of notogaster. Scale bars (1, 2) 200 µm, (3, 4) 100 µm

Rostral and lamellar setae setiform, smooth; interlamellar setae minute, thick. Four pairs of setiform notogastral setae present; h_1 and p_1 longest, p_3 shortest. Seven or nine pairs of genital setae present.

Material examined. The holotype and 14 paratypes: holotype and 11 paratypes have the following collection data: Ethiopia, 9º06'N, 38º09'E, 2810 m a.s.l., Cholomu forest, mountain, *Hagenia abissinica* forming the canopy, moss, 6.11.2011, coll. L.B. Rybalov and A.I. Bastrakov; the three paratypes are found in the same locality and data, but in litter.

Type deposition. The holotype is deposited in the collection of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia; three paratypes are deposited in the collection of Siberian Zoological Museum, Novosibirsk, Russia; 11 paratypes are in the collection of the first author.

Measurements. Body length: 597 (holotype), 547–664 (14 paratypes). Body width: 365 (holotype), 348–381 (14 paratypes).

Integument (Figs. 1, 3, 5, 6, 14). Body colour: brown to dark brown. Medial part of prodorsum and notogaster covered with thick cerotegument. Notogastral cerotegument with specific ornamentation: five longitudinal ridge-like structures. Entire body, setae and legs covered with small, round granules (diameter up to 4 µm).

Prodorsum (Figs. 1, 3). Rostrum rounded in dorsal view. Rostral and lamellar setae setiform, smooth, distally curved anteromediad. Rostral setae inserted laterally on prodorsum, lamellar setae inserted dorsolaterally on prodorsum. Poorly visible sclerotized line present between the insertions of lamellar setae. Interlamellar setae minute, conical, thickened. Sensilli longest setae on prodorsum, setiform, smooth. Dorso-lateral parts of prodorsum with muscle sigilla.

Notogaster (Figs. 1, 3–5). Clearly convex in lateral view. Oval in dorsal view. Scalps always absent. Four pairs of setiform, thin, smooth notogastral setae present. Setae h_1 and p_1 longest, set on small tubercles; setae p_3 shortest. Opisthonotal gland openings and thin lyrifissures *ia*, *im*, *ip* present in typical arrangement for genus, but invisible under the layer of cerotegument.

Lateral part of body (Figs. 1, 3). Exobothridial setae setiform, thin, smooth. Pedotecta I (Pt I) and pedotecta II (Pt II) typical for genus. Discidia absent. Lyrifissures *ih* and *ips* long, thin.

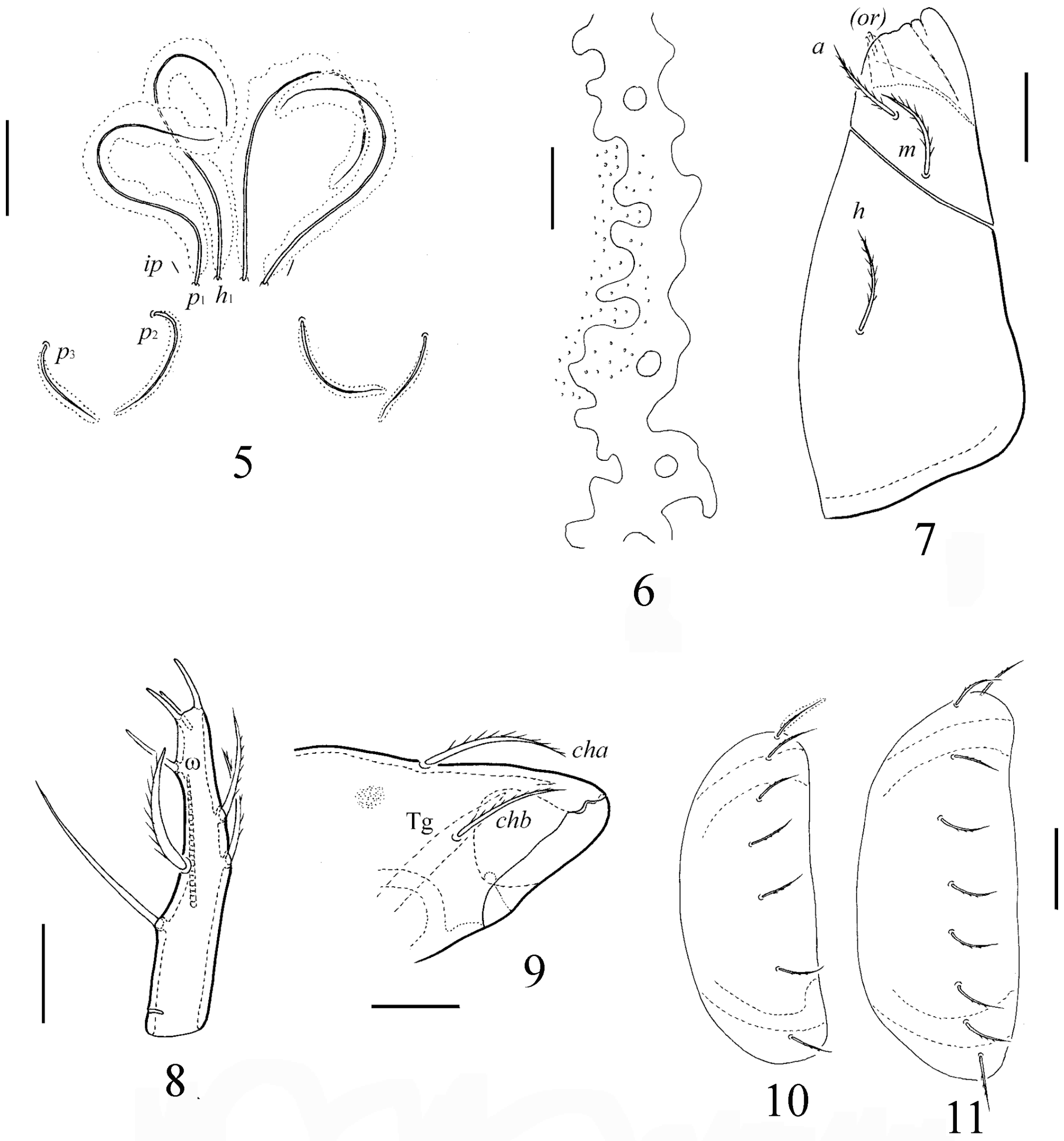
Gnathosoma (Figs. 7–9). Subcapitulum longer than wide. Hypostomal setae *a*, *m*, *h* similar in length, setiform, barbed. Two pairs of adoral setae (or_1, or_2) short, setiform, without distinct barbs. Palps with setation 0–2–1–3–8(+1ω). Solenidion long, pressed to surface of palptarsus, not attached to eupathidium. Cheliceral setae setiform, barbed; *cha* longer and slightly thicker than *chb*. Trägårdh's organ (Tg) visible.

Epimeral region (Fig. 2). Apodemes 1, 2 and sejugal apodema developed. Two pairs of tubercles *Sa* and *Sp* present, but *Sp* often poorly developed. Epimeral setal formula 3–1–3–3. Setae setiform, thin, smooth, similar in length.

Anogenital region (Figs. 2, 10, 11). Transverse ridge present between genital and anal plates, strongly pigmented. Genital plates with seven or nine pairs (1 : 1 in specimens) of barbed genital setae. One pair of aggenital (*ag*) and two pairs of adanal (ad_1, ad_2) setae setiform, smooth. Two pairs of anal setae (an_1, an_2) short, smooth. Lyrifissures *iad* not evident.

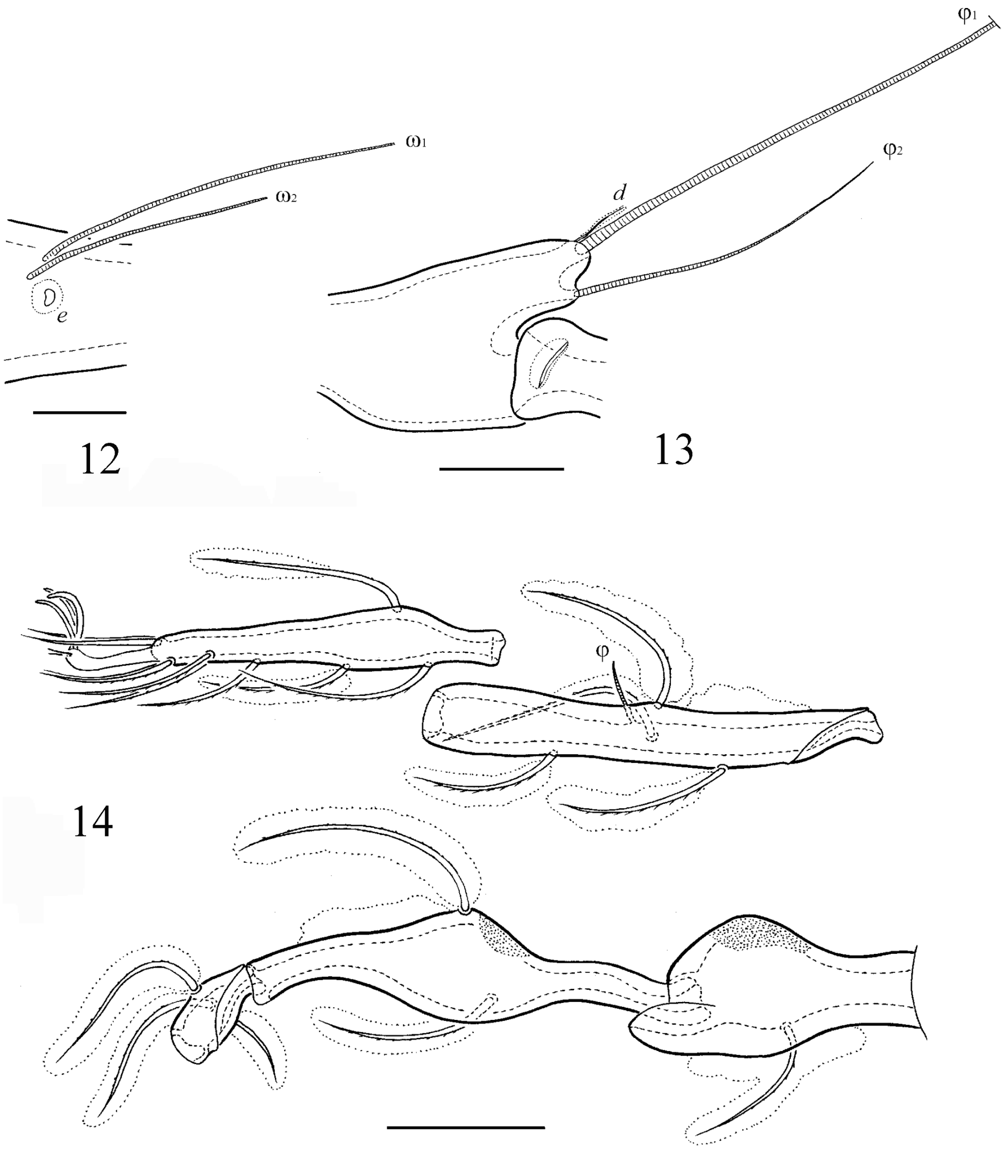
Legs (Figs. 12–14). Articulations without sockets, however it is often only clearly visible in dissected specimens. Formulae of leg setation and solenidia: I (1–5–4–5–20) [1–2–2], II (1–4–4–5–16) [1–1–2], III (2–3–3–4–15) [1–1–0], IV (1–2–3–4–12) [0–1–0]; homology of setae and solenidia indicated in Table. Famulus sunken, but we found it in one dissected specimen.

Comparative analysis. *Aleurodamaeus recenfesevpi* sp. nov. is similar to *A. australis* Woas,



Figures 5–11. *Aleurodamaeus recenfesevpi* sp. nov. 5 = Notogastral setae, posterior view of notogaster, 6 = fragment of cerotegument on notogaster, dorsal view, 7 = subcapitulum, ventral view of left half, 8 = palptarsus, 9 = chelicera, anterior part, 10 and 11 = genital plate, right of different individuals showing 7 or 9 genital setae. Scale bars (5) 50 µm, (6, 7, 9–11) 20 µm, (8) 10 µm

1992 from South Africa in having long, flagellate notogastral setae (h_1, p_1) and the absence of scalps. However, it can be clearly distinguished from the latter by the larger body size (547–664 × 348–381 in *A. recenfesevpi* sp. nov. versus 430 × 230 in *A. australis*), cerotegumental ornamentation on the notogaster five longitudinal ridge-like structures (with craterlike alveoli and concentric cerotegument lines in *A. australis*) and epimeral setal formula 3–1–3–3 (3–1–4–4 in *A. australis*).



Figures 12–14. *Aleurodamaeus recenfesevpi* sp. nov. 12 = Solenidia and famulus on tarsus I, 13 = solenidia on tibia I, 14 = leg IV, left, paraxial view. Scale bars (12) 10 µm, (13) 20 µm, (14) 50 µm

Table 1. Leg setation and solenidia of *Aleurodamaeus recenfesevpi* sp. nov.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	*v′*	*d*, *(l)*, *bv″*, *v″*	*d*, *(l)*, *v′*, σ	*d*, *(l)*, *(v)*, φ_1, φ_2	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*, *v′*, *(pl)*, *l″*, *e* (sunken), ω_1, ω_2
II	*v′*	*d*, *(l)*, *bv″*	*d*, *(l)*, *v′*, σ	*d*, *(l)*, *(v)*, φ	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*, *l″*, ω_1, ω_2
III	*l′*, *v′*	*d*, *l′*, *ev′*	*d*, *l′*, *v′*, σ	*d*, *l′*, *(v)*, φ	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*
IV	*v′*	*d*, *ev′*	*d*, *l′*, *v′*	*d*, *l′*, *(v)*, φ	*ft″*, *(tc)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*

Roman letters refer to normal setae (*e* – famulus), Greek letters refer to solenidia. One apostrophe (') marks setae on anterior and double apostrophe (") setae on posterior side of the given leg segment. Parentheses refer to a pair of setae.

Etymology. The new species is named after the Referral Center of the Federal service for Veterinary and Phytosanitary Inspection, Nizhniy Novgorod, Russia, where the first author had the opportunity to investigate oribatid mites for several years. The specific name "*recenfesevpi*" includes the reduced initial parts of the name of this organization.

Remarks on the taxonomic status of *Aleurodamaeus (Trichodamaeus)*

Mahunka (1984) proposed the subgenus *Aleurodamaeus (Trichodamaeus)* with *Aleurodamaeus (Trichodamaeus) africanus* Mahunka, 1984 as type species. This subgenus differs from *Aleurodamaeus (Aleurodamaeus)* Grandjean, 1954 only by the nine pairs of genital setae (versus seven pairs). The specimens of *A. recenfesevpi* sp. nov. have seven and nine (1 : 1) pairs of genital setae. Hence, it is unjustified to recognize subgenera in this genus based only on number of genital setae, and we consider the subgenus-level name *Trichodamaeus* to be a junior subjective synonym of *Aleurodamaeus*.

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REFERENCES

BERLESE, A. (1883): Sopra due nuovi generi di Acari italiani. Lettura fatta alla R. Accademia di Padova. *Atti R. Accademia, Padova*, 33: 45–52.

BERLESE, A. (1916): Centuria prima di Acari nuovi. *Redia*, 12: 19–67.

ERMILOV, S. G., SIDORCHUK, E. A. & RYBALOV, L. B. (2012): Oribatid mites (Acari: Oribatida) of Ethiopia. *Zootaxa*, 3208: 27–40.

GRANDJEAN, F. (1954): Observations sur les Oribates (28e série). *Bulletin de Muséum national d'Histoire naturelle*, 26 (2): 204–211.

MAHUNKA, S. (1984): Oribatids of the Eastern Part of the Ethiopian Region (Acari). V. *Acta Zoologica Hungarica*, 30 (1–2): 87–136.

NORTON, R. A. & BEHAN-PELLETIER, V. M. (2009): *Oribatida*. Chapter 15. In: KRANTZ, G. W. & WALTER, D. E. (Eds.). *A Manual of Acarology*. USA, Texas University Press, pp. 430–564.

PASCHOAL, A. D. & JOHNSTON, D. E. (1985): Aleurodamaeidae (Acari: Oribatei), a new family of oribatid mites, with a description of *Aleurodamaeus hungaricus*, sp. n. *Revista Brasileira de Biologia*, 29 (1): 21–26.

WOAS, S. (1992): Beitrag zur Revision der Gymnodamaeidae Grandjean, 1954 (Acari, Oribatei). *Andrias*, 9: 121–161.

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Notes on the distribution and taxonomy of the Ecuadorian Uropodina mites (Acari: Mesostigmata)

J. KONTSCHÁN[1]

Abstract. Comments on the generic and subgeneric concept of Neotropical *Uroseius* Berlese, 1888 species are presented. The family Cillibidae is discussed with resurrections of the genus *Ungulaturopoda* Hirschmann, 1984 and the subgenus *Laqueaturopoda (Hiramatsulaqueata)* Hirschmann, 1984. Three new species; *Uroseius loksai, Uropoda ecuadorica,* and *Clivosurella pilosa* spp. nov. are described and an invasive European Uropodina species *Uropoda minima* Kramer, 1882 is recorded for the first time from the Neotropical region.

Keywords. Acari, Uropodina, new species, new records, taxonomy, Ecuador.

INTRODUCTION

Uropodina is a characteristic group of soil dwelling mites in the tropical region, where they reach their maximum diversity in soil, leaf litter, moss, and other habitats of the tropical rain forests (Lindquist *et al.,* 2009).

Due to the intensive Hungarian researches and collections in the last three decades (Zicsi & Csuzdi, 2008) regarding the Uropodina fauna, Ecuador became a well-explored country. Currently, without the uropodids of the Galapagos Archipelago, 58 Uropodina mite species are recorded for this country (Wiśniewski, 1993; Kontschán, 2008a, b, 2010a).

In the present paper the new results on the Neotoropical Uropodina mites resulted by working on the unsorted soil samples of the Hungarian Natural History Museum are presented. I listed herein nine species from Ecuador of which three proved to be new to science.

MATERIAL AND METHODS

Specimens were cleared in lactic acid. Drawings were made with the aid of a drawing tube. Mites are stored in alcohol and deposited in the mite collection of the Natural History Museum Geneva (NHMG) and the Soil Zoology Collections of the Hungarian Natural History Museum, Budapest (HNHM). All measurements are given in micrometers (μm).

TAXONOMY

Family TRACHYTIDAE Trägårdh, 1938

Uroseius (Uroseius) rotondus Hiramatsu, 1981

(Figures 1–5)

Material examined. Seven females. ECU 1989, B140. Ecuador, 10 km leaving La Libertad to Tulcan, 3400 m a.s.l. (Prov. Carchi). Old quarry, completely overgrown with vegetation; litter and soil from under shrubs. 25. IV. 1989, leg. Loksa, I. & Zicsi, A.

Short description. Length of idiosoma 1000–1100 μm, width 980–990 μm. Idiosoma oval, posterior margin rounded.

Dorsal idiosoma (Fig. 1). Marginal and dorsal shield fused anteriorly, marginal shield reduced, posterior margins reaching level of coxae IV. Dorsal and marginal shields covered by oval pits and bearing smooth and needle-like setae. Membranous cuticle on posterior area of dorsal side bearing smooth and needle-like setae placed on small platelets.

Ventral idiosoma (Fig. 2). Sternal setae short and needle-like, ventral setae long and needle-

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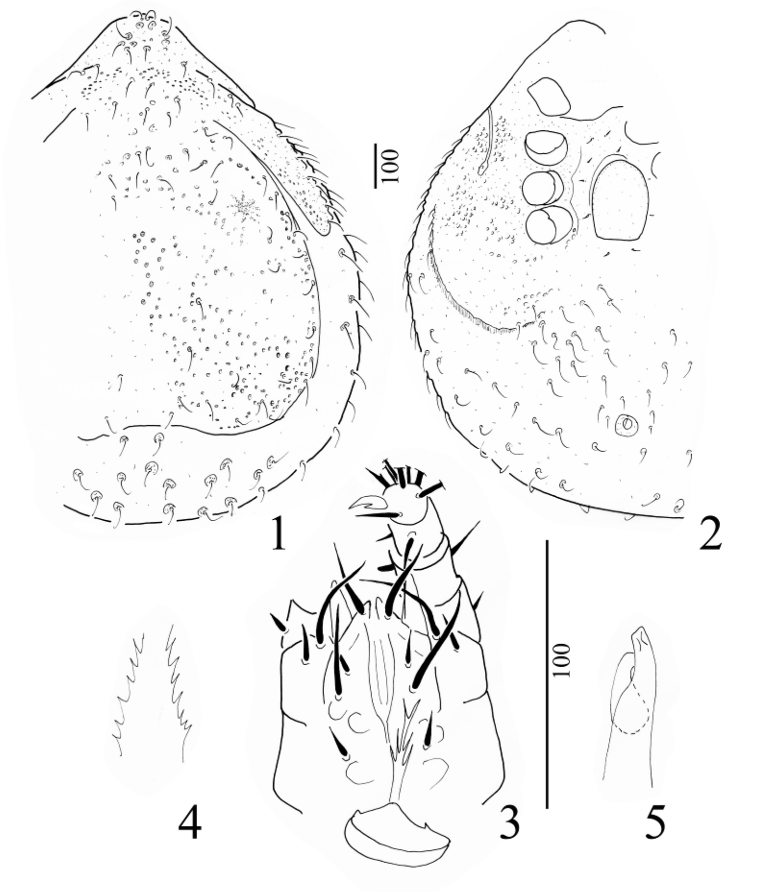


Figures 1–5. *Uroseius (Uroseius) rotondus* Hiramatsu, 1981, female. 1 = dorsal view, 2 = ventral view, 3 = tritosternum, palp and ventral view of gnathosoma, 4 = basal part of epistome, 5 = chelicera

like. Sternal and ventral shields smooth, only the peritrematal area covered by oval pits. Metapodal line undulate and well-developed. Genital shield oval, without anterior process and ornamentation.

Gnathosoma (Fig. 3). Corniculi horn-like, internal malae very short, hypostomal setae smooth, h1 and h3 long, h2 and h4 short. Tritosternum with wide basis, epistome with serrate margins (Fig. 4), fixed digit of chelicerae longer than movable digit, internal sclerotised node absent (Fig. 5).

Uroseius (Uroseius) loksai sp. nov.

(Figures 6–15)

Material examined. Holotype. Female. ECU 1989, B24. Ecuador, between Pifo and Papallacta, 4100 m a.s.l. S0°22'29", W78°08'10" (Prov. Pichincha). 14. IV. 1989. Withered leaves and soil under dicotyledon plant with big leaves (and lilac flowers). Leg. Zicsi, A. & Loksa, I. *Paratype.* One female (NHMG) Locality and date same as for the holotype.

Description. Female. Length of idiosoma 880–960 µm, width 540–580 µm (n = 2). Shape oval, posterior margin rounded.

Dorsal idiosoma (Fig. 6). Dorsal shield reduced, covering only the central region of idiosoma. Marginal shield absent. Dorsal shield covered by small oval pits and bearing smooth and needle like setae (*ca.* 22–26 µm). Setae on membranous cuticle similar in shape and length to setae of dorsal shield. Near margin of ventral shield several smooth and needle-like setae can be found, placed on small platelets on membranous cuticle (Fig. 7).

Ventral idiosoma (Fig. 8). Sternal shield without sculptural pattern. Sternal setae smooth and needle-like, St1 short and localized between coxae II (*ca.* 7–9 µm), St2 and St3 near anterior margin of genital shield, (*ca.* 20–30 µm), St4–5 similar in length to St2–3, and placed near anterior margin of coxae IV, St6 similar in shape and length to latter, but situated near posterior margin of coxae IV. Ventral shield with long (*ca.* 32–34 µm), smooth and needle-like setae. Adanal setae similar in shape to ventral setae, but *ca.* 7–10 µm long. Stigmata situated between coxae II and III. Peritremes straight (Fig. 7). Genital shield scutiform, without sculptural pattern and with spine like process on its apical margin. Base of tritosternum wide, tritosternal laciniae divided into three smooth branches (Fig. 9).

Gnathosoma (Fig. 10). Corniculi horn-like, internal malae short and smooth. Hypostomal setae as follows: h1 smooth, long (*ca.* 50–60 µm) and placed near the anterior margin of gnathosoma, h2 smooth, needle-like and three times shorter (*ca.* 15–20 µm) than h1, h3 similar in shape and length (*ca.* 55–60 µm) to h1, h4 needle-like, smooth and short (*ca.* 10–12 µm). Epistome marginally serrate, fixed digit of chelicerae longer than movable digit, without internal sclerotized nodes (Fig. 11).

Legs (Figs 12–15). All legs with ambulacral claws and bearing smooth and serrate or simple and robust setae.

Male, nymphs and larvae unknown.

Etymology. The new species is dedicated to Dr. Imre Loksa (1923–1992), associate professor of Department of Systematic Zoology and Ecology of the Eötvös Loránd University, who collected many soil samples in Ecuador.

Remarks. The common characters of the *Uroseius (Uroseius)* species are the smooth h4 setae and the short h2 setae (not reaching the basis of h1) on gnathosoma. Currently nine species are known on the basis of adults from the subgenus *Uroseius (Uroseius)*, one of them from Java and five species from Europe and Asia. The remaining three species were described from Ecuador. Interestingly the new species seems closely related to *Uroseius (Uroseius) hunzikeri* Schweitzer, 1922 (Europe), but the dorsal setae are pilose and dorsal shield is covered by large and irregular pits in the known species, while dorsal setae are smooth and the dorsal shield possesses small, oval pits in the new species. The most important distinguishing characters of the South-American species are summarized in Table 1.

Table 1. Characteristic differences between the three South-American *Uroseius (Uroseius)* species

	U. (U.) loksai sp. n.	*U. (U.) rotundus* Hiramatsu, 1981	*U. (U.) tuberosus* Hirschmann & Hirmatsu, 1977
Shape of idiosoma	oval	rounded	oval
Ventral setae	smooth	smooth	pilose
Ornamentation on ventral shield	alveolar	lacking	lacking
Setae on margins of idiosoma	smooth and short	smooth and short	pilose and long
Caudal idiosomal protuberance	absent	absent	present
Genital shield of female	scutiform, with spine-like anterior process	linguliform	scutiform, with short process

On the basis of the gnathosomal processes, Hiramatsu (1981) placed *U. rotondus* into the subgenus *Uroseius (Uroseius)* and I placed the new species into this subgenus as well. However several other characters of these species differ from all other *Uroseius (Uroseius)* species: (1) pygidial shield is present in other *Uroseius (Uroseius)* species, but it is missing from *U. (U.) rotondus* and *U. (U.) loksai*; (2) the metapodal shield is separate from the ventral and sternal shield, while all three mentioned shields are fused to each other in the two Ecuadorian species. According to my observations on the specimens studied, I suppose that these two species do not belong to the subgenus *Uroseius (Uroseius)* nor *Uroseius* (*Apioseius)*, therefore, in the future, it might be necessary to establish a new subgenus for them however, only after a thorough revision of the Neotropical *Uroseius* species.

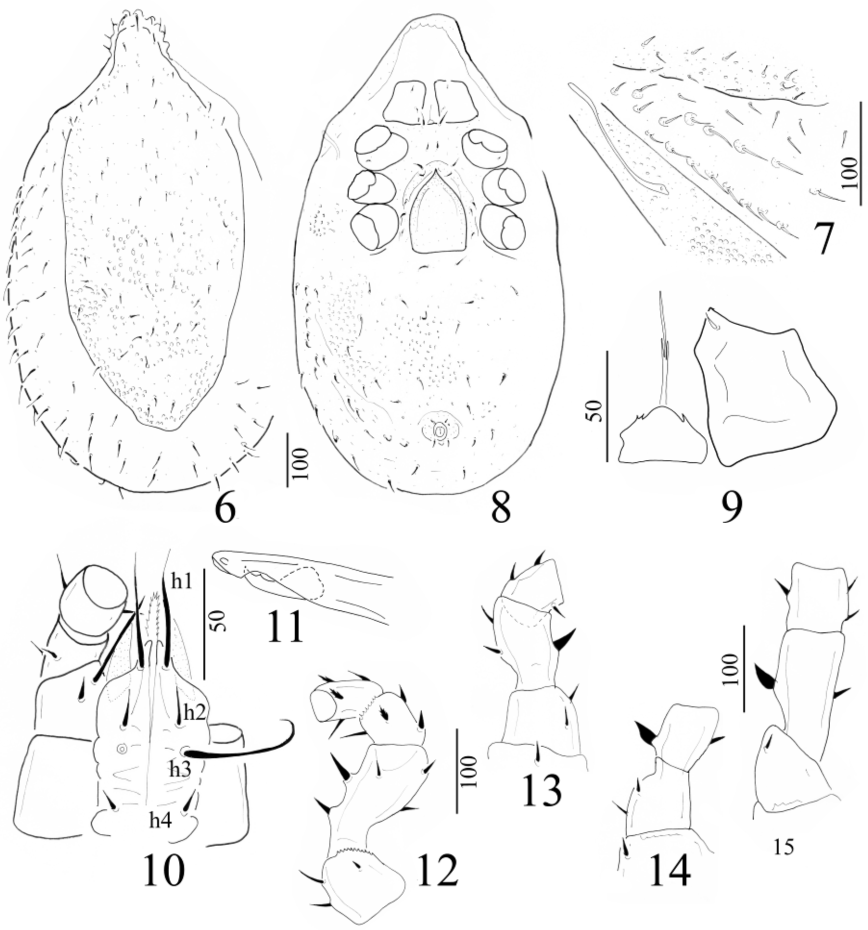
Family Nenteriidae Hirschmann, 1979

Nenteria longispinosa Hirschmann, 1985

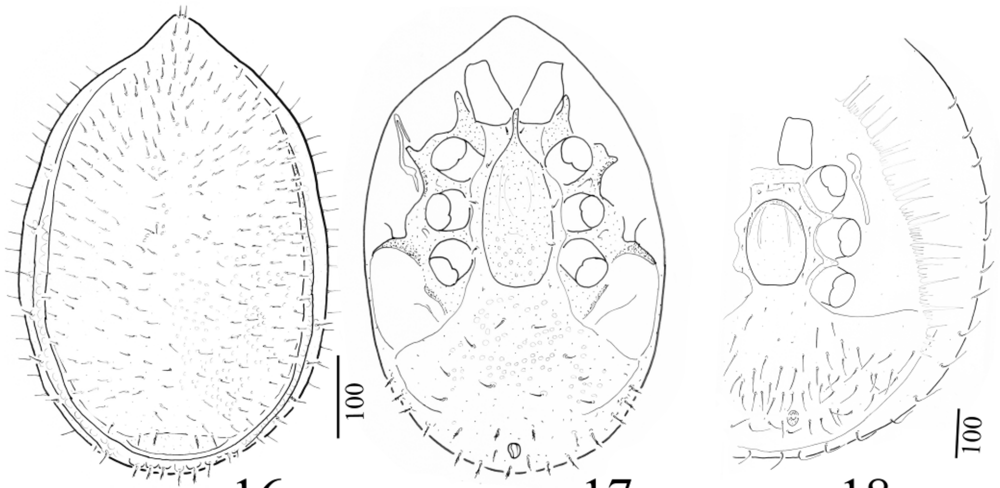
(Figures 16–17)

Material examined. One female. ECU 1986, B67. Ecuador, Pululagua crater and its surroundings, (Prov. Pichincha). 12. II. 1986. Eroded hollow in the direction of Mitad del Mundo, moss under bushes growing on the sides of the hollow, leg. Zicsi, A. & Loksa, I.

Distribution. Ecuador (Wiśniewski & Hirschmann, 1993).



Figures 6–15. *Uroseius (Uroseius) loksai* sp. nov., female. 6 = dorsal view, 7 = peritreme, 8 = ventral view, 9 = tritosternum and coxae I, 10 = ventral view of gnathosoma, 11 = chelicerae, 12 = leg I, 13 = leg II, 14 = leg III, 15 = leg IV



16 17 18

Figures 16–18. *Nenteria longispinosa* Hirschmann, 1985, female (16–17). 16 = dorsal view, 17 = ventral view, 18 = ventral view of *Trichocylliba mahunkai* Hirschmann, 1973, female

Family TRICHOCYLLIBIDAE Hirschmann, 1979

Trichocylliba mahunkai Hirschmann, 1973

(Figure 18)

Material examined. One female. ECU 1987, B136. Ecuador, Antisana volcano, road leading west, downwards to Pintag, 17. IV. 1987. 2900 m a.s.l., from moss and scale-moss, leg. Zicsi, A. & Loksa, I.

Distribution. Bolivia (Wiśniewski & Hirschmann 1993) and Ecuador.

Remarks. This is the first record from Ecuador.

Family TETRASEJASPIDAE Hirschmann, 1979

Tetrasejaspis ecuadorensis Kontschán 2008

(Figures 19–20)

Material examined. Two females. ECU 1986, B4. Ecuador, between Quito and Nono (Prov. Pichincha), 8 km to Nono, 3280 m a.s.l., 4. II. 1986. Moss from the stems of shrubs at the gorge entrance. leg. Zicsi, A. & Loksa, I.

Distribution. Ecuador (Kontschán 2008).

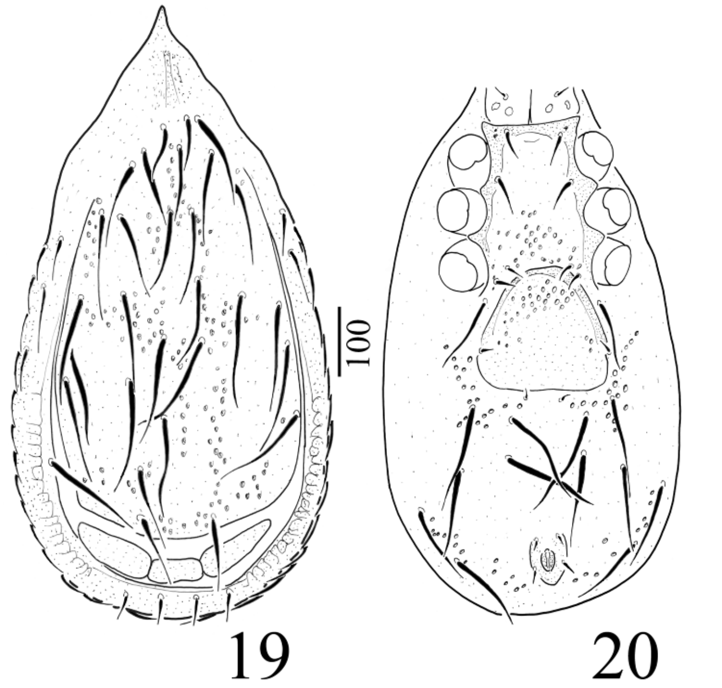
Family UROPODIDAE Kramer, 1881

Uropoda minima Kramer, 1882

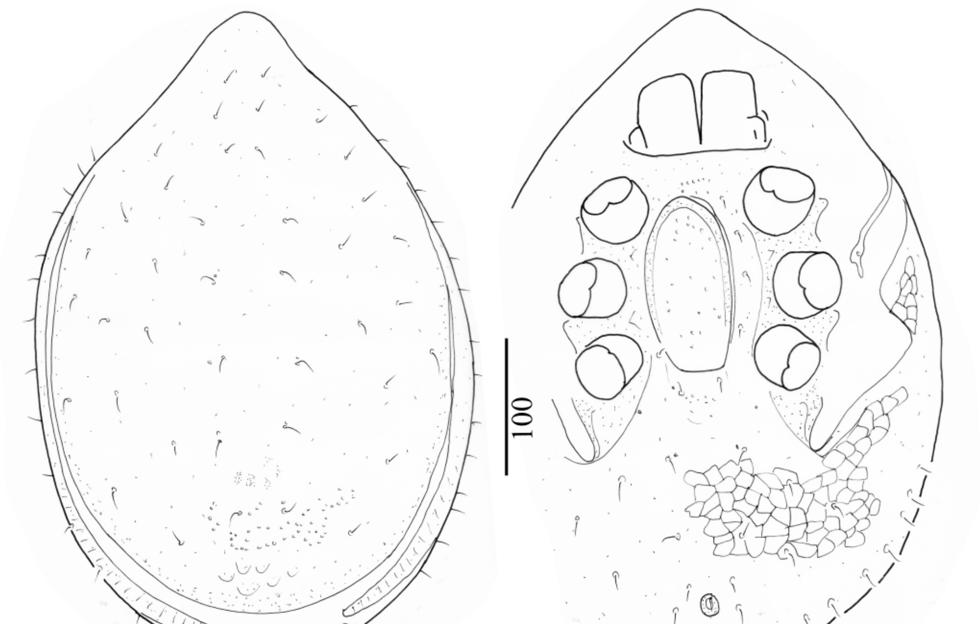
(Figures 21–22)

Material examined. Seven females. ECU 1989, B141. Ecuador, 10 km leaving La Libertad to Tulcan, 3400 m a.s.l. (Prov. Carchi), moss and cushion-vegetation. 25. IV. 1989, leg. Loksa, I. & Zicsi, A.

Remarks. U. minima is a widely distributed Palearctic species which occurs in most of the countries of Europe (Wisniewski & Hirschmann 1993). Till now, this species have not been found outside Europe. The occurrence of a Palearctic species in the tropical region is not an unknown phenomenon regarding soil animals. Several Palearctic earthworm species are listed from Ecuador from high elevation (Zicsi & Csuzdi 1988) where the climate is similar to that of Europe. Soil animals originated from the Palearctis usually arrive with soil, among the roots of plants (Mischis *et al.* 2006) and sometimes they can find suitable habitat in the tropical zone, mostly in the cooler mountain biotopes. Up to now not any imported Uropodina mites have been recorded, this is the first one which is considered as an invasive species in the tropics.



Figures 19–20. *Tetrasejaspis ecuadorensis* Kontschán 2008, female. 19 = Dorsal view, 20 = ventral view



Figures 21–22. *Uropoda minima* Kramer, 1882, female. 21 = dorsal view, 22 = ventral view

Uropoda ecuadorica sp. nov.

