Opusc. Zool. Budapest, 2011, 42 (1): 3–22

On the nematode genus *Heterodorus* Altherr, 1952 (Dorylaimida: Nordiidae) with descriptions of three new species

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Abstract. The genus *Heterodorus* Altherr, 1952 is analysed and redefined. Of the nominal species, four are synonymized, namely *H. magnificus* Altherr, 1952 and *H. thornei* (Baqri & Jairajpuri, 1974) with *H. arcuatus* (Thorne, 1939), *H. bongersi* (Mushtaq, Baniyamuddin & Ahmad, 2007) with *H. brevidentatus* (Thorne, 1939) and *H. satendri* (Baqri & Jairajpuri, 1974) with *H. constrictus* (Jairajpuri & Loof, 1968). Three species, new to science, are described. *Heterodorus unicus* sp. n. from Papua New Guinea is distinguished by its small body (on average 1.23 mm), continuous lip region, short odontostyle as long as lip region width, far posteriorly located D nucleus, greenish intestine, deep vulva, and by a single ventromedial supplement. *Heterodorus monticola* sp. n. from Peru is characterized by its short body (on average 1.36 mm), continuous lip region, short odontostyle as long as 1.1–1.2 lip region widths, far posteriorly widened pharynx, strongly swollen vagina, and by two or three ventromedial supplements. *Heterodorus alius* sp. n. from Papua New Guinea also belonging to the small species (on average 1.22 mm long) shows some atypical or marginal characters: a longer cylindrus, more anteriorly located D nucleus (54–57 %), more anteriorly posited vulva (39–41 %), longer vagina, longer spicula, and a row of six or seven ventromedial supplements beginning closer to the adanal pair as usual. A key to the identification of *Heterodorus* species is added. Finally, an *Enchodelus* species is transferred to *Papuadorus* Andrássy, 2009 as *P. coomansi* (Nicholas & Stewart, 1985) comb. n.

Keywords. Nematoda, Dorylaimida, *Heterodorus*, new species, key to the species.

In the second part of his classic paper on the nematode fauna of Swiss National Park, Altherr (1952) erected the genus *Heterodorus,* and described its type species, *Heterodorus magnificus* Altherr, 1952. He compared it with *Enchodelus* Thorne, 1939 and distinguished by the somewhat (apparently) different odontophore and the "peculiar" structure of the female gonad. In 1963, he reported on further specimens from Switzerland, and corrected the original description and measurements of *H.magnificus.* In the meantime, three excellent specialists of that time, M. Luc, J. B. Goodey and G. Thorne, checked the type specimens of *H. magnificus,* and *unisono* stated that they belonged to the genus *Enchodelus.* Both the structure of the odontostyle/odontophore and that of the genital organ corresponded to the usual types in *Enchodelus* species. Therefore, Altherr synonymized *Heterodorus* with *Enchodelus* and transferred the Swiss species to the latter genus as *Enchodelus magnificus* (Altherr, 1952) Altherr, 1963. Later, Siddiqi (1969) also studied Altherr's specimens, and provided fine drawings of the anterior and pharyngeal region (Fig. 4 M–N). In that paper, Siddiqi revised the classification of Dorylaimoidea, and accepted *Heterodorus* as valid genus characterized by the position of the second pair of subventral pharyngeal gland nuclei (PS nuclei) lying "considerably anterior to the base of the oesophagus".

Most of subsequent authors left Siddiqi's opinion out of consideration, and regarded *Heterodorus* as junior synonym of *Enchodelus*. Ahmad and Jairajpuri (1980) revised the genus *Enchodelus* and grouped its species under five subgenera. Subgenus *Heterodorus* was one of them including the only species, *E. (H.) magnificus.* The above authors stressed that *Enchodelus* essentially consists of two main groups of species defined by tail shape, either rounded or conical. For the second group, they proposed the new subgenera *Nepalus* (with long odontostyle) and *Paraenchodelus* (with shorter odontostyle). In their book (1992), Jairajpuri and Ahmad followed this classification.

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Recently, Andrássy (2009) expressed the opinion that the genus of Altherr can still be accepted as valid. It includes those *Enchodelus*-like species that have a conoid tail in both sexes, and ventromedial supplements few in number lying in their series at a distance from the adanal pair. Since the above mentioned two subgenera of Ahmad and Jairajpuri, *Nepalus* and *Paraenchodelus,* showed all the main structures of *Heterodorus,* he synonymized them with Altherr's genus. At the same time, Andrássy transferred 24 conical-tailed species from *Enchodelus* to *Heterodorus.*

The genus *Heterodorus* is characterized and differentiated from *Enchodelus* as follows.

Heterodorus Altherr, 1952

Syn. *Enchodelus* (*Heterodorus* Altherr, 1952) Ahmad & Jairajpuri, 1980; *Nepalus* Ahmad & Jairajpuri, 1980; *Paraenchodelus* Ahmad & Jairajpuri, 1980.

Diagnosis. *Nordiidae, Pungentinae.* Body ranging in length from 1.0 to 2.8 mm. Cuticle smooth or finely, exceptionally coarsely transversely annulated. Lips amalgamated or slightly separated, lip region not or moderately separated from adjoining body. Odontostyle thin to very thin with small aperture, 10 to 70 µm, one to four times the labial diameter long; odontophore rodlike, lacking basal flanges. Guiding ring double, but thin. Basal expanded part (cylindrus) shorter than half a pharyngeal length, weakly muscular. Anterior pair of pharyngeal nuclei (AS) often inconspicuous, posterior pair (PS) distinct and lying far anterior to basal end of cylindrus, close to the middle of glandularium. Intestine often filled with green-coloured food rests. Prerectum medium long. Female genital system amphidelphic, with bipartite uterus, transverse vulva and occasionally highly developed vagina. Males known in nearly 60 % of the species. Spicula dorylaimoid. Ventromedial supplements one to nine, well spaced, posterior ones lying well anterior to the adanal pair. Tail in sexes similar, short, conoid, ventrally arcuate, with finely rounded tip.

Relationships. *Heterodorus* shows a fairly constant morphological pattern. It is very similar to *Enchodelus* Thorne, 1939, but the simple odontophore (*vs*. basally flanged), bipartite uterus consisting of a proximal wider and a distal narrower section (*vs*. tripartite consisting of a proximal wider, an intermediate narrower and a distal spherical section), conoid and ventrally arcuate tail (*vs*. broadly rounded, not curved) and the low number (1–9 *vs*. 7–16) and arrangement of supplements (their row lying at a distance from the adanal pair, predominantly well outside the range of spicula *vs*. their row continuous with the adanal pair, and the posteriormost supplement(s) lying in spicular range) clearly distinguish it from its "sister" genus.

Type species. *Heterodorus magnificus* Altherr, 1952 = *Enchodelus arcuatus* Thorne, 1939 = *Heterodorus arcuatus* (Thorne, 1939) Andrássy, 2009 (see Remarks).

Currently, the following 25 species can be classified under *Heterodorus.*

H. alius sp. n.

H. arcuatus (Thorne, 1939) Andrássy, 2009
  Enchodelus arcuatus Thorne, 1939
  Enchodelus (Paraenchodelus) arcuatus Thorne, 1939 (Ahmad & Jairajpuri, 1980)
  Heterodorus magnificus Altherr, 1952 **syn. n.**
  Enchodelus magnificus (Altherr, 1952) Altherr, 1963
  Enchodelus (Heterodorus) magnificus (Altherr, 1952) Altherr, 1963 (Ahmad & Jairajpuri, 1980)
  Enchodelus thornei Baqri & Jairajpuri, 1974 **syn. n.**
  Enchodelus (Paraenchodelus) thornei Baqri & Jairajpuri, 1974 (Ahmad & Jairajpuri, 1980)
  Heterodorus thornei (Baqri & Jairajpuri, 1974) Andrássy, 2009

H. brevidentatus (Thorne, 1939) Andrássy, 2009
  Enchodelus brevidentatus Thorne, 1939
  Enchodelus (Paraenchodelus) brevidentatus Thorne, 1939 (Ahmad & Jairajpuri, 1980)
  Enchodelus bongersi Mushtaq, Baniyamuddin & Ahmad, 2007 **syn. n.**
  Heterodorus bongersi (Mushtaq, Baniyamuddin & Ahmad, 2007) Andrássy, 2009

H. conicaudatus (Ditlevsen, 1927) Andrássy, 2009
Dorylaimus conicaudatus Ditlevsen, 1927
Dorylaimellus conicaudatus (Ditlevsen, 1927) Thorne & Swanger, 1936
Enchodelus conicaudatus (Ditlevsen, 1927) Thorne, 1939
Enchodelus (Paraenchodelus) conicaudatus (Ditlevsen, 1927) Thorne, 1939 (Ahmad & Jairajpuri, 1980)

H. constrictus (Jairajpuri & Loof, 1968) Andrássy, 2009
Enchodelus constrictus Jairajpuri & Loof, 1968
Enchodelus satendri Baqri & Jairajpuri, 1974 **syn. n.**
Enchodelus (Paraenchodelus) satendri Baqri & Jairajpuri, 1974 (Ahmad & Jairajpuri, 1980)
Heterodorus satendri (Baqri & Jairajpuri, 1974) Andrássy, 2009

H. faeroensis (Ditlevsen, 1928) Andrássy, 2009
Dorylaimus (Doryllium) faeroensis Ditlevsen, 1928
Enchodelus faeroensis (Ditlevsen, 1928) Thorne, 1939
Enchodelus (Paraenchodelus) faeroensis (Ditlevsen, 1928) Thorne, 1939 (Ahmad & Jairajpuri, 1980)

H. geraldi (Winiszewska-Slipińska, 1987) Andrássy, 2009
Enchodelus geraldi Winiszewska-Slipińska, 1987

H. irregularis (Altherr, 1972) Andrássy, 2009
Enchodelus irregularis Altherr, 1972
Enchodelus (Paraenchodelus) irregularis Altherr, 1972 (Ahmad & Jairajpuri, 1980)

H. liangi (Ahmad, Wu & Shaheen, 2002) Andrássy, 2009
Enchodelus liangi Ahmad, Wu & Shaheen, 2002

H. longidens (Jairajpuri & Loof, 1968) Andrássy, 2009
Enchodelus longidens Jairajpuri & Loof, 1968
Enchodelus (Paraenchodelus) longidens Jairajpuri & Loof, 1968 (Ahmad & Jairajpuri, 1980)

H. lushani (Ahmad, Wu & Shaheen, 2002) Andrássy, 2009
Enchodelus lushani Ahmad, Wu & Shaheen, 2002

H. maximus (Baqri & Jairajpuri, 1974) Andrássy, 2009
Enchodelus maximus Baqri & Jairajpuri, 1974
Enchodelus (Nepalus) maximus Baqri & Jairajpuri, 1974 (Jairajpuri & Ahmad, 1992)

H. meghalayensis (Mushtaq, Baniyamuddin & Ahmad, 2007) Andrássy, 2009
Enchodelus meghalayensis Mushtaq, Baniyamuddin & Ahmad, 2007

H. monticola sp. n.

H. morgensis (Loof, 1989) Andrássy, 2009
Enchodelus morgensis Loof, 1989

H. nepalensis (Zullini, 1973) Andrássy, 2009
Enchodelus nepalensis Zullini, 1973
Enchodelus (Nepalus) nepalensis Zullini, 1973 (Ahmad & Jairajpuri, 1980)

H. porosus (Guerrero, Liébanas & Peña-Santiago, 2007) Andrássy, 2009
Enchodelus porosus Guerrero, Liébanas & Peña-Santiago, 2007

H. rhaeticus (Altherr, 1952) Andrássy, 2009
Enchodelus rhaeticus Altherr, 1952
Enchodelus (Paraenchodelus) rhaeticus Altherr, 1952 (Ahmad & Jairajpuri, 1980)

H. southeyi (Jairajpuri & Ahmad, 1986) Andrássy, 2009
Enchodelus (Paraenchodelus) southeyi Jairajpuri & Ahmad, 1986

H. striatus (Thorne, 1939) Andrássy, 2009
Enchodelus striatus Thorne, 1939
Enchodelus (Paraenchodelus) striatus Thorne, 1939 (Ahmad & Jairajpuri, 1980)

H. transsilvanicus (Ciobanu, Popovici, Guerrero & Peña-Santiago, 2010) **comb. n.**
Enchodelus transsilvanicus Ciobanu, Popovici, Guerrero & Peña-Santiago, 2010

H. tropicus (Mushtaq, Baniyamuddin & Ahmad, 2007) Andrássy, 2009
Enchodelus tropicus Mushtaq, Baniyamuddin & Ahmad, 2007

H. unicus sp. n.

H. veletensis (Guerrero, Liébanas & Peña-Santiago, 2007) Andrássy, 2009
Enchodelus veletensis Guerrero, Liébanas & Peña-Santiago, 2007

H. zonatus (Jairajpuri & Loof, 1968) Andrássy, 2009
Enchodelus zonatus Jairajpuri & Loof, 1968
Enchodelus (Paraenchodelus) zonatus Jairajpuri & Loof, 1968 (Ahmad & Jairajpuri, 1980)

REMARKS

Some species should be commented.

Heterodorus magnificus. – When in 1963 corrected the description and measurements of *Heterodorus magnificus,* Altherr compared his species with *Enchodelus arcuatus* Thorne, 1939 as described by different authors and found a great similarity between them. Indeed, if these two taxa are compared, there is hardly doubt about it whatever they represent the same species. As may be seen in Table 1, the morphometric characters of the two species are practically identical. In addition, they are very similar in the finely striated cuticle, shape of the lip region, length of the cylindrus, shape of the tail and length of its hyaline part. It can be concluded with good reason that the species of Altherr is the same as that of Thorne. Altherr's *magnificus* should be considered a junior synonym of Thorne's *arcuatus.*

Heterodorus thornei. – This species also cannot be differentiated from *H. arcuatus.* Their habitus, shape of the lip region, odontostyle, genital organ and tail are very similar. Ahmad and Jairajpuri (1980) separated them in their key by the dubious structure of the odontophore "with poorly developed basal flanges" in *thornei,* and "rod-like" in *arcuatus.* Table 1 shows how similar *arcuatus* and *thornei* are in their morphometrics as well.

Heterodorus bongersi. – In its morphometrics, this species completely agrees with *Heterodorus brevidentatus* as described by Thorne (1939) and redescribed by Guerrero and Peña-Santiago (2007) (see Tab. 2). Mushtaq, Baniyamuddin and Ahmad (2007) mentioned some very small differences between these species, of which the only real is, maybe, the greater length of the prerectum. This latter as such is, however, not enough for accepting the validity of *H. bongersi.*

Heterodorus satendri. – This species seems to be the same as *H. constrictus.* In their key to conical-tailed species, Ahmad and Jairajpuri (1980) give the minor difference: odontophore "rod-like" in *constrictus,* and "with poorly developed basal flanges" in *satendri.* The descriptions and the morphometric data of the two specific taxa well correspond to each other (Tab. 3).

Heterodorus irregularis. – The systematic position of this species is somewhat uncertain. Altherr (1972) described it from Sweden on the basis of three female specimens. The tail shows a transition from the *Enchodelus* to the *Heterodorus* type, it is 1.0–1.2 anal body widths long, conoid-rounded, straight with bluntly rounded tip. Not knowing the male characters, this taxon should be classified with some reservations under the genus *Heterodorus.*

Enchodelus coomansi. – Nicholas and Stewart (1985) described this conoid-tailed species from mangrove forests on the coast of south-eastern Australia. After them, their species would key out to the subgenus *Paraenchodelus*. However, it differs from every species of this group (now: genus *Heterodorus*) as well as from all the species of *Enchodelus (s. str.)* by the large number (26–31) of contiguous medioventral supplements. On the other hand, the Australian species, just in the number and arrangement of the supplements, resembles another enchodelid (nordiid) species, *Papuadorus amplus* Andrássy, 2009. *Papuadorus* also has an *Enchodelus*-like habitus and organization, differs however both from *Enchodelus* and *Heterodorus* in having a longitudinal vulva and a great number of contiguous supplements. Although the species of Nicholas and Stewart has a transverse vulva, it fits in other morphological respects, especially in the male characters, well into *Papuadorus. E. coomansi* should herewith be transferred to the Papuan genus as *Papuadorus*

Table 1. Comparison of some main morphometric characters of *Heterodorus magnificus* Altherr, 1952, *H. thornei* (Baqri & Jairajpuri, 1974) and *H. arcuatus* (Thorne, 1939)

	H. magnificus (after Altherr, 1952, and 1963)	*H. thornei* (after Baqri and Jairajpuri, 1974, and Ahmad and Jairajpuri, 1980)	*H. arcuatus* (after Thorne, 1939, and Guerrero and Peña-Santiago, 2007)
L (mm)	1.45–1.73	1.28–1.67	1.50–1.99
a	26–32	30–35	25–30
b	4.8–6.0	4.8–5.3	5.2–5.9
c	21–32	23–29	24–25
c’	2.0–2.5	2.0–2.4	2.0–2.2
V (%)	52–55	48–57	50–54
Lip region width (μm)	12–13	11–12	12–14
Odontostyle length (μm)	18–20	17–18	18–22
Odontostyle / lip width	1.4–1.5	1.4	1.5–1.6
Pharynx enlarged at (%)	60	60	58–62
Tail length	60–80	55–65	62–80

coomansi (Nicholas & Stewart, 1985) **comb. n.** It can be differentiated from the type species by the longer body (2.4–2.9 *vs*. 2.0 mm), shorter odontostyle (23–32 *vs*. 38–40), transverse vulva (*vs*. longitudinal), higher number of supplements (26–31 *vs*. 20–24), and by the straight and more spicate tail (*vs*. tail ventrally arcuate with rounded tip).

DESCRIPTIONS OF NEW SPECIES

Heterodorus unicus sp. n.

(Figs. 1–2)

Holotype female: L = 1.28 mm; a = 31; b = 5.2; c = 35; c’ = 1.3; V = 50 %.

Paratype females (n = 5): L = 1.07–1.30 mm; a = 26–34; b = 5.1–5.6; c = 31–35; c’ = 1.2–1.4; V = 50–55 %.

Paratype male: L = 1.09 mm; a = 27; b = 5.1; c = 35; c’ = 1.1.

General characters. Small nematodes. Body ventrally curved, C- or G-shaped, 40–47 μm wide at mid-region. Cuticle smooth (under optical microscopy), 1.5–2.0 μm thick. Labial region rounded, practically not separated from adjacent neck, 10–11 μm wide, lips amalgamated with very small papillae. Body at posterior end of pharynx 3.2–3.6 times as wide as labial region. Amphid aperture occupying about half of corresponding body width.

Odontostyle very thin and delicate, 10–11 μm long, as long as labial region width; aperture very small, hardly discernible. Odontophore rod-like without basal swelling, 18–20 μm long. Guiding ring double but thin. Pharynx weakly muscled, 210–245 μm long, gradually expanded at its 62–66 %; cylindrus weak. Distance between posterior end of pharynx and vulva 1.6–1.9 times as

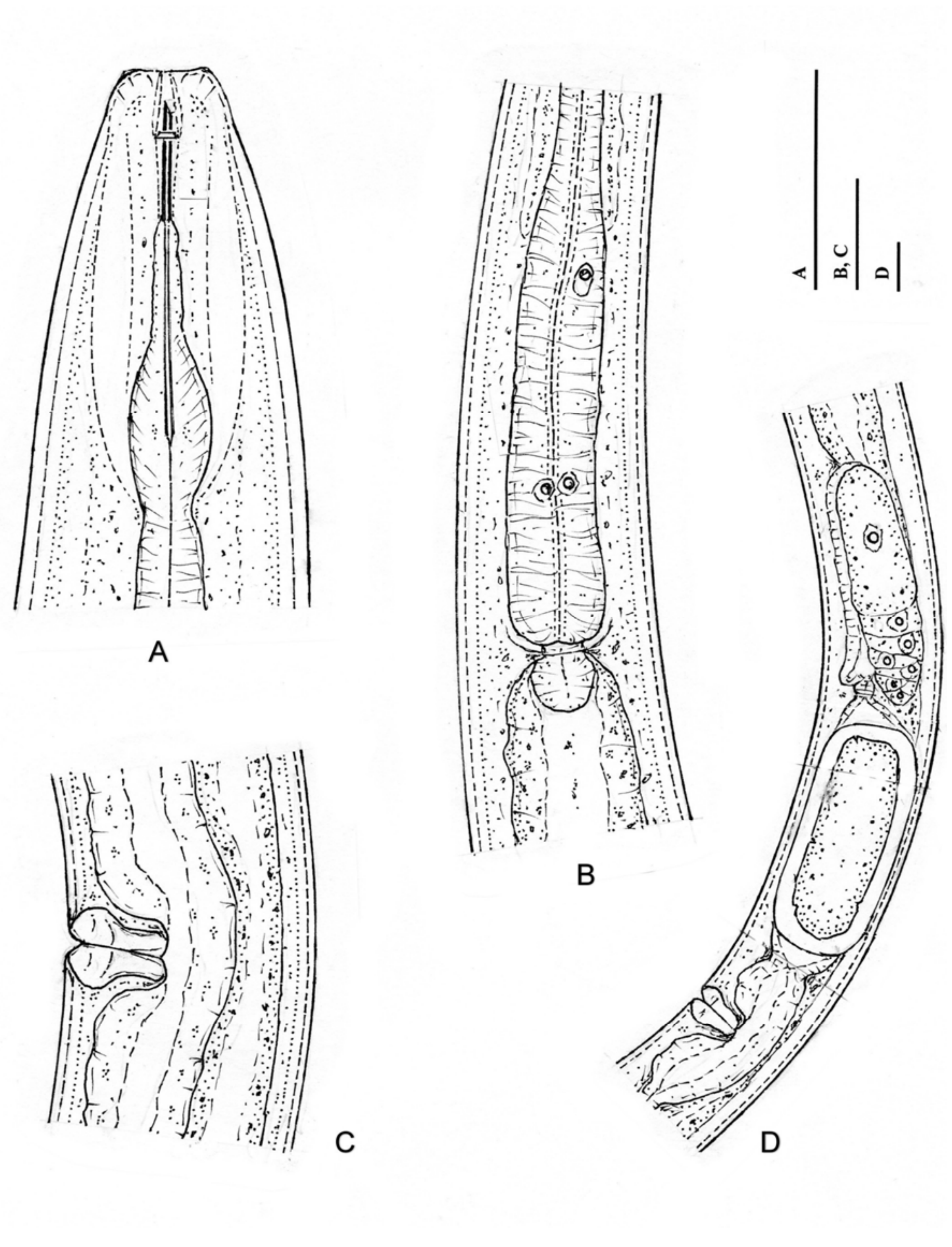

Figure 1. *Heterodorus unicus* sp. n. A: anterior end; B: posterior pharyngeal region; C: vulval region; D: anterior female gonad. (Scale bars = 20 µm)