(Figures 23–32)

Material examined. Holotype. Female. ECU 1989, B144. Ecuador, 14 km leaving La Libertad, towards Tulcan, 3500 m a.s.l. (Prov. Carchi), N0°49'17", W77°43'55". 25. IV. 1989. Bushes and ferns in *Espeletia*-vegetation; litter and soil. leg. Zicsi, A. & Loksa, I.. *Paratypes.* One female and two males (HNHM), one male (NHMG). Locality and date same as for the holotype.

Description. Female. Length of idiosoma 1080–1120 µm, width 820–830 µm (n=2). Shape oval, posterior margin rounded.

Dorsal idiosoma (Fig. 23). Marginal and dorsal shields fused anteriorly. Dorsal shield covered by small alveolar pits and bearing long (*ca*. 300–350 µm), narrow, needle-like dorsal setae. Caudal part of dorsal shield bearing a wide dorsal protuberance. Marginal shield with reticulate sculptural pattern, its setae placed on small protuberances and divided into two branches, one of the branches short and smooth, the other one long and marginally serrate (Fig. 24), apically pilose or blade-like (Fig. 26). Wide and serrate setae situated on margins of the body (Fig. 25).

Ventral idiosoma (Fig. 27). Sternal and ventral shields without sculptural pattern. Sternal setae St1, St2 and St3 short (*ca.* 14–17 µm), smooth and needle-like, situated near anterior margin of genital shield. St4 wide, long (*ca.* 130–140 µm) and placed on level of anterior margin of coxae III. St5 as long as St4, narrow and situated near basal line of genital shield. Ventral setae V1 and V2 long (*ca.* 220–240 µm) and narrow, V3, V4 and V5 shorter (*ca.* 120–130 µm) and wide, their position can be seen on Fig. 27. Adanal setae wide and phylliform, postanal setae absent. Stigmata situated between coxae II and III. Peritremes bow-shaped. Genital shield wide, oval, with reticulate sculptural pattern and short, spine-like anterior processes. Base of tritosternum narrow, laciniae divided into two short and two long branches, their margins serrate (Fig. 28).

Gnathosoma (Fig. 28). Corniculi horn-like, internal malae long, their apical part pilose. Visible hypostomal setae are the follows: h1 long (*ca.* 60 µm), smooth and placed near the anterior margin of gnathosoma, h2 marginally serrate and 1.25 times shorter (*ca.* 48 µm) than h1, h3 two times shorter (33 µm) than h1 and marginally serrate, h4 not clearly visible (covered by coxae I). Epistome, chelicerae and setae of palp not clearly visible (covered by coxae I).

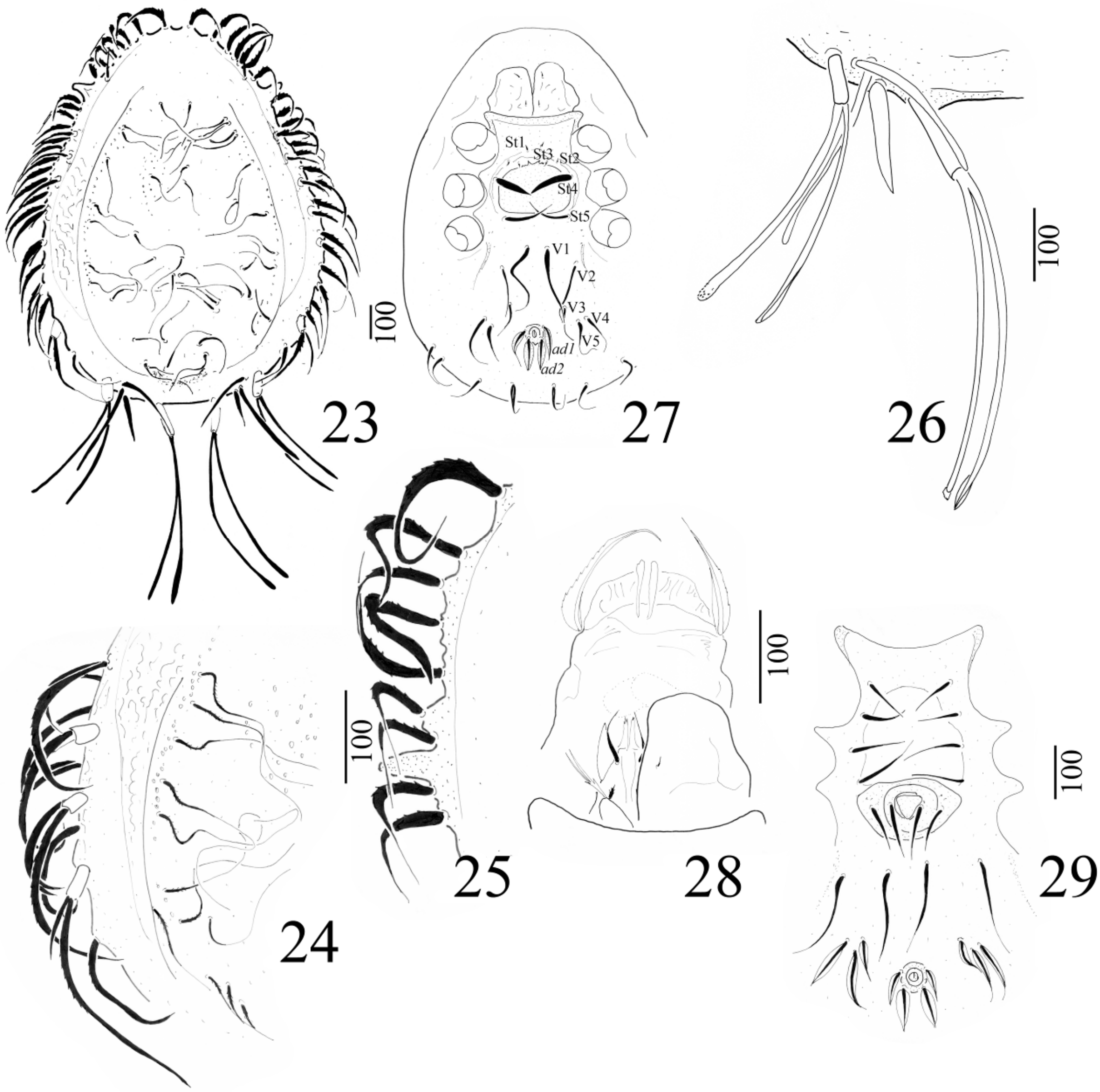
Legs. Each legs with ambulacral claws, and with long, smooth and serrate setae (Figs 30–32).

Male. Length of idiosoma 1050–1080 µm, width 780–810 µm (n=3). Shape of idiosoma, ornamentation and chaetotaxy of dorsal parts as in female (Fig. 29). Sternal setae long (*ca.* 80–115 µm), narrow and needle-like, their position depicted on Fig. 29. Ventral and adanal setae same as in female. Genital shield oval and bearing one pair of setae, placed between coxae IV. Ventral ornamentation and legs similar to those of female. Gnathosoma not clearly visible (covered by coxae I).

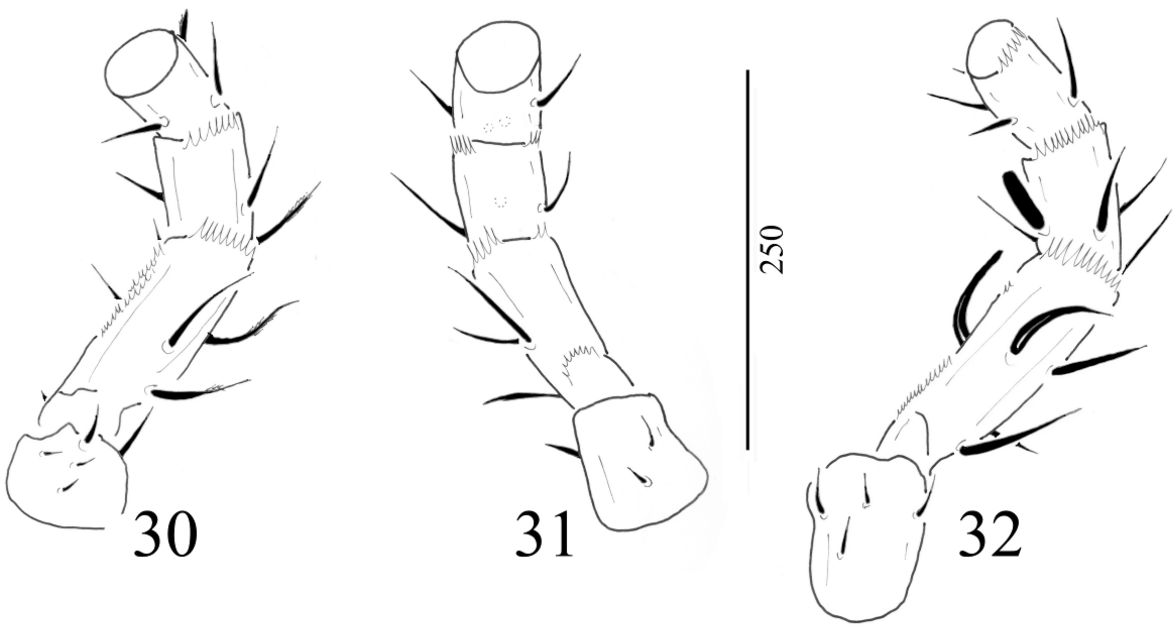
Nymphs and larvae unknown.

Etymology. The name of the new species refers to the country where it was collected.

Remarks. The new species belongs to the *Uropoda multipora* species group (on the basis of the presence of endometapodal line, apical part of peritremes situated on protuberances and the setae are placed on marginal shields). Currently this group contains five Neotropical species. Apart from the new species it containes *U. efferata* Hiramatsu, 1981 from Ecuador, *U. multipora* Hirschmann & Zirngiebl-Nicol, 1969 from Panama, *U. stolida* Hiramatsu & Hirschmann, 1978 and *U. stolidasimilis* Hiramatsu & Hirschmann, 1979 from Peru (Wiśniewski and Hirschmann 1993). The most important distinguishing characters of the species are summarized in Table 2.



Figures 23–29. *Uropoda ecuadorica* sp. nov., female. 23 = dorsal view, 24 = setae on marginal shield, 25 = setae on margins of body, 26 = setae on caudal region, 27 = ventral view, 28 = ventral view of gnathosoma, tritosternum and coxae I, 29 = intercoxal and ventral region of male



Figures 30–32. *Uropoda ecuadorica* sp. nov., female. 30 = Leg II, 31 = leg III, 32 = leg IV

Table 2. Characteristic differences between the species of *Uropoda multipora*-group

	U. ecuadorica	*U. multipora*	*U. stolida*	*U. stolidasimilis*	*U. efferata*
Genital shield of female					
Ornamentation	absent	reticulate	absent	reticulate	absent
Shape (length:width)	wider (1:1.4)	narrower (1:0.8)	wider (1:1.5)	wider (1:1.4)	wider (1:1.2)
Sternal setae					
St1	as long as St2, smooth	longer than St2, pilose	as long as St2, pilose	as long as St2, smooth	as long as St2, pilose
St3	as long as other sternal setae	as long as other sternal setae	longer than other sternal setae	as long as other sternal setae	longer than other sternal setae
Male					
Sternal setae	needle-like	St1 pilose, St2–St5 needle-like	phylliform,	needle-like	unknown
St1	as long as St2	as long as St2	longer than St2	shorter than St2	unknown

Family CILLIBIDAE Trägårdh, 1944

Diagnosis. Flattened mites with usually yellow colour. Idiosoma round or oval, marginal shield complete, not reduced on caudal area. Dorsal, ventral and marginal setae needle-like, genital shield of female oval or linguliform. Surface of idiosoma smooth, rarely ornamented. Sternal setae short and needle-like. Genital shield of male bearing one pair of smooth eugenital setae. Peritremes L-shaped, R-shaped or hook-like on prestigmatid part. Poststigmatid part reduced. Coxae I not touching together, pedofossae present, but not deep. Leg I without claws or with weakly developed claws. Tritosternum with narrow basis, laciniae with four–six branches. Corniculi horn-like. Hypostomal setae h1 long and smooth, other setae shorter, h4 apically pilose or serrate. Chelicerae without internal sclerotised node.

Remarks. Currently four genera belong to the family Cillibidae. The genus *Cilliba* v. Hayden, 1827 is distributed in Europe and the Middle-East, the genus *Laqueaturopoda* Hirschmann, 1979 (with its two subgenera *Laqueaturopoda* Hirschmann, 1979 and *Hiramatsulaqueata* Hirschmann, 1984) seems to be endemic in the Neotropical region similarly to the genus *Ungulaturopoda* Hirschmann, 1984 (Wiśniewski 1993). The fourth genus, *Australocilliba* Athias-Binche & Błoszyk, 1988 is distributed in Australia and a hitherto undescribed genus occurs in New Zealand (Kontschán in prep.).

Distribution. Species of the family Cillibidae occur in South-America, Australia, New Zealand, Europe and in the Middle-East. Species of the family are not recorded from Africa, North-America and Asia (excluding Middle-East). According to the distributional records, on the basis of the Australian, New Zealander, and South-American occurrences this family might have originated in the Gondwana and dispersed later in Europe and the Middle East.

Key to the genera and subgenera of the family Cillibidae

1 Genital shield of female with long anterior extension, setae h1 phylliform, leg I with small claws-- genus *Australocilliba*
– Genital shield of female without anterior extension, setae h1 needle-like, leg I without claws ------------- **2**

2 Peritremes L-shaped --------------------- genus *Cilliba*
– Peritremes not L-shaped ------------------------------- **3**

3 Shape of idiosoma oval, peritremes hook-like-- genus *Ungulaturopoda*
– Shape of idiosoma circular, peritremes R-shaped ----------------------------------genus *Laqueaturopoda* **4**

4 Marginal shield entire on caudal area ------------------------- subgenus *Laqueaturopoda* (*Laqueaturopoda)*
– A narrow incision present in marginal shield on caudal area --- subgenus *Laqueaturopoda (Hiramatsulaqueata)*

Ungulaturopoda Hirschmann, 1984

Diagnosis. Idiosoma oval, dorsal and marginal shields fused anteriorly. Peritremes hook-shaped. Leg I without claws.

Type species. Ungulaturopoda ungulata (Hirschmann & Hiramatsu, 1977), by original designation.

Remarks. Ungulaturopoda was established by Hirschmann (1984a) with type species *Uropoda ungulata* Hirschmann & Hiramatsu, 1977, by original designation. Later Hirschmann (1993) and his co-worker (Wiśniewski 1993, Wiśniewski & Hirschmann 1993) placed every *Ungulaturopoda* species into the large, catch-all genus *Uropoda*, forming the *ungulata* species group, which contained seven Neotropical species. In my opinion, on the basis of the shape of idiosoma and the peritremes, the genus *Ungulaturopoda* is well-defined and thus can easily be distinguished from the similar genera, therefore the genus needs to be resurrected.

Distribution. The species of *Ungulaturopoda* are recorded from Ecuador, Columbia and Costa Rica.

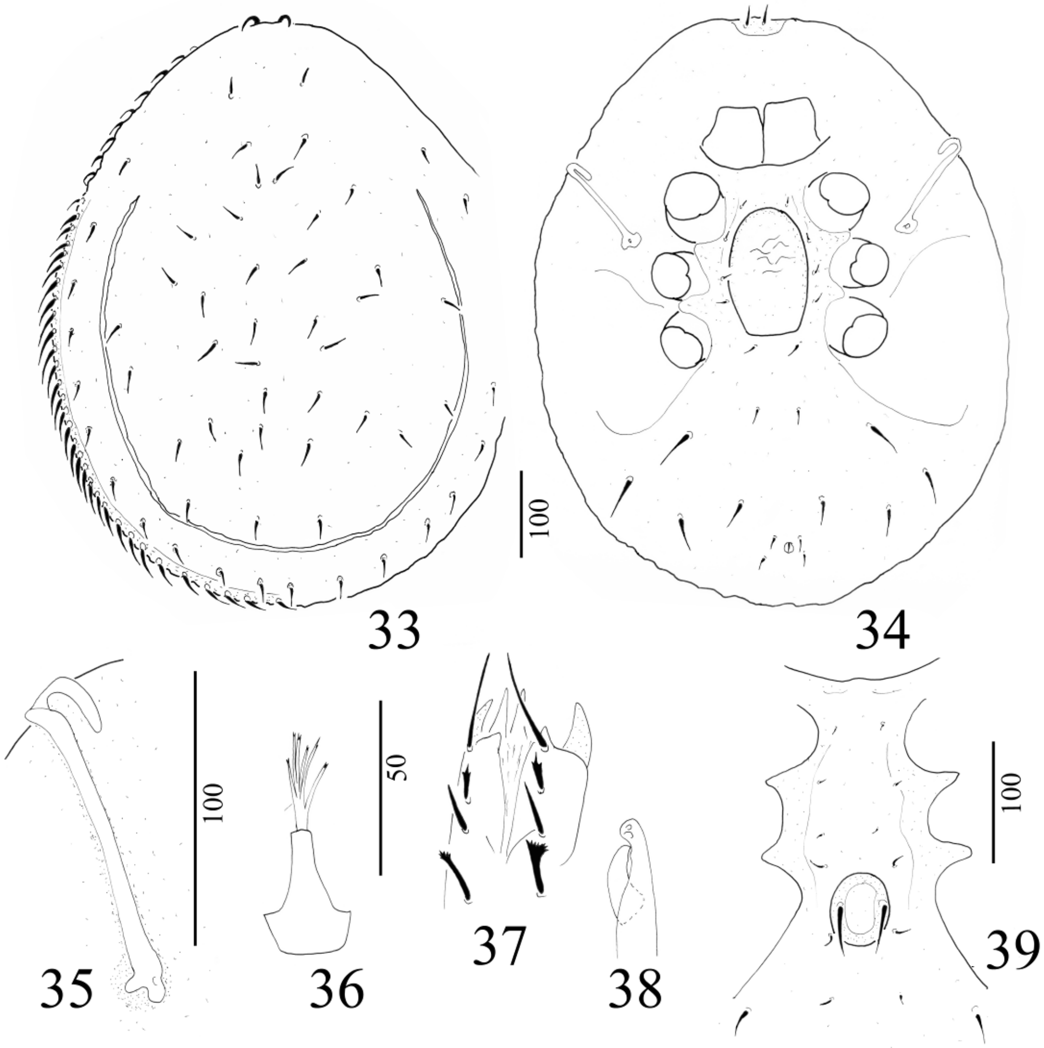
Ungulaturopoda ungulata (Hirschmann & Hiramatsu, 1977)

(Figures 33–39)

Material examined. Ecuador. Three females and seven males. ECU 1989, B142. 10 km leaving La Libertad to Tulcan, 3400 m a.s.l. (Prov. Carchi), cushion vegetation. 25. IV. 1989, leg. Loksa, I. & Zicsi, A. Four females and two males. ECU 1989, B37. Between Pifo and Papallacta, 4100 m a.s.l. (Prov. Pichincha), Moss and withered plant-debris from under bushes, 14. IV. 1989, leg. Loksa, I. & Zicsi. One female and three males. ECU 1989, B86. 30 km from Otavalo to Apuela, Otocique, 3250 m a.s.l. (Prov. Imbabura), cushion-plants, 19. IV. 1989, leg. Loksa, I. & Zicsi, A. Costa-Rica. One female. Cr92, B42. Vulcan Poa, 2704 m a.s.l., wet roots with soil. 21. I. 1992, leg. J. Balogh. Four females. Cr92, B50. Vulcan Poa, cloudy forest, soil, 21. I. 1992, leg. J. Balogh.

Short description. Female. Length of idiosoma 630–640 µm, width 540–550 µm (female). Idiosoma oval, posterior margin rounded.

Dorsal idiosoma (Fig. 33). Marginal and dorsal shields fused anteriorly, marginal shield entire. Dorsal and marginal shields without ornamentation and bearing smooth and needle-like setae.



Figures 33–39. *Ungulaturopoda ungulata* (Hirschmann & Hiramatsu, 1977), female. 33 = dorsal view, 34 = ventral view, 35 = peritreme, 36 = tritosternum, 37 = ventral view of gnathosoma, 38 = chelicera, 39 = intercoxal area of male

Ventral idiosoma (Fig. 34). Sternal setae short and needle-like, ventral setae long and needle-like. Sternal and ventral shields smooth, without sculptural pattern. Genital shield oval, without anterior process and with a few reticulate pattern. Peritremes hook-shaped (Fig. 35). Tritosternum with narrow basis, laciniae divided into six branches (Fig. 36).

Gnathosoma (Fig. 37). Corniculi horn-like, internal malae longer than corniculi, hypostomal setae h1 and h3 smooth, h2 provided with one pair of spines laterally, h4 apically serrate. Fixed digit of chelicerae longer than movable digit, internal sclerotised node absent (Fig. 38).

Male. Length of idiosoma 620–630 µm, width 530–540 µm. Shape oval, posterior margin rounded. Dorsal idiosoma ornamentation and chaetotaxy of dorsal shield as in female.

Ventral idiosoma (Fig. 39). Sternal shield with smooth surface. Sternal setae short and needle-like. Genital shield rounded, placed between coxae IV and bearing one pair of eugenital setae. Gnathosoma similar to that of female.

Remarks. This is the first record from Costa Rica.

Laqueaturopoda Hirschmann, 1979

Diagnosis. Idiosoma circular, dorsal and marginal shields fused anteriorly. Peritremes R-shaped. Leg I without claws.

Type species. Laqueaturopoda laqueta (Hirschmann & Hiramatsu, 1972), by original designation.

Remarks. Hirschmann (1984b) divided the genus *Laqueaturopoda* into two subgenera (*Laqueaturopoda* Hirschmann, 1979 and *Hiramatsulaqueata* Hirschmann, 1984) on the basis of presence/absence of the caudal incision in the marginal shield (see the key of Cillibidae). Later Hirschmann (1993) and his co-worker (Wiśniewski 1993, Wiśniewski & Hirschmann 1993) placed back all the *Laqueaturopoda* species into the large, catch-all genus *Uropoda*, forming the *laqueta* species group for the subgenus *Laqueaturopoda* and the *laquetasimilis* species group for the subgenus *Hiramatsulaqueata*. According to my new observations, I think the subgenus *Hiramatsulaqueata* is well-defined and thus can easily be distinguished from the subgenus *Laqueaturopoda* on the basis of the caudal incision, hence I resurrect this subgenus.

Laqueaturopoda (Hiramatsulaqueata) cocuyensis (Hirschmann, 1984)

(Figures 40–47)

Material examined. Two females. ECU 1986, B160. Ecuador, 31 km from the road-junction to Santa Barbara, on the riverside of Rio Chingual, 2480 m a.s.l. (Prov. Carchi), riverside rainforest gallery, litter and soil. 26. IV. 1989, leg. Loksa, I. & Zicsi, A.

Short description. Length of idiosoma 630 µm, width 510 µm (female). Shape of idiosoma circular.

Dorsal idiosoma (Fig. 40). Marginal and dor sal shields fused anteriorly, marginal shield with incision on caudal area. Dorsal and marginal shields without ornamentation and bearing smooth and needle-like setae.

Ventral idiosoma (Fig. 41). Sternal setae short and needle-like, ventral setae similar in shape and length to sternal setae. Sternal and ventral shield smooth, without sculptural pattern. Genital shield oval, without anterior process and with a few reticulate patterns. Peritremes R-shaped (Fig. 42). Tritosternum with narrow basis, laciniae divided into six branches (Fig. 43).

Gnathosoma (Fig. 44). Corniculi horn-like, internal malae shorter than corniculi, hypostomal setae h1 and h2 smooth, h3 and h4 apically pilose. Epistome marginally serrate on its basal part, pilose on its apical part (Fig. 45). Fixed digit of chelicerae longer than movable digit, internal sclerotised node absent (Fig. 46). Palp trochanter bearing two setae, one of them short and smooth, the other one apically divided and serrate (Fig. 47).

Remarks. This species was previously recorded from Columbia, this is the first record from Ecuador.

Family Discourellidae Baker & Wharton, 1952

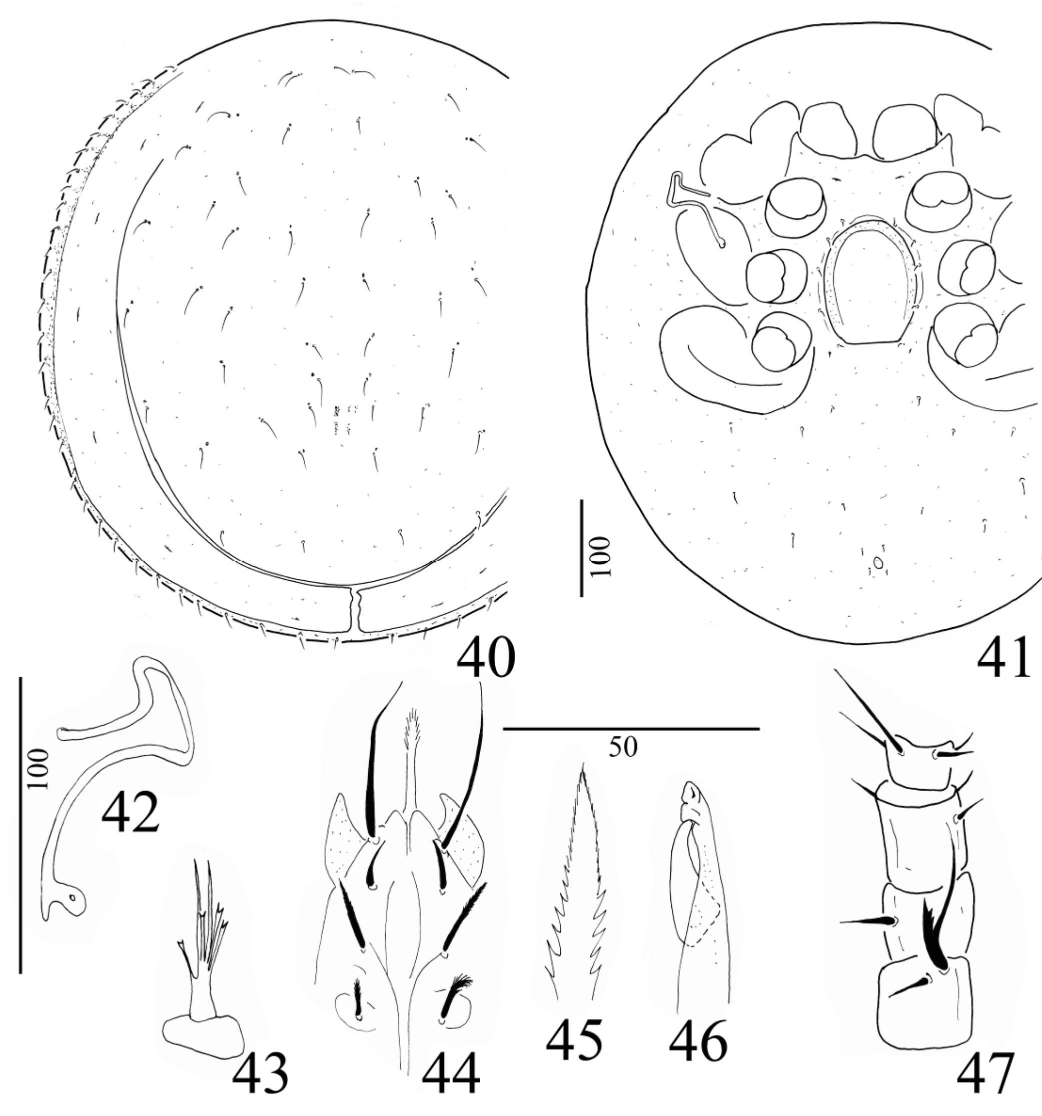
Clivosurella pilosa sp. nov.

(Figures 48–56)

Material examined. Holotype. Female. ECU 1989, B64. Ecuador, Rio Guajalito, Las Palmeras, 1850 m a.s.l. (Prov. Pichincha), moss from rocky roadside, 18. IV. 1989., leg. Loksa, I. & Zicsi, A. Paratypes. One female and eight males, locality and date as for the holotype. Holotype female and seven males paratypes deposited in HNHM, one female and male paratypes in NHMG.

Description. Female. Length of idiosoma 440–450 µm, width 320–330 µm (n=2). Shape pentangular.

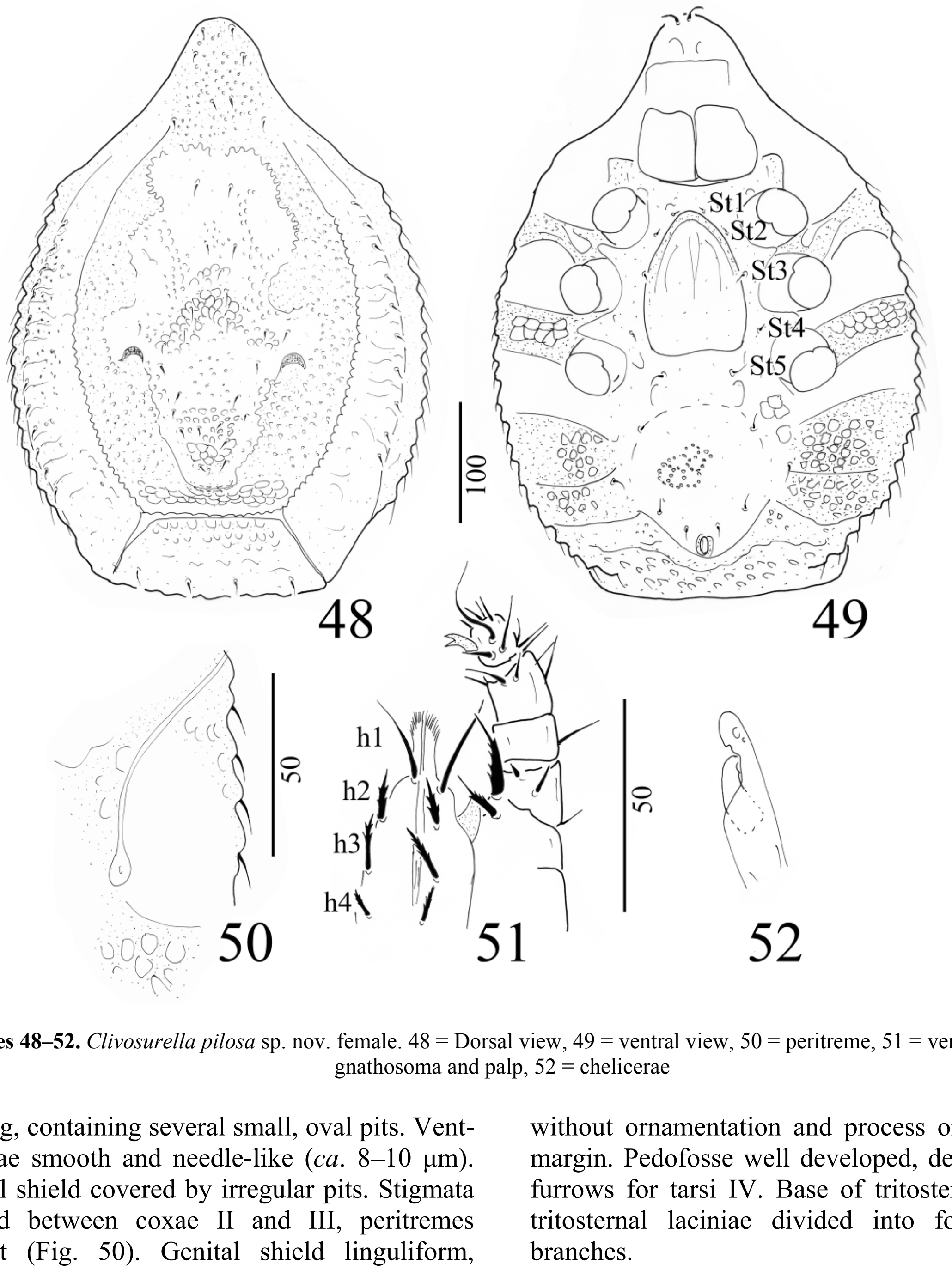
Dorsal idiosoma (Fig. 48). Marginal and dorsal shields fused anteriorly. Central region of dorsal shield elevated from the other parts of dorsum and bearing one pair of strongly sclerotized, C-shaped lines at level of coxae IV, smooth and needle like setae (*ca*. 7–8 µm) and irregular, small pits. Marginal setae (*ca*. 7–8 µm) smooth and needle-like as well and situated on small protuberances. Marginal shield divided into two lateral parts and one pygidial shield. Pygidial shield



Figures 40–47. *Laqueaturopoda (Hiramatsulaqueata) cocuyensis* (Hirschmann, 1984) female. 40 = Dorsal view, 41 = ventral view, 42 = peritreme, 43 = tritosternum, 44 = ventral view of gnathosoma, 45 = epistome, 46 = chelicera, 47 = ventral view of palp

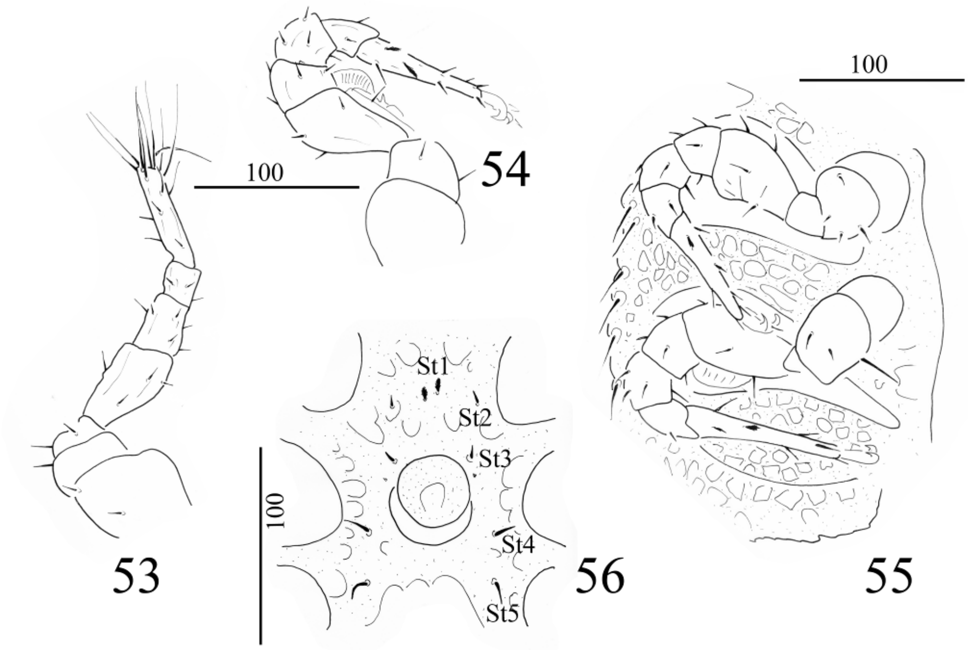
trapezoid, bearing alveolar pits near anterior margin, provided with two pairs of needle-like setae (*ca*. 8–9 µm) on small protuberances.

Ventral idiosoma (Fig. 49). Ornamentation on sternal shield absent. Sternal setae short (St1–St4 *ca*. 4–5 µm; St5 *ca*. 10 µm), smooth and needle-like. St1 situated near anterior margin of genital shield, St2 at the level of central region of coxae II, St3 at the level of central region of coxae III, St4 at the level of anterior margin while St5 at the level of posterior margin of coxae IV. One large, circular depression present anteriorly to the anal opening, containing several small, oval pits. Ventral setae smooth and needle-like (*ca*. 8–10 µm). Ventral shield covered by irregular pits. Stigmata situated between coxae II and III, peritremes straight (Fig. 50). Genital shield linguliform, without ornamentation and process on its apical margin. Pedofosse well developed, deep, without furrows for tarsi IV. Base of tritosternum wide, tritosternal laciniae divided into four smooth branches.



Figures 48–52. *Clivosurella pilosa* sp. nov. female. 48 = Dorsal view, 49 = ventral view, 50 = peritreme, 51 = ventral view of gnathosoma and palp, 52 = chelicerae

Gnathosoma (Fig. 51). Corniculi horn-like, internal malae longer than corniculi and their margins pilose. Hypostomal setae are the follows: h1 (*ca*. 23 µm) smooth and situated near anterior margin of gnathosoma, h2 (*ca*. 11 µm) wide, h3 (*ca*. 14 µm) and h4 (*ca*. 8 µm) narrow, h2–h4 marginally serrate. Base of epistome subtriangular, with serrate margins, apical part long and smooth. Movable digit of chelicerae shorter than fixed digit (Fig. 52).



Figures 53–56. *Clivosurella pilosa* sp. nov. female. 53 = Leg I, 54 = leg II, 55 = leg III and IV, 56 = intercoxal region of male

Legs with smooth and marginally pilose setae, leg I without apical claws (Figs. 53–55).

Male. Length of idiosoma 440–460 µm, width 310–330 µm (n = 8). Shape pentangular. Dorsal idiosoma. Ornamentation and chaetotaxy of dorsal shields as in female. Ventral idiosoma (Fig. 56). Sternal shield with irregular pits. St1 pilose (*ca*. 5 µm), other sternal setae smooth and needle-like, St2–St3 short (*ca*. 6–7 µm), St4–St5 long (*ca*. 12–14 µm). Genital shield rounded, placed between coxae III, without ornamentation and setae. Gnathosoma similar to that of the female.

Nymphs and larvae unknown.

Etymology. The name of the new species refers to the first sternal setae of male.

Remarks. Kontschán (2010b) resurrected the genus *Clivosurella* and prepared a new key to the species. This new species can easily be recognised and distinguished from the other *Clivosurella* species on the basis of the presence of strongly sclerotized, C-shaped dorsal lines, and the first pilose sternal setae in the males.

REFERENCES

Athias-Binche, F. & Błoszyk, J. (1988): Australian Uropodina (Acari: Anactinotrichida). 1. *Australocilliba* gen. n. (Cillibidae). *Journal of the Australian Entomological Society*, 27: 1–8.