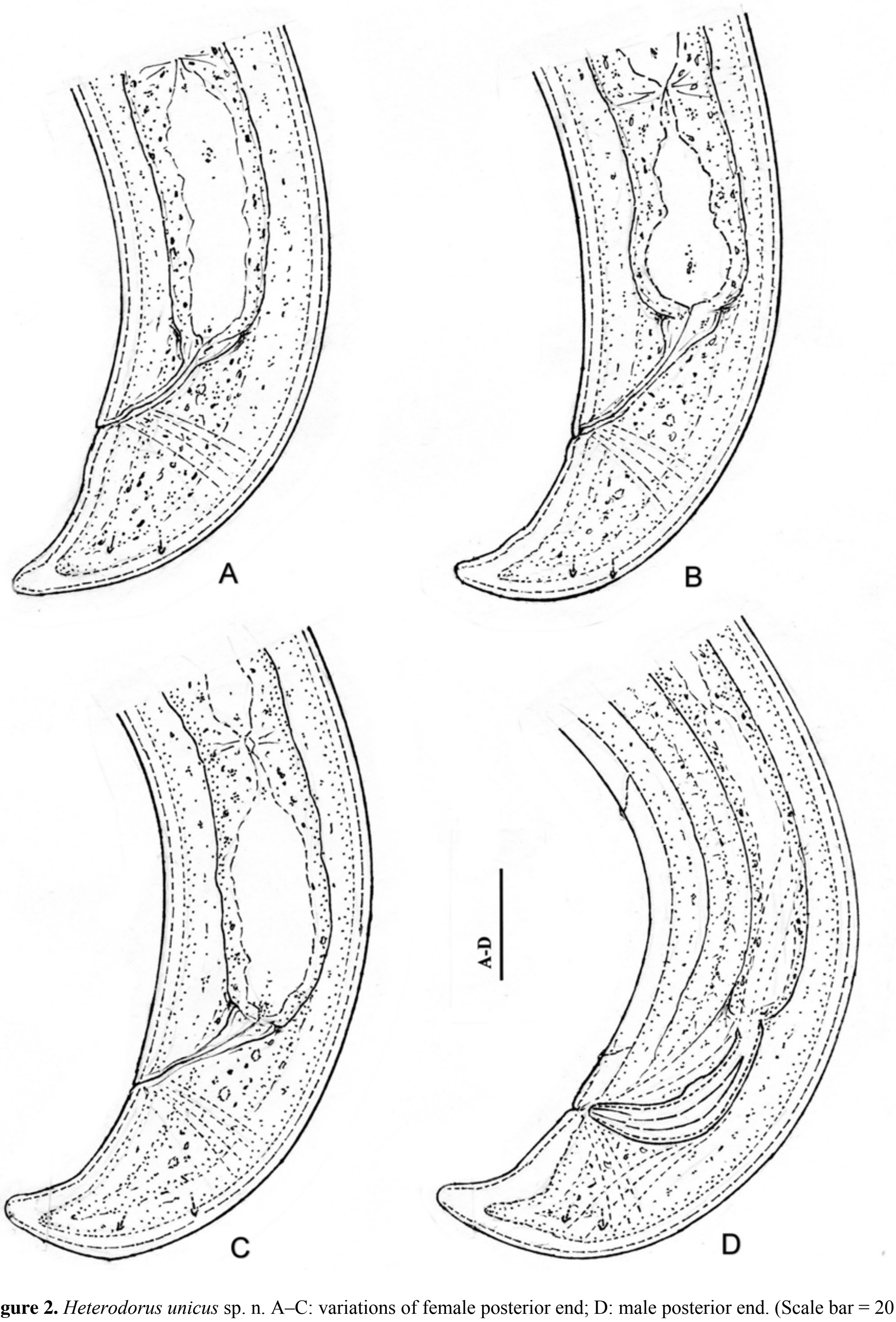

Figure 2. *Heterodorus unicus* sp. n. A–C: variations of female posterior end; D: male posterior end. (Scale bar = 20 µm)

Table 2. Comparison of some main morphometric characters of *Heterodorus bongersi* (Mushtaq *et al.*, 2007) and *H. brevidentatus* (Thorne, 1939)

	H. bongersi (after Mushtaq *et al.,* 2007)	*H. brevidentatus* (after Thorne 1939, and Guerrero and Peña-Santiago, 2007)
L (mm)	1.33–1.69	1.30–1.86
a	30–38	28–36
b	4.6–5.7	4.8–6.5
c	24–32	24–34
c’	1.7–2.1	1.5–2.4
V (%)	49–54	47–54
Lip region width (µm)	12	11–14
Odontostyle length (µm)	13–14	12–16
Odontostyle / lip width	1.2–1.3	1.1–1.4
Pharynx enlarged at (%)	58–64	54–65
Tail length (µm)	49–65	50–70

Table 3. Comparison of some main morphometric characters of *Heterodorus satendri* (Baqri & Jairajpuri, 1974) and *H. constrictus* (Jairajpuri & Loof, 1968)

	H. satendri (after Baqri and Jairajpuri, 1974, and Ahmad and Jairajpuri, 1980)	*H. constrictus* (after Jairajpuri and Loof, 1968, and Ahmad and Jairajpuri, 1980)
L (mm)	1.21–1.88	1.28–1.40
a	23–32	21–25
b	4.3–6.3	4.9–5.5
c	23–35	25–36
c’	1.5–1.9	1.5
V (%)	49–58	51
Lip region width (µm)	12–14	10–13
Odontostyle length (µm)	24–29	23–25
Odontostyle / lip width	1.9–2.1	2.0–2.5
Pharynx enlarged at (%)	63–66	60–65
Spicula (µm)	42–52	40–48
Ventromed. supplements	4–6	4–6

long as pharynx. Dorsal pharyngeal nucleus (D) at 73–75 % of pharyngeal length, or 13–14 % of entire length of body. AS nuclei minute, PS nuclei distinct, located at 56–59 % of glandularium. The latter 60–62 µm long. Cardia conoid-rounded. Intestine either in its total length or in its posterior half filled with green-coloured food (probably moss) rests.

Female. Genital apparatus amphidelphic. Each branch equally developed, 3.8–4.8 body diameters long or occupying 12–15 % of body length. Ovaries reflexed midway to vulva. Vulva a deep transverse slit, vagina 18–22 µm long, extending inwards 38–48 % of corresponding body width. Sphincter between oviduct and uterus present. Each uterus branch consisting of a proximal wider and a distal narrower portion; the former packed with sperms. Three females possess one thick-walled uterine egg each, 95–104×35–38 µm, 2.2–2.5 times the body width long. Rectum 0.6–1.2, prerectum 1.8–2.5 times as long as anal body width. Vulva–anus distance equal to 13–16 tail lengths. Tail 35–40 µm long or 2.8–3.2 % of total body length, ventrally curved with rather bluntly rounded tip.

Male. Similar in general morphology to female. Testes two, opposed, spermatozoa fusiform, 4–5 µm long. Spicula dorylaimoid, 38 µm long. Adanal pair of supplements at 12 µm from cloaca. Only a single ventromedial supplement present, situated at 60 µm from cloacal opening. Prerectum longer than the former distance. Tail 36 µm long, 2.8 % of entire length of body, ventrally curved, similar to that of female.

Diagnosis and relationships. A small and rather robust member of *Heterodorus*, with body on average 1.23 mm long, continuous lip region, short and delicate odontostyle, well posterior to its middle expanded pharynx, far posteriorly located D nucleus, but anteriorly located PS nuclei, greenish intestine, deep vulva, paired gonads, thick-walled eggs, only one ventromedial supplement, and with short, ventrally curved tail.

In having a small body, narrow lip region, short and very thin odontostyle, *Heterodorus unicus* sp. n. comes closest to *H. liangi* (Ahmad, Wu& Shaheen, 2002) Andrássy, 2009 described from China and *H. meghalayensis* (Mushtaq, Baniyamuddin & Ahmad, 2007) Andrássy, 2009 described from India. It differs from *H. liangi* by the shorter odontostyle (10–11 *vs*. 13 µm, or 1.0 *vs*. 1.3–1.4 lip region widths long), normal dorsal pharyngeal nucleus (*vs*. unusually large), strongly swollen vagina (*vs*. not or slightly swollen), much shorter prerectum (1.8–2.5 *vs*. 6–8 anal body widths long), and by the more strongly ventrally curved and narrowly tipped tail (*vs*. almost stright and more broadly rounded). Unfortunately, the male is unknown in *H. liangi.* The new species differs from *H. meghalayensis* by the somewhat shorter odontostyle (10–11 *vs*. 12–13 µm), shorter tail (1.2–1.4 *vs*. 2.0–2.1 anal body widths, or 35–40 vs. 50–53 µm long), more rounded tail tip (*vs*. sharply tipped), and especially by the presence of a single ventromedial supplement (*vs*. 4–6 in *H. meghalayensis*). In the latter respect, *Heterodorus unicus* sp. n. is unique within the genus. Where males have been described (in 13 other species), they are provided with 2 to 9 ventromedial supplements.

Type specimens. Holotype female on slide No. H-13607. Paratypes: five females, one male and two juveniles. They are deposited in the Department of Systematic Zoology and Ecology of the ELTE University, Budapest.

Type habitat and locality. Mosses from a fallen trunk in a rainforest lowland at Kiunga, a port town on the Fly River in the Western Province of Papua New Guinea; collected in July 1969 by J. Balogh.

Etymology. The species epithet *unicus* comes from the Latin and means: alone-standing or unique, referring to the single ventral supplement.

***Heterodorus monticola* sp. n.**

(Figs. 3–4)

Holotype female: L = 1.32 mm; a = 38; b = 4.9; c = 38; c' = 1.5; V = 57 %.

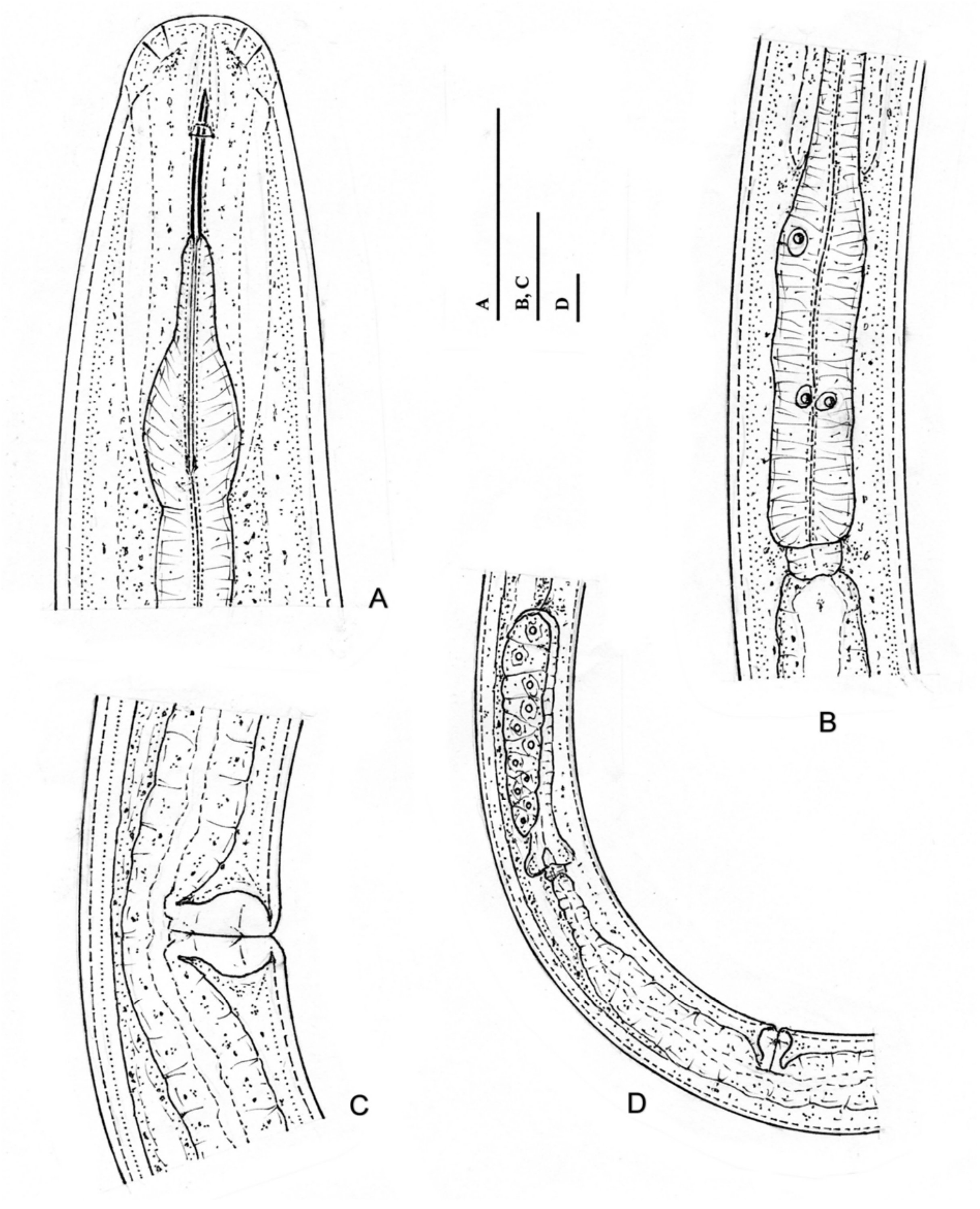

Figure 3. *Heterodorus monticola* sp. n. A: anterior end; B: posterior pharyngeal region; C: vulval region; D: anterior female gonad. (Scale bars = 20 µm)