Hiramatsu, N. (1981): Gangsystematik der Parasitiformes Teil 400. Stadium einer neuen *Uroseius (Uroseius)*-Art aus Ekuador. *Acarologie. Schriftenreihe für Vergleichende Milbenkunde,* 28: 100–101.

HIRSCHMANN, W. (1984a): Stadiensystematik der Parasitiformes, Teil 4. Die Adultengattung *Ungulaturopoda* nov. gen. Hirschmann, 1984. (Uropodidae, Atrichopygidiina). *Acarologie. Schriftenreihe für Vergleichende Milbenkunde,* 31: 45–46.

HIRSCHMANN, W. (1984b): Stadiensystematik der Parasitiformes Teil 3. Die Adultengattung *Laqueaturopoda* Hirschmann, 1979. Die Adultenuntergattung *Hiramatsulaqueata* nov. subgen. Hirschmann, 1984 (Uropodidae, Atrichopygidiina). *Acarologie. Schriftenreihe für Vergleichende Milbenkunde,* 31: 37–39.

HIRSCHMANN, W. (1993): Gangsystematik der Parasitiformes Teil 550. Bestimmungstabellen der Uropodiden der Erde, Atlas der Ganggattungen der Atrichopygiina. *Acarologie. Schriftenreihe für Vergleichende Milbenkunde,* 40: 292–370.

KONTSCHÁN, J. (2008): A review of the Neotropical family Tetrasejaspidae (Acari: Uropodina) with descriptions of three new species. *Opuscula Zoologica Budapest,* 37: 29–42.

KONTSCHÁN, J. (2008): New and rare *Rotundabaloghia* species (Acari: Uropodina) from the tropics. *Opuscula Zoologica Budapest,* 38: 15–41.

KONTSCHÁN, J. (2010a): Notes on *Kaszabjbaloghia* with the description of a new species from Ecuador (Acari: Mesostigmata: Uropodidae). *Zoologia, Curitiba,* 27(1): 138–145.

KONTSCHÁN, J. (2010b): New and little known Uropodina species from Brazil (Acari: Mesostigmata). *Acta Zoologica Academiae Scientiarum Hungaricae,* 56(4): 317–334.

MISCHIS C.C., CSUZDI, CS. & ARGUELLO, G. (2006): *A contribution to the knowledge of earthworm fauna (Annelida, Oligochaeta) from the Argentinian Patagonia.* In. POP, VV. & AA. POP (eds.) Advances in earthworm taxonomy II. University Press, Cluj, pp. 173–182.

WIŚNIEWSKI, J. (1993): Gangsystematik der Parasitiformes Teil 549. Die Uropodiden der Erde nach Zoogeographischen Regionen und Subregionen geordnet (Mit Angabe der Lande). *Acarologie. Schriftenreihe für Vergleichende Milbenkunde,* 40: 221–291.

WIŚNIEWSKI, J. & HIRSCHMANN, W. (1993): Gangsystematik der Parasitiformes Teil 548. Katalog der Ganggattungen, Untergattungen, Gruppen und Arten der Uropodiden der Erde. *Acarologie. Schriftenreihe für Vergleichende Milbenkunde,* 40: 1–220.

ZICSI, A. & CSUZDI, CS. (1988): Über einige *Thamnodrilus*-Arten und andere Regenwürmer aus Ekuador (Oligochaeta: Glossoscolecidae, Lumbricidae, Megascolecidae) Regenwürmer aus Südamerika, 3. *Opuscula Zoologica Budapest*, 23: 209–218.

ZICSI, A. & CSUZDI, CS. (2008): Report on the soil zoological expeditions to Ecuador and Columbia between 1986 and 1993. I. List of localities and habitats of “Berlese” samples. *Opuscula Zoologica Budapest,* 37: 71–88.

New Oppioidea taxa from Madagascar (Acari: Oribatida)

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Abstract. Within the framework of the continuous survey of the Madagascan Oribatida Fauna some newly surveyed Oppioidea (Acari: Oribatida) species are discussed. Altogether 15 species are listed of the recently studied, identified and described taxa originating from several sites of the island (Malagasy Republic). Seven species of them are new to science and some other known only from few localities. One species represents also a new genus, *Interbelba* gen. nov. Three species, *Berniniella bicarinata* (Paoli, 1908), *Quadroppia circumita* (Hammer, 1961) and *Discosuctobelba variosetosa* (Hammer, 1961) are recorded from Madagascar for the first time. With 22 figures.

Keywords. Moss mites, taxonomical studies, new species, new distribution, Republican'i Madagasikara.

INTRODUCTION

In this series of our papers we elaborate continuously the oribatids of Madagascar (Mahunka, 2009a, b, c, 2010, 2011; Mahunka & Mahunka-Papp, 2011). In our last work we identified, described and discussed oribatids with the exception of species belonging to the superfamily Oppioidea (sensu Norton & Behan-Pelletier, 2009). In the present paper we fill this gap giving a list containing description of fifteen species belonging to different oribatid families (Oppiidae Sellnick, 1927, Quadroppiidae Balogh, 1983 and Suctobelbidae Jacot, 1938). Of them, the following seven species are new to science: *Oxyoppia* (*Oxyoppiella*) *crassata* sp. nov., *Ramusella (Ramusella) arcuata* sp. nov., *Ramusella* (*Insculptoppia*) *lata* sp. nov. *Interbelba solifera* sp. nov., *Persuctobelba flagellatissima* sp. nov., *Suctobelbila punctocostulata* sp. nov. and *Suctobelbila tumida* sp. nov.

One of them represent also a new genus *Interbelba* gen. nov., and further three species *Quadroppia circumita* (Hammer, 1961), *Berniniella bicarinata* (Paoli, 1908) and *Discosuctobelba variosetosa* (Hammer, 1961) are recorded for the first time in Madagascar.

In this paper, as in the earlier ones, we follow the system of Norton and Behan-Pelletier (2009) and Subías (2004, 2010), and besides we also use some work, which was mentioned in Mahunka (2010). In the descriptions the morphological terminology follows our previous publications, the work of Norton and Behan-Pelletier (2009) and other listed authors (e.g. Weigmann, 2006 and Woas, 2002).

Depositories. The main part of the studied material and species examined are deposited in the Hungarian Natural History Museum, Budapest (HNHM), some types and voucher specimens also in the Muséum d'histoire naturelle de Genève (MHNG).

LOCALITIES

Afr – 858. Madagascar, Masoala Peninsula, Tropical rainforest the W coast, on the E side ridge of Ambanizana village. 9–11.September, 2009. Leg. T. Pócs (No. 9447).

Afr – 859. Madagascar, Antongil Bay, Nosy Mangabe Island. S of Maroansetra town, 13. September, 1994. Leg. T. Pócs (9450)

Afr – 917. Madagascar, Antsiranana Province, Nosy Komba Island. Submontane rainforest remnants in the NW valleyof Antaninaomby summit with tree ferns and with *Mariatta fraxinea*, at 570–580 m alt. 29. July, 1998. Leg. T. Pócs. (No. 9862).

Afr – 921. Madagascar, Toamasina Province, Mananara North Biosphere Reserve and National Park. Lowland rainforest on the E slopes of Mahavoho Hill (very wet types along Manahovo River, with many tree ferns, palms and Pandanus ssp., less humid on slopes) at 220–300 m alt. 14–15. August, 1998. Leg. T. Pócs. (No. 9878).

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†*Luise Mahunka-Papp* deceased on 28. November, 2011.

Afr – 923. Madagascar, Toamasina Province. Maromizaha forest. Mossy montane rainforest with bamboo (*Nastus* sp.) undergrowth on the summit ridge of Mt. Maromizaha, south of the Andasibe National Park and the Antananarivo – Toamasina road, 2 km W of Anevoka village, at 1080–1214 m alt. 26. August, 1998. Leg. T. Pócs (No. 9890).

Mad – 89/3. Madagascar, Prov. Tamatave Moramanga: Analamazoatra special reserve (Perinet) before Andasibe, primary forest with dominating Ravensara sp. (Lamuraceae). 1020 m. 21. November, 1989. Leg. B. Hauser.

LIST OF THE NEWLY IDENTIFIED SPECIES

OPPIIDAE Sellnick, 1927

Aethioppia cucheana (Mahunka, 1994)
Locality. Afr – 921.

Berniniella bicarinata (Paoli, 1908*)*
Locality. Afr – 917.

Lanceoppia madagascarensis Mahunka, 2002
Locality. Afr – 917.

Oppiella **(***Oppiella*) *nova* (Oudemans, 1902)
Locality. Afr – 917.

Oxyoppiella (*Oxyoppiella*) *zsuzsankae* Mahunka, 2002
Locality. Afr – 859

Oxyoppia (*Oxyoppiella*) *crassata* sp. nov.

Pseudoramusella arcuata sp. nov.

Ramusella (*Insculptoppia*) *lata* sp. nov.

Striatoppia madagascarensis Balogh, 1961
Locality. Afr – 917.

QUADROPPIIDAE Balogh, 1983

Quadroppia circumita (Hammer, 1961)
Locality. Afr – 917

SUCTOBELBIDAE Jacot, 1938

Discosuctobelba variosetosa (Hammer, 1961)
Locality. Afr – 858.

Interbelba solifera gen. nov., sp. nov.

Persuctobelba flagellatissima sp. nov.

Suctobelbila punctocostulata sp. nov.

Suctobelbila tumida sp. nov.

DESCRIPTIONS

Oxyoppia (Oxyoppiella) crassata sp. nov.

(Figures 1a – 1b)

Diagnosis. Prodorsum wide, gradually narrowed anteriorly, rostral apex slightly rounded. Costulae long, distinctly converging medially, a short translamella present. Lamellar cusp short, lamellar setae located behind the apices. Rostral, lamellar and interlamellar setae very short. Interbothridial region with two pairs of sigilla and one pair of short longitudinal crista observable. Bothridium large, sensillus very long, with fusiform, distinctly barbed head. Anterior margin of notogaster gradually convex, with a pair of very small apophysis. Ten pairs of setiform, simple notogastral setae present. Epimeral region well sclerotized, a pair of characteristic, sack-shaped formation present in sejugal region, laterally. Posterior part of sternal apodema absent, *ap*. 3 directed to genital apertures. Genito-anal setal formula: 5 – 1 – 2 – 3. Setae ad_3 in preanal, lyrifissures *iad* in inverse apoanal position.

Material examined. Holotype. Madagascar, Antongil Bay, Nosy Mangabe Island. S of Maroansetra town. 13. September, 1994. Leg. T. Pócs (9450) (Afr – 859). 1 paratype from the same sample. Holotype (1835-HO-2012) deposited in HNHM, paratype in MHNG.

Measurements. Length of body 275 μm, width of body 135 μm.

Prodorsum. Simple, wide, rostral part narrowed its surface punctuate. Costulae long, with short weak anterior part present in front of transversal parts. These parts bearing lamellar setae. Two pairs of round, interbothridial sigilla and one pair of short crests present in basal position. All four pairs of prodorsal setae very short and simple. Bothridium well sclerotized. Sensillus conspicuously long, its distal part dilate, with long bristles, scopulate.

Notogaster. Surface finely punctuate. Anterior margin of notogaster simply convex, with one pair

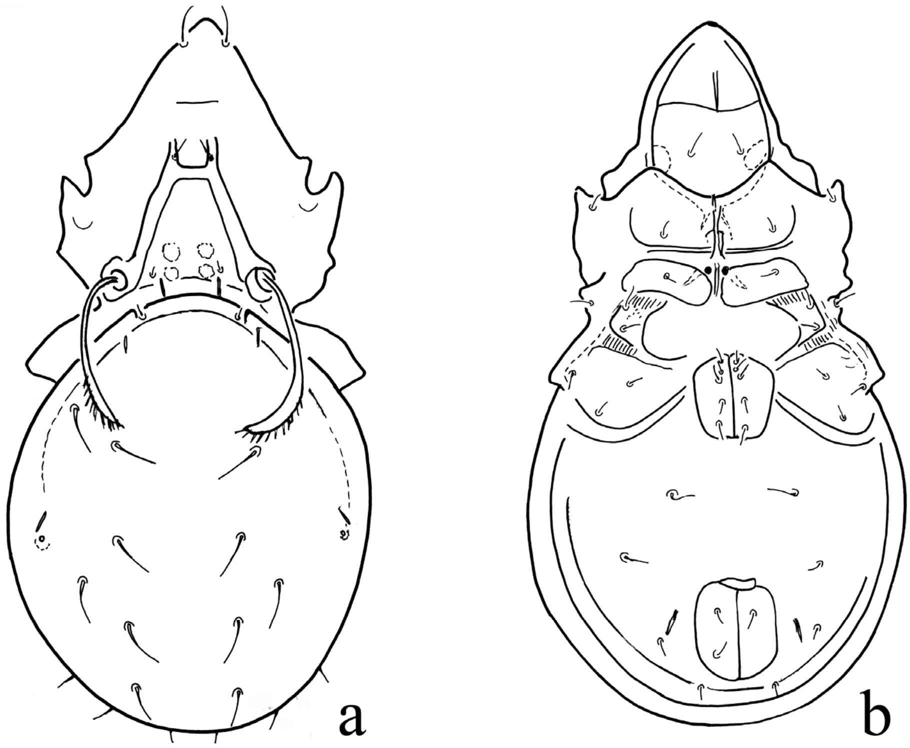

Figure 1. *Oxyoppia (Oxyoppiella) crassata* sp. nov. a = body in dorsal view, b = body in ventral view

of short apophysis laterally. Ten pairs of notogastral setae present, setae c_2 and *p* much shorter than the median setae. These latter pairs simple, setiform.

Ventral parts. Epimeral region with peculiar formation, epimere I and II normal, well sclerotized, this part with well developed sternal apodema. Sejugal and epimere III modified, between them a sack-shaped formation present. This part with darker cuticle. Posterior part of sternal apodema absent. Apodemes 4 bent behind the genital aperture. All epimeral setae short, simple, epimeral setal formula 3 – 1 – 3 – 3. Ventral plate finely punctuate. All setae of this region short and simple. Genitoanal setal formula 5 – 1 – 2 – 3. Among the adanal setae ad_1 in postanal, ad_3 in preanal position. Lyrifissures *iad* distinctly inverse apoanal type.

Remark: The new species is readily distinguishable from all related taxa by the unique sculpture of the epimeral region.

Etymology. The species name refers to the dilated, well sclerotized sculpture.

Ramusella (Ramusella) arcuata sp. nov.

(Figures 2a – 2c)

Diagnosis. Prodorsum wide, rostral part widely rounded. Rostral setae arising dorsally, near to each other, gradually bent inwards. Costulae and lateral carinae well distinct, Sensillus pectinate, slightly dilated medially, with 5–6 different ciliae. Epimeral region simple, All apodemes and borders typical for this group. Anogenital setal formula 5 – 1 – 2 – 3. Lyrifissures *iad* located in adanal position.

Material examined. Holotype. Madagascar, Toamasina Province, Mananara North Biosphere Reserve and National Park. Lowland rainforest on the E slopes of Mahavoho Hill (very wet types along Manahovo River, with many tree ferns, palms and *Pandanus* ssp., less humid on slopes) at 220–300 m alt. 14–15. August, 1998. Leg. T. Pócs. (No. 9878). (Afr – 921). 1 paratype from the same sample. Holotype (1836-HO-2012) deposited in HNHM, paratype in MHNG.

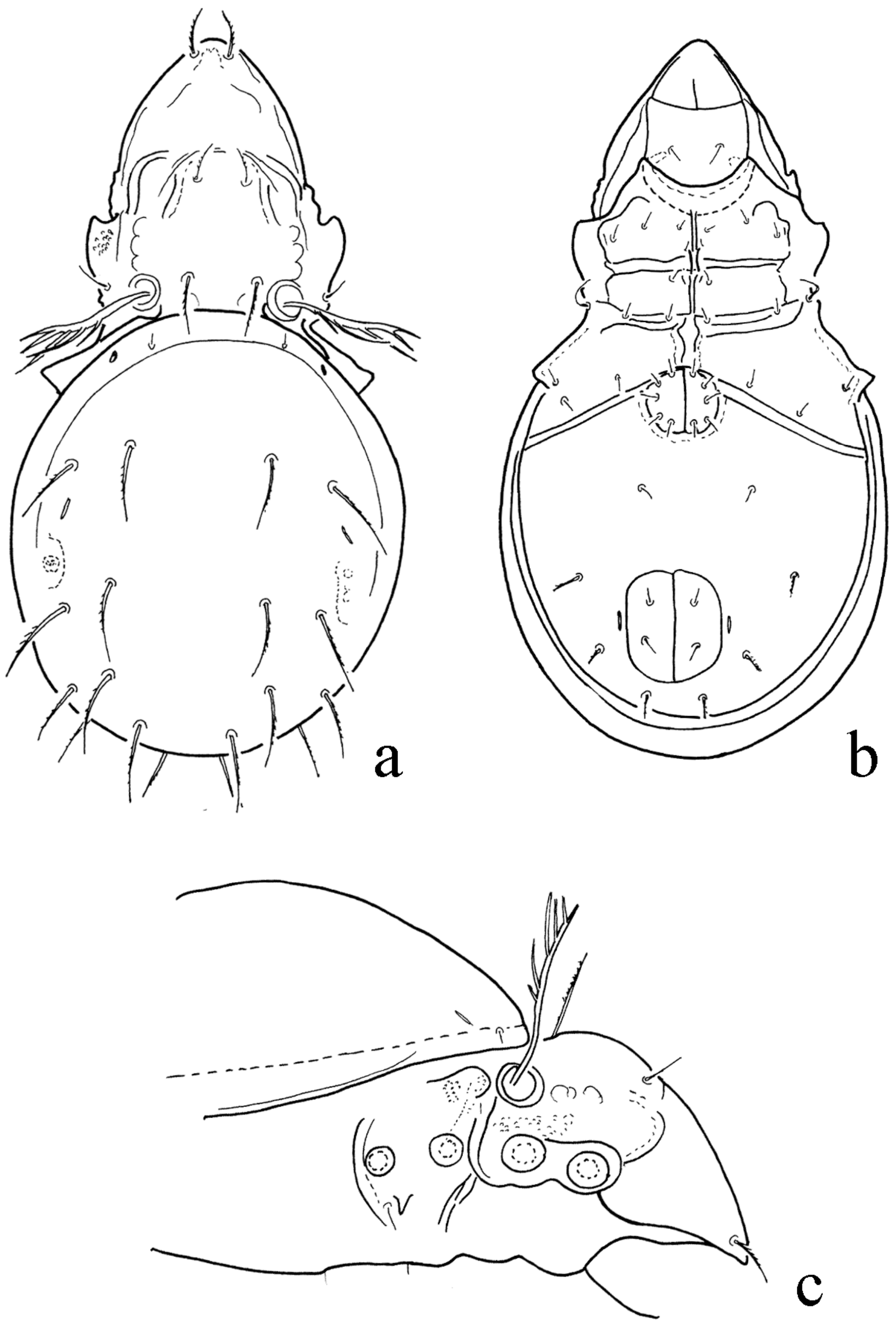

Figure 2. *Ramusella*(*Ramusella*) *arcuata* sp. nov. a = body in dorsal view, b = body in ventral view, c = body in lateral view

Measurements. Length of body 324–342 μm, width of body 178–219 μm.

Prodorsum. Rostral apex widely rounded. Rostral setae arising on dorsal surface, comparatively near to each other. Their shape simple, arched inwards, with short setae on lateral surface. Lamellar setae shorter, interlamellar one longer than rostral ones. Prodorsal costula distinct, well developed longitudinally, only a fine line anteriorly, transversally. A pair of well developed, horseshoe-shaped lateral carina also present. Sensillus

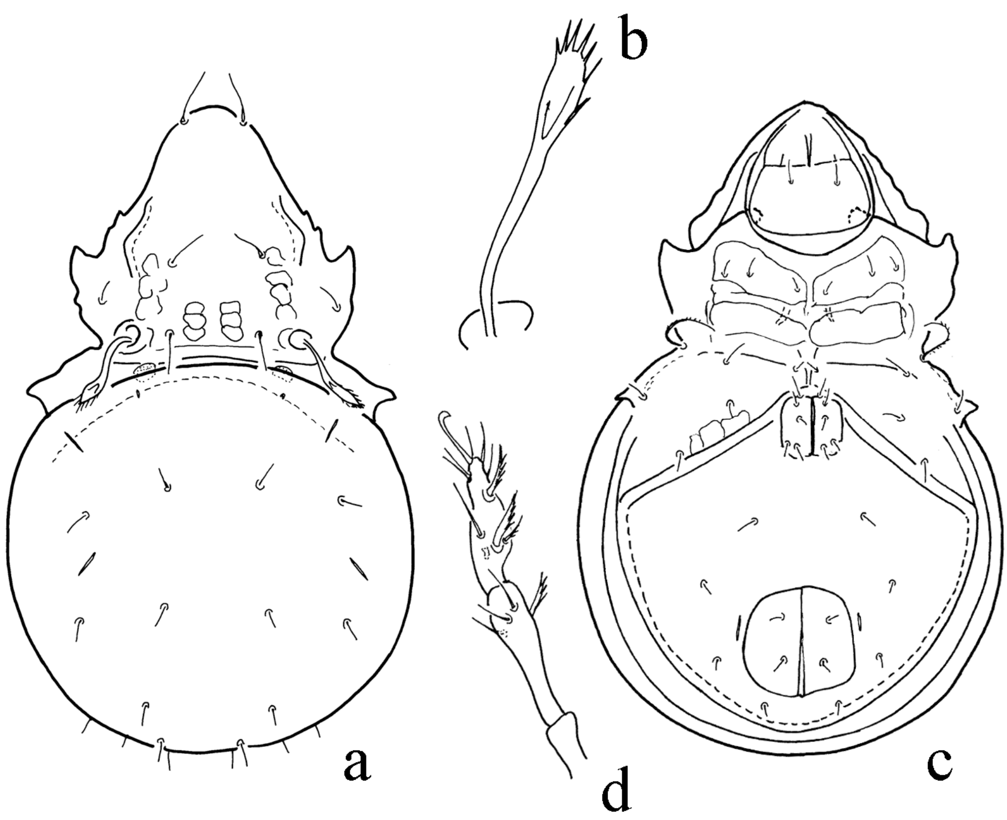

Figure 3. *Ramusella* (*Insculptoppia*) *lata* sp. nov. a = body in dorsal view, b = sensillus c = podosoma in ventral view, d = leg IV

distinctly dilated medially, pectinate, its cilia different in length. Exobothridial setae short, simple. Interbothridial sigilla absent.

Notogaster. Ten pairs of notogastral setae present, setae c_2 very short. Nine pairs nearly equal in length well ciliate.

Ventral parts. Epimeral region well scleroticzed, this part divided by transversal and sternal apodemes and borders. Apodemes 4 straight, directed laterally, posteriorly to genital plates. All epimeral setae simple, short.

Remarks. The new species can be identified as member of subgenus *Ramusella* (*Ramusella*) Hammer, 1962. It is well characterised by the conspicuous form of prodorsal crests, costula and the dilated, pectinate sensillus.

Etymology. Named after the form of prodorsal crests.

***Ramusella (Insculptoppia) lata* sp. nov.**

(Figures 3a – 3d)

Diagnosis. Whole body conspicuously wide, notogaster high in lateral view. Rostrum widely rounded, rostral setae originate very far from each other, arising in lateral position. Lamellar and translamellar lines absent. Three pairs of very large sigillae between the interlamellar setae. All prodorsal setae very fine. Sensillus fusiform with ciliate distal part. One pair of round area in dorsosejugal region. Nine pairs of same length notogastral setae, setae *la* posterior to setae *lm.* Apodemes and epimeral borders strongly sclerotized, compose a well observable network. Genital plates with 5 pairs of setae. Adanal setae in usual position, lyrifissures *iad* paraanal.

Material examined. Holotype. Madagascar, Toamasina Province, Mananara North Biosphere

Reserve and National Park. Lowland rainforest on the E slopes of Mahavoho Hill (very wet types along Manahovo River, with many tree ferns, palms and Pandanus ssp., less humid on slopes) at 220–300 m alt. 14–15. August, 1998. Leg. T. Pócs. (No. 9878) (Afr – 921). 1 paratype: Madagascar, Prov. Tamatave, Moramanga, Analamazoatra special reserve (Perinet) before Andasibe. 21. November, 1989. Leg. B. Hauser (Mad – 89/3). Holotype (1837-HO-2012) deposited in HNHM, paratype in MHNG.

Measurements. Length of body 302–324 µm, width of body 194–206 µm.

Prodorsum. Rostral apex widely rounded, rostral setae arched inwards, originate comparatively near to each other. Median costula well developed, with very thin and fine transversal line. Lateral crests directed medially, horseshoe shaped. Lamellar setae shorter than interlamellar ones. Sensillus pectinate, slightly dilate medially, with furcating distal end.

Ventral part. Epimeral region well sclerotized, but transversal apodemes and epimeral borders narrow. Sternal apodema present, but thinner than preceding ones. Epimeres with some weak polygonal pattern. Epimeral setae short, fine. Genito-anal setal formula: 5 – 1 – 2 – 3. All ventral setae simple, short. Setae ad_1 postanal, ad_3 in preanal position, lyrifissures *iad* in paraanal position.

Legs. All legs' articles short. Setae *pv*' and *pv*'' with characteristic bristles.

Remarks. The new species is well characterised by the conspicuous body size, by the characteristic prodorsal formation and the shape of sensillus.

Etymology. The species name refers to the form of the costulae and prodorsal crests.

Quadroppia circumita (Hammer, 1961)

(Figures 4a – 4b)

Notes to the morphology. Rostrum rounded, rostral field wide, quadrangular, its margins mostly straight, with small teeth on their outer side, anterior margin also well observable. Lamellae normal, translamellae continue in short and indistinct longitudinal crests posteriorly. Lateral crests well developed. Interlamellar surface smooth. Bothridium large, with angular basal part, sensillus directed mostly backwards, its head conspicuously large, well barbed. Notogaster with distinct longitudinal crests, its posterior part also well visible. Epimeral surface with wide sternal field between the epimer 1 and epimer 3. Apodemes IV with distinct longitudinal transversal crests.

Measurements. Length of body 157–166 µm, width of body 80–88 µm.

Interbelba gen. nov.

Diagnosis. Suctobelboid type. Rostral part of prodorsum wide, without elongated median apex. Rostral setae simple, setiform. Tectopedial field partly reduced, without median border, a large unpaired ring present medially. Lamellar knob modified, divided into two small tubercles bearing lamellar setae. Bothridium with large lateral lobe, sensillus long with fusiform head. Anterior margin of notogaster with an elongate median and one pair connected curved, lateral crests. Notogastral surface ornamented with longitudinal necklace of pearls. Wide sternal field absent, sternal apodema well developed, with median thickened parts. Apodemes IV with curved thickening laterally. Along the genital opening a pair of fine crest, on the ventral plate some necklace-shape rows observable. Genitoanal setal formula: 6 – 1 – 2 – 3.

Type species. *Interbelba solifera* sp. nov.

Remarks. On the basis of the main features as described above the new genus is without relation. First of all the median formation of prodorsum, the median part of notogaster and the form of apodemes are unique features in the family Suctobelbidae.

Interbelba solifera sp. nov.

(Figures 5a – 5b)

Diagnosis. Rostrum elongated, its apex narrow. Lateral part angularly dilated, with characteristic pattern. Tectopedial field well framed laterally, between them a characteristic sun-shaped ring present. Lateroprodorsal crest also distinct, reach-

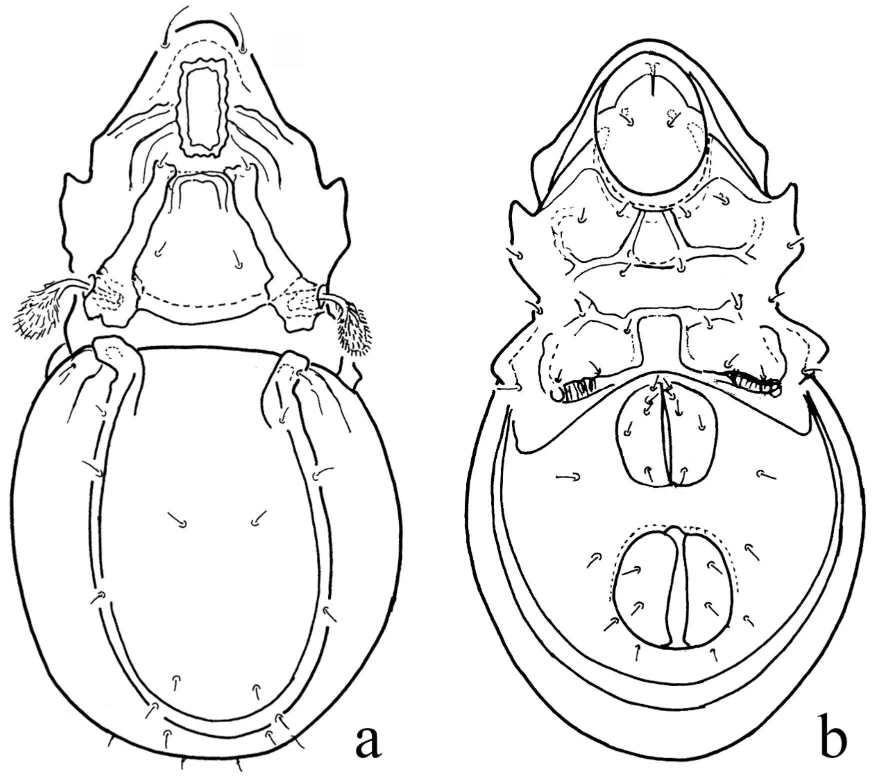

Figure 4. *Quadroppia circumita* (Hammer 1961). a = body in dorsal view, b = body in ventral view

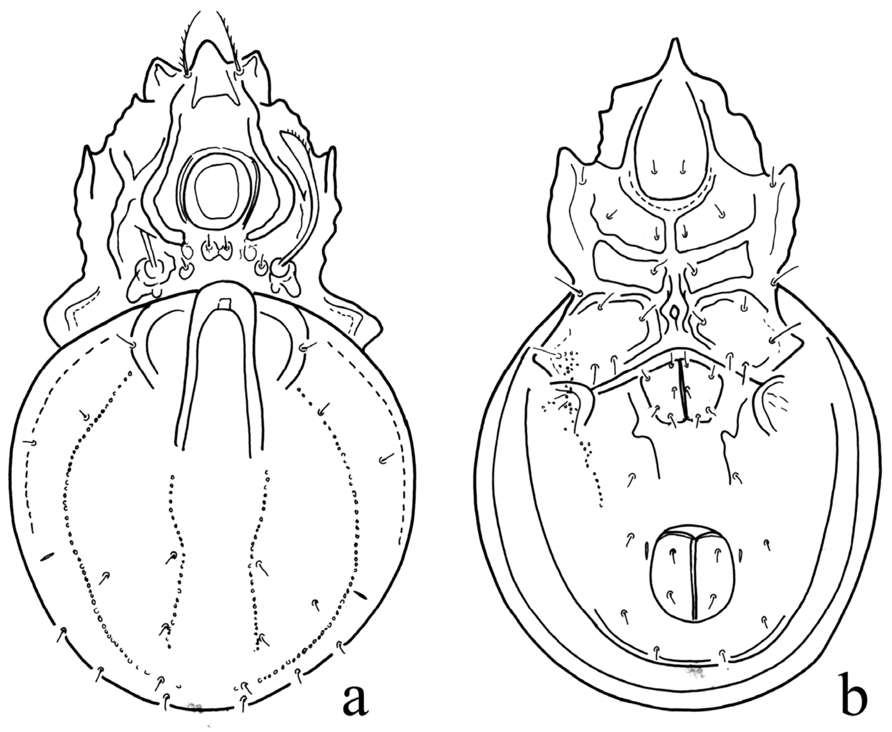

Figure 5. *Interbelba solifera* gen. nov., sp. nov. a = body in dorsal view, b = sensilus, c = body in ventral view

ing to the bothridium. Lamellar knob divided into two parts, weak, slightly dilated, bearing minute lamellar setae. Interbothridial field small, located far from each other. Bothridium well developed with large posterolateral lobe. Sensillus long with narrow, on its head some short bristles observable. Notogaster with characteristic longitudinal crests. Dorsosejugal crests consist of a longer and narrow medial and a pair of curved lateral crests. They are continuing in a longitudinal line of granules like pearl necklaces. Ten pairs of very short setae present. Epimeral region well sclerotised, sternal field absent, sternal apodema partly present. *Ap.* 4 with semicircle formation laterally. Genitoanal setal formula: 6 – 1 – 2 – 3.

Measurements. Length of body 260 µm, width of body 157 µm.

Material examined. Holotype. Madagascar, Antongil Bay, Nosy Mangabe Island. S of Maroansetra town. 13. September, 1994. Leg. T. Pócs (9450). (Afr – 859) Holotype (1838-HO-2012) deposited in the HNHM.

Prodorsum. Rostral tooth very large and wide. Rostral elevation weak, bearing the setiform rostral setae, with 5–6 distinct cilia. Some weak accessory teeth (or serrated margin) also observable on the lateral margin of prodorsum. Median part of prodorsum modified, a very large ring-shaped costula present medially between the tectopedial fields. The position of lamellar knob also modified, basally 2–3 pairs of rounded tubercles observable. Bothridium well developed, bothridial lobe large, directed outwards. Sensillus long, its head asymmetrically dilate, with some short bristles.

Notogaster. Dorsosejugal margin with an unpaired median and a pair of lateral thickening, true normal ”condyles” absent. Longitudinal rows of granules like pearl-necklaces also observable. Ten pairs of short simple and smooth notogastral setae.

Ventral parts. Epimeral region well sclerotized. Sternal field very narrow or absent, sternal apodema partly present, near to the sejugal region an angular field observable. Epimeres IV bordered by characteristic apodemes ending in concave lateral parts. Epimeral surface partly granulate, these sometimes ordered in longitudinal rows. Along the genital aperture a pair of fine line present. All setae in the epimeral and genitoanal region short and simple. Genitoanal setal formula: 6 – 1 – 2 – 3. Behind the anal aperture a semicircle crest present, setae ad_1 arising on it.

Remarks. See the remarks of the description and the differential diagnosis of the new genus.

Etymology. The species name refers to the characteristic, sun-shaped sculpture in the middle of prodorsum.

Persuctobelba flagellatissima **sp. nov.**

(Figures 6a – 6c)

Diagnosis. Rostrum elongated, with nasiform comparatively wide rounded apex. Four pairs of rostral teeth present laterally. Rostral setae simple, setiform. Tectopedial field framed laterally, its inner part with polygonal pattern. Lamellar knob confluent with interbothridial tubercles. Sensillus with dilated head bearing some short and a long distal seta. Anterior margin of notogaster with one pair of large rounded lateral condyles. Thirteen pairs of flagellate notogastral setae. Apodemes and borders of epimeral region well developed, without sternal apodema. Genitoanal setal formula: 5 – 1 – 2 – 3.

Material examined. Holotype. Madagascar, Antongil Bay, Nosy Mangabe Island. S of Maroansetra town. 13. September, 1994. Leg. T. Pócs (9450) (Afr – 859). Holotype (1839-HO-2012 deposited in the HNHM.

Measurements. Length of body 297 µm, width of body 172 µm.

Prodorsum. Rostral apex elongated nasiform. Four pairs of lateral teeth comparatively large well separated from each other by rostral incisures. Median rostral elevation long bearing simply curved rarely ciliate rostral setae. Tectopedial field distinct, its lateral border well separated. Inner surface ornamented by polygonal

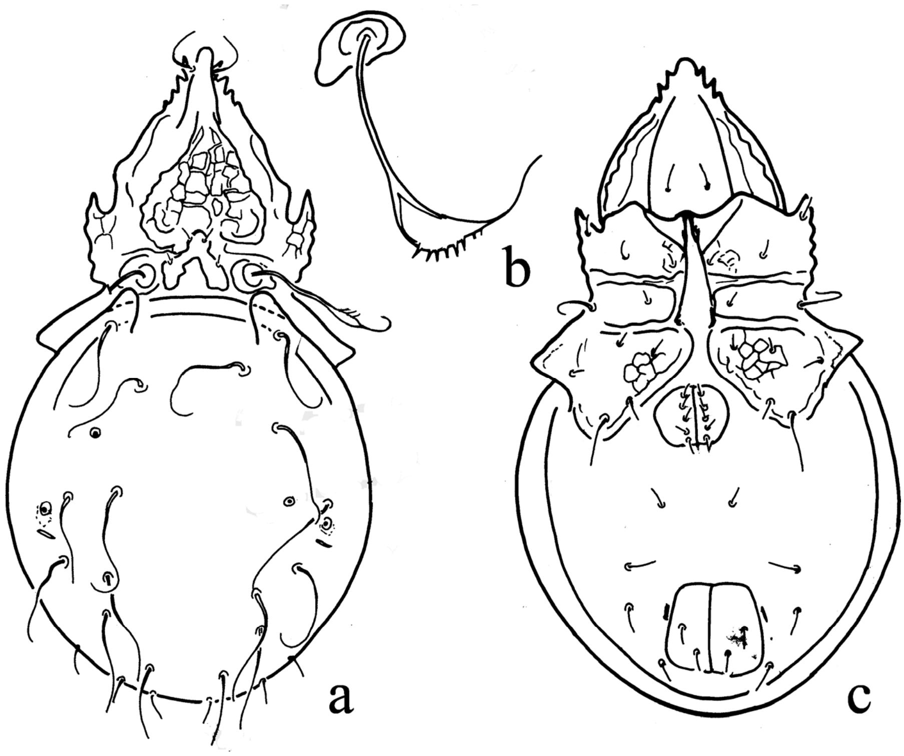

Figure 6. *Persuctobelba flagellatissima* sp. nov. a = body in dorsal view, b = sensillus, c = body in ventral view

pattern. Lamellar knob large, confluent with interbothridial tubercles. Lamellar and interlamellar setae minute. Bothridium large with large bothridial lobe directed laterally. Sensillus with dilated head bearing some short and a long distal seta.

Notogaster. Anterior margin of notogaster with one pair of large rounded lateral condyles, median condyles absent. Thirteen pairs of long, partly flagellate notogastral setae. Setae $p_1 - p_3$ short, simple.

Ventral parts. Apodemes and borders of epimeral region well developed, without sternal apodema. A narrow sternal field between the epimeres observable. Epimeral surface with irregular pattern. Epimeral setae simple, setae *3*c and *4*b longest of all. Genitoanal setal formula: 5 – 1 – 2 – 3, arising in one longitudinal row. Aggenital setae arising medially, anal setae located in the posterior part of anal plates.

Remarks. The new species is the third one of the genus *Persuctobelba* Mahunka, 2001, all described from Madagascar. The new species is well distinguishing from the earlier ones by the form of the rostrum and by the flagellate sensillus.

Etymology. The species name refers to the flagellate notogastral setae.

Suctobelbila punctocostulata sp. nov.

(Figures 7a – 7c)

Diagnosis. Large species, its length larger than 250 µm. Anterior part of prodorsum nasiform, with small rounded apex. Lateral margin of prodorsum with some small lateral teeth and incisure. A pair of tectopedial fields present, between them an undulate field visible. A rounded lamellar knob and behind it a characteristic, crescent-shaped, transversal rib observable. Bothridium large, they have a large, laterally dilated bothridial lobe. Sensillus long directed forwards, its head fusiform with dilated velum. Anterior margin of notogaster protruding medially, with two pairs of bent crests. Surface partly smooth, partly covered by small secretion granules ordered in two pairs of longitu

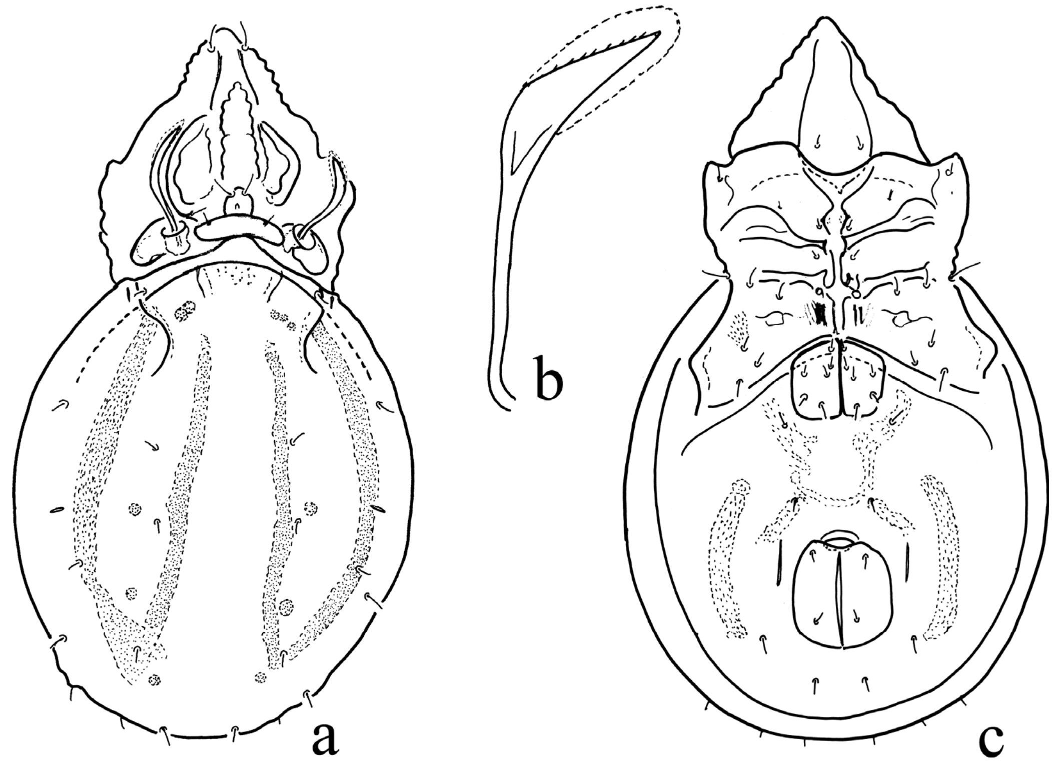

Figure 7. *Suctobelbila punctocostulata* sp. nov. a= body in dorsal view, = b = sensillus, c = body in ventral view

dinal rows. Four pairs of porose fields also present. Ten pairs of very short notogastral setae present. Epimeral region well sclerotized, with sternal apodema and a pair of short, bridge shaped formation. Ventral plate with irregular, mostly in longitudinal rows ordered granulate crests. Genito -anal setal formula: 6 – 1 – 2 – 3. Setae ad_3 in preanal position Lyrifissures *iad* in paraanal position.

Material examined. Holotype. Madagascar, Antongil Bay, Nosy Mangabe Island. S of Maroansetra town. 13. September, 1994. Leg. T. Pócs (9450) (Afr – 859). Holotype (1840-HO-2012) deposited in the HNHM.

Measurements. Length of body 280 µm, width of body 160 µm.

Prodorsum. Rostrum comparatively narrow, its apex nasiform slightly rounded. Some lateral teeth and incisura observable, so the margin seems to be serrate. A pair of tectopedial fields present, well framed laterally, between them an undulate field visible, its margin undulate. A rounded, comparatively large lamellar knob, with lamellar setae present. Lamelar knob connected with a transversal, crescent shaped crista, bearing short interlamellar setae. Bothridium with very large, laterally dilated bothridial lobe. Sensillus long, directed forwards, its head fusiform with dilated, serrated velum.

Notogaster. Anterior margin of notogaster with an unpaired median protuberance and a pair of S-shaped crista. Notogastral surface with granulate field, there are two pairs of longitudinal narrow fields and four pairs of small, round spots. Ten pairs of minute notogastral setae present, all equal in length.

Ventral parts. Epimeral region well sclerotized, epimeral surface partly finely granulate. Sternal apodema narrow, with some broadening parts. Bridge-shaped formation also observable, especially strong at the sejugal apodemes. A pair of characteristic, bridge-shaped formation visible on epimeres II-IV. All epimeral setae short, some of them hardly observable. Ventral plate with granulate crests, among them one pair stronger in lateral, some other mostly in irregular position. Genito-anal setal formula: 6 – 1 – 2 – 3. Setae ad_3 in preanal position Lyrifissures *iad* in paraanal position.

Remarks. On the basis of the sculpture of the prodorsum (e.g. tectopedial field present or absent, interbothridial region with or without transversal crest) and the notogaster (e. g. notogaster with tubercles or only granulate crests), the species of the genus *Suctobelbila* Jacot, 1937 can be divided into more groups. The new species belongs to a group which is characterised by the presence of tectopedial field, basal transversal crest, and absence of notogastral tubercles. The new species is well characterised by the tectopedial fields, the shape of notogastral basal crista and the granulate longitudinal lines. However, the new species is also well distinguished from all congeners by the form of bothridium, the median protruding tubercles, as well as by the four pairs of notogastral porose areas. The latter is a unique feature in this genus.

Etymology. Named after the peculiar sculpture of costula.

Suctobelbila tumida **sp. nov.**

(Figures 8a – 8c)

Diagnosis. Large species, its length longer than 250 µm. Anterior part of prodorsum nasiform, with small rounded apex. Lateral margin of prodorsum without lateral teeth and incisure. True tectopedial fields absent. Prodorsum with a characteristic, nearly reversed U-shaped, strongly protruding field. Lamellar knob hardly observable, bearing lamellar setae. Interbothridial region with a transversal crest, also rise from the prodorsal surface. Bothridium large, cup-shaped. Sensillus long, directed forwards, its head wide, fusiform, with serrated margin. Anterior margin of notogaster simply convex, without condyles. Notogastral surface ornamented by one pair of long, longitudinal crest, median part with fine irregular polygonal pattern. Ten pairs of very short notogastral setae present. Epimeral region well sclerotized, with sternal apodema with a ring shaped formation between the sejugal and 4 apodemes. Ventral plate with granules sometimes in polygonal order observable. All setae minute, hardly observable. Genito-anal setal formula: 5 – 1 – 2 – 3. Setae ad_3 in paraanal, lyrifissures *iad* in adanal position.

Material examined. Holotype. Madagascar,. Antongil Bay, Nosy Mangabe Island. S of Maroansetra town. 13. September, 1994. Leg. T. Pócs (9450) (Afr – 859). 3 paratypes from the same sample. Holotype (1841-HO-2012) and 2 paratypes (1841-PO-2012) deposited in the HNHM, 1 paratype in MHNG.

Measurements. Length of body 269–274 µm, width of body 168–182 µm.

Prodorsum. Very wide, rostral apex rounded. Rostral incisure and teeth absent, rostral setae very short, simple. Median part with conspicuous, protruding part, with distinct border. True tectopedial field absent. Lamellar knob small, semicircle, hardly observable, bearing minute lamellar setae. Interbothridial region with a strong transvesal crest, which connected with bothridium. Sensillus comparatively long, its head with a fine serrated velum.

Notogaster. Anterior margin well convex medially, protruding anteriorly between the bothridia. Median surface with fine, map-shaped sculpture, it consists of small, mostly polygonal field. This part framed by a pair of stronger longitudinal crest. Lateral part of notogaster with granules, ordered in short rows.

Lateral part. Rostral part beak-shaped. Rostral tubercles projecting, well observable in this view. Lateral part of notogaster with characteristic granulate lines.

Ventral part. Epimeral borders and apodemes well developed, composing a connected network. Sternal apodema also present, bearing a ring shaped formation. Epimeral region smooth, ventral plate with granulate lines, the setae of this region hardly or not observable. Five pairs of genital setae present.

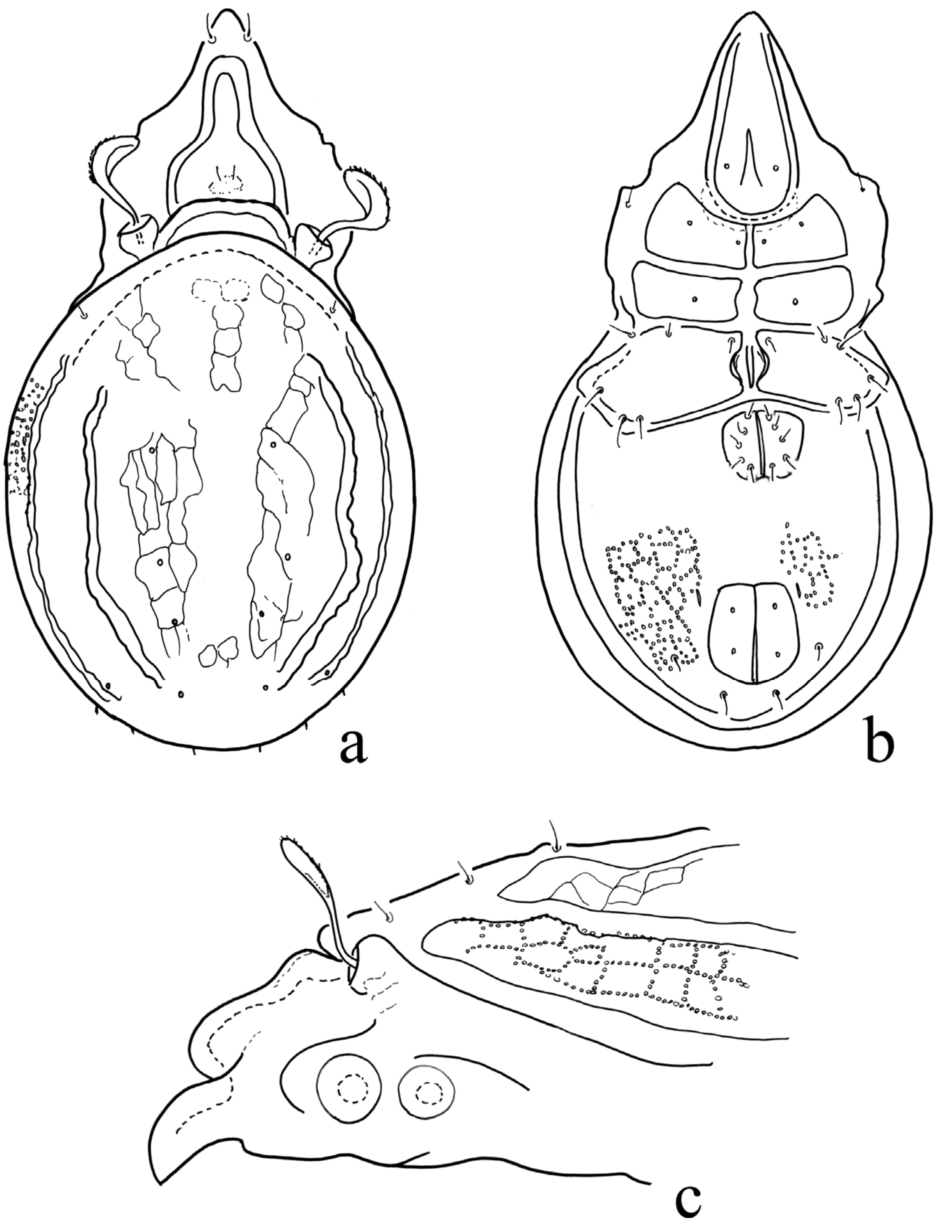

Figure 8. *Suctobelbila tumida* sp. nov. a = body in dorsal view, b = body in ventral view, c = body in lateral view

Remarks. The new species is closest to *Suctobelbila transrugosa* Mahunka, 1985, described from Tanzania. However the median projection of prodorsum much larger in the new species and the pattern of the median part of notogaster consists of irregular field (regular in *transrugosa*).

Etymology. The species name refers to the sculpture, which consists of different foveolae on the body surface.

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REFERENCES

MAHUNKA, S. (2009a): Oribatid mites from the Vohimana reserve (Madagascar) (Acari: Oribatida). I. *Acta Zoologica Academiae Scientiarum Hungaricae,* 55(2): 89–122.

MAHUNKA, S. (2009b): Oribatids from Madagascar IV (Acari: Oribatida). *Revue suisse de Zoologie,* 116 (3-4): 337–352.

MAHUNKA, S. (2009c): Oribatid mites from the Vohimana reserve (Madagascar) (Acari: Oribatida), II. *Opuscula Zoologica, Budapest*, 40(2): 47–61.

MAHUNKA, S. (2010): New and little known oribatid mites from Madagascar (Acari: Oribatida). I. *Opuscula Zoologica, Budapest,* 41(1): 47–56.

MAHUNKA, S. (2011): New and little known oribatid mites from Madagascar (Acari: Oribatida). II. *Acta Zoologica Academiae Scientiarum Hungaricae,* 57 (1): 1–21.

MAHUNKA, S. & MAHUNKA-PAPP L. (2011): New and little known oribatid mites from Madagascar (Acari: Oribatida). IV. *Opuscula Zoologica, Budapest,* 42(2): 125–145.

NORTON, R. A. & BEHAN-PELLETIER, V. (2009): *Suborder Oribatida.* In: Krantz, G. W. & Walter, D. E. (eds): A manuel of Acarology. 3rd edition. Texas Tech University Press, Lubbock, pp. 430–564.

SUBÍAS, L. S. (2004): Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes, Oribatida) del Mundo (1758–2002). *Graellsia,* 60: 3–305.

SUBÍAS, L. S. (2010): Listado sistemático, sinonímico y biogeográfico de los ácaros oribátidos (Acariformes, Oribatida) del Mundo (exepto fósiles). Originally published in *Graellsia* 60, 3–305, 2004, actualized April 2009), 547 pp. Available from http://www.ucm.es/info/zoo/Artropodos/Catalogo.pdf (accessed 1 May 2010).

WEIGMANN, G. (2006):Hornmilben (Oribatida). *Die Tierwelt Deutschlands,* 76: 1–520.

WOAS, S. (2002): 4. 1. Acari: Oribatida. In: Adis, J. (ed.) *Amazonian Arachnida and Myriopoda.* Pensoft Publishers, Sofia –Moscow, p. 21-291.

Opusc. Zool. Budapest, 2012, 43(1): 57–65

New records of pseudoscorpions for the fauna of the Bükk Mts., Northeast Hungary (Arachnida: Pseudoscorpiones)

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Abstract. A research was carried out to explore the pseudoscorpion species composition of the Bükk Mts., Northeast Hungary. During the survey seventeen species were recorded of which twelve are new to the area and four species [*Chthonius* (*Chthonius*) *carinthiacus* Beier, 1951, *Chthonius* (*C.*) *diophthalmus* Daday, 1888, *Mundochthonius carpaticus* Rafalski, 1948, *Chernes similis* (Beier, 1932)] are new to the fauna of Hungary. Five species, *Microbisium manicatum* (L. Koch, 1873), *Neobisium* (*Neobisium*) *seminudum* (Daday and Tömösváry, 1880), *Neobisium* (*Blothrus*) *minutum* (Tömösváry, 1882), *Roncus euchirus* (Simon, 1879) and *Rhacochelifer quadrimaculatus* (Tömösváry, 1882) were removed from the list of the Hungarian pseudoscorpion fauna.

Keywords. Pseudoscorpions, Hungary, Carpathian elements, Bükk Mountains.

INTRODUCTION

Pseudoscorpiones are one of the four meso-diverse orders of Arachnida (Harvey 2002). Europe is the most investigated continent from pseudoscorpions' point of view, having a long tradition of taxonomical and faunistical researches (Harvey 2007). The highest number of taxa is recorded from the Mediterranean countries due to their climatic factors and biogeographical history (Harvey 2007). However, several parts of Europe are still understudied with only a few published faunistic data (Petrov 2007).

The first summarizing work on the pseudoscorpion fauna of Hungary was presented by Tömösváry (1882a), followed by other remarkable publications on this animal group (Tömösváry 1882b, 1884, Daday 1888, 1889, 1918, Pillich 1914). In his significant work, Chamberlin (1930) has described a new species *Neobisium* (*Neobisium*) *inaeqale* Chamberlin, 1930 from Hungary. Later Szent-Ivány (1941) also has published some sporadic data from the Carpathian Basin, mostly from Hungary and Szalay (1968) presented an identification key to the Hungarian species.

In the second half of the 20th century, Loksa (1966) and Mahnert (1983, 1990) reported some new species to the fauna of the country, and Mahnert (1980) has described the new species *Chthonius* (*Chthonius*) *hungaricus* Mahnert, 1980 from Hungary. Recently, Murányi and Kontschán (2002), Kárpáthegyi and Kontschán (2005), Kárpáthegyi (2005, 2006, 2007), Farkas *et al.* (2009) and Novák (2011) published new occurrences including several newly recorded species for the Hungarian fauna.

The persistent groving in the number of pseudoscorpion taxa recorded for Hungary indicates the necessity of further investigations in this field. From most of the Hungarian national parks we have none or only a few data regarding pseudoscorpions (Murányi and Kontschán 2002, Kárpáthegyi 2007). It is true for the Bükk National Park (BNP) as well, which was established in 1976 in the inner region of the Bükk Mts., Northeast Hungary, and represents the largest forested national park in the country.

The Bükk Mts. covers 431 km^2, and it is one of the highest mountains in Hungary. According to the earlier published data five species of pseudocorpions have been recorded from the area, *Chthonius* (*Ephippiochthonius*) *tetrachelatus* (Preyssler, 1790), *Roncus lubricus* L. Koch, 1873, *Neobisium* (*N.*) *carcinoides* (Hermann, 1804), *Neobisium* (*N.*) *erythrodactylum* (L. Koch, 1873) and *Neobisium* (*N.*) *sylvaticum* (C. L. Koch, 1835) (Szent-Ivány 1941, Loksa 1966). The fact that in the Bükk Mts. has not been carried out any comp-

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rehensive investigation on the pseudoscorpions has inspired the author to carry out researches and summarize the pseudoscorpion fauna of this area.

MATERIAL AND METHODS

The specimens were collected by individual sampling, sifting and using pitfall traps. The material deposited in the Collections of Soil Zoology of the Hungarian Natural History Museum (HNHM) was studied and there was also additional material collected by the author. The material was examined using a stereomicroscope and light microscope; the specimens were cleared in lactic acid. Drawings were made with the aid of a Bresser LCD microscope. The specimens were identified using the publications of Beier (1963), Szalay (1968), Mahnert (2004) and Christophoryová *et al*. (2011c) and deposited in the Hungarian National History Museum, in 70% ethanol. The collecting localities are listed below according to the settlemens in the alphabetical order.

List of the collecting sites (Fig. 1)

1. Bélapátfalva, Ravasz-lyuk, 680 m a.s.l. (48°02’58”N, 20°23’20”E), 04.07.1981, leg. László Ádám.
2. Bükkszentkereszt, Kerek Hill, 610 m a.s.l. (48°04’44”N, 20°37’38”E), 28.08.2010, leg. János Novák.
3. Bükkszentkereszt, Rókafarm, 585 m a.s.l. (48°03’42”N, 20°36’01”E), 05.08.2010, leg. János Novák.
4. Bükkszentkereszt, Nagy-Som Valley, 574 m a.s.l. (48°02’47”N, 20°38’19”E), 05.08.2010, leg. János Novák.
5. Bükkszentkereszt, 594 m a.s.l. (48°03’31”N, 20°37’ 56”E), 05.08.2010, leg. János Novák.
6. Bükkszentkereszt, Hollóstető, Hollós Valley, 515 m a.s.l. (48°04’21”N, 20°36’16”E), 12.08.2010, leg. János Novák.
7. Bükkszentkereszt, Hollóstető, Nagy-dél, 741 m a.s.l. (48°04’31”N, 20°34’20”E), 12.08.2010, 21.08.2010, leg. János Novák.
8. Bükkszentkereszt, Vivrát Hill, 653 m a.s.l. (48°03’27”N, 20°36’33”E), 05.08.2010, leg. János Novák.
9. Bükkzsérc, Hosszú Valley, 345 m a.s.l. (48°00’36”N, 20°30’30”E), 26.05.1982, leg. Pál Holló.
10. Cserépfalu, Hór Valley, Oszla, 255 m a.s.l. (47°57’ 45”N, 20°31’54”E), 26.05.1982, leg. Pál Holló.
11. Cserépváralja, Karud Hillside, 291 m a.s.l. (47°55’29”N, 20°35’51”E), 19.08.2010, leg. János Novák.
12. Dédestapolcsány, 269 m a.s.l. (48°10’24”N, 20°28’ 42”E), 02.08.2010, leg. János Novák.
13. Eger, Sík Hill, 250 m a.s.l. (47°54’40”N, 20°25’25”E), 26.08.2010, leg. János Novák.
14. Felsőtárkány, Tar-kő, 942 m a.s.l. (48°03’26”N, 20°27’ 38”E), 02.07.1981, 13.07.1983, leg. László Ádám.
15. Miskolc, Savós Valley, 410 m a.s.l. (48°06’35”N, 20° 36’32”E), 31.07.2010, 21.08.2010, leg. János Novák.
16. Miskolc, Sebes, 643 m a.s.l. (48°06’19”N, 20°34’07”E), 21.08.2010, leg. János Novák.
17. Miskolc, Jávor Hill, 583 m a.s.l. (48°05’07”N, 20°37’ 57”E), 28.08.2010, leg. János Novák.
18. Miskolc, Felsőhámor, Lencsés Hillside, 362 m a.s.l. (48° 06’31”N, 20°37’03”E), 08.08.2010, leg. János Novák.
19. Miskolc, Jávorkút, 712 m a.s.l. (48°05’55”N, 20°31’ 40”E), 31.07.2010, leg. János Novák.
20. Miskolc, Lillafüred, 334 m a.s.l. (48°06’03”N, 20°37’ 21”E), 29.07.2010, 30.07.2010, 12.08.2010, leg. János Novák.
21. Miskolc, Lillafüred, Fehérkő-lápa, 539 m a.s.l. (48°05’ 47”N, 20°37’39”E), 28.08.2010, leg. János Novák.
22. Miskolc, Fény és Kő Valley, 318 m a.s.l. (48°05’55”N, 20°40’05”E), 28.08.2010, leg. János Novák.
23. Miskolc, Forrás Valley, 299 m a.s.l. (48°07’02”N, 20° 38’10”E), 26.07.1981, leg. László Ádám.
24. Miskolc, Hegyes Hilltop, 593 m a.s.l. (48°05’26”N, 20° 38’28”E), 28.08.2010, leg. János Novák.
25. Miskolc, Lyukas Ridge, 905 m a.s.l. (48°05’42”N, 20° 29’23”E), 04.07.1981, leg. László Ádám.
26. Miskolc, Vaskapu, 553 m a.s.l. (48°05’22”N, 20°39’ 28”E), 28.08.2010, leg. János Novák.
27. Miskolc, Ómassa, 490 m a.s.l. (48°06’35”N, 20°31’ 55”E), 21.05.1926, leg. Lajos Méhely.
28. Miskolc, Sebesvíz Valley, 519 m a.s.l. (48°06’31”N, 20° 33’15”E), 30.03.1967, leg. Sándor Mahunka.
29. Miskolc, Kurta Crag, 802 m a.s.l. (48°05’11”N, 20°33’ 33”E), 21.08.2010, leg. János Novák.
30. Miskolc, Nagy-hárs Hill, 815 m a.s.l. (48 °05’23”N, 20° 32’39”E), 21.08.2010, leg. János Novák.
31. Nagyvisnyó, Bánkút, 917 m a.s.l. (48°05’52”N, 20°28’ 23”E), 06.10.1988, leg. Zoltán Korsós, 31.07.2010, leg. János Novák.
32. Nagyvisnyó, Ablakos-kő Valley, 494 m a.s.l. (48°06’ 17”N, 20°27’05”E), 14.07.1983, leg. László Ádám.
33. Nagyvisnyó, Youth camp, 283 m a.s.l. (48°08’48”N, 20° 27’17”E), 27.08.2010, leg. János Novák.
34. Nagyvisnyó, Leány Valley, 501 m a.s.l. (48°05’42”N, 20°26’12”E), 01.11.1989, leg. Zoltán Korsós.
35. Parasznya, mouth of Csókás-forrási Cave, 492 m a.s.l. (48°07’21”N, 20°35’01”E), 19.06.1963, leg. Imre Loksa.
36. Parasznya, Dolka Ridge, 451 m a.s.l. (40°07’03”N, 20° 36’38”E), 08.08.2010, leg. János Novák.
37. Parasznya, mouth of Udvarkő Cave, 452 m a.s.l. (48°07’ 50”N, 20°36’00”E), 08.10.1963, 24.03.1964, leg. Imre Loksa.
38. Répáshuta, Nagy-mező (Big Field), 788 m a.s.l. (48° 04’ 43”N, 20°29’57”E), 07.06.1957, leg. Imre Loksa.
39. Répáshuta, Tebe-puszta, 385 m a.s.l. (48°01’58”N, 20° 33’25”E), 03.11.1982, leg. Pál Holló.

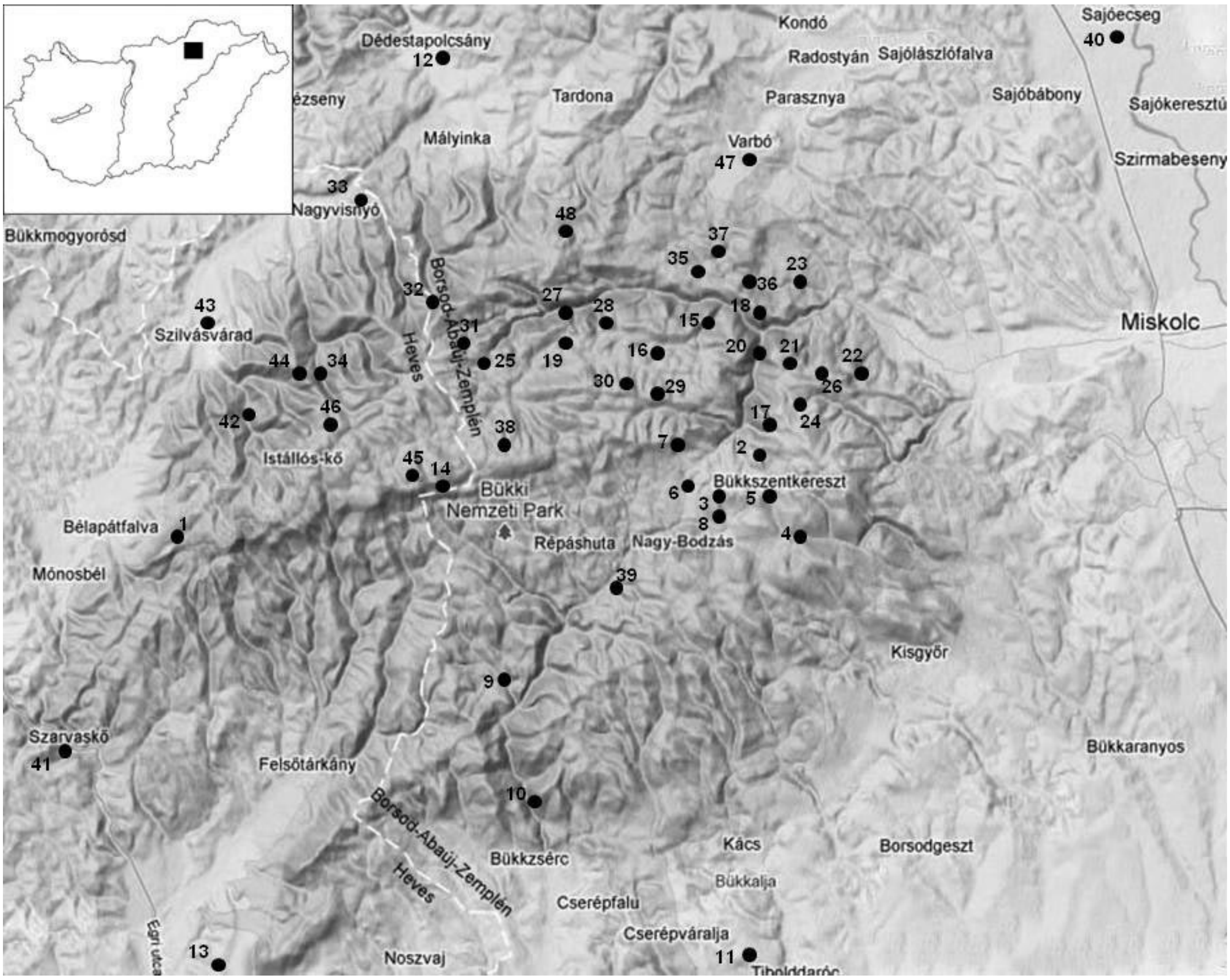

Figure 1. Sampling localities marked by numbers given in the Material and methods section

40. Sajóecseg, 118 m a.s.l. (48°11’55”N, 20°46’20”E), 17.08.2010, leg. János Novák.
41. Szarvaskő, 235 m a.s.l. (47°59’13”N, 20°19’53”E), 30.04.1982, leg. Pál Holló.
42. Szilvásvárad, Szalajka Valley, 435 m a.s.l. (48°05’31”N, 20°24’25”E), 27.06.1951, leg. Edit Somfai.
43. Szilvásvárad, 363 m a.s.l. (48°06’16”N, 20°23’30”E), 26.06.1951, leg. Edit Somfai.
44. Szilvásvárad, Geremmavár, 732 m a.s.l. (48°05’23”N, 20°25’53”E), 13.07.1983, leg. László Ádám.
45. Szilvásvárad, Őserdő (Virgin Forest), 853 m a.s.l. (48°03’35”N, 20°26’39”E), October, 1975, leg. Rita Szonntagh.
46. Szilvásvárad, Köves Ridge, 653 m a.s.l. (40°04’46”N, 20°25’20”E), 02.07.1981, 24.09.1981, leg. László Ádám.
47. Varbó, 189 m a.s.l. (48°09’35”N, 20°37’11”E), 1964, leg. Imre Loksa.
48. Varbó, Örvény-kő, 767 m a.s.l. (48°07’45”N, 20°32’16”E), 29.03.1967, leg. Sándor Mahunka.

RESULTS

CHTHONIIDAE Daday, 1888

Chthonius (Chthonius) carinthiacus Beier, 1951

(Figures 2B and 2I)

Localities. *No.* 23, *No.* 35, *No.* 39, *No.* 44.

Short description. Carapace, chelicerae and chelal hands darker brown than the other parts of the body. Carapace with 18 setae, 2 of them located on the posterior carapace margin (Fig. 2I). Two pairs of eyes present on carapace, anterior pair well-developed with lenses, posterior pair flattened, epistome small and serrated. Palps (Fig.

2B) slight, fixed chelal finger with 33–37 peaked, countinuous teeth and with 8 trichobothria, movable chelal finger with similar 20 teeth on the distal part of the finger, and with flattened basal teeth, and with 4 trichobothria. Number of coxal spines: 4–10 on pedal coxae II, 1–6 on pedal coxae III. Body length: 1.3–1.5 mm.

Remarks. This species is recorded for the first time in Hungary. It occures also in Slovenia (Harvey 2011), Austria (Mahnert 2004), the Czech Republic, Slovakia (Christophoryová *et al.* 2011b), and Italy (Harvey 2011). The specimens collected in the Bükk Mts. are from mixed linden and ash forests and from moss.

Chthonius (C.) diophthalmus Daday, 1888

(Figures 2A and 2H)

Locality. *No.* 34.

Short description. Carapace (Fig. 2H) with 20 setae, 2 longer and 2 shorter of them located on the posterior carapace margin. Two pairs of eyes present, anterior pair well-developed with lenses, posterior pair flattened, epistome small and serrated. Fixed chelal finger with 28–40 straight and mostly clearly separated teeth, movable chelal finger with triangular teeth on its distal half, proximal part with blunt and flattened teeth (Fig. 2A). Number of coxal spines: 5–7 on pedal coxae II, 4–5 on pedal coxae III. Body length: 1.3–1.6 mm.

Remarks. New species for the fauna of Hungary. Its ocurrence in Hungary is not surprising, because this species is listed in Romania, the Czech Republic, Germany, and Greece (Harvey 2011).

Cthonius **(***C.***)** *heterodactylus* **Tömösváry, 1882**

Localities. *No.* 23, *No.* 34.

Remarks. New to the fauna of the Bükk Mts. So far this species was known only from the Zemplén Mountains (Kárpáthegyi 2006), so the Bükk Mts. is the second known locality of *C. (C.) heterodactylus* in Hungary.

Chthonius (C.) hungaricus **Mahnert, 1980**

Localities. *No.* 7, *No.* 11, *No.* 15, *No.* 16, *No.* 19, *No.* 20, *No.* 35, *No.* 36, *No.* 47, *No.* 48.

Remarks. New to the fauna of the Bükk Mts. Until now, the species was known only from the Hortobágy NP, Hungary (Mahnert 1980) and from Slovakia (Christophoryová *et al.* 2011a). As the Bükk Mts. is situated between the two above mentioned localities, the occurence of the species was expected in the studied area. *C. (C.) hungaricus* is reported from the altitude of 85 m

(Újszentmargita, Hungary, type locality) to 712 m a.s.l. (Jávorkút, Hungary). The present specimens were found in oak and in beech forests, in decaying wood and mostly in leaf litter.

Chthonius (Ephippiochthonius) tetrachelatus **(Preyssler, 1790)**

Localities. *No.* 13, *No.* 20.

Remarks. Loksa (1966) has already reported this species from the Bükk Mts. It occurs all across the country (Kárpáthegyi 2007). Specimens were collected in oak and beech forests.

Chthonius (E.) tuberculatus **Hadži, 1937**

Locality. *No.* 11.

Remarks. New to the fauna of the Bükk Mts. The species was recently found in Slovakia for the first time (Christophoryová *et al*. 2011b) and after the Hortobágy National Park (Mahnert 1983) this is the second record of *C. (C.) tuberculatus* in Hungary. The single specimen was collected in an oak forest.

Mundochthonius carpaticus **Rafalski, 1948**

(Figures 2C, 2F, 2J and 2K)

Locality. *No.* 37.

Short description. Carapace (Fig. 2J) with 18 setae, 2 of them located on posterior carapace margin. Two well developed eyes with lenses

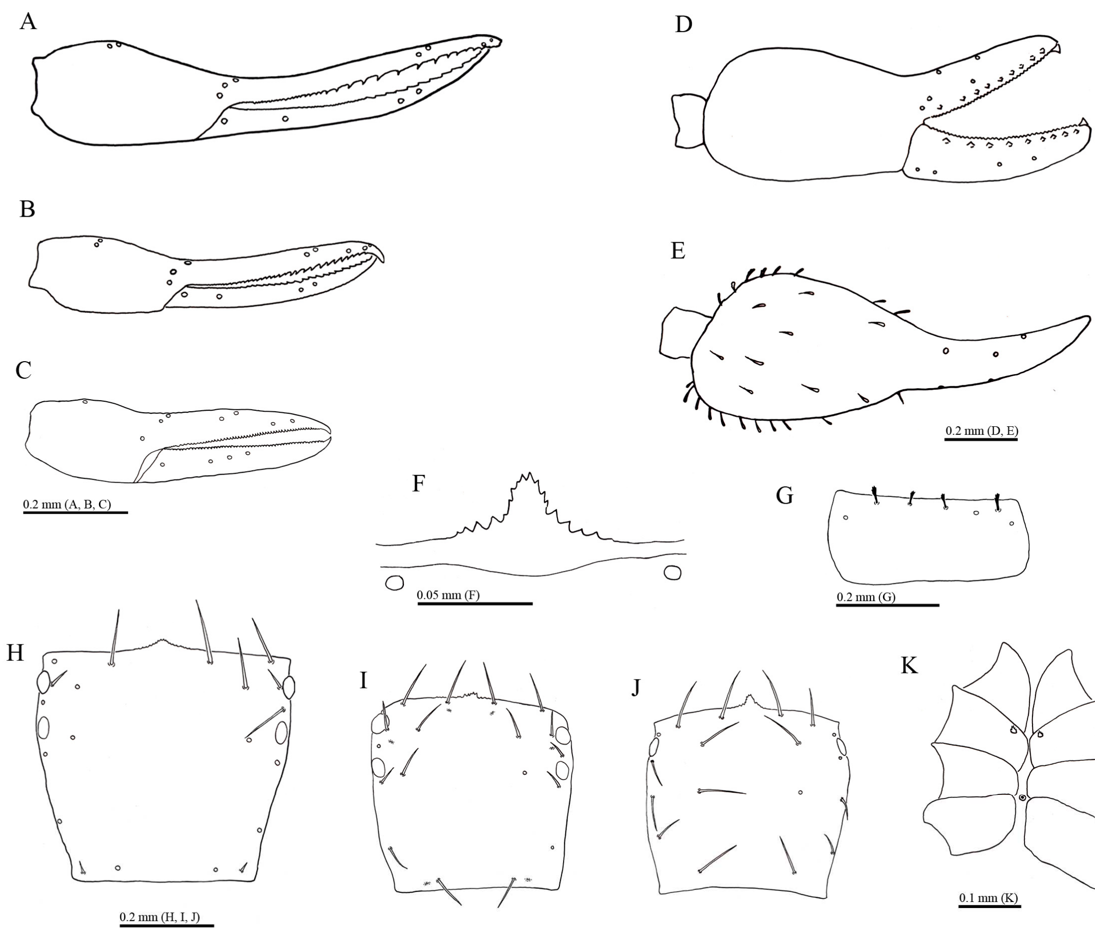

Figure 2. A = Pedipalp of *Chthonius diophthalmus,* B = Pedipalp of *Chthonius carinthiacus,* C = Pedipalp of *Mundochthonius carpaticus,* D = Pedipalp of *Chernes similis,* E = Pedipalp of *Chernes similis* dorsal view, F = Epistome of *Mundochthonius Carpaticus,* G = Sternite IX of *Chernes similis,* H = Carapace of *Chthonius diophthalmus,* I = Carapace of *Chthonius carinthiacus,* J = Carapace of *Mundochthonius carpaticus,* K = Pedal coxae I–IV of *Mundochthonius carpaticus*

present, epistome triangular and serrated (Fig. 2F). Fixed chelal finger with 53, movable with 55 small blunt and continuous teeth (Fig. 2C). Coxal spines present only on pedal coxae II (Fig. 2K). Body length: 1.25 mm.