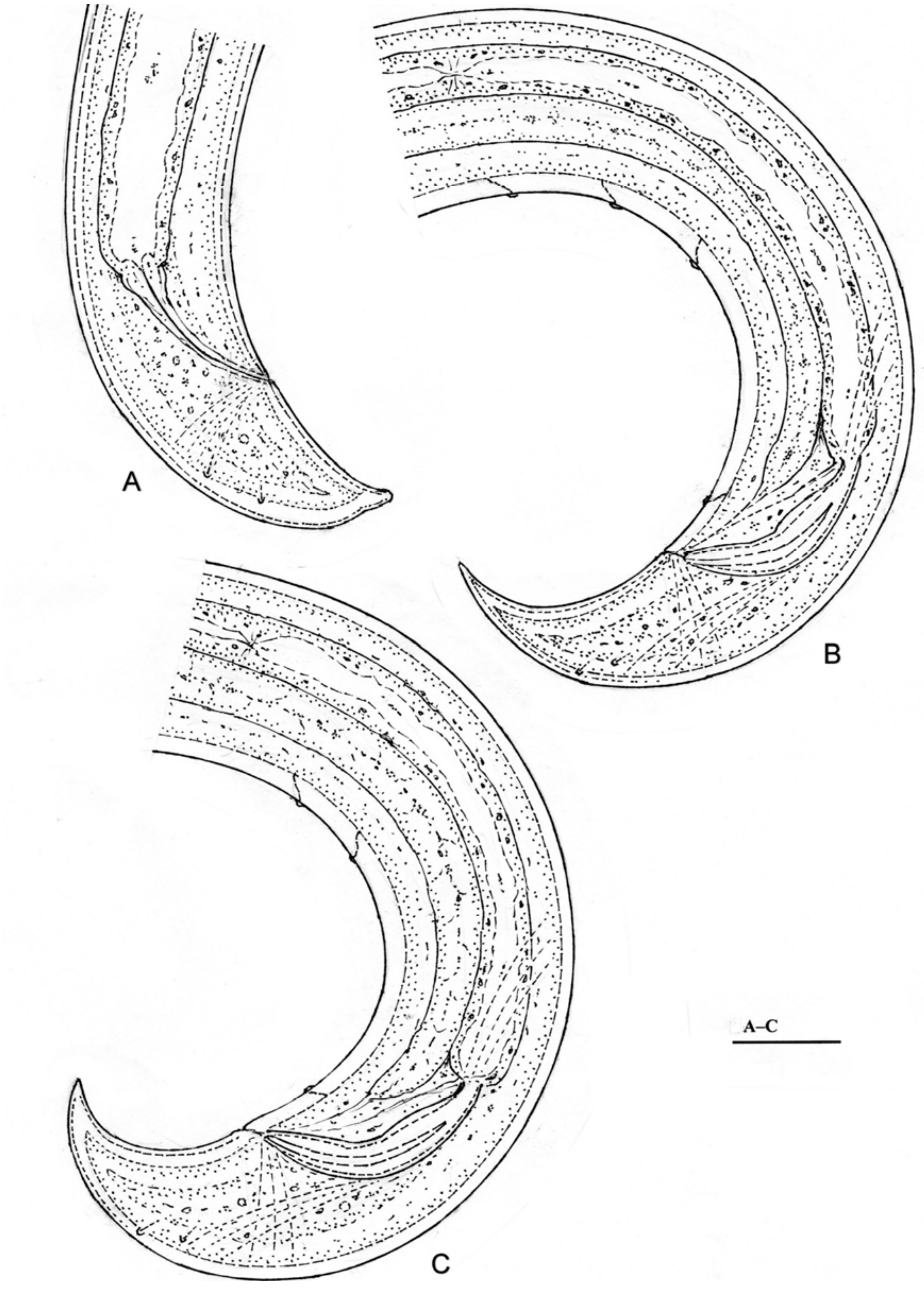

Figure 4. *Heterodorus monticola* sp. n. A: Female posterior end; B–C: male posterior ends. (Scale bar = 20 µm)

Paratype females (n = 2): L = 1.30–1.45 mm; a = 32–35; b = 5.0–5.4; c = 31–32; c' = 1.5–1.9; V = 54–55 %.

Paratype males (n = 3): L = 1.26–1.46 mm; a = 37–40; b = 4.6–5.6; c = 33–40; c' = 1.2–1.3.

General characters. Body strongly curved, G-shaped after fixation, 34–41 µm wide at mid-region. Cuticle smooth under light microscope, 1.5–2.0 thick on most part of body. Lip region 12–13 µm wide, practically confluent with adjacent neck, lips amalgamated, rounded. Body at posterior end of pharynx 2.6–2.8 times as wide as lip region. Amphids caliciform with aperture occupying half the corresponding body width.

Odontostyle 13–15 µm long, 1.1–1.2 times longer than lip region width, very thin and delicate. Odontophore rod-like, without basal swelling, 21–24 µm long. Guiding ring double but thin. Pharynx weakly muscular, 260–272 µm long, gradually enlarged at 70–74 % of its length. Dorsal nucleus located at 77–82 % of pharyngeal length or 14–17 % of entire length of body. AS nuclei inconspicuous, PS nuclei well discernible, as large as D, located in the middle of glandularium (at 49–54 %). Glandularium 52–56 µm long. Cardia spherical. Intestine transparent, not greenish.

Female. Genital system amphidelphic, each branch 4–6 times as long as mid-body diameter, occupying 12–15 % of body length. Vulva transverse, not sclerotized. Vagina strongly developed, 15 µm broad at its swollen in distal part, 20–22 µm long, extending inwards 52–54 % of corresponding body width. Ovaries reflexed about midway to vulva. Each uterine branch consisting of a proximal wider and a distal narrower section. Uterine eggs not observed. Distance between posterior end of pha-rynx and vulva 1.7–1.9 times as long as pharynx. Rectum 1.0–1.2 times, prerectum 2.6–2.8 times the anal body width long. Vulva–anus distance equal to 13–14 tail lengths. Tail 35–48 µm long, 2.6–3.3 % of total body length, conoid, ventrally curved with rounded tip.

Male. In most respects similar to female. Testes two, opposed, spermatozoa fusiform. Spicula dorylaimoid, 44–46 µm, nearly as long as tail. Adanal pair of supplements located at a distance of 13–14 µm from cloaca. Ventromedial supplements two in two males and three in one male, situated at 66–68, 84–86 and 102 µm from cloaca, respectively. Prerectum longer than the series of supplements. Tail similar to that of female, 38–42 µm long or occupying 2.5–3.1 % of total length of body.

Diagnosis and relationships. This new species belongs to the smaller representatives of the genus *Heterodorus.* It is distinguished by its body on average 1.36 mm long, lip region continuous, narrow, odontostyle short, slightly longer than lip region width, pharynx far posteriorly widened, D and PS nuclei large, the former far posterior, the latter in the middle of glandularium, intestine uncoloured, genital system paired, vulva transverse, vagina strongly swollen, two or three ventromedial supplements, and by a short, conical, ventrally curved tail.

In length of the body, the small odontostyle (as long as or only slightly longer than lip region width) and the very posterior location of the D nucleus (at 77–82 % of pharyngeal length), *Heterodorus monticola* sp. n. resembles *H. morgensis* (Loof, 1989) Andrássy, 2009. In comparing the present new species with the descriptions of *H. morgensis* by Loof (1989) from Switzerland, and Guerrero, Liébanas and Peña-Santiago (2007) from the Iberian Peninsula as well as with the paratype specimens (one female and two males) kindly sent by Loof to the present author, it differs by the shorter and plumper tail (35–48 *vs.* 44–84 µm, c' = 1.5–1.9 *vs.* 2.0–2.9; tail in *H. morgensis* sharply tipped), the shorter hyaline portion on tail tip, and especially by the lower number of ventromedial supplements (2–3 vs. 4–7).

By having a small body, narrow lip region and short odontostyle, *Heterodorus monticola* sp. n. can also be compared with *H. liangi* (Ahmad, Wu & Shaheen, 2002) Andrássy, 2009, *H. meghalayensis* (Mushtaq, Baniyamuddin & Ahmad, 2007) Andrássy, 2009 and *H. unicus* sp. n. From *Heterodorus liangi* it differs by the broader lip region (12–13 *vs.* 9–10 µm), far posteriorly located D nucleus of normal size (77–82 vs. 64–67 %, and exceptionally large), shorter prerectum

(2.6–2.8 vs. 6–8 anal body widths long, and bythe longer tail (35–48 vs. 26–30 µm). From *H. meghalayensis* it differs by the more posteriorly located D nucleus (77–82 vs. 71–72 %), tail with rounded tip (vs. sharply tipped), and by the lower number of medioventral supplements (2–3 vs. 4–6). From *Heterodorus unicus* it differs by the somewhat longer odontostyle (13–15 vs. 10–11 µm), uncoloured intestine, longer spicula (44–46 vs. 38 µm), and by he number of ventral supplements (2–3 vs. 1).

Type specimens. Holotype female on slide No. H-13661. Paratypes: two females, three males and one juvenile; all deposited in the Department of Systematic Zoology and Ecology of the ELTE University, Budapest.

Type habitat and locality. Soil and detritus from a rainforest (high jungle) at 2600 m above sea level, Oxapampa, Selva Alta Natural Park, eastern side of Pasco Region, Peru; collected in July 1999 by J. Farkas.

Etymology. Latin *monticola* (a noun) means: a mountain inhabitant, referring to the high altitude level where this species was collected.

***Heterodorus alius* sp. n.**

(Figs. 5–6)

Holotype female: L = 1.14 mm; a = 27; b = 5.1; c = 41; c’ = 1.2; V = 41 %.

Paratype females (n = 2): L = 1.16–1.25 mm; a = 28–33; b = 5.2–5.3; c = 38–40; c’ = 1.3–1.4; V = 39–41 %.

Paratype males (n = 2): L = 1.26–1.30 mm; a = 33–38; b = 5.3–5.5; c = 40–44; c’ = 1.1–1.2.

General characters. Body ventrally curved after fixation, more in posterior half, 35–41 µm wide at mid-region. Cuticle smooth and thin, 1.5 µm thick on most body. Lip region slightly separated, 11–12 µm wide, lips amalgamated. Body at posterior end of pharynx 3.0–3.5 times as wide as lip region. Amphids caliciform, nearly half as wide as corresponding body.

Odontostyle very thin, 13–14 µm long, only 1.1–1.2 times longer than lip region width. Odontophore simple, 20–24 µm long. Guiding ring thin. Pharynx 210–235 µm long, weakly muscular, enlarged at 52–55 % of its length. Dorsal nucleus less conspicuous, at 54–57 % of pharyngeal length or 10–11 % of total body length. AS nuclei inconspicuous, PS nuclei located at 55–57 % of glandularium. Glandularium 95–103 µm long. Cardia hemispherical. Intestine light green.

Female. Reproductive system amphidelphic, anterior genital branch 3.7–4.6 body diameters long, occupying 13–17 % of body length, posterior branch 4.2–5.0 body diameters long, occupying 15–18 % of body length. Ovaries short, reflexed. Each uterus branch with a proximal wider and a distal narrower part. Uterus–oviduct junction with sphincter. Vulva a transverse deep oval slit, its inner lips not sclerotized. Vagina highly developed, strongly swollen distally, 30–34 µm long, occupying 70–75 % of corresponding body diameter. Uterine eggs not observed. Distance between posterior end of pharynx and vulva only slightly longer (1.1 times) than pharynx. Rectum 1.2–1.4, prerectum 2.5–3.2 anal body widths long. Vulva–anus distance equal to 22–23 tail lengths. Tail 28–31 µm long, occupying 2.4–2.5 % of entire length of body, conoid, slightly bent ventrally with finely rounded tip.

Male. In most respects similar to female. Testes two, spermatozoa fusiform. Spicula 50–52 µm long, much longer than tail. Adanal pair of supplements at 8–10 µm from cloaca. Ventromedial supplements six or seven, the posteriormost levelling with the anterior end of spicula, at 36–38 µm from cloaca, the anteriormost at 150–160 µm from cloacal opening. Tail similar to that of female, slightly ventrally curved, 27–29 µm long, occupying 2.2–2.3 % of entire length of body.