Remarks. New to the fauna of Hungary. *M. carpaticus* was originally described by Rafalski (1948) from Poland but later, it was reported from the neighbouring countries Slovakia (Christophoryová *et al.* 2011c) and Ukraine (Schawaller 1989) as well. All specimens were collected from moss.

NEOBISIIDAE Chamberlin, 1930

Neobisium (Neobisium) carcinoides (Hermann, 1804)

Localities. *No.* 3, *No.* 4, *No.* 5, *No.* 7, *No.* 11, *No.* 13, *No.* 15, *No.* 17, *No.* 19, *No.* 23, *No.* 25, *No.* 29, *No.* 30, *No.* 33, *No.* 37, *No.* 41, *No.* 45.

Remarks. *N. (N.) carcinoides* is one of the most common species in Hungary (Kárpáthegyi 2007). Szent-Iványi (1941) has already reported it from the studied region. Specimens were collected in beech and oak forests.

Neobisium (N.) crassifemoratum (Beier, 1928)

Localities. *No.* 2, *No.* 16, *No.* 18, *No.* 27, *No.* 30, *No.* 31.

Remarks. *N. (N.) crassifemoratum* is recorded for the first time in the Bükk Mts. It was collected mostly on the Bükk Plateu, the central higher region of the mountains. Beier (1963) reported this species from East-Hungary but without mentioning closer locality data. The present specimens were collected in beech forest.

Neobisium (N.) erythrodactylum (L. Koch, 1873)

Localities. *No.* 7, *No.* 8, *No.* 15, *No.* 16, *No.* 20, *No.* 26, *No.* 27, *No.* 31, *No.* 33, *No.* 38.

Remarks. This species is quite common in Hungary and has already been recorded from several regions of the country (Kárpáthegyi 2007) including the Bükk Mts. as well (Loksa 1966). The specimens were collected in beech forests and mixed linden and ash forests.

Neobisium (N.) sylvaticum (C. L. Koch, 1835)

Localities. *No.* 7, *No.* 8, *No.* 14, *No.* 32, *No.* 42, *No.* 43, *No.* 48.

Remarks. *N. (N.) sylvaticum* is a common species in Hungary (Kárpáthegyi 2007) and Loksa (1966) has already reported it from the Bükk Mts. Specimens were collected in beech forests and mixed linden and ash forests.

Roncus lubricus L. Koch, 1873

Localities. *No.* 1, *No.* 2, *No.* 4, *No.* 5, *No.* 6, *No.* 7, *No.* 9, *No.* 10, *No.* 11, *No.* 12, *No.* 15, *No.* 16, *No.* 17, *No.* 18, *No.* 19, *No.* 20, *No.* 21, *No.* 22, *No.* 23, *No.* 24, *No.* 26, *No.* 27, *No.* 29, *No.* 30, *No.* 32, *No.* 33, *No.* 35, *No.* 38, *No.* 42, *No.* 46, *No.* 48.

Remarks. The species is known all over the country (Kárpáthegyi 2007) and Loksa (1966) has already found it in the Bükk Mts. In the present samples *R. lubricus* proved to be the most numerous species present in oak, beech and mixed linden - ash forests as well.

CHELIFERIDAE Risso, 1826

Chelifer cancroides (Linnaeus, 1758)

Locality. *No.* 40.

Remarks. New species for the fauna of the Bükk Mts. The only specimen was collected synanthropically inside a house. The author observed *C. cancroides* also in beehives in Sajóecseg.

Dactylochelifer latreillii (Leach, 1817)

Locality. *No.* 23.

Remarks. The species has already been recorded for Hungary (Kárpáthegyi 2007). During the present survey a single juvenile specimen was recorded which represents a new record for the region studied.

CHERNETIDAE Menge, 1855

Chernes similis (Beier, 1932)

(Figures 2D, 2E and 2G)

Locality. *No.* 48.

Short description. Carapace longer than broad and finely granulated, with two distinct transverse furrows, eyes absent. Abdominal tergites divided, with 6–8 setae on a hemitergite. Tergite XI without a pair of tactile setae. Sternite IX bearing mainly clavate setae (Fig. 2G). Pedipalps (Fig. 2D, E) granulated. Femur 2.5–2.7x, tibia 2.1–2.3x, hand 1.4–1.6x, fixed chelal finger 2.9–3.0x longer than broad. Fixed chelal finger with 33–38 teeth and medially with 4–6 accessory teeth, movable with 37–39 teeth and medially with 2–4 accessory teeth. Laterally both of the fingers bear 8–9 accessory teeth, venom apparatus developed in both of them. Body length: 1.7–2 mm.

Remarks. New species to the Hungarian fauna. *C. similis* has already been reported from several neighbouring countries e.g. Austria (Mahnert, 2004), Romania (Beier 1932), the Czech Republic and Slovakia (Christophoryová *et al.* 2011c), thus its occurence in Hungary was not unexpected. The present specimens were collected in mixed linden and ash forest, and in meadow.

***Allochernes powelli* (Kew, 1916)**

Locality. *No.* 11.

Remarks. New species for the fauna of Bükk Mts. Until now, *A. powelli* was known only from the Bátorliget Nature Reserve (Mahnert 1990), thus the Bükk Mts. are the second known locality of the species in Hungary. The only specimen was found in decaying wood in an oak forest.

***Pselaphochernes scorpioides* (Hermann, 1804)**

Localities. *No.* 5, *No.* 11.

Remarks. There are many data on the presence of this species in several regions of Hungary (Mahnert 1983, 1990, Murányi & Kontschán 2002, Kárpáthegyi 2007, Novák 2011) however, our present data represent new record to the fauna of Bükk Mts. The specimens were found in oak and beech forests.

DISCUSSION

During the research, 17 pseudoscorpion species was found in the area of the Bükk Mts. 12 of which were recorded for the first time in the studied region and four species [*Chthonius (C.) carinthiacus, C. (C.) diophthalmus, Mundochthonius carpaticus* and *Chernes similis*] proved to be new for the Hungarian fauna. There are several other species [*Chthonius (C.) pygmaeus* Beier, 1934, *Neobisium (N.) fuscimanum* (C. L. Koch, 1843), *Chernes hahnii* (C. L. Koch, 1839), *Chernes cimicoides* (Fabricius, 1793), *Dendrochernes cyrneus* (L. Koch, 1873), *Withius piger* (E. Simon, 1878), *Rhacochelifer peculiaris* (L. Koch, 1873)] which, according to their distribution in the neighbouring areas in Hungary (Kárpáthegyi 2007) might also be present in the Bükk Mountains.

In accordance with the zoogeographical divison of Varga (1964), the Bükk Plateau is considered as part of the *Carpathicum* fauna region, while the remaining parts of the Bükk Mountains belong to the *Matricum* region. The presence of some Carpathian elements, such as *M. carpaticus*, *C. (C.) diophthalmus* or *C. (C.) heterodactylus* shows well the Carpathian influence in the Bükk Mts which can be observed in other soil-dweller groups as well. Mountain species with Carpathian affinities are represented e.g. by the earthworm species *Fitzingeria platyura montana* (Černosvitov, 1932) and *Eisenia lucens* (Waga, 1857) (Csuzdi & Zicsi 2003), the woodlice *Hyloniscus transsylvanicus* (Verhoeff, 1901) and *Porcellium consperum* (C. L. Koch, 1841) (Kontschán *et. al.* 2006), and the oribatid mites *Conchogneta dalecarlica* (Forsslund, 1947) and *Gammazetes alpestris* (Willmann, 1929) (Mahunka & Mahunka-Papp 2004).

After the border changes in the first part of the 20th century many historical data appeared ambiguous. This situation resulted in incorrect faunistic records in the world checklists, catalogues and keys (Beier 1932, 1963, Harvey 2011). Therefore the late 19th and early 20th century records needed to be carefully reevaluated. This work resulted in exclusion of some pseudoscorpion species from the list of Hungarian fauna. The localities of *Neobisium (Blothrus) minutum* (Tömösváry 1882) and *Roncus euchirus* (Simon 1879) are actually situated in Mehádia, Romania (Tömösváry 1882a). The only known locality of *Rhacochelifer quadrimaculatus* (Tömösváry, 1882) is Humenné (Homonna) now in Slovakia (Tömösváry 1882b). The records of *Microbisium manicatum* (L. Koch, 1873) and *Neobisium* (*N.*) *seminudum* (Daday & Tömösváry, 1880) also fall within the borders of the present Romania (Daday 1918, Tömösváry 1882a). Consequently, the number of pseudoscorpion species recorded for Hungary by Harvey (2011) has dropped to 45.

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REFERENCES

BEIER, M. (1932): Pseudoscorpionidea II. Subord. C. Cheliferinea. *Tierreich,* 58: i-xxi, 1–294.

BEIER, M. (1963): *Ordnung Pseudoscorpionidea (Afterskorpione).* Bestimmungsbücher zur Bodenfauna Europas, 1. Akademie-Verlag, Berlin, pp. 313.

CHAMBERLIN, J. C. (1930): A synoptic classification of the false scorpions or chela-spinners, with a report on a cosmopolitan collection of the same. Part II. The Diplosphyronida (Arachnida-Chelonethida). *Annals and Magazine of Natural History,* (10)5: 1–48, 585–620.

CHRISTOPHORYOVÁ, J., FENĎA, P. & KRIŠTOFÍK, J. (2011a): *Chthonius hungaricus* and *Larca lata* new to the fauna of Slovakia (Pseudoscorpiones: Chthoniidae, Larcidae). *Arachnologische Mitteilungen*, 41: 1–6

CHRISTOPHORYOVÁ, J., MOCK, A. & ĽUPTÁČIK , P. (2011b): *Chthonius (Chthonius) carinthiacus* and *Chthonius (Ephippiochthonius) tuberculatus* new to the fauna of Slovakia (Pseudoscorpiones: Chthoniidae). *Arachnologische Mitteilungen*, 42: 23–28.

CHRISTOPHORYOVÁ, J., ŠŤÁHLAVSKÝ, F. & FEDOR, P. (2011c): An updated identification key to the pseudoscorpions (Arachnida: Pseudoscorpiones) of the Czech Republic and Slovakia. *Zootaxa*, 2876: 35–48.

CSUZDI, CS. & ZICSI, A. (2003): *Earthworms of Hungary (Annelida: Oligochaeta, Lumbricidae).* In: Csuzdi, Cs. & Mahunka, S. (eds.): Pedozoologica Hungarica 1. Hungarian Natural History Museum and Systematic Zoology Research Group of the Hungarian Academy of Sciences, Budapest, pp. 271.

DADAY, E. (1888): A Magyar Nemzeti Muzeum álskorpióinak áttekintése. *Természetrajzi Füzetek*, 11: 111–136, 165–192.

DADAY, E. (1889): Ujabb adatok a magyar-fauna álskorpióinak ismeretéhez. *Természetrajzi Füzetek,* 12: 25–28.

DADAY, E. (1918): *Ordo Pseudoscorpiones.* In: A Magyar Birodalom Allatvilága. Regia Societas Scientiarum Naturalium Hungarica, Budapest, pp. 1–2.

FARKAS, S., KÁRPÁTHEGYI, P., KISS, M., NOVÁK, J. & UJVÁRI, ZS. (2009): Adatok a Zselic talajlakó mezo- és makrofaunájának ismeretéhez (Nematoda, Pseudoscorpiones, Acari, Chilopoda, Isopoda). *Natura Somogyiensis,* 13: 57–72.

HARVEY, M.S. (2002): The neglected cousins: what do we know about the smaller arachnid orders? *Journal of Arachnology,* 30: 357–372.

HARVEY, M.S. (2007) The smaller arachnid orders: diversity, descriptions and distributions from Linnaeus to the present (1758 to 2007). In: Zhang, Z.Q. & Shear, W.A. (Eds.), Linnaeus Tercentenary: Progress in Invertebrate Taxonomy. *Zootaxa*, 1668: 363–380.

HARVEY, M.S. (2011): Pseudoscorpions of the World, version 2.0. Western Australian Museum, Perth. <http://www.museum.wa.gov.au/catalogues/pseudoscorpions>

KÁRPÁTHEGYI, P. (2005): Neobisidae család (Pseudoscorpiones) fajainak előfordulásai Borsod-Abaúj-Zemplénmegyében. *Folia Historico Naturalia Musei Matraensis,* 29: 65–66.

KÁRPÁTHEGYI, P. (2006): Két ritka álskorpió [*Atemnus politus* (Simon, 1878) és *Chthonius heterodactylus* Tömösvári, 1883] hazai előfordulásai. *Folia Historico Naturalia Musei Matraensis,* 30: 115–116.

KÁRPÁTHEGYI, P. (2007): Pseudoscorpions of Hungary. *Folia Historico Naturalia Musei Matraensis,* 31: 81–90.

KÁRPÁTHEGYI, P. & KONTSCHÁN, J. (2005): First record the *Neobisium fuscimanum* (C.L. Koch, 1843) in Hungary. *Folia Entomologica Hungarica,* 66: 5–6.

KONTSCHÁN, J., HEGYESSY, G. & CSORDÁS, B. (2006): *Abaúj és Zemplén tájainak makroszkopikus rákjai (Crustacea).* Sátoraljaújhely, pp. 89.

LOKSA, I. (1966): *Die bodenzoozönolgischen Verhältnisse der Flaumeichen-Buschwälder Südostmitteleuropas.* Akadémiai Kiadó, Budapest, pp. 437.

MAHNERT, V. (1980): *Chthonius (C.) hungaricus* sp. n., eine neue Afterscorpion-Art aus Ungarn (Arachnida). *Folia Entomologica Hungarica,* 33: 279–282.

MAHNERT, V. (1983): *Pseudoscorpions of the Hortobágy National Park (Arachnida).* In: Mahunka, S. (ed.): The fauna of Hortobágy National Park 2. Akadémiai Kiadó, Budapest, pp. 361–363.

MAHNERT, V. (1990): *Pseudoscorpions of the Bátorliget Nature Reserve (NE Hungary).* In: Mahunka, S. (ed.): The Bátorliget Nature Reserves – after forty years 2. Hungarian Natural History Museum, Budapest, pp. 683–684.

MAHNERT, V. (2004): Die Pseudoskorpione Österreichs (Arachnida, Pseudoscorpiones). *Denisia*, 12: 459–471.

MAHUNKA, S. & MAHUNKA-PAPP, L. (2004): *A Catalouge of the Hungarian oribatid mites (Acari: Oribatida)*. In: Csuzdi, Cs. & Mahunka, S. (eds.): Pedozoologica Hungarica 2. Hungarian Natural History Museum and Systematic Zoology Research Group of the Hungarian Academy of Sciences, Budapest, pp. 363.

MURÁNYI, D. & KONTSCHÁN, J. (2002): *Pseudoscorpions from the Fertõ-Hanság National Park.* In: Mahunka, S. (ed.): The fauna of Fertõ-Hanság National Park 1. Hungarian Natural History Museum, Budapest, pp. 191–193.

NOVÁK, J. (2011): Adatok a Bakony álskorpió-faunájához (Arachnida: Pseudoscorpiones). *Folia Musei Historico-Naturalis Bakonyiensis,* 28: 67–70.

PETROV, B. (2007): New species of pseudoscorpions (Arachnida: Pseudoscorpiones) of the fauna of Bulgaria. *Historia naturalis bulgarica,* 18: 15–27.

PILLICH, F. (1914): *Aus der Arthropodenwelt Simontornya's.* Simontornya Hungaria occidentalis. Komitat Tolna, pp. 153.

SCHAWALLER, W. (1989): Pseudoskorpione aus der Sowjetunion, Teil 3 (Arachnida: Pseudoscorpiones). *Stuttgarter Beiträge zur Naturkunde, (A),* 440: 1–30.

SZALAY, L. (1968): *Pókszabásúak I.* Magyarország Állatvilága (Fauna Hungariae) LXXXIX., 18. Akadémiai Kiadó, Budapest, pp. 122.

SZENT-IVÁNY, J. (1941): Neue Angaben zur Verbreitung der Pseudoscorpione im Karpatenbecken. *Fragmenta Faunistica Hungarica,* 4 (1–4): 85–90.

TÖMÖSVÁRY, Ö. (1882a): A Magyar fauna álskorpiói. *Magyar Tudományos Akadémia Matematikai és Természettudományi Közlemények,* 18: 135–256.

TÖMÖSVÁRY, Ö. (1882b): Egy új alak hazánk Arachnoida faunájában Zemplén megyéböl. *Természetrajzi Füzetek,* 6: 226–228, 296–298.

TÖMÖSVÁRY, Ö. (1884): Adatok az álskorpiók ismeretéhez (Data ad cognitionem Pseudoscorpionum). *Természetrajzi Füzetek,* 8: 16–27.

VARGA, Z. (1964): Zoogeographische Einteilung Ungarns auf Grung der Makrolepidopteren–Faunakomponenten. *Folia Entomologica Hungarica*, 17: 119–197.

RAFALSKI, J. (1948): *Mundochthonius carpaticus* sp. nov., nowy gatunek zaleszczotka (Pseudoscorpionidea). *Annales Musei Zoologici Polonici* 14: 13-20.

Rotifera diversity of a floodplain lake of the Brahmaputra river basin of lower Assam, Northeast India

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Abstract. This study analyzed diversity and ecology of planktonic Rotifera of Ghorajan beel, a floodplain lake of the Brahmaputra river basin of lower Assam region of Northeast India. Plankton samples collected (January–December, 2010) from littoral (station 1) and semi-limnetic regions (station 2) of this tropical wetland revealed a fairly rich rotifer fauna (84 and 80 species) with distinct variations (range, average ± SD) in monthly richness (35–55, 46±6 and 24–54, 36±5 species) and community similarities (46.6–80.4 and 37.0–95.9 %) at both sampling stations. The richness followed unclear annual patterns. The rotifers mainly contributed (53.3±5.1 and 55.6± 3.6 %) to zooplankton abundance variations and showed high abundance from June through November at both stations. Brachionidae > Lecanidae exhibited high number of individuals; Asplanchnidae and Flosculariidae were also quantitatively important families; specifically, *Asplanchna priodonta, Sinantherina socialis, Brachionus falcatus* and *Lecane bulla* were important species for their abundance. Single abiotic factors exerted a more limited influence on richness than on abundance. Canonical correspondence analysis (CCA) explained 55.6 % and 59.5 % cumulative variance of the rotifer assemblages along axis 1 and 2, respectively; the CCA indicated the importance of transparency and rainfall at station 1, and of transparency, dissolved oxygen and rainfall at station 2. Consequently, the littoral and semi-limnetic stations are characterized by micro-environmental differences.

Keywords. Abundance, Assam, diversity indices, ecology, richness, tropical wetland.

INTRODUCTION

Rotifera, an important component of the littoral and limnetic invertebrate communities and an integral link of aquatic food-webs, have been studied from varied freshwater environments in different parts of India since more than one century. Ironically, few noteworthy investigations exist up to date on freshwater ecology in the Indian floodplain lakes in general and on diversity and ecology rotifers of these ecotones in particular (Sharma & Sharma, 2008). The related studies on the floodplain lakes ('beels' or 'pats') of northeast India concern rotifer diversity of two beels of Assam (Sharma, 2000, 2010) while Sharma (2009) deals with their ecology in Loktak Pat of Manipur.

The present study on Rotifera diversity of Ghorajan Beel, a floodplain lake of the Brahmaputra river basin of lower Assam, assumes interest in light of paucity of studies from India. The rotifer communities were sampled qualitatively and quantitatively at two sampling stations to observe spatial and temporal variations in species richness, community similarities, abundance, species diversity, dominance and evenness during the study period. In addition, the influence of various abiotic parameters on richness and abundance of Rotifera was investigated to examine ecological relationships.

MATERIALS AND METHODS

This study was undertaken during January–December 2010 in Ghorajan Beel (91° 41' 25'' E, 26° 09'26'' N; area: 117 ha) located along NH 31 in the Kamrup district of lower Assam (Northeast India). Various aquatic macrophytes of this floodplain lake included *Azolla pinnata, Eichhornia crassipes, Hydrilla verticillata, Hygrorhiza aristata, Ipomea fistulosa, Lemna* sp., *Najas indica, Polygonum hydropiper, Vallisneria spiralis* and *Utricularia flexuosa.*

Water samples were collected monthly at two study sites i.e., station 1 (littoral) and station 2 (semi-limnetic), and analyzed for nineteen abiotic factors (Table 1). Water temperature, specific conductivity and pH were recorded by field probes,

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transparency was noted with Secchi disc, dissolved oxygen was estimated by the Winkler's method and other parameters were analyzed following APHA (1992). The qualitative (by towing) and quantitative (by filtering 25 L water each) plankton samples were collected monthly from both the sampling stations by nylobolt plankton net (mesh size 50 µm) and preserved in 5% formalin. The former were screened for the rotifer species and the latter were analyzed for their abundance (ind. L^{-1}). Rotifera species were identified following Koste (1978), Segers (1995), Sharma (1998) and Sharma & Sharma (1999, 2000, 2008).

The diversity indices, namely community similarities (Sørensen index), species diversity (Shannon index), dominance (Berger-Parker index) and evenness (Pielou index) were calculated following Ludwig & Reynolds (1988) and Magurran (1988). The significance of differences in variations of biotic parameters was ascertained by two-way ANOVA. The hierarchical cluster analysis, based on Sørensen similarities, was done using SPSS (version 11.0) to examine the monthly rotifer community groupings. Ecological relationships between abiotic and biotic parameters were determined by simple correlation coefficients (Pearson r_1 and r_2, respectively) for each sampling station; their P values were calculated *vide* http://faculty.vassar.edu/lowry/tabs.html and significance was ascertained after use of Bonferroni correction. Canonical correspondence analysis (CCA) (ECOM II: version 2.1.3.137, PISCES Conservation Ltd. 2007) was used to elucidate the relationships between the rotifer assemblages and their abiotic environment.

Table 1. Temporal variations in abiotic parameters

	Station 1		**Station 2**	
Factors	Range	Average ± SD	Range	Average ± SD
Water temperature ^{0}C	19.7 – 33.2	27.8 ± 4.0	20.2 – 32.7	27.9 ± 3.7
Rainfall mm	4.8 – 365.0	150.4. ± 145.7	4.8 – 365.0	150.4 ± 145.7
Transparency cm	16.0 – 76.0	52.7 ± 20.5	17.0 – 79.0	55.4 ± 21.2
pH	6.72 – 7.16	6.95 ± 0.12	6.75 – 7.12	6.94 ± 0.11
Specific conductivity µS cm^{-1}	99.0 – 193.0	137.8 ± 30.0	108.0 – 190.0	136.9 ± 27.8
Dissolved oxygen mg L^{-1}	4.0 – 8.0	6.5 ± 1.2	4.0 – 8.2	6.1 ± 1.4
Free carbon dioxide mg L^{-1}	4.0 – 30.0	11.3 ± 7.0	2.0 – 28.9	10.9 ± 6.8
Alkalinity mg L^{-1}	50.0 – 84.0	64.8 ±10.0	52.0 – 81.0	66.3 ± 9.4
Hardness mg L^{-1}	48.0 – 68.0	56.8 ± 75.1	46.0 – 70.0	57.3 ± 7.8
Calcium mg L^{-1}	24.1 – 42.4	35.1 ± 5.9	25.7 – 47.3	34.5 ± 5.8
Magnesium mg L^{-1}	0.9 – 7.5	4.9 ± 2.2	0.8 – 7.5	5.3 ± 2.1
Chloride mg L^{-1}	18.9 – 42.9	28.5 ± 6.4	16.9 – 43.9	27.5 ± 6.8
Dissolved organic matter mg L^{-1}	0.9 – 3.8	2.66 ± 0.87	0.8 – 3.8	2.38 ± 0.80
Total dissolved solids mg L^{-1}	1.1 – 2.9	1.97 ± 0.52	1.1 – 2.9	2.01 ± 0.50
Phosphate mg L^{-1}	0.095 – 0.351	0.171 ± 0.083	0.099 – 0.341	0.170 ± 0.077
Sulphate mg L^{-1}	6.3 – 30.3	15.52 ± 7.41	6.8 – 26.3	14.43 ± 6.23
Nitrate mg L^{-1}	0.272 – 1.548	1.011 ± 0.375	0.268 – 1.521	1.016 ± 0.373
Silicate mg L^{-1}	0.599 – 2.657	1.687 ± 0.692	0.543 – 2.704	1.710 ± 0.700
$B.O.D_5$ mg L^{-1}	1.6 – 4.4	2.72 ± 0.70	1.4 – 4.8	2.63 ± 0.86

RESULTS

The variations observed in abiotic parameters in littoral (station 1) and semi-limnetic (station 2) regions of Ghorajan Beel are indicated in Table 1. Water temperature ranged between 19.7–33.2 °C, rainfall between 4.8–365.0 mm, transparency between 16.0–79.0 cm, pH between 6.72–7.15, specific conductivity between 99.0–193.0 µS cm^{-1}, dissolved oxygen between 4.0–8.2 mg L^{-1}, free CO_2 between 2.0-30.0 mg L^{-1}, alkalinity 50.0–84.0 mg L^{-1}, hardness between 46.0–70.0 mg L^{-1}, calcium between 24.1–47.3 mg L^{-1} and magnesium between 0.8–7.5 mg L^{-1}. Chloride content varied between 16.9–43.9 mg L^{-1}, dissolved organic matter varied between 0.8-3.8 mg L^{-1}, total dissolved solids ranged between 1.1–2.9 mg L^{-1}, BOD_5 varied between 1.4–4.8 mg L^{-1}, while concentrations of phosphate, sulphate, nitrate and silicate ranged between 0.095–0.351 mg L^{-1}, 6.3–30.3 mg L^{-1}, 0.268–1.548 mg L^{-1} and 0.543–2.704 mg L^{-1}, respectively during the study period (Table 1).

The occurrence and abundance of Rotifera species observed are indicated in Appendices I and II while their variations (annual ranges and average ± SD) are summarized in Table 2. This study revealed a total of 85 Rotifera species (Table 2) with 46 ± 6 and 36 ± 5 species, and 46.6–80.4% and 37.0–95.9% community similarities (Sørensen index) at station 1 and station 2 respectively (Tables 3–4). The monthly variations in species richness are shown in Fig. 1. Annual variations in the hierarchical cluster analysis of zooplankton, based on their community similarity values (*vide* Sørensen index) are indicated in Figs. 2–3. The rotifers (185 ± 45 ind. L^{-1}, 180 ± 58 ind. L^{-1}) comprised 53.3 ± 5.1 % and 55.6 ± 3.6 %) of total zooplankton abundance in littoral (station 1) and semi-limnetic (station 2) regions respectively (Table 2). Brachionidae (53 ± 10 ind. L^{-1}, 45 ± 13 ind. L^{-1}), Lecanidae (39 ± 13 ind. L^{-1}, 39 ± 14 ind. L^{-1}), Asplanchnidae (20 ± 11 ind. L^{-1}, 18 ± 10 ind. L^{-1}) and Synchaetidae (16 ± 10 ind. L^{-1}, 18± 11 ind. L^{-1}) were important families of Rotifera at the two sampling stations; these were followed by Synchaetidae and Trichocercidae. In addition, quantitatively important genera and species are indicated in Table 2. The monthly variations in abundance of Rotifera and that of two important families namely Lecanidae and Brachionidae are shown in Figs. 4–5. The species diversity of rotifers (Table 2) ranged between 3.442 ± 0.115 and 3.491 ± 0.131 and its monthly variations are shown in Fig. 6. In addition, their dominance ranged between 0.110 ± 0.026 and 0.110 ± 0.032 while evenness varied between 0.901 ± 0.033 and 0.957 ± 0.067 in littoral (station 1) and semi-limnetic (station2) regions respectively (Table 2). Canonical correspondence analysis (CCA) explained 55.6 % and 59.5 % cumulative variance of the rotifer assemblages along axis 1 and 2 at stations 1 and 2, respectively (Table 5). The CCA indicated the importance of transparency and rainfall at station 1 (Fig. 7), and of transparency, dissolved oxygen and rainfall at station 2 (Fig. 8).

DISCUSSION

Abiotic parameters

The circum-neutral and marginally hard waters of Ghorajan Beel showed concentrations of Ca > Mg and are characterized by low ionic concentrations; this last feature warranted its inclusion under ‘Class I’ category of trophic classification *vide* Talling & Talling (1965). Mean water temperature affirmed the tropical range concurrent with the geographical location of this wetland. Concomitantly, moderate concentrations of dissolved oxygen, low free CO_2; low chloride content and low concentrations of micro-nutrients and other parameters are recorded throughout. The annual ranges of various abiotic factors showed small insignificant differences between stations 1 and 2.

Species richness, community similarities and abundance

The present report of a total of 85 species, belonging to 18 families and 28 genera, indicates a fairly high faunal diversity of Rotifera and reflects

Table 2. Temporal variations of Rotifera (range, average ± SD)

Parameters ↓ Stations →	**Station 1**		**Station 2**	
Species richness				
Zooplankton 145 species	143 species		138 species	
Monthly richness	57 - 97	81 ± 11	48 - 89	72 ± 11
Rotifera 85 species	84 species		80 species	
Monthly richness	35- 55	46 ± 6	24 - 52	36 ± 5
Community similarity %	46.6-80.4		37.0-95.9	
Quantitative				
Zooplankton ind. L^{-1}	188 - 496	354 ± 103	154 - 456	342 ± 111
Rotifera ind. L^{-1}	111 - 242	185 ± 45	92 - 245	180 ± 58
% composition	42.8 – 62.2	53.3 ± 5.1	49.2 – 60.5	55.6 ± 3.6
Species Diversity	3.222 – 3.583	3.442 ± 0.115	3.275 – 3.712	3.491 ± 0.131
Dominance	0.061 – 0.151	0.110 ± 0.026	0.049 – 0.137	0.110 ± 0.032
Evenness	0.865 – 0.968	0.901 ± 0.033	0.834 – 1.084	0.957 ± 0.067
Important Families				
Brachionidae ind. L^{-1}	40-70	53 ± 10	22-60	45 ± 13
Lecanidae ind. L^{-1}	22-61	39 ± 13	22-61	39 ± 14
Asplanchnidae ind. L^{-1}	2-40	20 ± 11	0-34	18 ± 10
Flosculariidae ind. L^{-1}	1-39	16 ± 10	2-42	18± 11
Synchaetidae ind. L^{-1}	4-20	11 ± 4	2-18	9 ± 4
Trichocercidae ind. L^{-1}	3-16	10 ± 3	2-14	9± 3
Important genera				
Lecane ind. L^{-1}	22-61	39 ± 12	22-61	39 ± 14
Brachionus ind. L^{-1}	15-31	26 ± 5	7-35	22 ± 7
Sinantherina ind. L^{-1}	1-39	16 ± 10	2-42	18± 11
Keratella ind. L^{-1}	5-27	15 ± 6	7-21	10 ± 4
Trichocerca ind. L^{-1}	3-16	10 ± 3	2-13	8 ± 3
Important species				
Asplanchna priodonta ind. L^{-1}	0-32	22 ± 6	0-30	19 ± 10
Sinantherina socialis ind. L^{-1}	0-20	11 ± 7	0-20	10 ± 9
Brachionus falcatus ind. L^{-1}	5-25	14 ± 7	0-19	8 ± 7
Polyarthra vulgaris ind. L^{-1}	4-20	11 ± 4	2-18	9 ± 4
Lecane bulla ind. L^{-1}	1- 23	11 ± 6	0-23	8 ± 6

Table 3. Percentage Rotifera community similarity after Sørensen's index between months (Station 1)

Months	**Jan.**	**Feb.**	**March**	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Jan.	-	67.4	63.3	50.0	64.1	60.7	73.8	70.3	61.2	66.0	64.0	74.7
Feb.		-	63.4	60.2	61.7	65.2	75.9	63.8	67.3	80.4	62.4	77.1
March			-	52.2	57.8	59.4	58.3	64.1	60.0	64.1	60.8	62.9
April				-	63.9	50.6	69.2	64.1	67.4	63.6	66.7	69.0
May					-	61.7	68.4	67.5	55.6	74.4	48.8	70.9
June						-	66.7	57.4	61.4	63.9	68.8	64.6
July							-	69.7	58.3	69.6	54.5	70.3
Aug.								-	46.6	68.7	61.0	69.4
Sept.									-	52.8	62.7	66.7
Oct.										-	55.1	71.3
Nov.											-	59.8
Dec												-

Table 4. Percentage Rotifera community similarity after Sørensen's index between months (Station 2)

Months	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Jan.	-	70.0	95.9	59.3	38.5	67.6	53.7	81.7	77.5	74.3	92.1	70.1
Feb.		-	87.7	70.4	48.1	67.6	76.6	81.7	82.5	88.6	69.8	80.5
March			-	68.7	41.8	76.2	67.4	88.1	90.3	81.9	76.3	77.8
April				-	52.8	40.0	63.1	64.6	75.7	75.0	73.7	70.4
May					-	42.7	40.0	47.2	40.8	51.0	37.0	62.6
June						-	53.8	63.4	65.9	74.1	75.1	59.1
July							-	62.4	56.9	63.0	51.8	62.6
Aug.								-	54.9	74.1	78.4	72.7
Sept.									-	57.8	67.5	78.3
Oct.										-	57.5	78.2
Nov.											-	57.5
Dec												-

the general environmental heterogeneity of Ghorajan Beel. Rotifers are the main component of total zooplankton richness (145 species) and signifycantly influence its temporal variations ($r_1 = 0.922$, $P < 0.001$; $r_2 = 0.938$, $P < 0.001$, respectively). High rotifer richness concurs with the reports of Sharma (2000, 2005, 2009, 2010), Sharma & Sharma (2001, 2008) and Khan (2002). The rotifer richness of Ghorajan Beel is similar to the range of 69-93 species recorded from 15 beels of Assam (Sharma & Sharma, 2008) while it is relatively lower than that of Deepor Beel (110 species; Sharma & Sharma, 2005) and Loktak Lake (120 species; Sharma, 2009), two Ramsar sites and important floodplain lakes of Northeast India. Nevertheless, the richness is notably higher than the reports of 48 species from 37 beels (Sharma, 2000), 64 species from twelve beels of the Pobitora Wildlife Sanctuary (Sharma, 2006) of Assam and it presented a distinct contrast to the reports of only 27 species from two floodplain lakes of Kashmir (Khan 1987) and 38 species from four ox-bow lakes and nine floodplain lakes of South-eastern West Bengal (Khan, 2003). We caution against over-emphasis of such comparisons in view of inadequate sampling or incomplete species inventories of several previous Indian works. The rotifer richness of Ghorajan Beel is, however, lower that the reports of 124 species (Oguta Lake) and 136 species (Iyi-Efi Lake) in the Niger delta (Segers et al., 1993); the 130 species from Lake Guarana, Brazil (Bonecker et al*.,* 1994) and the 114 taxa reported from Rio Pilcomayo National park, Formosa, Argentina (Jose de Paggi, 2001). The differences can probably be attributed to the planktonic nature of our collections.

We observe 84 Rotifera species at station 1 and 80 species at station 2; rotifer communities of both sampling stations showed a high similarity (96.3%). In contrast, five species namely *Anuraeopsis coelata, Euchlanis triquetra, Lecane furcata, L. inermis* and *L. lateralis* occurred only at station 1,while only *Dicranophorus forcipatus* is reported at station 2. The monthly rotifer richness varies between 35-55 (46 ± 6) and 24-52 (36 ± 5) species, and shows irregular annual patterns with peaks during March and July and minima during summer (May and April) at both stations respectively, with significant temporal variations between stations ($F_{1, 23} = 5.239$, $P = 0.043$). Mean annual rotifer richness of Ghorajan Beel is lower than that of Loktak Pat (Sharma, 2009) and Deepor Beel (Sharma, 2010) while monthly trends differ distinctly from the latter two sites in the periods of peak richness and patterns of variations.

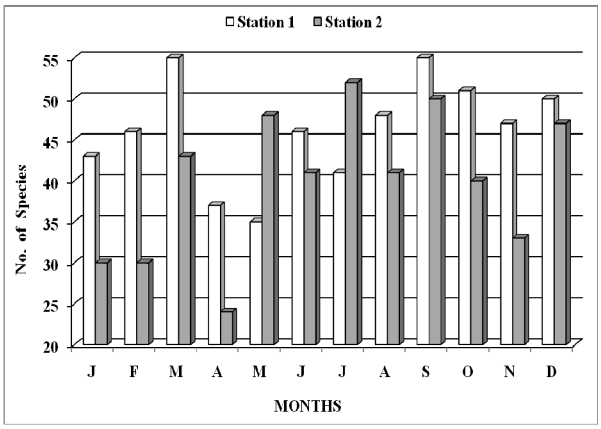

Figure 1. Monthly variations in species richness of Rotifera

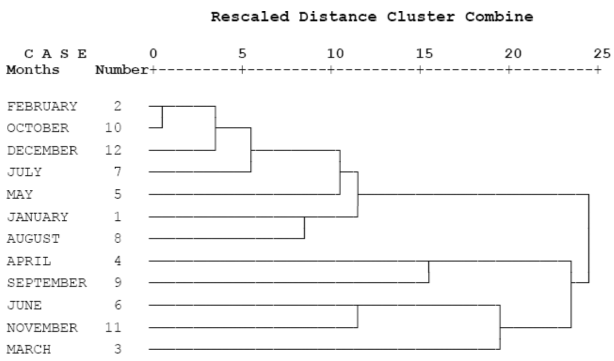

Figure 2. Hierarchical cluster analysis for Rotifera (Station 1)

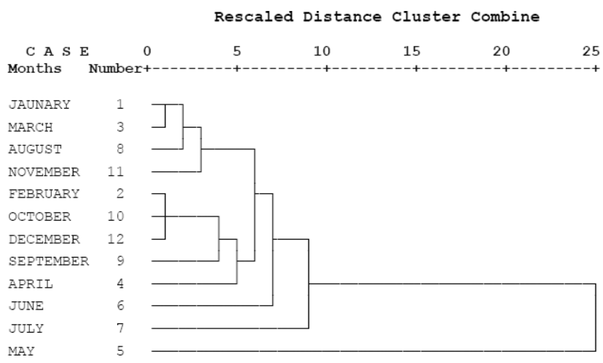

Figure 3. Hierarchical cluster analysis for Rotifera (Station 2)

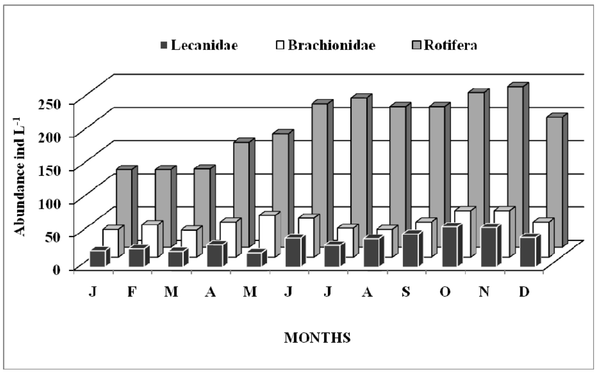

Figure 4. Monthly variations in abundance (ind. L^{-1}) of Rotifera and dominant families (Station 1)

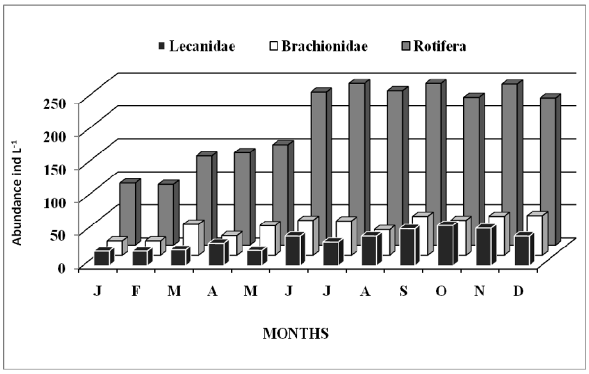

Figure 5. Monthly variations in abundance (ind. L^{-1}) of Rotifera and dominant families (Station 2)

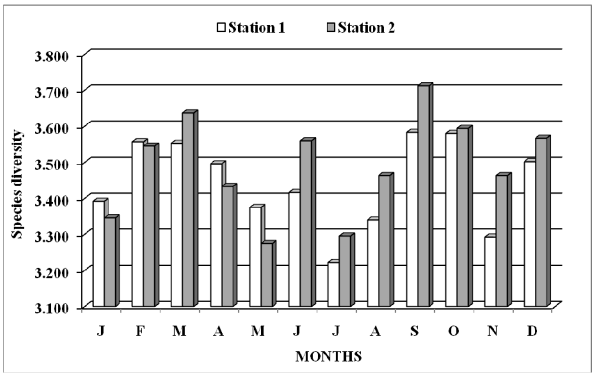

Figure 6. Monthly variations in species diversity of Rotifera

According to the Sørensen index, rotifer communities showed 46.6–80.4 % similarity between months at Station 1 but record a wider range (37.0–95.9 %) at Station 2 and moreover indicated wide variations in the monthly rotifer community composition. Furthermore at station 1 and station 2, community similarity between months in the range of 50–70 % and 50–80 %, respectively, occurred in the majority of instances (80.3% and 84.8%, respectively). At both stations, highest rotifer similarities are recorded between February–October and January–March. Cluster analysis indicates more heterogeneity of the monthly groupings at station 1 in general than at station 2. Our results at station 1 show a higher affinity between February–October while the April, September, June, November and March communities differ distinctly from the rest of the months, with maximum divergence in the June and March samplings. On the other hand, high affinities at station 2 are noticed between January–March and again between February–October–December samples while May and July communities exhibit the greatest divergence in their composition.

Rotifera abundance (annual ranges and average ± SD) exhibits less difference (111–242, 185±45 ind. L^{-1} at station 1 and 92–245, 180±58 ind. L^{-1} at station 2); this is supported by insignificant temporal variations between stations while abundance varied significantly between months ($F_{11, 23} = 24.927$, $P < 0.001$). The rotifers represent more than 50% of the total number of individuals in the zooplankton and contribute significantly to variations in zooplankton abundance at both stations. This finding concurs with the results of Khan (1987), Sanjer & Sharma (1995), Sharma & Sharma (2001, 2008) and Sharma (2005, 2006) but differs from the findings of Baruah *et al*. (1993), Sharma (2000) and Khan (2002) who noted higher abundances for Copepoda. In general, rotifer abundance in Ghorajan beel is higher than that of Loktak Pat (Sharma, 2009) and other wetlands (Yadava *et al.* 1987; Baruah *et al.* 1993; Sharma 2000, 2005; Sharma & Sharma 2008), while it is lower than that of Deepor Beel (Sharma, 2010).

Our results show broadly concurrent annual rotifer density variations at both sampling stations and high abundances (< 200 ind. L^{-1}) from June through November, lacking any distinct maximum. This is in contrast to annual patterns with winter maxima observed in Deepor Beel (Sharma 2010) and Loktak Pat (Sharma, 2009). Our results are also in contrast to summer maxima reported from the beels of Assam (Yadava *et al.*, 1987), Bihar (Baruah *et al.,* 1993, Sanjer & Sharma, 1995). The present study shows a lack of any definite pattern of quantitative variations of the loricate or illoricate rotifers and thus corroborates the results of Sharma (1992, 2009, 2010).

Species diversity, dominance and evenness

Our results are characterized by a high species diversity (3.442±0.115 and 3.491±0.131) and, hence, reflecting high rotifer heterogeneity. The species diversity recorded limited differences between both stations and showed an irregular annual pattern with maxima during September and minima during July at both sampling stations. The present findings are broadly in accord with mean diversity values and multimodal annual patterns reported from Loktak Lake (Sharma, 2009) and Deepor Beel (Sharma, 2010) but differ from these wetlands in the periods of maxima and minima. The higher diversities observed in this study with respect to the reports of Sharma (2000, 2005, 2006) can be attributed to a higher species richness and abundance. In general, the salient feature of high species diversity with relatively low densities for the majority of species in our samplings can be ascribed to fine niche partitioning amongst species, in combination with high micro- and macro-scale habitat heterogeneity as hypothesized by Segers (2008) and affirmed by Sharma (2009, 2010).

The high rotifer evenness (0.867 ± 0.046 and 0.872 ± 0.035), another salient feature of this study, affirms the equitable abundance of various species and, in turn, concurs with our findings for the floodplain lakes of Assam (Sharma, 2005, 2010; Sharma & Sharma, 2008) and Manipur (Sharma, 2009). The evenness follows multimodal but different annual patterns at the two sampling stations and is inversely correlated with rotifer richness ($r_2 = -0.870$, $P = 0.0002$) only at station 2. The rotifer communities exhibit low dominance (0.125 ± 0.037 and 0.133 ± 0.039). This feature concurs with our reports from certain beels of Assam (Sharma, 2005, 2006, 2010) and from Loktak Pat (Sharma, 2009). The dominance follows indefinite but broadly concurrent annual patterns with peaks during January and February at Stations 1 and 2 respectively. Only at station 2, species dominance correlates negatively with species diversity ($r_2 = -0.633$, $P < 0.02$).

Important taxa

Of the eighteen families of Eurotatoria represented in our samples, the members of six families collectively contribute notably (station 1: 149±37 ind. L^{-1} and station 2: 137±43 ind. L^{-1}) to the rotifer abundance at both sampling stations. These families determined patterns of total Rotifera with low mean abundance from January–May. Abundance of Brachionidae (station 1: 53±10 ind. L^{-1} and station 2: 45±12 ind. L^{-1}) is higher than that of Lecanidae (station 1: 39±12 ind. L^{-1} and station 2: 39±14 ind. L^{-1}) and notably influenced rotifer abundance during the study period; this result is in contrast to the reports of Sharma (2000, 2006, 2010). Besides, Asplanchnidae (18±10 ind. L^{-1}) and Flosculariidae (18 ±10 ind. L^{-1}) show certain quantitative importance while Synchaetidae and Trichocercidae also deserve mention. Of the stated families, ANOVA recorded significant density variations of Brachionidae ($F_{1, 23}$ = 4.833, P = 0.050), Asplanchnidae ($F_{1, 23}$ = 9.512, P = 0.010) and Synchaetidae ($F_{1, 23}$ = 8.693, P = 0.013) between the sampling stations.

Abundance of two 'tropic-centered' genera, *Lecane* (39±12 ind. L^{-1} and 39±14 ind. L^{-1}) > *Brachionus* (26±5 ind. L^{-1} and 22±7 ind. L^{-1}) is observed; this feature agrees broadly with results of Sharma (2006, 2009) and Sharma & Sharma (2008) while it is in contrast to dominance of *Brachionus* reported by Sharma (2010). In spite of the report of 85 rotifer species from Ghorajan Beel, only five species, namely *Asplanchna priodonta* > *Sinantherina socialis* > *Brachionus falcatus* > *Polyarthra vulgaris* and *Lecane bulla,* are relatively important. Our samples show low abundance of majority of species and lack of definite quantitative periodicity of any family, genera or species. This salient feature concurs with the results of Sharma (2009, 2010).

Ecological relationships

Our results indicate a more limiting influence of individual abiotic parameters on rotifer richness than on abundance; the former correlated positively only with nitrate (r_2 = 0.645, P = 0.023) at station 2. Rotifer abundance correlated positively with sulphate (r_1 = 647, P = 0.023, r_2 = 0.847, P = 0.0005), nitrate (r_1 = 0.795, P = 0.002; r_2 = 0.858, P = 0.0004) and silicate (r_1 = 0.778, P = 0.003; r_2 = 0.679, P = 0.003) at both stations; and only with alkalinity (r_2 = 0.663, P = 0.019) at station 2. CCA explained high (55.6 % and 59.5 %) cumulative variance of the rotifer assemblages along axis 1 and 2 respectively. Furthermore, CCA showed (Fig. 7) the importance of transparency, rainfall, CO_2 and conductivity at station 1 (littoral region) for higher abundances of rotifer taxa. Rotifer richness, species diversity and evenness, and the abundance of Brachionidae, *Brachionus* and *Keratella* are influenced by higher transparency; abundance of Rotifera, Lecanidae and Brachionidae and to a certain extend of Filiniidae and *Polyarthra vulgaris* are influenced by lower DO and transparency; *Brachionus falcatus* and rotifer dominance are influenced by water temperature and conductivity while the abundance of Synchaetidae and Asplanchnidae is influenced by lower rainfall and lower free CO_2 at station 1. Transparency, DO, rainfall, conductivity and free CO_2 are important at station 2. Abundance of Rotifera, Lecanidae, Floscularidae and *Keratella* is influenced by higher dissolved oxygen; richness and species diversity of Rotifera, abundance of Brachionidae and *Brachionus* are influenced by higher conductivity; and richness, species diversity and evenness is influenced by rainfall and conductivity at station 2. In addition, abundance of Synchaetidae is influenced by lower alkalinity at station 2. The stated differences reflect micro-environmental differences amongst the sampling stations.

CONCLUSIONS

The fairly species rich planktonic Rotifera of Ghorajan Beel formed important qualitative and quantitative components of zooplankton. Our observations reveal a relative quantitative importance of fewer species, low abundance of majority of species, high species diversity, high evenness and low dominance. The results suggest a more limited influence of individual abiotic factors on rotifer richness than on their abundance. CCA with ten abiotic factors explained 55.6 % and 59.5 % cumulative variance of the rotifer assemblages along axis 1 and 2. This study is a useful contribution to diversity and ecology of Rotifera in tropical floodplains in general the Indian floodplain lakes in particular.

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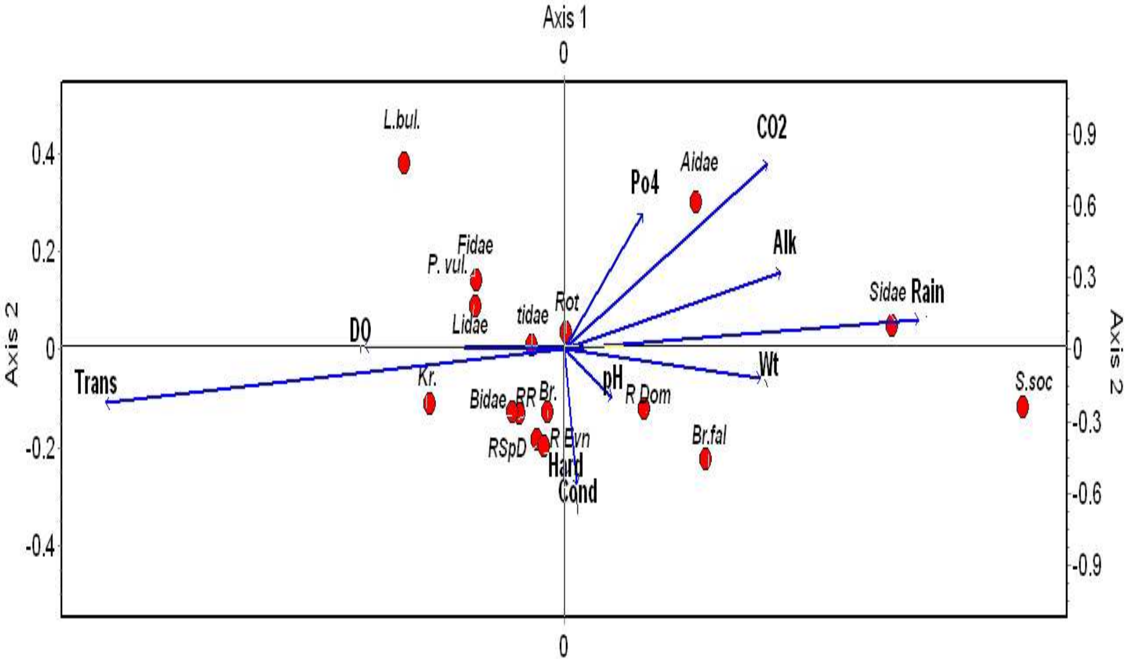

Figure 7. CCA ordination biplot of Rotifera assemblages and environmental variables (Station 1)

Abbreviations. Biotic - Aidae (Asplanchnidae), Bidae (Brachionidae), Fidae (Flosculariidae) Sidae (Synchaetidae), tidae (Trichocercidae), Br. (*Brachionus*), Kr. (*Keratella*), Br.fal (*Brachionus falcatus*), L.bul.(*Lecane bulla*), P.vul (*Polyarthra vulgaris*), S. soc (*Sinantherina socialis*), RR (rotifer richness), Rot (rotifer abundance), R SpD (rotifer species diversity), R Dom (rotifer dominance), R Evn (evenness). **Abiotic.** Alk (alkalinity), CO_2 (free carbon dioxide), Cond (conductivity), DO (dissolved oxygen), Hard (hardness), pH (hydrogen-ion concentration), PO4 (phosphate), Rain (rainfall), Trans (transparency), Wt (water temperature).

Table 5. Variance explained in the Canonical Correspondence Analysis (CCA) by the first two axes

Sampling Stations ↓ Canonical Axis →		**Axis 1**	**Axis 2**
Station 1			
Total variance in species data	0.069844		
Sum of canonical eigen values	0.063459		
Sum of non-canonical eigen values	0.006386		
Canonical eigen value		0.0236544	0.0151901
% variance explained		33.9	21.7
Cumulative % variance		33.9	55.6
Station 2			
Total variance in species data	0.083148		
Sum of canonical eigen values	0.078786		
Sum of non-canonical eigen values	0.004362		
Canonical eigen value		0.0294438	0.0200042
% variance explained		35.4	24.1
Cumulative % variance		35.4	59.5

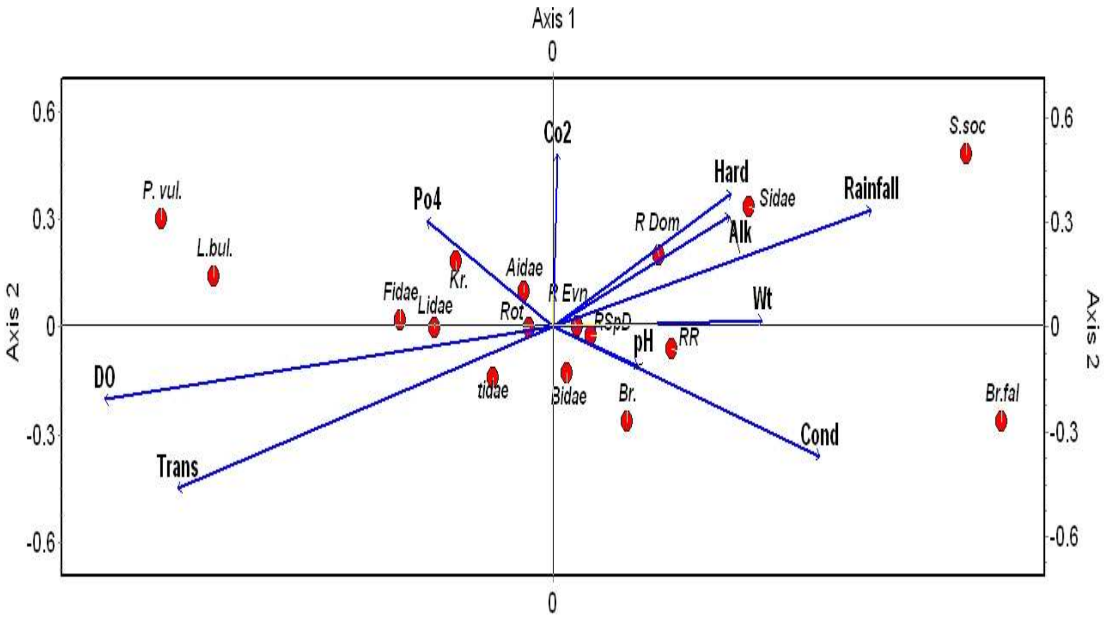

Figure 8. CCA ordination biplot of Rotifera assemblages and environmental variables (Station 2)

Abbreviations. **Biotic** - Aidae (Asplanchnidae), Bidae (Brachionidae), Fidae (Flosculariidae) Sidae (Synchaetidae), tidae (Trichocercidae), Br. (*Brachionus*), Kr. (*Keratella*), Br.fal (*Brachionus falcatus*), L.bul.(*Lecane bulla*), P.vul (*Polyarthra vulgaris*), S. soc (*Sinantherina socialis*), RR (rotifer richness), Rot (rotifer abundance), R SpD (rotifer species diversity), R Dom (rotifer dominance), R Evn (evenness). **Abiotic:** Alk (alkalinity), CO_2 (free carbon dioxide), Cond (conductivity), DO (dissolved oxygen), Hard (hardness), pH (hydrogen-ion concentration), PO4 (phosphate), Rain (rainfall), Trans (transparency), Wt (water temperature).

REFERENCES

A. P. H. A. (1992): *Standard Methods for the Examination of Water and Wastewater* (18^{th} ed.). American Public Health Association, Washington D. C.

BARUAH, A., SINHA, A.K. & SHARMA, U.P. (1993): Plankton variability of a tropical wetland, Kawar (Begusarai), Bihar. *Journal of Freshwater Biology,* 5: 27–32.

BONECKER, C.C., LANSAC-TÔHA, F.A. & STAUB, A. (1994): Qualitative study of Rotifers in different environments of the high Parana river floodplain (Ms), Brazil. *Revista UNIMAR,* 16: 1–16.

JOSÉ DE PAGGI, S. (2001): Diversity of Rotifera (Monogononta) in wetlands of Rio Pilcomayo national park, Ramsar site (Formosa, Argentina). *Hydrobiologia,* 462: 25–34

KHAN, M.A. (1987): Observations on Zooplankton composition, abundance and periodicity in two flood--plain lakes of the Kashmir Himalayan valley. *Acta Hydrochemica Hydrobiologica,* 15: 167-174

KHAN, R.A. (2002): The ecology and faunal diversity of two floodplain Ox-bow lakes of South-Eastern West Bengal. *Records of the Zoological Survey of India, Occasional Paper No.* 195: 1–57.

KHAN, R.A. (2003): Faunal diversity of zooplankton in freshwater wetlands of Southeastern West Bengal. *Records of the Zoological Survey of India, Occasional Paper No.,* 204: 1–107.

KOSTE, W. (1978): *ROTATORIA*. Die Rädertiere Mitteleuropas, begründet von Max Voigt. Überordnung Monogononta. Gebrüder Borntraeger, Berlin, Stuttgart. I. Text (673 pp) und II. Tafelband (T. 234).

LUDWIG, J.A. & REYNOLDS, J.F. (1988): *Statistical Ecology: a Primer on Methods and Computing*. John Wiley & Sons, New York.

MAGURRAN, A.E. (1988): *Ecological Diversity and its Measurement*. Croom Helm Limited, London.

SARMA, P. K. (2000): *Systematics, distribution and ecology of zooplankton of some floodplain wetlands of Assam, India.* Ph.D. thesis. Gauhati University, Assam.

SANJER, L.R. & SHARMA, U.P. (1995): Community structure of plankton in Kawar lake wetland, Begusarai, Bihar: II Zooplankton. *Journal of Freshwater Biology,* 7: 165-167.

SEGERS, H. (1995): Rotifera 2: Lecanidae. 6: 1–226. In: *Guides to identification of the Microinvertebrates .of the Continental waters of the world* (H. J. Dumont & T. Nogrady Eds.). SPB Academic Publishing bv. Amsterdam, the Netherlands.

SEGERS, H. (2008): Global diversity of rotifers (Rotifera) in freshwater. *Hydrobiologia,* 595: 49–59.

SEGERS, H., NWADIARO C.S. & DUMONT H.J. (1993): Rotifera of some lakes in the floodplain of the river Niger (Imo State, Nigeria). II. Faunal composition and diversity. *Hydrobiologia* 250: 63–71.

SHARMA, B.K. (1992): Systematics, Distribution and Ecology of Freshwater Rotifera in West Bengal. Chapter 14: 231-273. In: *Recent Advances in Aquatic Ecology* (S.R. Mishra & D. N. Saksena Eds.). Ashish Publishing House, New Delhi.

SHARMA, B.K. (1998): Freshwater Rotifers (Rotifera: Eurotatoria). In: *Fauna of West Bengal. State Fauna Series*, 3(11): 341-461. Zoological Survey of India, Calcutta.

SHARMA, B.K. (2000): Synecology of Rotifers in a tropical floodplain lake of Upper Assam (N. E. India). *Indian Journal of Animal Sciences*, 70: 880–885.

SHARMA, B.K. (2005): Rotifer communities of floodplain lakes of the Brahmaputra basin of lower Assam (N. E. India): biodiversity, distribution and ecology. *Hydrobiologia,* 533: 209–221.

SHARMA, B.K. (2009): Diversity of rotifers (Rotifera, Eurotatoria) of Loktak Lake, Manipur, North-eastern India. *Tropical Ecology,* 50(2): 277-285.

SHARMA, B.K. (2010): Rotifer communities of Deepor beel, Assam, India: richness, abundance and ecology. *Journal of Threatened Taxa,* 2 (8): 1077–1086.

SHARMA, B.K. & SHARMA, S. (1999): Freshwater Rotifers (Rotifera : Eurotatoria). In: *State Fauna Series: Fauna of Meghalaya,* 4(9):11-161. Zoological Survey of India, Calcutta.

SHARMA, B.K. & SHARMA, S. (2000): Freshwater Rotifers (Rotifera: Eurotatoria). In: *State Fauna Series: Fauna of Tripura,* 7(4): 163-224. Zoological Survey of India, Calcutta.

SHARMA, B.K. & SHARMA, S. (2001): Biodiversity of Rotifera in some tropical floodplain lakes of the Brahmaputra river basin, Assam (N. E. India). *Hydrobiologia,* 446 / 447: 305–313.

SHARMA, B.K. & SHARMA, S. (2005): Faunal diversity of Rotifers (Rotifera: Eurotatoria) of Deepor Beel, Assam (N. E. India) - a Ramsar site. *Journal of the Bombay Natural History Society,* 102 (2): 169–175.

SHARMA, S. (2006): Rotifer diversity (Rotifera: Eurotatoria) of floodplain lakes of Pobitora Wild-Life Sanctuary, Assam. *Records of the Zoological Survey of India,* 106: 76–89.

SHARMA, S. & SHARMA, B.K. (2008): Zooplankton diversity in floodplain lakes of Assam. *Records of the Zoological Survey of India, Occasional Paper No.,* 290: 1–307.

TALLING, J.F. & TALLING, I.B. (1965): The chemical composition of African lake waters. *Internationale Revue gesamten Hydrobiologie*, 50: 421-463.

YADAVA, Y.S., SINGH, R.K., CHOUDHURY, M. & KOLEKAR, V. (1987): Limnology and productivity in Dighali beel (Assam). *Tropical Ecology*, 28: 137-146.

Supporting online material: Appendix 1 (http://opuscula.elte.hu/PDF/Tomus43_1/Sharma_App1.pdf)

Appendix I. Monthly Rotifera abundance (ind. L^{-1}) at station 1

Species ↓ Months→	J	F	M	A	M	J	J	A	S	O	N	D
Family : Brachionidae												
Anuraeopsis coelata	0	0	1	0	0	0	0	0	0	0	2	0
A. fissa	0	1	0	0	3	2	0	3	0	0	0	2
Brachionus angularis	1	0	3	2	0	0	3	3	0	0	5	2
B. bidentatus	0	2	1	0	0	4	0	0	3	6	0	4
B. calyciflorus	1	1	3	0	0	0	2	3	6	2	4	0
B. caudatus	3	5	2	3	0	3`	2	0	3	0	8	4
B. diversicornis	1	1	3	0	0	0	0	2	0	4	3	0
B. falcatus	5	13	7	17	21	25	19	10	7	15	9	6
B. forficula	2	3	3	0	1	0	2	2	2	0	0	2
B. mirabilis	0	0	0	2	1	2	0	0	0	2	0	1
B .quadridentatus	2	1	2	0	4	0	0	4	2	2	0	3
B. rubens	0	0	0	2	2	0	0	0	2	0	0	1
Plationus patulus	7	7	8	8	7	5	6	9	10	10	7	7
Platyias quadricornis	3	1	2	6	8	7	2	1	3	2	6	5
Keratella cochlearis	12	10	4	9	9	5	3	4	9	14	12	9
K. lenzi	2	1	0	2	0	0	0	0	2	1	0	2
K. procurva	0	0	0	2	3	2	0	0	1	0	2	0
K. quadrata	0	1	1	0	0	3	4	0	0	4	2	0
K. tropica	3	2	1	0	4	4	2	1	3	8	10	5
Family : Euchlanidae												
Dipleuchlanis propatula	0	0	0	0	2	0	0	0	0	0	0	3
Euchlanis dilatata	4	6	8	6	9	3	6	7	4	6	5	7
E. triquetra	1	0	0	0	0	0	2	0	0	0	0	0
Family : Mytilinidae												
Mytilina bisulcata	0	0	2	2	0	0	0	0	2	0	1	2
M. ventralis	3	2	0	3	2	0	0	2	0	2	3	4
Family : Trichotriidae												
Macrochaetus sericus	2	1	0	1	1	0	1	0	2	2	3	2
Trichotria tetractis	1	2	0	2	2	2	3	2	3	0	0	2
Family : Lepadellidae												
Colurella obtusa	1	0	2	0	2	1	0	0	2	0	0	2
C. uncinata	2	0	0	3	0	0	2	2	3	0	1	1
Lepadella apsicora	0	0	0	0	0	0	0	0	0	0	2	0
L. ehrenbergi	1	0	1	0	2	3	0	1	0	2	0	2
L. heterostyla	0	1	0	2	0	2	2	0	1	2	1	3
L. ovalis	1	1	1	0	3	0	0	4	0	3	4	2
L. patella	2	1	0	0	0	1	1	0	2	0	3	1
L. rhomboides	1	0	1	4	2	0	2	0	2	1	0	0
Family : Lecanidae												
Lecane aculeata	0	0	2	3	3	0	0	0	1	2	0	0
L. bulla	6	1	1	4	4	5	6	10	8	16	23	12
L. closterocerca	1	1	1	3	2	0	2	2	3	3	0	2
L. crepida	0	0	0	0	1	0	2	0	0	2	0	0
L. curvicornis	5	6	9	5	5	3	3	2	6	9	7	5
L. furcata	0	3	0	0	2	0	0	2	0	3	0	1
L. hamata	1	2	1	0	0	0	0	0	2	0	0	0
L. hornemanni	3	0	0	0	0	0	0	0	4	0	0	0
L. inermis	0	0	0	0	0	2	0	0	0	0	0	0
L. inopinata	0	0	0	2	0	2	0	0	2	0	1	0

Appendix I. Monthly Rotifera abundance (ind. L^{-1}) at station 1 (continued)

Species ↓ Months→	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Lecane lateralis	0	0	1	0	0	0	0	0	0	0	2	0
L. leontina	2	2	3	4	0	5	8	12	7	4	6	5
L. luna	1	0	0	0	0	4	3	2	0	1	3	0
L. lunaris	1	1	0	0	0	3	0	2	0	3	2	0
L. nana	0	0	0	1	0	4	0	0	0	2	0	0
L. ohioensis	0	0	0	3	0	0	0	0	0	2	4	6
L. papuana	0	0	1	0	0	3	0	0	2	0	2	0
L. pertica	0	2	0	0	2	0	0	0	0	2	0	0
L. ploenensis	0	4	1	0	0	0	0	0	2	3	0	1
L. pyriformis	0	1	0	2	0	0	0	0	1	2	0	1
L. quadridentata	2	0	1	0	0	3	0	6	4	0	3	5
L. thienemanni	0	2	0	3	0	4	2	2	0	0	1	0
L. unguitata	2	1	2	4	2	3	4	3	2	3	6	2
L. ungulata	1	2	1	0	0	6	4	0	6	4	0	5
Family : Notommatidae												
Cephalodella forficula	0	2	0	0	2	0	3	2	0	2	0	1
Monommata longiseta	0	1	2	4	2	0	2	4	0	2	2	0
Family : Scarididae												
Scaridium longicaudum	1	0	2	0	6	5	0	2	0	1	4	2
Family : Trichocercidae												
Trichocerca capucina	0	1	0	3	2	3	2	0	2	2	0	0
T. cylindrica	0	2	1	3	0	0	2	2	6	5	0	2
T. elongata	0	0	4	2	0	0	0	2	0	0	2	0
T. longiseta	1	0	1	0	0	3	0	3	2	4	2	6
T. porcellus	0	1	1	0	4	2	3	3	0	2	0	1
T. similis	1	3	1	0	0	2	0	0	4	3	1	0
Family : Asplanchnidae												
Asplanchna priodonta	0	1	7	8	14	23	28	32	24	18	26	13
Family : Synchaetidae												
Polyarthra vulgaris	6	2	3	11	4	3	14	4	14	6	16	9
Family : Flosculariidae												
Sinantherina socialis	17	0	9	0	14	18	12	20	0	14	0	10
S. spinosa	0	0	0	7	6	12	30	0	12	6	12	0
Family : Conochilidae												
Conochilus unicornis	0	5	0	0	0	8	12	14	10	16	0	8
Family : Hexarthridae												
Hexarthra mira	0	1	0	0	0	0	0	0	1	0	2	0
Family : Trochosphaeridae												
Filinia camasecla	0	4	0	0	0	8	0	0	0	0	8	6
F. longiseta	1	0	1	0	0	0	0	0	4	0	3	0
F. pejleri	0	1	1	0	0	4	2	2	0	3	0	0
F. opoliensis	0	1	0	2	0	0	3	3	0	0	0	2
Trochosphaera aequatorialis	0	0	0	0	4	6	0	10	0	0	0	0
Family : Testudinellidae												
Testudinella emarginula	0	1	0	2	0	0	2	0	2	0	0	2
T. greeni	0	0	0	0	0	0	0	0	0	0	3	0
T. patina	3	0	4	3	3	6	14	4	6	0	8	5
T. tridentata	0	0	0	3	0	0	0	2	0	0	0	0
Family : Philodinidae												
Rotaria rotatoria	1	0	1	0	0	0	0	0	0	0	0	0
R. neptunia	1	0	0	0	1	0	0	0	1	0	0	0
Rotifera abundance ind.L^{-1}	**117**	**117**	**118**	**158**	**171**	**216**	**225**	**212**	**212**	**233**	**242**	**196**

0 refers to below detection limit

Appendix II. Monthly Rotifera abundance (ind. L^{-1}) at station 2

Species ↓ Months→	J	F	M	A	M	J	J	A	S	O	N	D
Family : Brachionidae												
Anuraeopsis fissa	2	0	1	0	3	4	0	3	4	0	2	2
Brachionus angularis	1	0	3	2	0	0	2	3	0	0	6	0
B. bidentatus	0	2	1	0	0	4	0	0	3	6	0	4
B. calyciflorus	1	1	3	0	0	0	0	6	12	0	4	0
B. caudatus	2	2	13	3	0	0	4	0	3	0	14	8
B. diversicornis	1	1	3	0	0	0	0	2	0	4	3	0
B. falcatus	0	5	7	0	17	19	14	0	7	14	0	8
B. forficula	0	1	3	0	0	3	2	2	2	0	3	0
B. mirabilis	0	0	0	0	3	2	0	0	0	2	0	1
B. quadridentatus	2	1	2	0	4	0	0	4	2	2	0	3
B. rubens	0	0	0	2	2	0	0	0	2	0	0	1
Plationus patulus	3	4	3	11	9	7	15	3	13	2	11	23
Platyias quadricornis	1	1	2	0	0	3	4	6	4	2	2	4
Keratella cochlearis	7	2	4	6	4	0	7	8	6	10	7	4
K. lenzi	1	1	0	4	0	0	0	0	2	3	0	2
K. procurva	0	0	0	2	3	4	0	0	0	0	2	0
K. quadrata	0	1	1	0	0	3	4	0	0	4	2	0
K. tropica	1	0	1	0	0	4	0	2	0	4	3	0
Family : Euchlanidae												
Dipleuchlanis propatula	0	2	1	0	0	4	3	4	2	0	3	2
Euchlanis dilatata	4	13	9	14	9	7	10	14	8	10	16	22
Family : Mytilinidae												
Mytilina bisulcata	3	0	1	0	0	2	0	0	2	0	3	0
M. ventralis	2	1	4	0	0	3	4	2	4	0	0	6
Family : Trichotriidae												
Macrochaetus sericus	0	2	1	2	0	0	3	5	4	2	0	3
Trichotria tetractis	1	2	1	0	2	0	3	2	3	0	0	2
Family : Lepadellidae												
Colurella obtusa	1	0	2	0	0	4	0	0	2	3	0	2
C. uncinata	2	0	0	3	0	0	2	2	3	0	1	1
Lepadella apsicora	0	1	0	0	4	3	1	0	3	0	2	2
L. ehrenbergi	1	0	1	0	2	3	0	1	0	2	0	2
L. heterostyla	1	0	0	2	0	0	2	0	1	4	0	3
L. ovalis	1	1	1	0	3	0	0	4	0	3	4	2
L. patella	1	0	2	0	0	3	0	2	2	0	3	0
L. rhomboides	0	0	1	4	3	0	0	0	2	1	0	0
Family : Lecanidae												
Lecane aculeata	0	0	2	3	3	0	0	0	1	2	0	0
L. bulla	6	1	1	4	4	5	6	10	8	16	23	12
L. crepida	0	0	1	0	1	3	2	0	0	2	0	0
L. closterocerca	1	1	1	3	2	0	2	2	3	3	0	2
L. curvicornis	2	0	8	2	4	4	3	2	8	6	4	3
L. hamata	1	2	1	0	0	0	0	0	2	0	0	0
L. hornemanni	3	0	1	0	0	2	0	0	4	3	2	1
L. inopinata	0	0	0	2	0	1	0	0	2	1	1	0
L. leontina	2	2	3	4	0	5	8	12	7	4	6	5
L. ludwigii	0	0	1	3	2	0	2	2	4	3	0	2
L .luna	1	0	0	0	0	2	3	2	0	1	3	0
L. lunaris	1	1	0	0	0	3	0	2	0	3	2	0

Appendix II. Monthly Rotifera abundance (ind. L^{-1}) at station 2 (continued)

Species ↓ Months→	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Lecane nana	0	3	0	1	2	4	0	2	0	2	0	0
L. ohioensis	0	0	0	3	0	0	0	0	0	2	4	6
L. papuana	0	0	1	0	0	3	0	0	2	0	2	0
L. pertica	0	2	0	0	2	0	0	0	0	2	0	0
L. ploenensis	0	4	1	0	0	0	0	0	2	3	0	1
L. pyriformis	0	1	0	2	1	0	0	0	1	2	0	1
L. quadridentata	2	0	1	0	0	3	0	6	4	0	3	5
L. thienemanni	0	2	0	3	0	4	2	2	0	0	1	0
L .unguitata	2	1	2	4	2	3	4	3	2	3	6	2
L. ungulata	1	2	1	0	0	6	4	0	6	4	0	5
Family : Notommatidae												
Cephalodella forficula	1	2	1	0	2	0	3	2	2	2	0	1
Monommata longiseta	0	1	2	4	2	0	2	4	0	2	2	0
Family : Scaridiidae												
Scaridium longicaudum	1	0	2	0	6	5	0	2	0	1	4	2
Family : Trichocercidae												
Trichocerca capucina	0	1	0	3	2	3	2	0	2	2	0	0
T. cylindrica	1	2	1	3	0	0	2	2	6	5	o	2
T. elongata	0	0	4	2	0	0	0	2	0	0	2	0
T. longiseta	1	0	1	0	0	3	0	3	2	4	2	6
T. porcellus	0	1	1	0	4	2	3	3	0	2	0	1
T. similis	1	3	1	0	0	2	0	0	4	3	1	0
Family : Asplanchnidae												
Asplanchna priodonta	0	1	7	8	14	23	28	32	24	18	26	13
Family : Synchaetidae												
Polyarthra vulgaris	6	2	3	11	4	3	14	4	14	6	16	9
Family : Dicranophoridae												
Dicranophorus forcipatus	1	0	1	3	0	0	0	2	2	0	3	2
Family : Flosculariidae												
Sinantherina socialis	17	0	9	0	14	18	12	20	0	14	0	10
S. spinosa	0	0	0	7	6	12	30	0	12	6	12	0
Family : Conochilidae												
Conochilus unicornis	0	5	0	0	0	8	12	14	10	16	0	8
Family : Hexarthridae												
Hexarthra mira	0	1	0	0	0	0	0	0	1	0	2	0
Family : Trochosphaeridae												
Filinia camascela	0	3	0	0	0	8	0	0	0	0	8	6
F. longiseta	1	0	1	0	0	0	0	0	4	0	3	0
F. pejleri	1	1	1	0	0	3	2	2	0	2	0	0
F. opoliensis	0	2	1	2	0	0	3	3	0	1	0	4
Trochosphaera aequatorialis	0	1	0	2	0	0	2	0	1	0	0	2
Family : Testudinellidae												
Testudinella emarginula	0	0	0	0	4	6	0	10	0	0	0	0
T. greeni	0	0	0	0	0	0	0	0	0	0	3	0
T. patina	2	0	3	3	3	6	14	4	7	0	8	3
T. tridentata	0	0	0	3	0	0	0	2	0	0	0	0
Family : Philodinidae												
Rotaria neptunia	0	0	0	0	0	0	0	3	2	0	4	2
Rotifera abundance ind.L^{-1}	**94**	**92**	**135**	**140**	**152**	**232**	**245**	**234**	**245**	**224**	**244**	**223**

0 refers to below detection limit

In Memoriam Reginald William Sims

Reginald William Sims will be remembered for his outstanding contribution to oligochaete taxonomy, however the world of oligochaete taxonomy was not his original profession and oligochaetes were not in fact originally his chosen taxa.