Diagnosis and relationships. Body short, on average 1.22 µm long, lip region slightly offset,

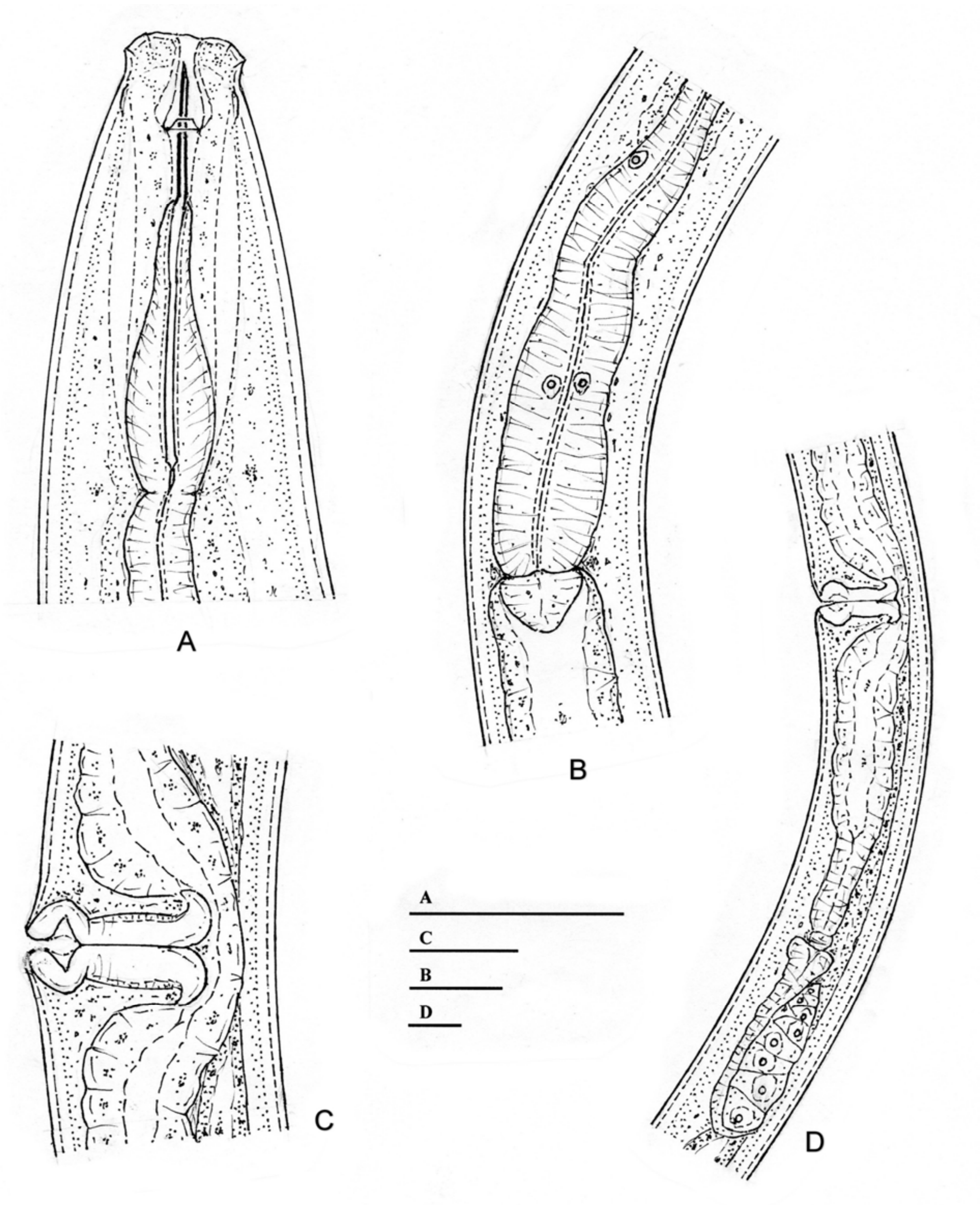

Figure 5. ***Heterodorus alius*** sp. n. A: anterior end; B: posterior pharyngeal region; C: vulval region; D: detail of the female gonad. (Scale bars = 20 μm)

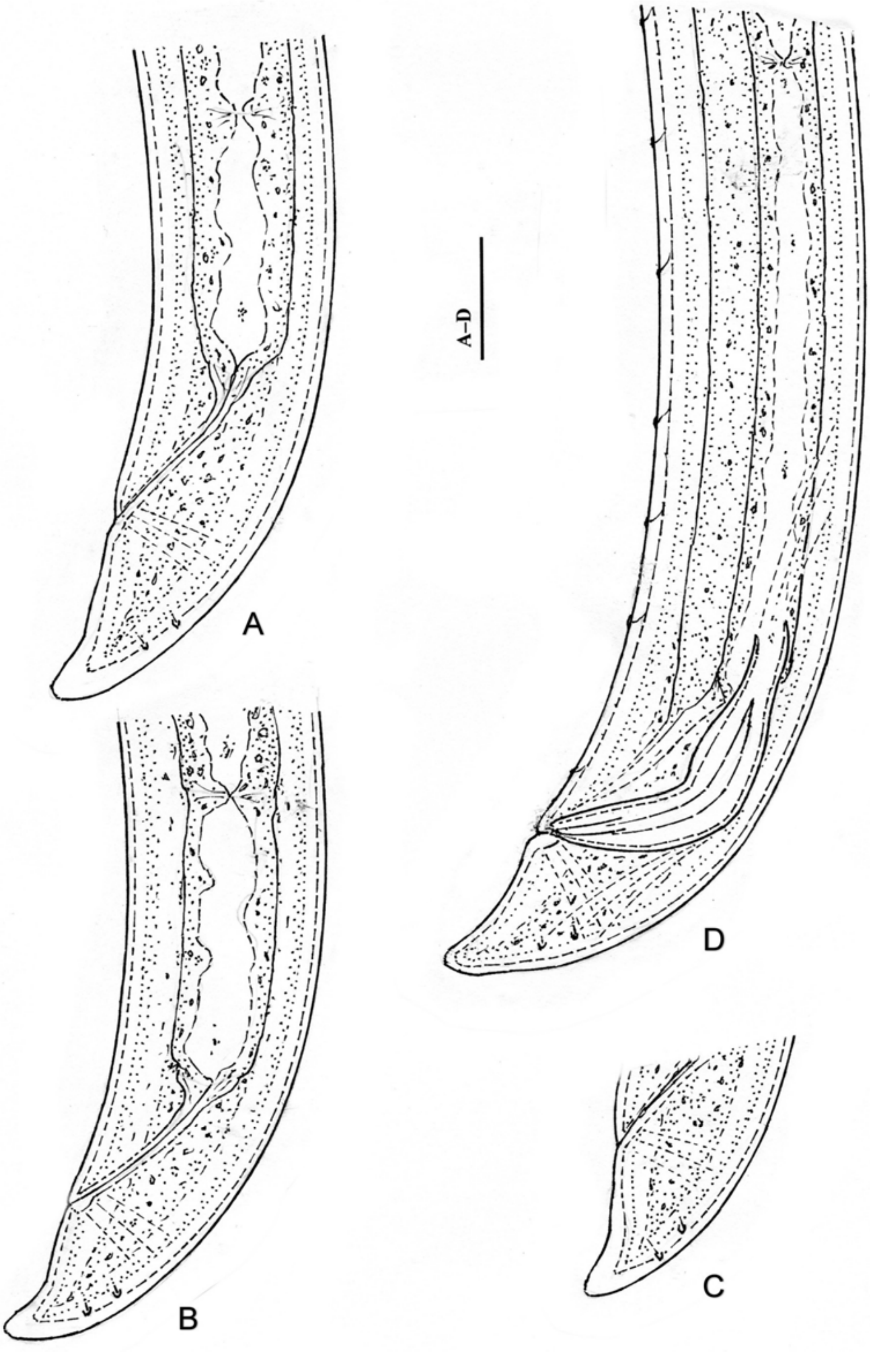

Figure 6. *Heterodorus alius* sp. n. A–C: female posterior ends; D: male posterior end. (Scale bar = 20 µm)

odontostyle thin and scarcely longer than lip region width, pharynx widened slightly posterior to its middle, D nucleus anteriorly located, PS nuclei in the middle of glandularium, genital system paired, vulva transverse, not sclerotized, anterior to the middle of body, vagina very strongly developed, spicula unusually large, male ventral supplements six or seven, the posteriormost at levelof proximal end of spicula, and tail short, conoid, slightly ventrally curved with finely rounded tip.

Heterodorus alius sp. n. is an interesting taxon within the genus showing a number of marginal values in its morphological characters. Thus, it differs from the general pattern of *Heterodorus* in having a longer and stronger cylindrus (pharynx - enlarged at 52–55 % *vs*. 56–75 % in other species), a more anteriorly located dorsal pharyngeal nucleus (D = 54–57 *vs*. 57–82 %), more anteriorly posited vulva (39–41 *vs*. 41–58 %), very long vagina (70–75 *vs*. 36–60 % of body diameter), spicula much longer than tail (vs. as long as or shorter than tail, with one exception), and in having the row of ventromedial supplements closer to the adanal pair than usual.

Type specimens. Holotype female on slide No. H-13028. Paratypes: two females, two males and two juveniles. Deposited in the collection of Department of Systematic Zoology and Ecology of the ELTE University, Budapest.

Type habitat and locality. Soil with fallen leaves around *Styphelia suaveolens* (a kind of shrubs of the family Epacridaceae)*,* 4000 m above sea level, Mt. Wilhelm, highest mountain in Papua New Guinea; collected in September 1968 by J. Balogh.

Etymology. Latin *alius* means: different or other, referring to the special structures of this new species.

Key to species of Heterodorus

1 Odontostyle 40 μm or longer (to 70 μm) 2
– Odontostyle 35 μm or shorter (to 10 μm) 6

2 Body 2.5–2.8 mm long 3
– Body 1.5–2.0 mm long 4

3 Tail 25 μm, as long as anal body diameter ....*faeroensis* (Ditlevsen, 1928)
– Tail 60 μm, nearly twice as long as anal body diameter ... *maximus* (Baqri & Jairajpuri, 1974)

4 Odontostyle 65–70 μm long .... *nepalensis* (Zullini,1973)
– Odontostyle 40–48 μm long 5

5 Odontostyle as long as 3–4 labial diameters; tail tip sharp.. .... *longidens* (Jairajpuri & Loof, 1968)
– Odontostyle as long as 2–3 labial diameters; tail tip rounded .... *geraldi* (Winiszewska-Slipińska, 1987)

6 Odontostyle longer, 25–35 μm 7
– Odontostyle shorter, 10–22 μm 12

7 Tail 25–50 μm long 8
– Tail 50–80 μm long 9

8 Tail tip sharp; male supplements 4–6 .... *constrictus* (Jairajpuri & Loof, 1968)
– Tail tip rounded; male supplements 6–8 .... *transsilvanicus* (Ciobanu *et al.,* 2010)

9 Shorter species, 1.1–1.4 mm .... *southeyi* (Jairajpuri & Ahmad, 1986)
– Longer species, 1.6–2.0 mm 10

10 Tail 70–80 μm long .... *veletensis* (Guerrero *et al*., 2007)
– Tail 50–60 μm long 11

11 Lip region 16–18 μm broad; ventral supplements three . *zonatus* (Jairajpuri & Loof, 1968)
– Lip region 12–14 μm broad; ventral supplements six to nine .... *striatus* (Thorne, 1939)

12 Tail straight 13
– Tail ventrally arcuate 14

13 Tail cuticle with numerous “bubbles”............ .... *irregularis* (Altherr, 1972)
– Tail cuticle simple, without “bubbles” .... *conicaudatus* (Ditlevsen, 1927)

14 Two rows of ring-like lateral body pores present .... *porosus* (Guerrero *et al.,* 2007)
– Lateral body pores absent or inconspicuous .15

15 Labial diameter 16–17 µm ....*rhaeticus* (Altherr, 1952)
– Labial diameter 9–14 µm 16

16 Odontostyle 18–22 µm long 17
– Odontostyle 10–16 µm long 18

17 Tail short, 28–32 µm, 1.0–1.1 anal body diameter .... *lushani* (Ahmad *et al.,* 2002)
– Tail longer, 55–80 µm, 2.0–2.5 anal body diameters .... *arcuatus* (Thorne, 1939)

18 Dorsal pharyngeal nucleus unusually large .... *liangi* (Ahmad *et al.,* 2002)
– Dorsal pharyngeal nucleus normal 19

19 Tail shorter, 1.1–1.4 anal body width long .. 20
– Tail longer, 1.5–2.9 anal body widths long . 22

20 Odontostyle 15–16 µm long .... *tropicus* (Mushtaq *et al*., 2007)
– Odontostyle 10–14 µm long 21

21 Spicula 50 µm, much longer than tail; supplements 6–7 ....*alius* sp. n.
– Spicula 38 µm, as long as tail; supplement 1 ... . *unicus* sp. n.