Sims served in the Royal Navy during the Second World War and continued this service for a few years after the war ended until he left the forces to obtain a degree in biology. By 1952 he had got a job as a scientific officer in the Ornithology section at the Natural History Museum, London (although based at Tring in Hertfordshire) and by 1955 he was a Senior Scientific officer with several publications to his name. A highlight of his time with this group came in 1956, when he took part in a six-month expedition to North Borneo jungle, along with Edward Banks, and collected 700 bird specimens.

In 1960 however things changed dramatically when Sims was moved to be head of the Annelid section at the South Kensington site of the Museum, and then his work on oligochaetes began. Very soon he was encouraging depositions from all over the world. Specimens started arriving from the Solomon Islands, Malta, Bolivia, Anatolia to name but a few. Sims wrote out easy instructions for enthusiastic helpers, such as civil servants who were stationed overseas, on how to go about collecting and fixing earthworms for him and he was in correspondence with many international colleagues. The biggest growth in the collection came when Edward Easton joined Sims' team. In 1978 alone, 2,863 oligochaete specimens were donated to the Museum. Sims and Easton collaborated on a paper on the pheretimoid earthworms in 1972 which is still one of the most authoritative texts on this group despite the 40 years which have passed since its publication.

Sims was also co-author on the 1985 (revised 1999) key to the British fauna which certainly is considered a bible for the next generation of British earthworm scientists, so his legacy continues.

Sims was not just a highly skilled traditional taxonomist but was also a moderniser and was early to recognise the benefit of using computers in taxonomy, beginning with utilising punch-card systems in the 1960s. He was instrumental in establishing the Earthworm Society and helped to organise one of the first International Oligochaeta conferences in 1985 in Grange-over-Sands.

Sims retired in 1986 although kept working on taxonomy until unfortunately his eye sight began to fail. He will be very sadly missed by colleagues and friends alike both in the UK and overseas.

Emma Sherlock and *Louise Berridge*
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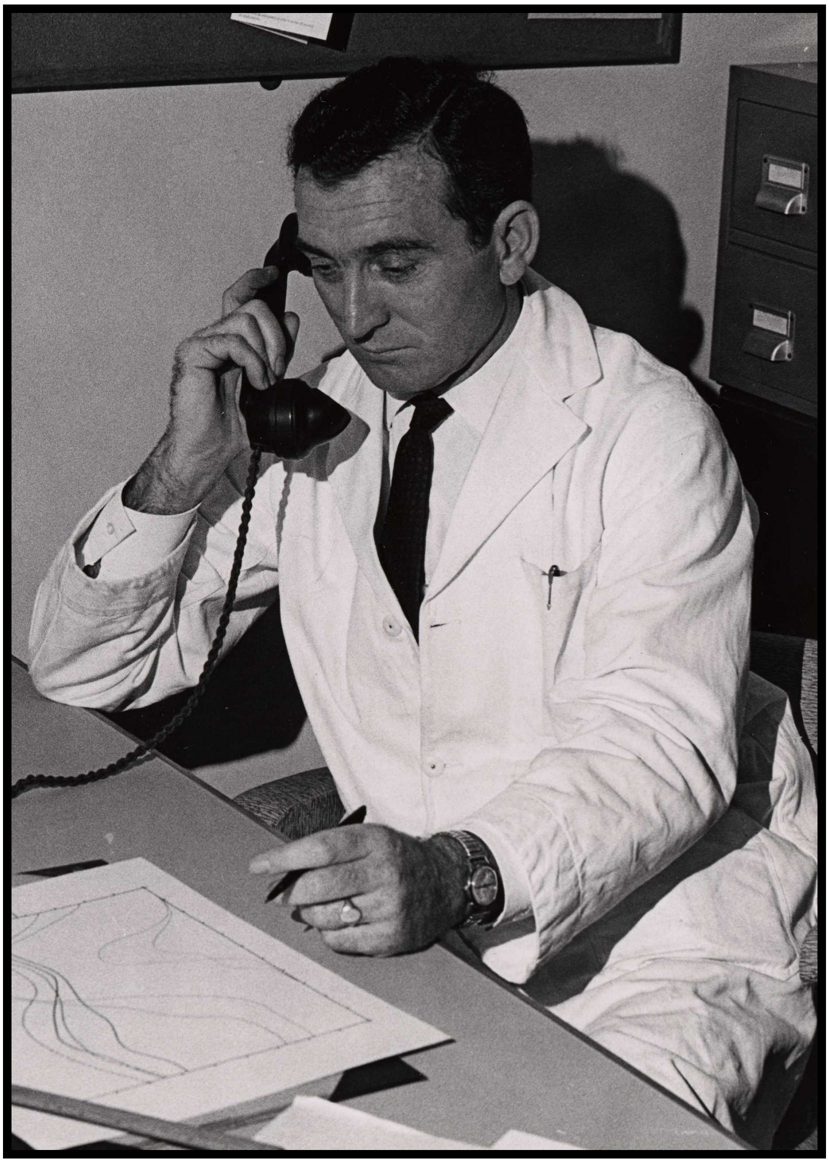
The Natural History Museum, London



(Photo: David George)

Reginald William Sims
(1926–2012)

Bibliography of R. W. Sims

SIMS, R. W. (1953): On the status of *Cyanoramphus magnirostris* Forbes and Robinson, Bull. Liverpool Mus. 1, p. 21, 1897: Tahiti, Society Islands. *Bulletin of the British Ornithologists' Club,* 73: 104.

SIMS, R. W. (1954): Black-billed Cuckoo in Shetland. *British Birds,* 47: 173.

SIMS, R. W. (1954): A new race of Button-quail (*Turnix maculosa*) from New Guinea. *Bulletin of the British Ornithologists' Club,* 74: 37–40.

SIMS, R. W. (1954): The Black-billed Cuckoo in the Shetlands. *The Scottish Naturalist,* 65: 196.

SIMS, R. W. (1955): The morphology of the head of the Hawfinch *(Coccothraustes coccothraustes*). *Bulletin of the British Museum (Natural History), Zoology,* 2: 369–393.

SIMS, R. W. & WARREN, R. M. L. (1955): The names of the races of the Pompadour Pigeon, *Treron pompadora* (Gmelin), in Java and Celebes. *Bulletin of the British Ornithologists' Club,* 75: 96.

SIMS, R. W. (1956): Birds collected by Mr. F. Shaw-Mayer in the Central Highlands of New Guinea 1950–1951. *Bulletin of the British Museum (Natural History), Zoology,* 3: 387–438.

SIMS, R. W. (1957): A new race of babbler (*Trichastoma abbotti*) from Central Annam. *Bulletin of the British Ornithologists' Club,* 77: 153–154.

PHILLIPS, W. W. A. & SIMS, R. W. (1958): Some observations on the fauna of the Maldive Islands. Part III. Birds. *Journal of the Bombay Natural History Society*, 55: 195–217.

PHILLIPS, W. W. A. & SIMS, R. W. (1958): Two new races of birds from the Maldive Archipelago. *Bulletin of the British Ornithologists' Club,* 78: 51–53.

SIMS, R. W. (1958): Killdeer in Cornwall. *British Birds,* 51: 398.

SIMS, R. W. (1959): Edible birds' nests. *New Biology,* 30: 47–58.

SIMS, R. W. (1959): The *Ceyx erithacus* and *rufidorsus* species problem. *Journal of the Linnaean Society, Zoology,* 44: 212–221.

SIMS, R. W. 1961. The identification of Malaysian species of swiftlets *Collocalia. Ibis* 103a: 205–210.

SIMS, R. W. (1962): A new subspecies and first European record of *Eophila moebii* (Michaelsen), Lumbricidae: Oligochaeta. *Annals and Magazine of Natural History,* 13(109): 109–111.

SIMS, R. W. (1963): Oligochaeta (Earthworms) [results of Sims collecting worms at Buckingham Palace]. *Proceedings of the South London Entomological and Natural History Society*, 2: 53.

SIMS, R. W. (1963): A small collection of earthworms from Nepal (Megascolecidae: Oligochaeta). *Journal of the Bombay Natural History Society*, 60(1): 84–91.

SIMS, R. W. (1964): Oligochaeta from Ascension Island and Sierra Leone including records of *Pheretima* and a new species of *Dichogaster*. *Annals and Magazine of Natural History*, 13(7): 107–113.

SIMS, R. W. (1964): Internal fertilization and the functional relationship of the female and spermathecal systems in new earthworms from Ghana (Eudrilidae: Oligochaeta). *Proceedings of the Zoological Society of London*, 143: 587–608.

SIMS, R. W. (1965): Acanthodrilidae and Eudrilidae (Oligochaeta) from Ghana. *Bulletin of the British Museum (Natural History), Zoology,* 12: 283–311.

SIMS, R. W. (1965): The identity of the Western African Earthworm *Millsonia nigra* Beddard, 1894 (Synonym *Dichogaster eudrilina* Cognetti, 1909) Octochaetinae, Oligochaeta. *Journal of the West African Science Association*, 10(1): 39–44.

SIMS, R. W. (1966): The classification of the Megascolecoid earthworms: an investigation of Oligochaete systematics by computer techniques. *Proceedings of the Linnean Society of London*, 177: 125–141.

SIMS, R. W. (1967): Earthworms (Acanthodrilidae and Eudrilidae: Oligochaeta) from Gambia. *Bulletin of the British Museum (Natural History), Zoology,* 16: 3–43.

SIMS, R. W. (1969): Obituary, Alexander (Alastair) Charles Stephen, 1894–1966. *Cahiers Pacific*, 10: 43.

SIMS, R. W. (1969): Outline of an application of computer techniques to the problem of the classification of the Megascolecoid earthworms. *Pedobiologia*, 9: 35–41.

SIMS, R. W. (1969): *A numerical classification of Megascolecoid earthworms*. In: SHEALS, J. G. (ed.) The soil Ecosystem. Systematics Association's Publications No. 8, pp. 143–153.

SIMS, R. W. (1969): Internal fertilization in Eudrilid earthworms with the description of a new Pareudriline genus and species (Oligochaeta) from Ghana. *Journal of Zoology London*, 157: 437–447.

SIMS, R. W. (1971): Eudrilinae from southern Nigeria and a taximetric appraisal of the family Eudrilidae (Oligochaeta). *Journal of Zoology London*, 164: 529–549.

SIMS, R. W. (1971): Earthworms of Diego Garcia. *Atoll Research Bulletin*, 149:171.

SIMS, R. W. 1(972): *Oligochaeta*. In: Van Zinderen Bakker, E.M., Winterbottom, J.M.,Dyer, R.A. (eds). Marion and Prince Edward Islands. Report on the South African biological and geographical expedition 1965–1966. A. A. Balkema, Cape Town, pp. 391–393.

SIMS, R. W. & EASTON, E. G. (1972): A numerical revision of the earthworm genus *Pheretima* auct. (Megascolecidae: Oligochaeta) with the recognition of new genera and an appendix on the earthworms collected by the Royal Society North Borneo Expedition. *Biological Journal of the Linnaean Society,* 4: 169–268.

SIMS, R. W. (1973): *Lumbricus terrestris* Linnaeus, 1758 (Annelida, Oligochaeta): Designation of a neotype in accordance with accustomed usage. Problems arising from the misidentification of the species by Savigny (1822 & 1826). *The Bulletin of Zoological Nomenclature*, 30(1): 27–33.

SIMS, R. W. (1978): *Megadrilacea (Oligochaeta)*. In. Werger, M. J. A. (ed.) Biogeography and Ecology of Southern Africa. Monographiae biologicae, No. 31, pp. 661–676.

KERRICH, G. J., HAWKSWORTH, D. L. & SIMS, R. W. (1978): *Key works to the fauna and flora of the British Isles and North Western Europe*. Systematics Association Special volume, No. 9, Academic press London, pp. 179.

SIMS, R. W. (1980): A preliminary numerical evaluation of the taxonomic characters of *Allolobophora* auct. And some allies (Lumbricidae: Oligochaeta) Occurring in France. *Pedobiologia*, 20: 212–226.

SIMS, R. W. (ed.) (1980): *Animal Identification: A Reference Guide*. Volume 1: Marine and Brackish Water Animals (pp. 111) and Volume 2: Land and Freshwater Animals (not Insects) (pp. 120). British Museum (Natural History), London, and John Wiley and Sons Ltd., Chichester.

SIMS, R. W. (1980): A classification and the distribution of earthworms, suborder Lumbricina (Haplotaxida: Oligochaeta). *Bulletin of the British Museum (Natural History), Zoology,* 39: 103–124.

SIMS, R. W. (1981): Oligochaeta (Vermes). Contributions à l'étude de la faune terrestre des îles granitiques de l'archipel des Séchelles (Mission P. L. G. Benoit – J. J. Van Mol 1972). *Revue Zoologique Africaine*, 95(3): 721–726.

SIMS, R. W. (1982): *Monoligastrida, Alluroidina and Lumbricina*. In: PARKER, S. P. (ed.) Synopsis and classification of living organisms. 2. McGraw-Hill New York, pp. 51–61.

SIMS, R. W. (1982): Classification and distribution of the suborder Lumbricina (Haplotaxida: Oligochaeta). *Pedobiologia*, 23: 284–285.

SIMS, R. W. (1982): Revision of eastern African earthworm genus *Polytoreutus* (Eudrilidae: Oligochaeta). *Bulletin of the British Museum (Natural History) Zoology*, 43: 253–298.

SIMS, R. W., PRICE, J. H. & WHALLEY, P. E. S. (eds.) (1983): *Evolution, time and space: the emergence of the biosphere*. Systematics Association special volume No. 23, Academic press London, New York pp. 492.

SIMS, R. W. (1983): *The scientific names of earthworms*. In: SATCHELL, J E. (ed.) Earthworm Ecology from Darwin to Vermiculture. Chapman and Hall, London, pp. 467–474.

SIMS, R. W. (1984): *Octolasion* Örley, 1885 (Annelida, Oligochaeta, Lumbricidae): Ratification of the designation of the type species and the introduction of *Octolasion (Octodrilus)* by Omodeo, 1956 in accordance with usage, with the suppression of the designation of the type species and of the names *Octolasion (Incolore)* and *Octolasion (Purpureum)* by Omodeo, 1952. *The Bulletin of Zoological Nomenclature*, 41(4): 254–258.

SIMS, R. W. (1985): A new genus of West African earthworm with notes on the identity of *Iridodrilus* Beddard, 1897 (Eudrilidae: Oligochaeta). *Bulletin of the British Museum (Natural History) Zoology*, 48(1): 11–14.

SIMS, R. W. & GERARD, B. M. (1985): *Earthworms. Keys and notes for the identification and study of the species*. Synopses of the British Fauna (New Series) No. 31, Published for the Linnean Society of London and The Estuarine and Coastal Sciences Association by the Field Studies Council, pp. 171.

SIMS, R. W. (1987): New species and records of earthworms from Jamaica with notes on the genus *Eutrigaster* Cognetti, 1904 (Octochaetidae: Oligochaeta). *Journal of Natural History*, 21(2): 429–441.

SIMS, R. W. (1987): *Review of the central African family Eudrilidae (Oligochaeta)*. In: PAGLIAI, A. M. B. & OMODEO, P. (eds.) On Earthworms. Selected Symposia and Monographs, No. 2, Unione Zoologica Italiana, Mucchi, Modena, pp. 359–388.

SIMS, R. W. & GERARD, B. M. (1999): *Earthworms. Notes for the identification of British Species*. Synopses of the British Fauna (New Series) No 31 (Revised). Published for the Linnean Society of London and The Estuarine and Coastal Sciences Association by the Field Studies Council, pp. 169.

Draconizercon punctatus gen. et sp. nov., a peculiar zerconid mite (Acari: Mesostigmata: Zerconidae) from Taiwan

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Abstract. A new genus and species, *Draconizercon punctatus* gen. et sp. nov. is described from low and high elevation areas of Taiwan. The classification problems within the family Zerconidae are discussed.

Keywords. Zerconidae, new genus, new species, Taiwan, rainforest.

INTRODUCTION

Zerconid mites were thought to be distributed in the Holarctic region, inhabiting the cold and temperate climate zones only, however several records of the last two years show that Zerconidae were able to disperse southwards through the high mountain zone, reaching and expanding beyond the Tropic of Cancer (Ujvári, 2010, 2011a, b, c; Ma *et al.,* 2011). According to our present knowledge, altogether eight species of five genera are known from Taiwan, seven of the species are endemic on the island, besides one genus (*Rotundozercon* Ujvári, 2011) and two subgenera (*Parazercon (Formosella)* Ujvári, 2011 and *Zercon (Zercorientalia)* Ujvári, 2011)) seem also to be endemic.

The present paper contributes to the knowledge of the Zerconidae fauna of Taiwan reporting on a remarkable species which, because of the special character-combination necessitated establishing a new genus.

It should be remarked that all previously recorded specimens were found between 1500–3100 meters a.s.l. and were missing from the lowland rainforests of the island. However two specimens of the species described herein were found on 585 meters elevation and inhabit the latter vegetation type.

MATERIAL AND METHODS

Mites were extracted using Berlese funnels, then cleared with lactic acid and mounted in glycerine. Preparates were examined using a light microscope; drawings were made with the aid of a drawing tube. Mites are deposited in the Collection of Soil Zoology of Hungarian Natural History Museum (HNHM), and the National Museum of Natural Sciences, Taichung, Taiwan (NMNS), in 70% ethanol. The terminology of idiosomal setae follows Lindquist & Evans (1965), with modifications for the caudal region as given by Lindquist & Moraza (1998). The system of notation for dermal glands and lyrifissures follows Johnston & Moraza (1991). The description of gnathosomal structures is in accordance with Ujvári (2011d). All measurements including scale bars of the figures are given in micrometres.

TAXONOMY

Draconizercon gen. nov.

Diagnosis. Podonotal shield carapace-like, expanded anteroventrally and lateroventrally, setae j1 situated ventrally. The slit between peritrematal shields and dorsal shields not conspicuous, posterolateral tips of peritrematal shields expanded posteriorly. Peritremes of general size, expanded to anterior half of coxae III, straight or slightly bent. Setae r1 and r3 shifted ventrally to peritrematal shields, both short, bristle-like. A single opening of glands *gv2* present. Ventrianal shield bearing 19 setae, setae Zv1 absent. Setae z1 absent. Glands *gv3* situated posterolaterally to adanal setae. Third pair of opisthonotal pores associated with the Z-series (*gdZ4*). Margin of opis-

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thonotum generally with 7–8 pairs of R-setae. Opisthomarginal setae of distinctive shape, bent, apically tapering and serrate.

Remarks. The new genus is similar to the genera *Aleksozercon* Petrova, 1978, *Blaszakzercon* Kemal & Koçak, 2009, *Cosmozercon* Błaszak, 1981, *Krantzas* Błaszak, 1981 and *Prozercon* Sellnick, 1943 on the basis of the following features: carapace-like podonotal shield; two short peritrematal setae; posteriorly expanded peritrematal shield; peritremes expanded to anterior half of coxae III; third pair of podonotal glands situated medial to the s-series; third pair of opisthonotal glands associated to the Z-series. The six genera can be distinguished by the combination of characters listed in Table 1.

Etymology. The name of the new genus is composed of the Latin '*draco*', means dragon, and the name *Zercon*.

Gender. Male.

Type species. *Draconizercon punctatus* sp. nov.

Draconizercon punctatus sp. nov.

Diagnosis. Central setae of podonotum smooth, submarginal and marginal setae pilose. Opisthonotal J-setae, Z1–4 and S2 elongate, apically tapering, densely covered by short pili; Z5 pointed, smooth or finely serrate; S3–5 brush-like, apically plumose; marginal setae bent, serrate. Glands *gdZ4* (Po3) situated medially to Z4. Dorsal cavities small, well-sclerotized. The area between J-series covered by large alveolar pits. Sternal setae st2 situated in the central area of the shield, near each other.

Material examined. Holotype. Taiwan, Hualien County, Jhuosi Township, Wa-la-mi, 585 m a.s.l., from leaf-litter, 05 May 2006, leg. Huang, K-W (deposited in HNHM). Paratypes. One female: locality and date as for the holotype (deposited in HNHM). Three females: Taiwan, Tseuhun lake, 1890 m a.s.l., from leaf-litter 21 October 2004, leg. Huang, K-W (deposited in HNHM). One female: Taiwan, Dabachinshan, 2120 m a.s.l., from soil, 25 March 2004, leg. Huang, K-W (deposited in NMNS).

Measurements. Female. Length of idiosoma: 317–328 µm; width: 269–285 µm (*n*=6). Holotype: length: 323 µm; width: 280 µm.

Dorsal side (Fig. 1). Podonotum with 22 pairs of setae (j2–6, z2–6, s1–6, r2 and r4–5 inserted dorsally, setae j1 shifted ventrally, r1 and r3 inserted on peritrematal shields). Setae j3–5 and z5 smooth and needle-like, z4, z6 and s4–5 basally pilose. Among marginal setae s1, z2, s2, r2 and r4 serrate and pointed, others brush-like, plumose. Glands *gds1* (po1) situated posterior to insertions of s1; *gdj4* (po2) positioned on line connecting j5 and z4, equidistantly; *gds4* (po3) lying medial to s5. Podonotal shield covered by reticulate pattern, posterior surface with a few small, alveolar pits.

Opisthonotum with 22–23 pairs of setae (J1–5, Z1–5, S1–5, marginal R-series with 7–8 pairs of setae). Setae J1–5 (Fig. 6) elongate, apically tapering, pointed, provided with short pili, each reaching far beyond bases of the following one in the series. Setae Z1–4 (Fig. 8) and S2 similar in shape to J-setae, but shorter; each reaching bases of the following one in the series. Setae Z5 straight, pointed, smooth or finely serrate. Setae S3–5 (Fig. 7) elongate, brush-like, distally pilose, expanding beyond margin of idiosoma. Marginal setae (Fig. 9) bent, apically tapering and serrate. Size of opisthonotal setae and distances between their insertions as in Table 2. Glands *gdZ1* (Po1) anteromedial to Z1; *gdS2* (Po2) on line connecting Z2 and S3; *gdZ4* (Po3) medial to insertions of Z4; *gdS5* (Po4) anterior to insertions of R7 (or R8, if present). Marginal serration deep, several spines can be found between setae Z5 (Fig. 5). The area between J-series covered by large alveolar pits, other parts of opisthonotal shield smooth. Dorsal cavities small, well-sclerotized, with finely undulate inner margin. Axes of cavities slightly converging anteriorly.

Ventral side (Fig. 2). The slit between peritrematal and dorsal shields not conspicuous. Posterolateral tips of peritrematal shield reaching level of R6, surface of the shield covered by longitudinal

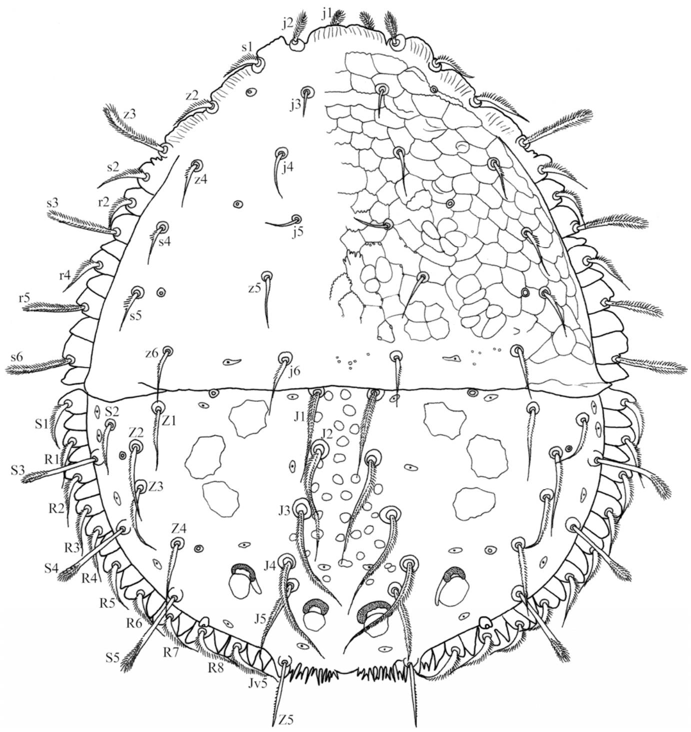


Figure 1. Dorsal view of *Draconizercon punctatus* sp. nov.

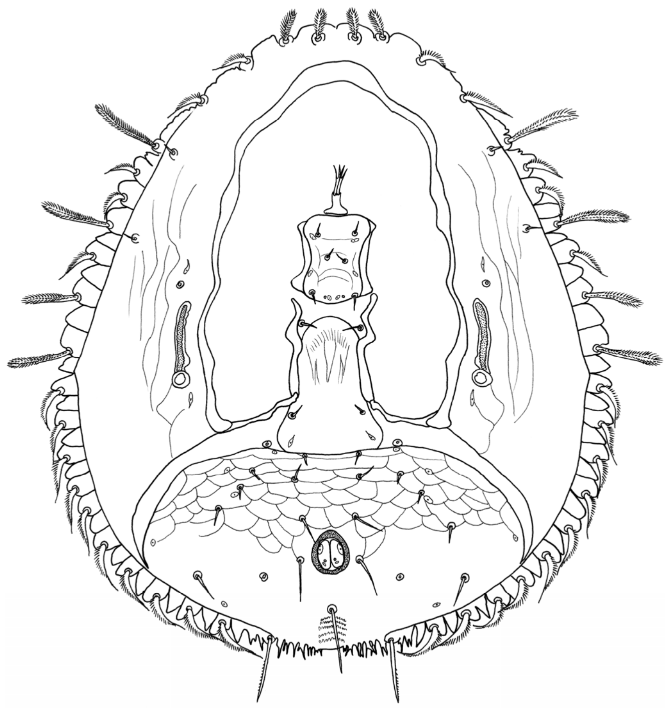
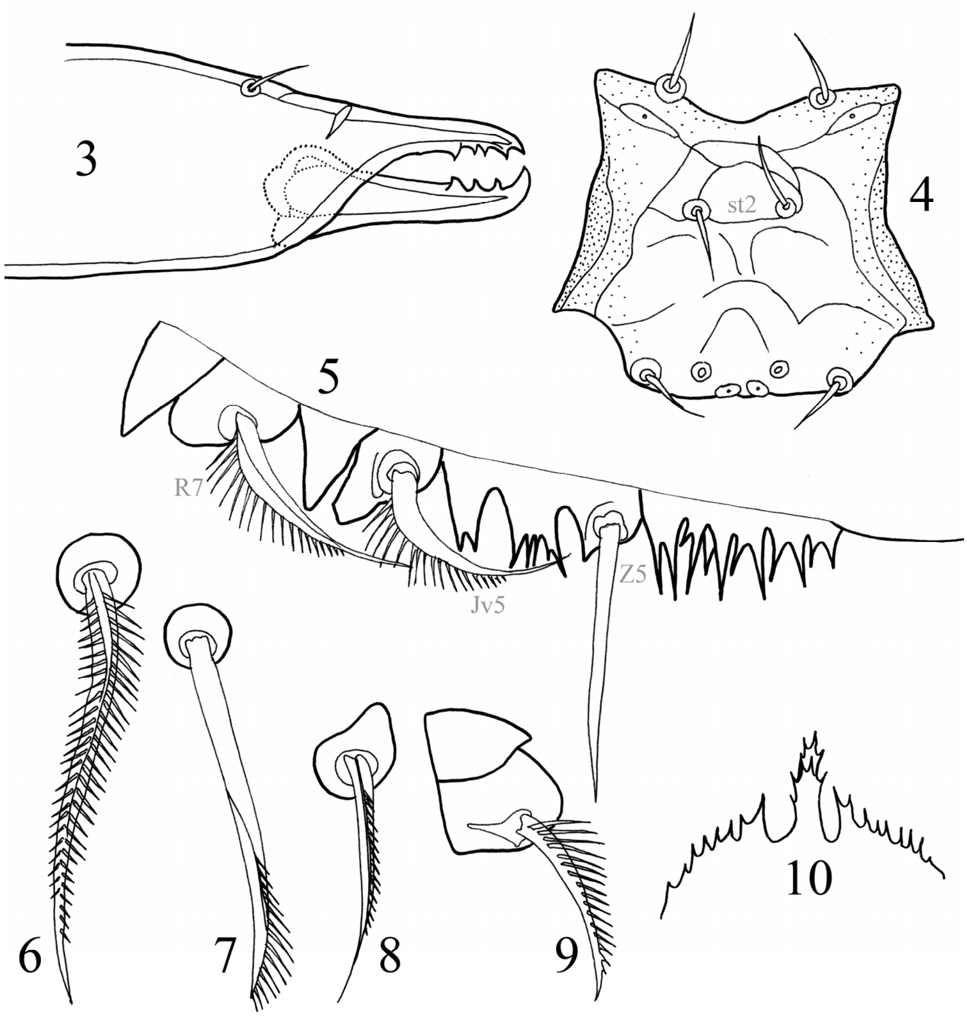


Figure 2. Ventral view of *Draconizercon punctatus* sp. nov.



Figures 3–10. Different structures of *Draconizercon punctatus* sp. nov. female: 3 = chelicera, 4 = sternal shield of paratype, 5 = posteriormost setae with marginal spines, 6 = seta J1, 7 = seta S5, 8 = seta Z3, 9 = seta R2, 10 = epistome.

sutures. Peritrematal setae r1 and r3 short, smooth and pointed. Peritremes straight, with a dilation near stigmata. Sternal shield (Fig. 4) well sclerotized, 45 µm long and 32 µm wide at the level of setae st2, with fine, reticulate ornamentation. Setae st2 situated extraordinarily near each other. Ventrianal setae short, smooth and needle-like, setae Zv1 absent. Setae Jv3–4 1.5 times longer, adanal setae 2 times longer, postanal seta 3 times longer than anterior ventrianal setae. Setae Jv5 similar in shape and length to marginal setae of opisthonotum. Anal valves with vestigial euanal setae. Glands *gv3* situated posterolateral to adanal setae. Anterior surface of ventrianal shield covered by reticulate pattern, posterior surface smooth.

Gnathosoma. Situation of hypostomal and subcapitular setae typical for the family. Setae h1–2 similar in appearance, elongate, needle-like. Setae h3 shorter than h1–2, needle-like, h4 somewhat longer than previous setae, serrate. Corniculi horn-like, internal malae with a pair of bifurcate anterocentral branches and with serrate margins. Fixed digit of chelicerae (Fig. 3) with 5 teeth, movable digit with 4 teeth. Epistome (Fig. 10) of *Prozercon*-type.

Male and immature stages unknown.

Etymology. The name of the new species refers to the punctuate opisthonotal ornamentation.

DISCUSSION

The generic classification of Zerconidae suffers from several problems. With the appearance of more and more exotic and special species it has become obvious that some of the previously used characters are not suitable for generic delimitation or some of them have to be handled with care. The newest results show that most of the characters previously kept discrete (e.g. shape of peritrematal setae and shields) have several intermediate stages, others show intraspecific variation, which makes them difficult to apply. The case of genus *Prozercon* Sellnick 1943 serves as a perfect example: due to the intensive research of the last decades (e.g. Mašán & Fenďa, 2004; Urhan, 2008; Ujvári, 2011e) the genus became the second largest among Zerconidae, with more than 50 species. With the discovery of several interesting species the diagnosis of the genus was changed from time to time, some restrictions have been erased, new observations have been added, but it is almost sure that neither the latest diagnosis given is perfect (Ujvári, 2011e).

Another problem is, however the new diagnosis of *Prozercon* is in accordance with the latest observations, most of the genera of the family have not been dealt with. It is obvious that the whole family badly needs an overall revision.

Because of these problems I had much trouble with the insertion of the new species described above into the existing Zerconidae system therefore, it was necessary to establish a new genus *Draconizercon* gen. nov. to accommodate it.

I tried to choose the most reliable characters during the classification of the new species. There is a well-recognizable character regarding the shape of the body which is not easy to define. There are at least two different types of Zerconidae on the basis of the body shape. One of these possesses a carapace-like podonotal shield, which is extended anteroventrally and lateroventrally (Lindquist & Moraza, 1998) and have relatively short legs in proportion to the body length (e.g. *Aspar* Halašková, 1977, *Echinozercon* Błaszak, 1976, *Mesozercon* Błaszak, 1976 and *Prozercon* Sellnick, 1943). The species belonging to this type are generally small. The other type has not been defined yet, but the podonotal shield of these zerconids is not extended ventrally and they usually have longer legs in proportion to the body length. Latter type has large (*Zercon* C. L. Koch, 1836) and small (*Zeronella* Willmann, 1953) representatives as well. *Draconizercon* gen. nov. belongs to the first group possessing carapace-like podonotal shield.

The second character chosen was the number and general appearance of setae shifted to peritrematal shields. Those genera which possess three pairs of setae on peritrematal shields are most probably closely related to each other, constituteing a separate evolutionary lineage within the family. The unique, hipertrichous *Syskenozercon* Athias-Henriot, 1977 represents also a separate, probably the most ancient linage of Zerconidae. However the majority of zerconid mites possess two pairs of peritrematal setae (r1 and r3). The shape of peritrematal setae shows a large degree of variation and has to be handled with care (Ujvári, 2010, 2011e). Setae r1 are always relatively short, and apart from some exceptions (e.g. *Echinozercon* Błaszak, 1976) are always shorter than or as long as setae r3. To reduce the mutual character stages of r1 and r3 I considered only the relative size of them: both r1 and r3 short or r3 significantly longer than r1. *Draconizercon* gen. nov. belongs to the group possessing two short peritrematal setae.

As the third character I have chosen the shape of peritrematal shields. Nowadays we recognize several different stages: in some groups these shields end truncate, in most of the cases posteriorly separated from podonotal shields (e.g. *Zercon* C. L. Koch, 1836); in other cases the posterolateral tips of these shields are expanded posteriorly, in a different degree (e.g. *Prozercon* Sellnick, 1943). Rarely can we see special sclerotized areas next to the ventrianal shield which are usually called ventrilateral shields. The originof these sclerotized areas is not clear, but presumably is different in different groups. In *Ma-*

crozercon Błaszak, 1975 it seems to be an expansion of the ventrianal shield, in *Rotundozercon* Ujvári, 2011 it seems if the dorsal sclerotization would shifted ventrally, but the ventrilateral shields in *Krantzas* Błaszak, 1981 may have been detached from the peritrematal shields. To reduce the number of stages of peritrematal shields' shape I considered only the relative ending of it: posteriorly truncate or expanded (including *Krantzas* as well, with its special ventrilateral shields). *Draconizercon* gen. nov. belongs to the group possessing posteriorly expanded peritrematal shields.