22 Body 1.6–1.9 mm long .... *brevidentatus* (Thorne, 1939)
– Body 1.1–1.5 mm long 23

23 Tail tip rounded; supplements 2–3 .... *monticola* sp. n.
– Tail tip sharp; supplements 4–7 24

24 Dorsal pharyngeal nucleus at 78–82 %; tail terminus slightly ventrally arcuate .... *morgensis* (Loof, 1989)
– Dorsal pharyngeal nucleus at 71–72 %; tail terminus strongly ventrally bent .... *meghalayensis* (Mushtaq *et al.,* 2007)

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Table 4. Main morphometric characters of *Heterodorus* species. (In the de Manian ratios, up: females, down: males)

	L (mm)	a	b	c	c'	V	Lip w. (µm)	Odont. (µm/lip w.)	Tail (µm)	Spicula (µm)	Suppl.
alius sp. n.	1.1–1.2 1.3	27–33 33–38	5.1–5.3 5.3–5.5	38–41 40–44	1.2–1.4 1.1–1.2	39–41	11–12	13–14 (1.1–1.2)	28–31	50–52	6–7
arcuatus (Thorne, 1939)	1.4–2.0	25–35	4.8–6.0	21–32	2.0–2.5	48–57	12–14	18–22 (1.5–1.6)	50–80	42	6
brevidentatus (Thorne, 1939)	1.6–1.9	28–38	4.6–6.5	24–34	1.5–2.4	47–54	11–14	12–16 (1.1–1.4)	49–70	–	–
conicaudatus (Ditlevsen, 1927)	2.0	30	6.1	30	1.4–2.2	42	12	18 (1.4)	36–50	–	–
constrictus (Jairajpuri & Loof, 1968)	1.2–1.9 1.2–1.4	21–32 23–32	4.3–5.5 5.1–5.4	23–36 22–32	1.5–1.9 1.6	49–58	10–14	25–29 (2.0–2.5)	25–50	40–53	4–6
faeroensis (Ditlevsen, 1928)	2.8	26	6	28	1.0	41	16	65 (3.0)	25	–	–
geraldi (Winiszewska-Sl., 1987)	1.7–2.0	27–38	4.5–5.8	30–38	1.5–2.0	49–52	14–16	39–45 (2.7–3.2)	52–58	–	–
irregularis (Altherr, 1972)	1.8–2.0	22–37	7.0–7.3	55–60	1.0–1.2	41–45	10–12	20 (1.7–2.0)	33–34	–	–
liangi (Ahmad *et al.*, 2002)	1.1–1.3	28–38	4.1–5.2	43–49	1.2–1.4	46–48	9–10	13 (1.3–1.4)	26–30	–	–
longidens (Jairajpuri & Loof, 1968)	1.5–1.7 1.5–1.8	24–35 28–37	4.2–5.3 5.2–5.8	30–35 25–34	1.3–1.8 1.5–1.8	48–51	12–14	40–48 (3.0–4.0)	45–50	50–56	7–8
lushani (Ahmad *et al.*, 2002)	1.3–1.5	27–31	4.6–5.0	47–49	1.0–1.1	45–49	11–12	19–22 (1.5–1.6)	28–32	–	–
maximus (Baqri & Jairajpuri, 1974)	2.5–2.6	41–45	5.8–6.0	41–43	1.8–1.9	49–51	15–18	54–57 (3.5)	60–62	–	–
meghalayensis (Mushtaq *et al.*, 2007)	1.0–1.2 1.0–1.2	26–29 25–30	5.2–5.8 5.1–5.8	22–24 18–23	2.0–2.1 1.8–2.2	43–46	11–12	12–13 (1.0–1.2)	50–53	40–46	4–6

Table 4. (continued)

	L	a	b	c	c’	V	Lip w.	Odontost.	Tail	Spicula	Suppl.
monticola sp. n.	1.3–1.4 1.3–1.5	32–38 37–40	4.9–5.4 4.6–5.6	31–38 33–40	1.5–1.9 1.2–1.3	54–57	12–13	13–15 (1.1–1.2)	35–48	44–46	2–3
morgensis (Loof, 1989)	1.1–1.5 1.1–1.6	27–35 30–39	4.4–6.7 4.1–6.2	18–28 19–31	2.0–2.9 1.6–2.6	42–52	10–12	11–13 (1.0–1.1)	46–84	45–56	4–7
nepalensis (Zullini, 1973)	2.0–2.3 2.1	23–36 37	5.0–7.1 6.3	30–45 40	1.5–2.4 1.1	43–53	16–18	65–70 (4.3)	46–83	60	5
porosus (Guerrero *et al.*, 2007)	1.4–1.7 1.5–1.8	36–50 34–45	7.2	32–36 30–39	1.9–2.5 1.5–1.9	50–55	11–12	16–18 (1.4–1.6)	40–48	39–45	4–6
rhaeticus (Altherr, 1952)	1.6–2.0	29–35	6–7	29–38	1.6–1.7	40–41	16–17	22 (1.4)	50	–	–
southeyi (Jairajpuri & Ahmad, 1986)	1.1–1.4 1.0–1.1	23–27 23–27	4.5–5.0 4.4–4.6	21–23 21–30	1.8–2.0 1.3–1.7	43–48	10–12	30–33 (2.5–3.2)	49–64	41–42	4
striatus (Thorne, 1939)	1.6–2.0 1.5–1.7	25–32 27–37	5.1–6.7 4.6–6.1	28–40 25–32	1.6–1.9 1.5–1.8	45–49	12–14	35–38 (2.5–3.0)	50–59	51–58	6–9
transsilvanicus (Ciobanu *et al.*, 2010)	1.3–1.5 1.4–1.5	22–30 27–30	4.6–5.1 4.7–5.1	28–36 26–30	1.3–1.5 1.4–1.5	45–48	12–13	29–34 (2.1–2.6)	42–47	47–50	6–8
tropicus (Mushtaq *et al.*, 2007)	1.0–1.1	26–29	3.5–3.8	30–39	1.1–1.4	44–47	11–12	15–16 (1.3–1.4)	24–34	–	–
unicus sp. n.	1.1–1.3 1.1	26–34 27	5.1–5.6 5.1	31–35 35	1.2–1.4 1.1	50–56	10–11	10–11 (1.0)	35–40	38	1
veletensis (Guerrero *et al.*, 2007)	1.8–2.0	34–36	4.9–5.3	23–26	2.3–2.6	48–52	16–18	29–31 (1.6–1.9)	72–78	–	–
zonatus (Jairajpuri & Loof, 1968)	1.6–2.0 1.6	35–39 36	4.6–5.8 4.5	28–36 33	1.9–2.2 1.0	46–50	16–18	34–35 (2.0)	54–62	52	3
From – to (range)	1.0–2.8	21–50	3.5–7.2	18–49	1.0–2.9	40–58	9–18	10–70 (1.0–4.3)	24–84	38–60	1–9

Enchodelus coomansi n. sp. (Nematoda: Nordiidae) associated with the roots of the mangrove *Avicennia marina* (Forsk.) Vierh. *Nematologica,* 30: 429–436.

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Opusc. Zool. Budapest, 2011, 42(1): 23–34

Die Regenwurmfauna (Oligochaeta: Lumbricidae) der Aue der Großen Kokel als Abhängige der Böden im Flusseinzugsgebiet und der Auengradienten

N. HÖSER[1]

Abstract. In five floodplain transects along the course of the river Târnava Mare in Rumania, 17 earthworm species were counted. The species spectrum of the earthworm fauna of the studied floodplains is dependent on the provenance of the floodplain sediments. On the basis of this provenance, the fauna of three groups of soil localities on the floodplain are differentiated: in the upper reaches of the river, the fauna of the floodplain soils derived from brown forest soils and podzolic soils (near Sub Cetate); on the eastern side of the middle reaches, the fauna of the soils mainly derived from gray-brown podzolic soils (near Porumbenii Mari, Hoghilag); and on the western side of the middle reaches and the lower reaches, the fauna of the soils principally derived from planosols (near Alma, Valea Lungă). *Proctodrilus tuberculatus* occurs in the floodplain sediments predominantly derived from the gray-brown podzolic soils, and in those parts of the floodplain derived from planosols *P. opisthoductus* and *Aporrectodea georgii* are found. *Ap. georgii* and *Allolobophora leoni* are mostly mutually exclusive in the floodplain transect, were they are apparently indicator species of sediment deposition close to the river and/or the effect of high water on the soil chemistry. *P. tuberculatus* and *P. opisthoductus* occur as vicarious species in the soil profile of the area where their distribution overlaps. Three soil factors that are significant in determining earthworm distribution are emphasized: lessivage, or translocation of clay; the pervection of colloidal organic matter (humus) into the soil, and the texture of the soil layers resulting from sedimentation. An additional record of the new species *P. thaleri* is given.

Keywords. Earthworms, floodplain, Târnava Mare, Romania, indicator species.

EINLEITUNG

Das Auftreten einer Reihe von Regenwurmarten in der Aue, genauer im Anlandungsbereich der Aue, wird deutlich von der Wirkung der periodischen Überflutung und des Grundwassergangs bestimmt, die beide die Gradienten der Umweltfaktoren im Auenquerschnitt einstellen und Bodenprofile prägen. Derartiges ist in wenigen Arbeiten entlang von Transekten durch die Aue untersucht worden (z.B. Höser, 1994, 2008, 2009 *a, b*, 2010 *a*; Bauer *et al*., 1998; Graefe *et al*., 2002), obwohl die edaphischen Gradienten der Aue seit langem bekannt sind (Alechin, 1927; Obrejanu *et al.,* 1964). Darüber hinaus wird die Regenwurmfauna der Aue vom Charakter der Auensedimente und somit durch die Gesteins- und Bodeneigenschaften im hydrologischen Einzugsgebiet der betrachteten Aue beeinflusst. Das geht sowohl aus der Verteilung von Regenwürmern der Gattung *Proctodrilus* in Querschnitten mitteleuropäischer Auen unterschiedlicher Bodenregionen (Höser, 2010 *b*) als auch aus dem Vorkommen von *Ap. jassyensis* in tonreichen Auenböden (Höser, 2009 *a*) hervor, deren Substrat aus dem siebenbürgischen Harbach-Hochland stammt. Im folgenden Beitrag soll am Beispiel der Kokel-Auen Südsiebenbürgens gezeigt werden, wie sich die Regenwurmfauna in den Auenquerschnitten entlang eines Flusslaufs, der durch mehrere Bodenregionen führt, mit dem Wechsel der vorherrschenden Bodentypen des hydrologischen Einzugsgebietes dieser Auenquerschnitte ändert. Die Untersuchungsergebnisse tragen auch zur Kenntnis der Autökologie einiger Regenwurmarten bei.

MATERIAL UND METHODEN

Untersuchungsgebiet

Die Untersuchungen fanden in Auenquerschnitten der Großen Kokel im Siebenbürgischen Hügelland (Rumänien) statt. Der Fluss gehört zum Donau-Theiss-System und entwässert Teile des Gurghiu- und des Harghita-Gebirges (Ostkarpaten), ihrer Vorberge und des Kokel-Hochlandes. Im hydrologischen Regime des Flusses,

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einem ausgeprägten Mittelgebirgsregime, sind Frühjahrshochwässer mit Abflussgipfel im April charakteristisch (Schneider, 1998). Der Jahresniederschlag in der collinen Stufe des Gebietes beträgt 600 – 750 mm, die mittlere Jahrestemperatur 7 – 9 °C.

Vorherrschende Böden des Einzugsgebietes der Großen Kokel sind Gebirgsbraunerden sowie Parabraunerden und Planosole, zumeist Pseudogley-Lessivés (Chiriță *et al.,* 1967; Orlenu *et al.*, 1973). Von diesen Bodengesellschaften stammen Auensedimente, auf denen sich im Auenquerschnitt vom Flussufer zum Auenrand hin Böden der Reihe Auenrohboden – Auenpararendzina – Auenbraunerde oder Auenparabraunerde bilden (Schirmer, 1991), grundwassernah auch Auengley.

Das Quellgebiet der Großen Kokel wird von Fichtenwäldern und Buchen-Fichtenwäldern bedeckt, das übrige Einzugsgebiet des Flusses gehört zumeist zu den Vegetationszonen der Buchenwälder (>600 m Höhe ü. NN, Coldea & Wagner, 1997) und Buchen-Traubeneichenwälder (Symphyto-Fagion, Lathyro-Carpinion). In den untersuchten Auen gibt es kaum Wälder, sondern nur noch galerieartige, flussbegleitende Weichholzgesellschaften (zumeist *Salix alba, S. fragilis, S. triandra*). Die Auenwiesen sind im Hügelland an tiefer liegenden Standorten Kriech-Straußgras-Wiesen (Agrostion alba), an höheren Standorten Glatthaferwiesen (Schneider, 1998), beides großenteils zu verarmtem Dauergrünland gestaltet.

Methoden

Auf Untersuchungsflächen von 0,5 x 0,5 m wurden bis in 0,5 m Tiefe alle Regenwürmer ausgegraben und in zweimaliger Durchsicht des ausgegrabenen Bodens von Hand eingesammelt. Die konservierten adulten Individuen befinden sich in der Sammlung des Autors.

Um die Regenwurmfauna eines Auenquerschnitts zu erfassen, wurden 6-13 Untersuchungsflächen auf jeweils einem Transekt angelegt, das quer zur Flussrichtung durch den Talboden der Aue führt. Alle Untersuchungen fanden auf Grünland statt. Auf diese Weise konnte (auf acht Transekten) an fünf Orten entlang des Flusslaufs der Großen Kokel ein Überblick über die Regenwurmfauna im Talboden des Auenquerschnitts gewonnen werden, nämlich am Oberlauf des Flusses 2 km nördlich von Sub Cetate (630 m ü. NN), am Mittellauf des Flusses bei Porumbenii Mari (420 m ü. NN), östlich von Hoghilag (327 m ü. NN) und zwischen Dumbrăveni und Alma (320 m ü. NN) sowie am Unterlauf des Flusses zwischen Lunca und Valea Lungă / Kreis Alba (280 m ü. NN). Untersuchungen im Bereich des Flussbetts (an der Mittelwasserlinie, wo *Eis. tetraedra* und *A. chlorotica* nachgewiesen wurden) fanden nur bei Dumbrăveni statt und sind deshalb im folgenden Bericht nicht berücksichtigt.

Bei Alma konnten Bodenstandorte auf zwei Auenterrassen des Talbodens erfasst werden. Die verwendeten Begriffe der Auenmorphologie sind bei Schirmer (1983) definiert. Die Taxonomie folgt Csuzdi und Zicsi (2003).

ERGEBNISSE

Regenwurmfauna im Längsschnitt durch die Auen der Großen Kokel

An den fünf Untersuchungsorten entlang des Flusslaufs der Großen Kokel (Tab. 1) konnten insgesamt 17 Regenwurmarten gefunden werden, davon 15 Arten in den Auenquerschnitten außerhalb des Flussbetts, also oberhalb der Mittelwasserlinie.

Die Arten *D. octaedra, L. rubellus, Ap. rosea* und *O. lacteum* wurden in allen untersuchten Auen angetroffen. *A. leoni, Ap. caliginosa* und tiefgrabende (anözische) Arten fehlten lediglich am Oberlauf bei Sub Cetate.

Es fällt auf, dass *L. terrestris* und *P. tuberculatus* nur in den Auen am Mittellauf des Flusses, so bei Porumbenii Mari und Hoghilag, festgestellt wurden, was deckungsgleich mit einer Lücke im Vorkommen von *Ap. georgii* ist. *P. opisthoductus* beschränkt sich auf die Auen des

Tabelle 1. Artenspektrum der Regenwurmfauna in den Auenböden (oberhalb der Mittelwasserlinie) am Oberlauf (Sub Cetate), Mittellauf (Porumbenii Mari, Hoghilag, Alma) und Unterlauf (Valea Lungă / Kreis Alba) der Großen Kokel. Aufgrund zusätzlicher Untersuchungen wurden bei Alma und Valea Lungă mehr Arten nachgewiesen als in den Tabellen 4 und 5 verzeichnet sind. Außerdem wurden bei Alma an der Mittelwasserlinie *Allolobophora chlorotica chlorotica* (Savigny, 1826) und *Eiseniella tetraedra* (Savigny, 1826) gefunden

	Nachweise (+) in den Auenböden				
	Sub Cetate	Porumbenii Mari	Hoghilag	Alma	Valea Lungă
Allolobophora dacica (Pop, 1938)			+	+	
Allolobophora leoni Michaelsen, 1891		+	+	+	+
Aporrectodea caliginosa (Savigny, 1826)		+	+	+	+
Aporrectodea georgii (Michaelsen, 1890)	+			+	+
Aporrectodea rosea (Savigny, 1826)	+	+	+	+	+
Dendrobaena auriculata (Rosa, 1897)				+	
Dendrobaena octaedra (Savigny, 1826)	+	+	+	+	+
Fitzingeria platyura platyura (Fitzinger, 1833)			+	+	+
Lumbricus rubellus Hoffmeister, 1843	+	+	+	+	+
Lumbricus terrestris Linnaeus, 1758		+	+		
Octolasion lacteum (Örley, 1881)	+	+	+	+	+
Octodrilus transpadanus (Rosa, 1884)				+	+
Proctodrilus opisthoductus Zicsi, 1985			+	+	+
Proctodrilus tuberculatus (Černosvitov, 1935)		+	+		
Proctodrilus thaleri Höser & Zicsi, 2009				+	

Tabelle 2. Regenwurmfauna im Querschnitt durch die Aue am Oberlauf der Großen Kokel bei Sub Cetate. Auensedimente überwiegend aus sauren Braunerden und tiefgründigen Braunerden, auf denen zumeist Buchen-Fichten- und Buchenwälder wachsen

Nummer des untersuchten Standorts im Transekt	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Entfernung vom Flussufer (in m)	1	3	7	10	13	25	40	55	75	90	105
	Anzahl der adulten Individuen pro 0,25 m²										
Aporrectodea georgii	1				1						
Aporrectodea rosea	1	1			4			2	2	6	10
Dendrobaena octaedra	3	1	2	4		3		1		1	
Lumbricus rubellus	1							1			
Octolasion lacteum	4	2	1	2	4	2	5	3			
juvenile	19	5		7	3	6	2	3	2	47	15
Summe	29	9	3	13	12	11	7	10	4	54	25

Mittel- und Unterlaufs des Flusses, wo vereinzelt auch *A. dacica*, *F. p. platyura* und *O. transpadanus* auftreten. Die Verbreitung von *P. tuberculatus* und *P. opisthoductus* im Auenlängsschnitt zeigt also Vikarianz beider Arten.

O. lacteum und *P. opisthoductus* ändern am Rand der Planosol-Vorkommen ihre Verteilung im Auenquerschnitt. So tritt *O. lacteum* in den Auen am Mittellauf nur noch spärlich, unregelmäßig und geklumpt verteilt auf (Tab. 4) und ist aus der vom Planosol-Eintrag geprägten Aue am Unterlauf bei Valea Lungă nahezu verschwunden, während *P. opisthoductus* am Beginn seines Vorkommens entlang der Großen Kokel, nämlich bei Hoghilag, vorwiegend die flussnahen Teile des Auenquerschnitts besiedelt. Die neue Art *P. thaleri*, die nach bisherigen Befunden in Auenquerschnitten anstelle von *P. tuberculatus* auftritt, wurde zuerst am Unterlauf des Flusses bei Copşa Mică (Höser & Zicsi, 2009), später auch am Mittellauf bei Alma (Tab. 4) gefunden.

Regenwurmfauna in Querschnitten durch die Auen der Großen Kokel

Zwischen Flussufer und Auenrand bestehen Gradienten der ökologischen Faktoren des Auenbodens. Daher bildet die Verteilung der Regenwurmarten im Querschnitt durch die Aue die Ansprüche dieser Arten an das Habitat ab.

Die epigäische *D. octaedra* wurde am Oberlauf des Flusses bei Sub Cetate in allen Teilen des Auenquerschnitts nachgewiesen, dessen Böden erdfeucht oder feuchter sind. In den übrigen untersuchten Auen beschränkte sich diese Art auf den feuchten Auenrand und einen Streifen am Uferwall (Tab. 2-5). Der epigäisch-endogäische *L. rubellus* konnte in der relativ humosen Aue bei Alma als weit verbreitete Art (Tab. 4), in den übrigen untersuchten Auen zumindest am Auenrand und/oder beim Uferwall angetroffen werden, wo sichtlich mehr Streureste liegen. Flussnahe Böden über niedrigem Grundwasserstand bevorzugt der tiefgrabende *L. terrestris* (Tab. 3: Nr. 2).

Unter den endogäischen Arten erreichen drei die Besiedlung des gesamten Auenquerschnitts, nämlich *Ap. rosea* in allen untersuchten Auen der Großen Kokel, *O. lacteum* am Oberlauf des Flusses bei Sub Cetate und *P. opisthoductus* am Mittel- und Unterlauf, so zwischen Dumbrăveni und Alma und bei Valea Lungă (Tab. 4, 5). *Ap. caliginosa* erreicht ihren größten Bestand als subdominante Art in den Auen am Mittellauf, hier zumeist abseits des Flusslaufs (Tab. 3, 4).

Zwischen Dumbrăveni und Alma (Tab. 4) beherrscht *P. opisthoductus* nahezu den gesamten Auenquerschnitt, sowohl den tonigen Boden am Auenrand als auch den mehr feinsandigen in Flussnähe. Hier erreicht die Art am Fuße des Uferwalls im obersten Dezimeter des hellbraunen, tonig-feinsandigen Fluvisoliments ihre größte Individuendichte (Tab. 4: Nr. 3). In ihren Lebensraum einbezogen ist in ca. 70 bis 270 m Entfernung vom Fluss ein dunkler humoser, klebriger, vermutlich aus den Planosolen der Umgebung stammender Mineralboden (Tab. 4: Nr. 5-6, 2e-2g), der in einem stellenweise etwa 30 m breiten Streifen einen 23 bis >30 cm mächtigen schwarzen, fettig glänzenden Oberbodenhorizont („Klebsandschicht“) enthält. Der Boden dieses Streifens (Tab. 4: Nr. 2g) liegt maximal 1,5 m höher als der flussnahe Talboden, also auf einer höheren (älteren) als der flussnahen Auenterrasse.

Im Gegensatz dazu wurden *L. terrestris* und *P. tuberculatus* bei Porumbenii Mari und Hoghilag in humusarmen Oberböden gefunden, die aus gut wasserdurchlässigem, sichtlich tondurchschlämmtem, mittelbraunem Auenlehm bestehen. *P. tuberculatus* lebt bei Hoghilag auch im ungeschichteten Bodenprofil der Vega einer mächtigen Auenlehmdecke (Tab. 3: Nr. 3). Er tritt im selben Bereich der Gradienten von Textur und Bodenalter auf, in dem *P. opisthoductus* vorkommt.

P. thaleri wurde bei Alma am Auenrand in einer ca. 1,8 m über dem flussnäheren Talbodenniveau liegenden Auenterrasse gefunden (Tab. 4: Nr. 7). Dort tritt er in ca. 40 cm Tiefe im etwas festeren, erdfeuchten Auenlehm auf, der verbraunt und tondurchschlämmt ist.