The fourth major character chosen was the size of peritremes. Three stages can be recognized. The majority of species possess peritremes reaching the anterior margin of coxae III. Some groups have reduced peritremes reaching only the posterior margin of coxae III (*Skeironozercon* Halašková, 1977, *Syskenozercon* Athias-Henriot, 1977 and *Zerconella* Willmann, 1953), other groups possess elongate peritremes reaching level of coxae II (*Carpathozercon* Balan, 1991 and *Echinozercon* Błaszak, 1976). No matter which of these three stages is the ancient one, it seems to be sure that each derived stages are formed independently in different groups, as a result of convergent evolution. *Draconizercon* gen. nov. belongs to the largest group possessing peritremes reaching anterior margin of coxae III.

With the discovery of more and more new species in the Nearctic and Eastern Palearctic regions the significance of dorsal adenotaxy is becoming increasingly conspicuous in systematics of Zerconidae. The special position of proper dorsal pores most probably reflects phylogenetic relationship reliably, which is also supported by the distribution pattern of the morphologically similar genera. I chose the position of the third pair of podonotal and the third pair of opisthonotal glands. There is a group of genera in East Asia the members of which (*Aquilonozercon* Halašková, 1979, *Eurozercon* Halašková, 1979, *Kaikiozercon* Halašková, 1979, *Koreozercon* Halašková, 1979 and *Mesozercon* Błaszak, 1975) are very similar to the newly established genus *Draconizercon* gen. nov., but the position of the third podonotal glands (situated lateral to s-series, near r4 in former genera) suggests that *Draconizercon* gen. nov. does not belong to this group (besides *Draconizercon* gen. nov. possesses epistome of *Prozercon*-type, while the other East Asian genera have epistome of *Parazercon*-type).

Close phylogenetic relationship between *Draconizercon* gen. nov. and some Nearctic genera can also be excluded by considering the situation of the third pair of opisthonotal pores. There is an endemic Nearctic group of genera possessing the third pair of opisthonotal glands in association with the J-series (e. g. *Bakeras* Błaszak, 1984, *Blaszakiella* Sikora & Skoracki, 2008 and *Microzercon* Błaszak, 1975). This unique phenomenon can not be observed on any Palearctic species, the third pair of opisthonotal glands of latter are always associated to the Z-series.

Applying these restrictions only five genera remained as a possibility to classify the new Taiwanese species with. Two of these (*Prozercon* Sellnick, 1943 and *Aleksozercon* Petrova, 1978) are distributed in the Western Palearctic region, the other three (*Blaszakzercon* Kemal et Koçak, 2009, *Cosmozercon* Błaszak, 1981 and *Krantzas* Błaszak, 1981) are Nearctic genera. If we consider the special shape of opisthomarginal setae as a mark of phylogenetic relationship, the new species can only be related to *Cosmozercon* Błaszak, 1981 and *Krantzas* Błaszak, 1981. This is also supported by the distribution pattern of these genera: the eastern distribution border of *Prozercon* Sellnick, 1943 lies in Mongolia (Błaszak, 1979), the single species of *Aleksozercon* Petrova, 1978 is known only from the north-eastern shores of the Black Sea (Petrova, 1978), while *Blaszakzercon* Kemal & Koçak, 2009 seems to be endemic in the Appalachian Mountains (Ujvári, 2012). Therefore, apparently there is no sign of possible biogeographical connection between the former genera and the new Taiwanese species as well. On the contrary, *Cosmozercon* Błaszak, 1981 and *Krantzas* Błaszak, 1981 are distributed on the Pacific Coast of North America. Asia and Western North America were connected by Trans-Beringian land bridges several times from the Mid Creataceous, which served as an important dispersal route for different animal groups (Sanmartín et al. 2001). Besides, with the drop of sea level several other land bridges may have emerged in the Northern Pacific region, especially through the recent island arcs of the Pacific Plate (Aleutian Islands, Kuril Islands, Japanese Islands etc.), resulting in other possible dispersal routes. These paleogeographic connections might explain the relationship between the fauna of the Western Nearctic and the Eastern Palearctic and support the hypothesis of the common origin of *Draconizercon* gen. nov., *Cosmozercon* and *Krantzas*.

The presence or absence of adgenital glands *gv2* is applied with a great emphasis, and (so far) seems to be a very useful and stable character in classification of Zerconidae. Both *Cosmozercon* Błaszak, 1981 and *Krantzas* Błaszak, 1981 lack these glands, this is the main reason why I decided to establish a new genus for the new Taiwanese species.

The presence or absence of ventrianal setae Zv1 is a character I did not take into account with great relevance. It seems that the presence of Zv1 is a plesiomorphic stage within Zerconidae. During the evolutionary history, many groups might lost these setae independently from each other, as a result of convergent evolution. This can be proven by examples selected from genus *Zercon* C. L. Koch, 1836. There are different, closely related groups (from external morphological point of view) within *Zercon*, the members of which differ by the presence of Zv1. These hypothetical groups represent different branches within the evolutionary tree of *Zercon*. Presumably these groups diverged much earlier than the separation inside a group has taken place by losing Zv1. Therefore losing setae Zv1 can be considered as a frequent phenomenon, which usually occurs independently during speciation processes in different groups of Zerconidae. Hence it does not seem to be a good character for generic delimitation. Excluding species with lacking Zv1 from a genus usually possessing Zv1 may results a morphological classification which does not correspond to the evolutionary history, puts proper, closely related species into separate genera, while other, more distant relatives would remain in the same genus.

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REFERENCES

BŁASZAK, C. (1979): Systematic studies on the family Zerconidae IV. Asian Zerconidae (Acari, Mesostigmata). *Acta Zoologica Cracoviensia*, 24: 3–112.

JOHNSTON, D. E. & MORAZA, M. L. (1991): The idiosomal adenotaxy and poroidotaxy of Zerconidae (Mesostigmata: Zerconina). *In:* DUSBÁBEK, F. & BUKVA, V. (eds): *Modern Acarology. Vol. 2.*, Academia, Prague, pp. 349–356.

LINDQUIST, E. E. & EVANS, G. O. (1965): Taxonomic concepts in the Ascidae, with a modified setal nomenclature for the idiosoma of the Gamasina (Acarina: Mesostigmata). *Memoirs of the Entomological Society of Canada*, 47: 1–64.

LINDQUIST, E. E. & MORAZA, M. L. (1998): Observations on homologies of idiosomal setae in Zerconidae (Acari: Mesostigmata), with modified notation for some posterior body setae. *Acarologia*, 39: 203–226.

MA, L. M., HO, C. C. & WANG, S. C. (2011): One new species of Zerconidae and one new recorded species of Blattisocidae from Taiwan (Acari: Mesostigmata). *Formosan Entomologist*, 31: 157–165.

MAŠÁN, P. & FENĎA, P. (2004): *Zerconid mites of Slovakia* (*Acari*, *Mesostigmata*, *Zerconidae*). NOI Press, Bratislava, 238 pp.

PETROVA, A. D. (1978): A new genus and species of peculiar zerconid-mites (Parasitiformes, Gamasoidea, Zerconidae) with entire dorsal shield. *Revue d'Entomologie de l'URSS*, 57: 218–220.

SANMARTÍN, I, ENGHOFF, H. & RONQUIST, F. (2001): Patterns of animal dispersal, vicariance and diversification in the Holarctic. *Biological Journal of the Linnean Society*, 73: 345–390.

UJVÁRI, ZS. (2010): *Zerconella* Willmann, 1953, a forgotten group of Zerconidae (Acari, Mesostigmata). *Zootaxa*, 2558: 33–47.

UJVÁRI, ZS. (2011a): New Zerconid mites (Acari: Mesostigmata: Zerconidae) from Taiwan. *Zoological Studies*, 50 (1): 87–102.

UJVÁRI, ZS. (2011b): First records of Zerconidae (Acari: Mesostigmata) south of the Tropic of Cancer, Mexico, with description of five new species. *International Journal of Acarology*, 37 (3): 201–215.

Table 1. Distinctive characters of *Draconizercon* gen. nov, *Aleksozercon*, *Blaszakzercon*, *Cosmozercon*, *Krantzas* and *Prozercon*.

character	*Draconizercon*	*Aleksozercon*	*Blaszakzercon*	*Cosmozercon*	*Krantzas*	*Prozercon*
gv2	present (single)	present (single)	present (double)	absent	absent	absent
posterolateral tips of peritrematal shield	expanded to posterior R-setae, fitting to opisthonotal shield	expanded to posterior R- setae, fitting to opisthonotal shield	expanded to anterior R-setae, separate from opisthonotal shield	expanded to posterior R-setae, fitting to opisthonotal shield	as separate ventri-lateral shields, fitting to opisthonotal shield	with different measure of expansion, fitting to or slightly separate from opisthonotal shield
podonotal and opisthonotal shields	separate	central and lateral regions fused	separate	separate	separate	separate or laterally fused
general number of R-setae	7 or 8	7	7	6	8	6 or 7
shape of R-setae	long, bent, apically tapering and serrate	short, smooth, thorn-like	short, thorn-like, smooth / pilose or longer, brush-like and plumose	long, bent, apically tapering and serrate	long, bent, apically tapering and serrate	short, thorn-like, smooth / pilose or longer, brush-like and plumose
epistome	with 1 central branch	with 1 central branch	with 2 central branches	with 1 central branch	with 1 central branch	with 1 central branch

Table 2. Length of opisthonotal setae and distance between their bases in *Draconizercon punctatus* sp. nov.

	F		F		F
J1	45	**Z1**	33	**S1**	24
J1-J2	31	**Z1-Z2**	23	**S1-S2**	23
J2	55	**Z2**	38	**S2**	26
J2-J3	31	**Z2-Z3**	22	**S2-S3**	19
J3	53	**Z3**	30	**S3**	40
J3-J4	26	**Z3-Z4**	30	**S3-S4**	37
J4	55	**Z4**	37	**S4**	40
J4-J5	13	**Z4-Z5**	80	**S4-5**	43
J5	37	**Z5**	32	**S5**	44

UJVÁRI, ZS. (2011c): A new subgenus and two new species of *Zercon* C. L. Koch, 1836 (Acari: Zerconidae) from Southeast Asia. *Zootaxa*, 2995: 45–54.

UJVÁRI, ZS. (2011d): Comparative study on the taxonomic relevance of gnathosomal structures in the family Zerconidae (Acari: Mesostigmata). *Opuscula Zoologica Budapest*, 42 (1): 75–93.

UJVÁRI, ZS. (2011e): Six new species of *Prozercon* Sellnick, 1943 (Acari, Mesostigmata, Zerconidae) from Greece, with remarks on the genus. *Zootaxa*, 2785: 1–31.

UJVÁRI, ZS. (2012): Review of the American genera *Aspar* Halašková, 1977 and *Blaszakzercon* Kemal et Koçak, 2009 (Acari, Mesostigmata, Zerconidae) with description of three new species. *Acta Zoologica Academiae Scientiarum Hungaricae*, in press.

URHAN, R. (2008): Contributions to the genus *Prozercon* Sellnick, 1943 (Acari: Zerconidae) from Turkey, with the description of two new species and a key to species. *Zoology in the Middle East*, 45: 97–104.

Rare and little known Collembola species from Hungary

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Abstract. Two species, *Pseudosinella bohemica* Rusek, 1979 and *Folsomides marchicus* (Frenzel, 1941) are recorded from Hungary, the latter species for the first time. An illustrated morphological description of the two species is presented.

Keywords. *Pseudosinella bohemica*, *Folsomides marchicus*, Entomobryidae, Isotomidae, soil fauna, first record.

INTRODUCTION

During investigations of the soil fauna diversity of different habitat types in Hungary, we found two rare and little known collembolan species; *Pseudosinella bohemica* Rusek, 1979 and, as new to the Hungarian fauna, *Folsomides marchicus* (Frenzel, 1941). Since the publication of the checklist of the Hungarian collembolan fauna (Dányi & Traser, 2008) the number of recorded species has been steadily increasing (Traser & Dányi, 2008; Traser *et al.,* 2009; Traser, 2010; Traser *et al.,* 2011; Winkler *et al.,* 2011; Winkler & Traser, 2012) to the current number of 430.

MATERIAL AND METHODS

Pseudosinella bohemica was collected in Tüskevár, com. Veszprém, Hungary (47°7' 12.55" N, 17°20'3.90" E, 146 m a.s.l.) on 16 October 2011 in the litter of a lowland hornbeam-pedunculate-oak forest close to the stream Torna (leg. D. Winkler).

Folsomides marchicus was found in soil samples taken on the Tétényi Plateau, Budapest, Hungary (47°25'46.02"N, 18°58'21.58"E, 207 m a.s.l.) on 10 December 2011 (leg. M. Korda). The specimens were collected in xerophilous dolomite-steppe meadow associations.

The terminology follows Gisin (1967) and Mateos (2008) for *P. bohemica* and Potapov (2001) for *F. marchicus.*

Abbreviations used in the text: Ant. = Antennal segments; Th. I–III = thoracic tergites; Abd. I–VI = abdominal tergites.

RESULTS

Pseudosinella bohemica Rusek, 1979

(Figs. 1–11)

Material examined. Altogether ca. 100 ♂ and ♀ kept in D. Winkler's collection at the Institute of Wildlife Management and Vertebrate Zoology, University of West Hungary.

Description. Body length 0.86 mm (without head and furca), head diagonal 0.26 mm. Color pale with an orange hue. Head and body densely covered with scales (Fig. 1). Antennae and legs without scales. Eye patch bluish black. Eyes 2+2, B closely above A. Antenna 1.26 times the head length. Ratio of antennal joints I–IV = 1:1.5:1.5:3.0. Two lenticular organs ventrally on each antennal base (Fig. 2). Setae on the antennal joints I–III as in Figs. 3–4. Ant. IV without apical bulb. Labrum and frontoclypeal area as in Fig. 2. Prelabral setae ciliated, labral setae smooth, in 4/554 arrangement. The labrum forms an inverted, wide 'V' below the anterior row of setae. Maxillary outer lobe with 2 sublobal hairs on the sublobal plate. The modified seta on the external labial papilla 'E' reaches to the top of the papilla which bears 5 other setae (Fig. 5). Formula of the labial triangle $M_1M_2r^*EL_1L_2$ (Fig. 5): $L_1<L_2$ and r*

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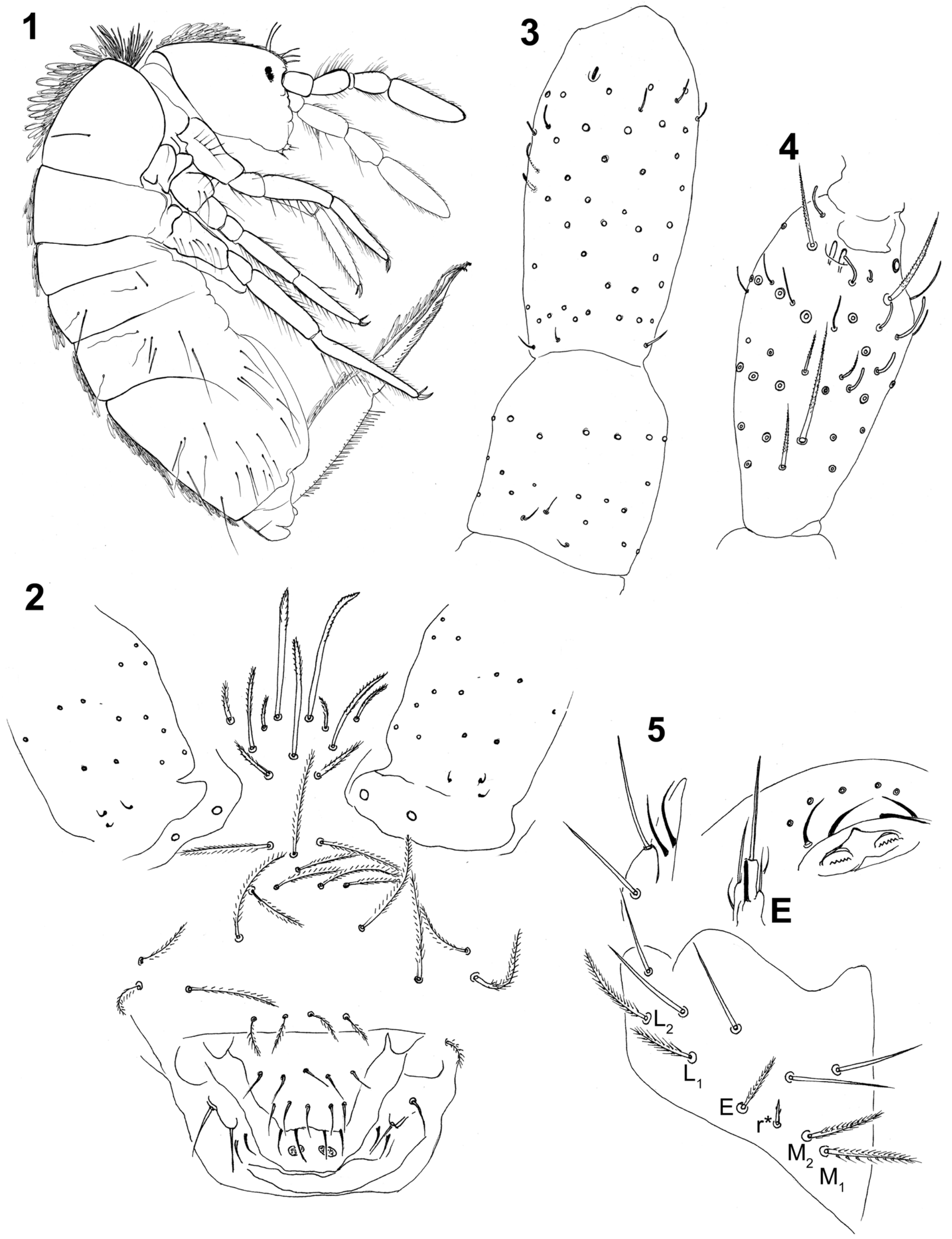
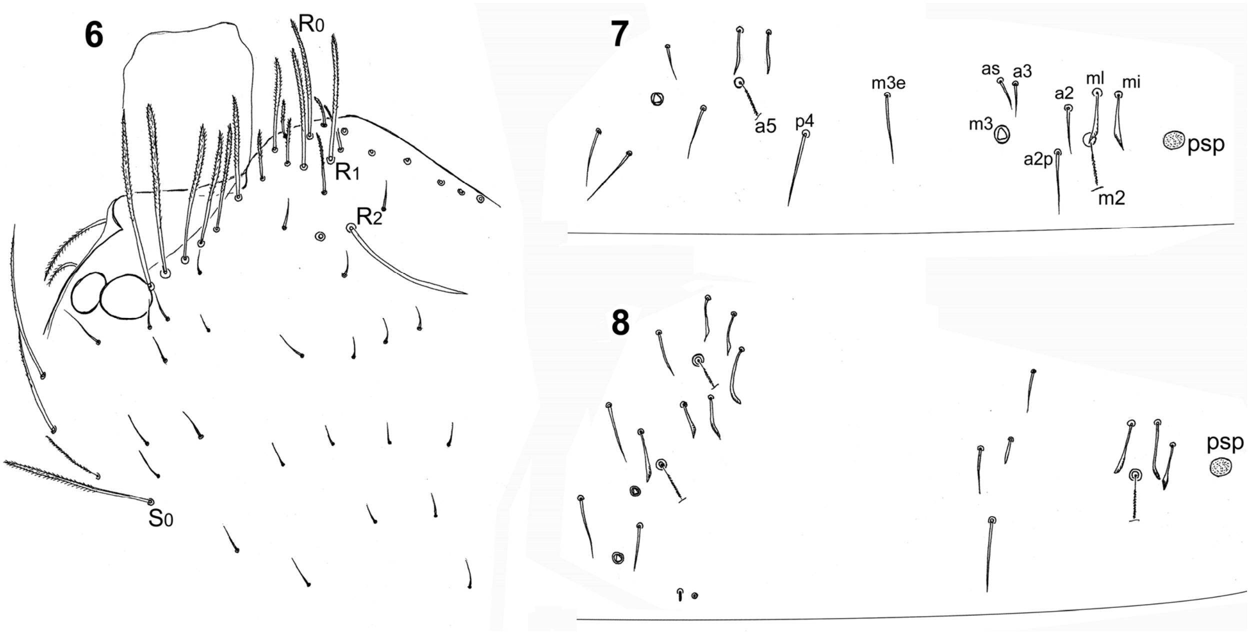
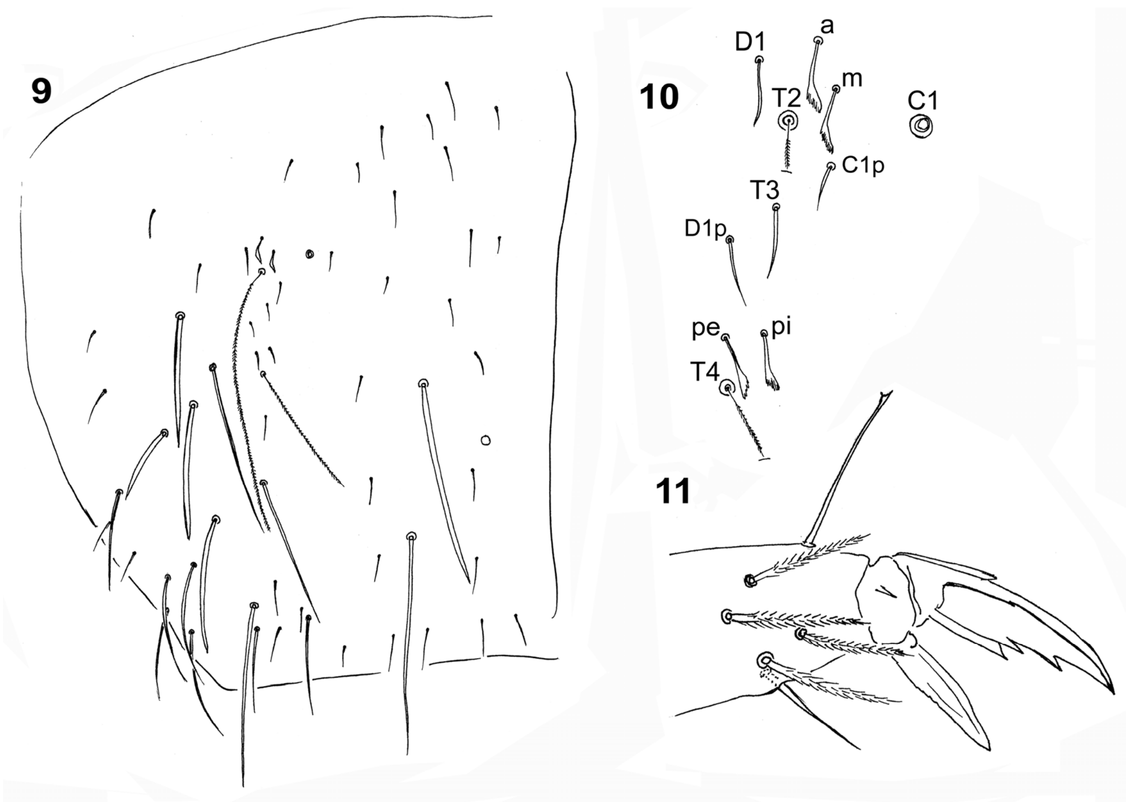


Figures 1–5. *Pseudosinella bohemica,* 1 = Habitus, 2 = Mouthparts and frontoclypeal area with antennal basal organ, 3 = Ant. I-II chaetotaxy, 4 = Ant. III chaetotaxy, 5 = Labial triangle with labial papilla ‘E’



Figures 6–8. *Pseudosinella bohemica,* 6 = Dorsal head chaetotaxy, 7 = Abd. II complete chaetotaxy (left side), 8 = Abd. III complete chaetotaxy (left side)



Figures 9–11. *Pseudosinella bohemica,* 9 = Abd. IV complete chaetotaxy, 10 = Abd. IV trichobothrial complex, 11 = Claw and empodium (leg III)

shortened, nearly smooth, only with 1 or 2 tiny barbs. All 5 'a' setae of the anterior row smooth. At the base of the labial palps 3 proximal setae. (9)10+(9)10 'A' setae between the apex of the head and the eyes. Along the labial ventral grove 4+4 ciliated setae. Dorsal cephalic macrochaetae $R_0R_{1s}R_1R_2S_o$ as in Fig. 6. Body macrochaetae 10/0101+2. Abd. II chaetotaxy $paBq_1q_2$ (notation after Gisin 1967), and m2, a2p, a2, mi, ml, as, a3, m3, m3e, p4, a5 (trichobothria m2 and a5; notation after Mateos 2008) (Fig. 7). Abd. III chaetotaxy as in Fig. 8. Chaetotaxy and trichobothrial complex of Abd. IV as in Figs. 9–10.

Claws with paired proximal teeth, the outer one somewhat bigger and positioned slightly lower. The unpaired subapical tooth is distinct, a very small apical tooth hardly observable (Fig. 11). Lateral and external teeth smooth, clearly visible. Outer margin of the empodium very finely serrated. Tenent hair clavate. Manubrial plate with 2+2 setae on both sides of the 2 pseudopori. Ventral tube with 5+5 smooth laterodistal setae, 5+5 ciliated setae on the anterior side, and 11 unpaired setae (3+3+1+1+1+1+1) on the posterior side. Trochanteral organ on leg III with 10-11 setulae forming roughly a V.

Remarks. *P. bohemica* was formerly known only from the Czech Republic, Austria and Bulgaria (Bedos & Fjellberg 2011). The Hungarian specimens basically fit the description by Rusek (1979), but the chaetotaxy of Ant. II–III clearly differs from Rusek's illustration. Furthermore, in our specimens one of the 3 accessorial setae at the base of the anterior trichobotria on Abd. IV is nearly smooth (D1, Fig. 10), whereas all these setae appear fan-shaped in Rusek's Fig. 4. The taxonomic significance of these differences remains open.

Folsomides marchicus (Frenzel, 1941)

(Figs. 12–23)

Material examined. 10 ♀ held in Gy. Traser's personal collection.

Description. Total body length 0.8 mm (including the 0.18 mm long head), antennal length 0.15 mm. Body shape rather short and stout. The decline between Abd. IV and V, characteristic for the genus *Folsomides,* inconspicuous. Body colour dark grey to nearly black. 5+5 eyes in dark eye patches (Fig. 12). Postantennal organ elongated, rather broad, about 2.5-3.0 times the length of nearest eye, usually with 2 posterior setae. 2/554 labral setae (Fig. 13). Ventral chaetotaxy of Ant. I–II as in Fig. 14. Maxillary outer lobe (Fig. 15) with bifurcated maxillary palp and 3 sublobal hairs. Labium with modified thick finger-like projection (Fig. 16). Sensillae ('s') on the body short, shorter than the half length of the surrounding setae. Th. II – Abd. V with 3,3/2,2,2,2,4 sensillae ('s') and 1,0/0,0,1 microsensillae ('ms') (Fig. 17). The lower pair of sensillae on Abd. V is slightly thicker than the upper pair. Dorsomedial chaetotaxy of Th. II, Abd. III and Abd. IV as in Figs. 18–20. The medial sensilla 's' on Abd. IV is inserted far from the subaxial macrochaeta (Fig. 20). Macrochaetae of Th. II – Abd. V as 11/11133. The subaxial macrochaeta on Abd. IV 0.41, on Abd. V 0.75 times the tergite length. Ventral chaetotaxy of the anal lobe as in Fig. 21. Ventral tube with 3+3 laterodistal and 2 posterior setae. Furca with 3 posterior and 0 anterior setae (Fig 22). Mucro ± separated from the dens, bidentate, with a lamella. Tibiotarsi I–III with 20,20,22 setae (Fig. 23). Empodium about half the length of the claw.

Remarks. According to the Fauna Europaea database (Potapov & Fjellberg 2011), *F. marchicus* is present in many European countries including the southern areas. Compared to specimens from Israel (Kaprus & Nevo 2003), our specimens differ in the number of setae on the dens and on the laterodistal part of the ventral tube. They conform however, to redescription by Potapov (2001).

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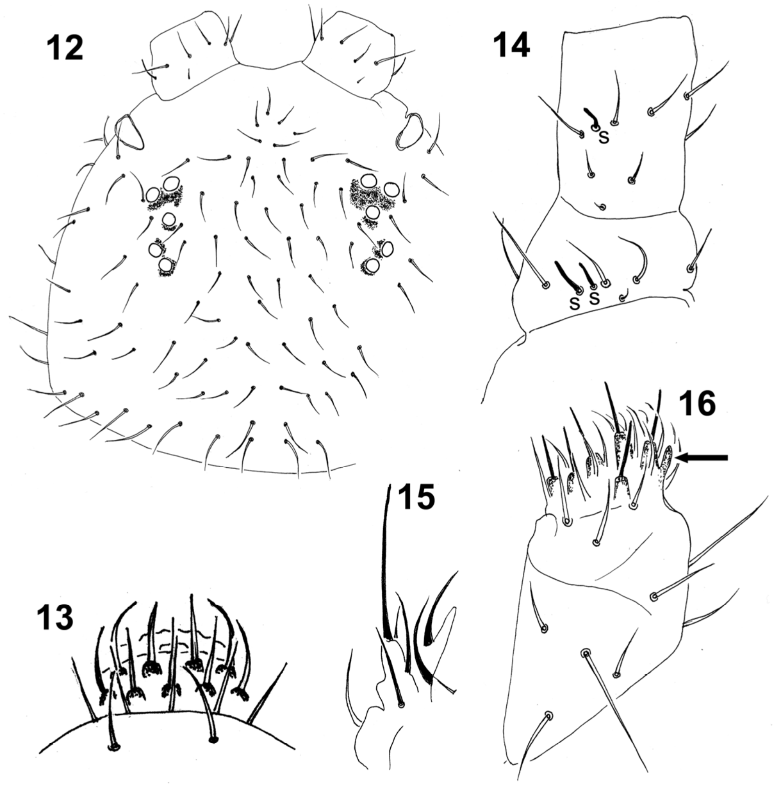
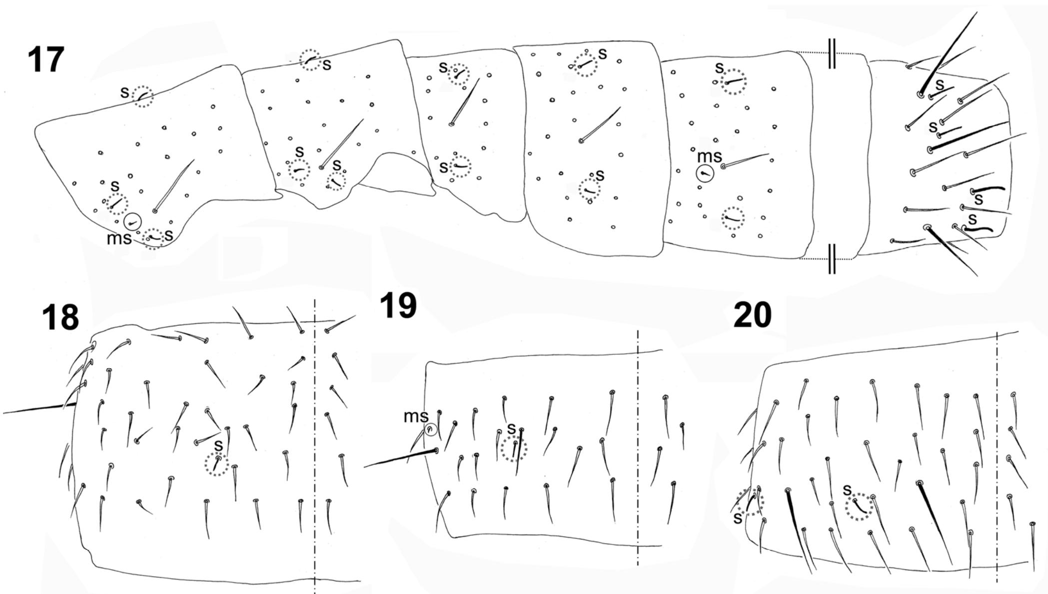
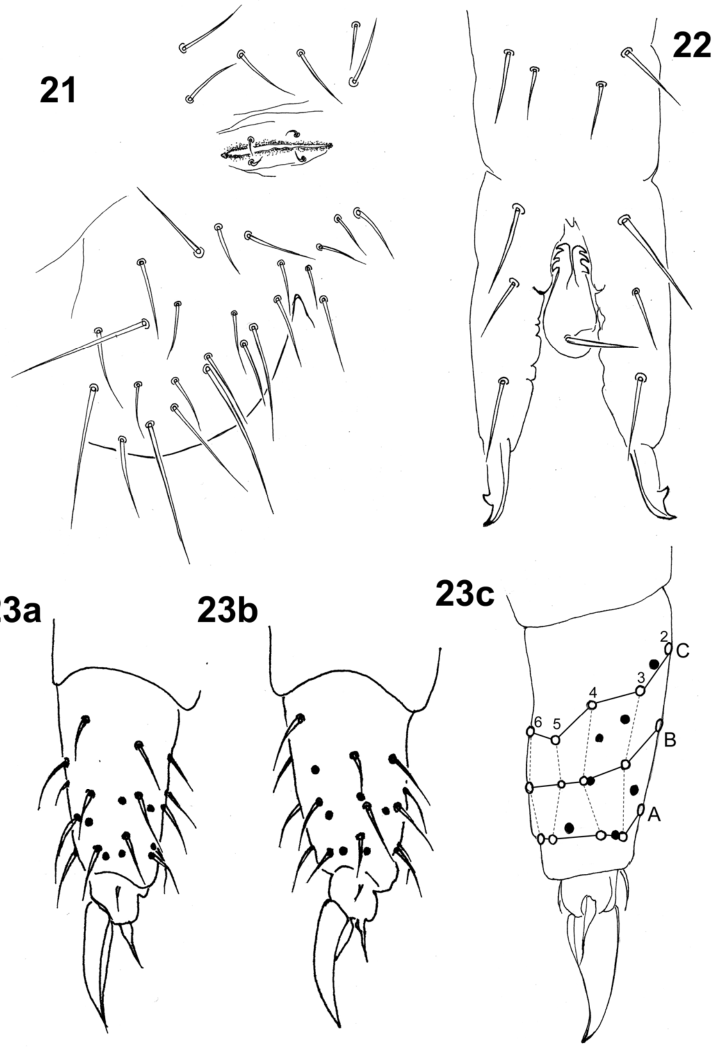


Figures 12–16. *Folsomides marchicus,* 12 = Dorsal head chaetotaxy, 13 = Labrum; 14 = Ventral chaetotaxy of Ant. I–II 15 = Maxillary outer lobe with 3 sublobal hairs, 16 = Labium in ventral view with modified thick finger-like projection (arrow)



Figures 17–20. *Folsomides marchicus,* 17 = Th. II – Abd. III, Abd. V, pattern of sensillae (dotted circle) and microsensillae (circle), 18 = Mesothorax dorsomedial; 19 = Abd. III dorsomedial; 20 = Abd. IV dorsomedial



Figures 21–23. *Folsomides marchicus,* 21 = Ventral chaetotaxy of anal lobe, 22 = Furca; 23a–c = Chaetotaxy of Tita I–III

REFERENCES

BEDOS, A. & FJELLBERG, A. (2011): *Entomobryidae*. In: Deharveng, L. (ed.) Collembola. Fauna Europaea version 2.4, http://www.faunaeur.org, [accessed 10 February 2012]

DÁNYI, L. & TRASER, GY. (2008): An annotated checklist of the springtail fauna of Hungary (Hexapoda: Collembola). *Opuscula Zoologica,* 38: 3–82.

GISIN, H. (1967) Espèces nouvelles et lignèes évolutives de *Pseudosinella* endogès (Collembola). *Memorias e estudos do Museu Zoológico da Universidade de Coimbra*, 301: 1–25.

KAPRUS, I.J. & NEVO, E. (2003): New Species of Collembola (Entognatha) from Israel. *Vestnik zoologii*, 37(4): 65–70.

MATEOS, E. (2008): The European *Lepidocyrtus* Bourlet, 1839 (Collembola: Entomobryidae). *Zootaxa,* 1769: 35–59.

POTAPOV, M. (2001): Synopses on Palaearctic Collembola: Isotomidae. *Abhandlungen und Berichte des Naturkundemuseums Görlitz,* 73(2): 603 pp.

POTAPOV, M. & FJELLBERG, A. (2011): *Isotomidae*. In: Deharveng, L. (ed.) Collembola. Fauna Europaea version 2.4, http://www.faunaeur.org, [accessed 10 February 2012]

RUSEK, J. (1979): Three new *Pseudosinella* species from Czechoslovakia (Collembola, Entomobryidae). *Acta Entomologica Bohemoslovaca,* 76: 255–265.

TRASER, GY. & DÁNYI, L. (2008): *Lepidocyrtus mariani* sp. n., a new springtail species from Hungary (Collembola: Entomobryidae). *Opuscula Zoologica,* 39(1): 91–98.

TRASER, GY. (2010): A Collembola fauna (Hexapoda: Entognatha) Porva körzetében a harmadik Biodiverzitás Nap gyűjtése alapján. *Folia Musei historico-naturalis Bakonyiensis,* 27: 49–54.

TRASER, GY., WINKLER, D. & KECSKEMÉTI, G. (2009): *A vegetáció és a talaj hatása az ugróvillás sűrűségre a Szárhalmi erdőben.* In: Lakatos, F. & Kui, B. szerk.: Kari Tudományos Konferencia. Nyugat-magyarországi Egyetem, Erdőmérnöki Kar, Sopron, pp. 179–182.

TRASER, GY., WINKLER, D. & MOLNÁR, M. (2011): A mezőföldi Szent László-víz völgyének ugróvillás (Collembola) faunája. *Folia Musei historico-naturalis Bakonyiensis,* 28: 71–79.

WINKLER, D. & TRASER, GY. (2012): *A Lajta Project ugróvillás (Collembola) faunája.* In. Faragó S. [ed.]: A Lajta Project - Egy tartamos mezei vad és ökoszisztéma vizsgálat 20 éve. *in press*.

WINKLER, D., KORDA, M. & TRASER, GY. (2011): Two new species of Collembola for the fauna of Hungary. *Opuscula Zoologica,* 42(2): 199–206.