Ap. georgii beschränkt sich auf den internen (flussnäheren) Bereich der Auenterrassen, so bei Alma auch auf den Rand einer höheren, weniger

Tabelle 3. Regenwurmfauna im Querschnitt durch die Aue am Mittellauf der Großen Kokel bei Hoghilag. Auensedimente überwiegend aus Parabraunerden, teils aus Braunerden, auf denen zumeist Traubeneichen-Buchenwälder wachsen. „Klebsandschicht" (15 cm) an Nr. 1

Nummer des untersuchten Standorts im Transekt	**1**	**2**	**3**	**4**	**5**	**6**
Entfernung vom Flussufer (in m)	15	165	375	525	825	900
	Anzahl der adulten Individuen pro 0,25 m²					
Allolobophora dacica			1			
Allolobophora leoni			1		12	
Aporrectodea caliginosa		1	2			1
Aporrectodea rosea	4	9	5	18	14	10
Dendrobaena octaedra	2					
Fitzingeria platyura platyura					5	
Lumbricus rubellus						2
Lumbricus terrestris		2				
Octolasion lacteum		9				3
Proctodrilus opisthoductus	2	3		5		
Proctodrilus tuberculatus			5	5		
juvenile	13	14	16	49	81	27
Summe	21	38	30	77	112	43

Tabelle 4. Regenwurmfauna im Querschnitt durch die Aue am Mittellauf der Großen Kokel bei Alma. Zwei Transekte: Transekt am Gleitufer des Flusses mit den Standorten Nr. 1-7; Teil eines Transekts am Prallufer des Flusses mit den Standorten Nr. 2a-2g. Auensedimente überwiegend aus Planosolen, teils aus Parabraunerden und Braunerden, auf denen zumeist Eichen-Hainbuchenwälder mit Traubeneiche und Rotbuche wachsen. „Klebsandschicht" an Nr. 5, 6 (ca. 30 cm) und Nr. 2e – 2g (23 bis >30 cm)

Nummer des untersuchten Standorts im Transekt	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Entfernung vom Flussufer (in m)	9	12	25	70	150	255	405
	Anzahl der adulten Individuen pro 0,25 m²						
Allolobophora leoni				5	4		
Aporrectodea caliginosa					3	2	1
Aporrectodea georgii	2	4	2				4
Aporrectodea rosea		6	8	7	8	6	2
Dendrobaena octaedra		2					
Lumbricus rubellus			1	1	2	3	
Proctodrilus opisthoductus	1	2	8		1	2	
Proctodrilus thaleri							1
juvenile	6	54	82	15	53	44	11
Summe	9	68	101	28	71	57	19
Nummer des untersuchten Standorts im Transekt	**2a**	**2b**	**2c**	**2d**	**2e**	**2f**	**2g**
Entfernung vom Flussufer (in m)	12	40	50	65	71	82	125
	Anzahl der adulten Individuen pro 0,25 m²						
Allolobophora dacica			1	3	5		
Allolobophora leoni	5						
Aporrectodea georgii		2		1		1	4
Aporrectodea rosea	4	4		5	2	7	5
Lumbricus rubellus			1				1
Octolasion lacteum			1				
Octodrilus transpadanus		2					
Proctodrilus opisthoductus	3	5	2	2	2		1
juvenile	12	15	12	14	21	6	30
Summe	24	28	17	25	30	14	41

Tabelle 5. Regenwurmfauna im Querschnitt durch die Aue am Unterlauf der Großen Kokel bei Valea Lungă / Kreis Alba. Auensedimente überwiegend aus Planosolen, auf denen zumeist Eichen-Hainbuchenwälder und Stieleichenwälder wachsen

Nummer des untersuchten Standorts im Transekt	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Entfernung vom Flussufer (in m)	15	30	60	82	105	123	200	206	215	220	223
	Anzahl der adulten Individuen pro 0,25 m^2										
Allolobophora leoni								1	6		
Aporrectodea caliginosa						1					
Aporrectodea georgii		3	15	9	17	11					
Aporrectodea rosea		2		2		2		2	1	2	2
Dendrobaena octaedra	4										
Fitzingeria platyura platyura										2	1
Octodrilus transpadanus						1					
Proctodrilus opisthoductus				1		1	4	3	4	2	2
juvenile	8	20	12	9	23	40	21	20	34	31	16
Summe	12	25	27	21	40	56	25	26	45	37	21

oft überfluteten (Tab. 4: Nr. 2f, 2g, 7). Folglich sind die von ihr bewohnten Bodenstandorte von deutlich unterschiedlichem Entwicklungsstand.

Die Arten *Ap. georgii* und *A. leoni* schließen einander in den untersuchten Auenquerschnitten aus (Tab. 4, 5). Bei Alma kommen beide auf der flussnahen Auenterrasse vor. Dort lebt *Ap. georgii* im zumeist auffällig humosen Fluvisoliment der flussnächsten, am häufigsten überfluteten Bereiche, deren Bodenbildung durch Sedimentaufwuchs gestört wird (Tab. 4: Nr.1-3, 2b, 2d). Demgegenüber tritt *A. leoni* außerhalb dieses Streifens starker, sichtbarer Sedimentzufuhr auf, also in den flussferneren, mehr Ton enthaltenden Mineralböden oder am Prallufer, wo im Stromstrich der Hochflut der Sedimentaufwuchs nicht stattfindet (Tab. 4: Nr. 4, 5 bzw. 2a). So erreicht *A. leoni* auch die am Auenrand liegenden Bodenstandorte (Tab. 3: Nr. 5; Tab. 5: Nr. 8,9), meidet jedoch die sichtlich vom Kolluvium beeinflussten (Tab. 3: Nr. 6; Tab. 5: Nr. 10, 11).

Bemerkenswert ist, dass sich *A. dacica* bei Alma auf die im Relief erkennbare Sedimentablage beschränkt, die am Fuße der um >1 m höheren (älteren), die Klebsandschicht tragenden Auenterrasse liegt (Tab. 4: Nr. 2c-2e).

Regenwurmarten in geschichteten Auenbodenprofilen

In den Auen bei Porumbenii Mari und Hoghilag (Tab. 3) wurden *L. terrestris* und *P. tuberculatus* in geschichteten flussnahen Bodenprofilen über sehr niedrigem Grundwasserstand gefunden, *P. tuberculatus* in der feinkörnigen Schicht, die über einer gröberen, manchmal über einer kieshaltigen lagert. Bei einer Überlappung der Vorkommen von *P. opisthoductus* und *P. tuberculatus* in der Aue bei Hoghilag unter Dauergrünland (Tab. 3: Nr. 4) leben beide Arten separat im Bodenprofil. Die erstgenannte Art konzentriert sich am unteren Ende des 3 cm mächtigen, von Wurzeln durchsetzten Teils des Ah-Horizonts, so also oberhalb des Lebensraums der anderen Art. Dieser Standort liegt im Wege einer Nebenströmung der Hochflut, die sich an einem Mäander einstellt.

DISKUSSION

Einfluss der Bodentypen des Flusseinzugsgebietes auf die Regenwurmfauna der Aue

Aufgrund Chiriță *et al.* (1967), einer Bodenkarte von Conea *et al.* (1973) und eigener Beobachtungen sind längs der Großen Kokel drei Bereiche anhand der Herkunft der Auensedimente zu unterscheiden: Am Oberlauf (Tab. 2) stammen die Auensedimente überwiegend von Braunerden, auch von sauren und podsoligen Braunerden. Im zweiten Bereich, am östlichen Teil des Mittellaufs und zugleich am östlichen Rand der siebenbürgischen Parabraunerde-Planosol-Region (Tab. 3), resultieren sie anscheinend zumeist aus Parabraunerden, teils aus Pseudogley-Parabraunerde. Im dritten Bereich, an der anschließenden übrigen Flusslaufstrecke (Tab. 4, 5), herrschen Auensedimente aus Planosolen und Parabraunerden vor, wobei im westlichen Teil des Mittelaufs überwiegend Planosole in die Aue eingetragen werden. Vom Ober- zum Mittellauf des Flusses hin verstärken sich also kräftig die Staunässemerkmale der Böden des hydrologischen Einzugsgebietes der Auenstandorte. Die verdichteten, staunassen Planosole, auch als pseudoverleyte Parabraunerden oder Pseudogleye beschrieben (Conea *et al.,* 1973; Păunescu & Chiriță, 1970), summierte und kartierte Stefanovits (1971 *a, b*) seinerzeit noch als Gruppe der Mitteleuropäischen Braunerden. Vergleicht man die Herkunft der Auensedimente mit der Regenwurmfauna der Auenstandorte, so fallen Bindungen von *O. lacteum* an die erste, von *L. terrestris* und *P. tuberculatus* an die zweite und von *P. opisthoductus*, der offensichtlich mit *P. tuberculatus* ökologisch (edaphisch) vikariiert, an die dritte Art der Sedimentherkunft auf. Das führt uns zu der Annahme, dass die Auensedimente aus ihren Herkunftsgebieten dauerhafte Valenzen der Umweltbedingungen (Müller, 1984) für Regenwürmer mitbringen.

Die Planosole und die davon stammenden Auenböden treten durch die Funde des anscheinend endemischen *P. thaleri* als edaphische Besonderheit hervor (Tab. 4; Höser & Zicsi, 2009). Dieses gehört wohl zur besonderen evolutionären Situation im Karpatenbogen, in der orographische Bedingungen endemische Artenvielfalt und beschleunigte Artbildung bei der Gattung *Octodrilus* verursachten (Pop 1994; Pop *et al*., 2010; Csuzdi *et al*., 2011). Von den übrigen 16 Arten aus den Kokel-Auen (Tab. 1) sind acht peregrin, daneben drei Arten transägäisch (*A. leoni, O. transpadanus, P. tuberculatus*), zwei zentraleuropäisch (*F. p. platyura, P. opisthoductus*) und je eine Art atlantisch-mediterran (*Ap. georgii*), ost-alpin (*D. auriculata*) und dakisch endemisch (*A. dacica*) verbreitet (Csuzdi & Zicsi, 2003; Csuzdi *et al.,* 2011).

Übernahme von Bodeneigenschaften aus dem hydrologischen Einzugsgebiet in den Bodenstandort der Aue

Der genannte Import ökologischer Valenzen in die Aue betrifft die nach Ehwald (1982) konservativen Bodeneigenschaften, sowohl vom Ausgangssubstrat ererbte als auch während der Entwicklung der gegenwärtigen Biogeozönose gebildete. Dazu gehört z.B. der Bestand an schwer verwitterbaren Mineralen, daneben unseren Beobachtungen zufolge wohl auch ein Anteil an Ton und humosen Substanzen, der aus dem stromauf liegenden Flusseinzugsgebiet stammt. Die vermutlich lange „Löschzeit“ dieser Eigenschaften, ihre Übernahme in die Auenböden und in diesem Falle ihre Beibehaltung durch gleichartige und gleichsinnig fortwirkende Prozesse (z.B. Durchschlämmung und Bodenschichtung) in der Bodenbildung, Hang- und Auendynamik ergeben, dass einige Regenwurmarten in den Gradienten des Auenbodens dieselbe oder eine ähnliche ökologische Existenz finden wie an entsprechenden Standorten auf Hängen und im Kolluvium.

Die Habitate der *Proctodrilus*-Arten entstehen wohl bei der Durchschlämmung, die aus dem natürlichen Verbund (Bridges, 1978) von Tonverlagerung (= Tondurchschlämmung) und Einwaschung der Huminstoffe besteht. Tonverlagerungen, so die syngenetische, die im Kolluvium und durch versickernde Hochwässer im Auenlehm (Kopp, 1964) stattfindet, oder die aus der Parabraunerde-Dynamik bekannte, schaffen (Höser, 1986) ökologische Valenzen für *P. tuberculatus*. Als sedimentationseigener Prozess gewährleistet die Durchschlämmung faktisch Kontinuität dieser Valenzen beim Übergang des Sediments vom Hang in die Aue, so dass *P. tuberculatus* in lessivierten Hangböden (Höser, 1998 *b*) und schon in rohbodennahen geschichteten Auenbodenprofilen am Fluss gefunden wird (Tab. 3 in Höser, 2003), so gemäß seiner anscheinend größeren ökologischen Potenz

(Zicsi, 1959). Offensichtlich werden diese Valenzen durch entsprechende für *P. opisthoductus* ersetzt, wo große Mengen wanderfähiger kolloidaler Humusstoffe auftreten, z.B. in der Aue bei Alma (Tab. 4). Damit ergibt sich edaphische Vikarianz beider Arten. Andererseits bringt Tonanreicherung in hydromorphen Böden ökologische Valenzen für *P. antipai* hervor, z.B. am Sd-Horizont (Höser, 2008).

Zur Autökologie der Regenwurmarten in der Aue

D. octaedra besiedelt den Auenquerschnitt offenbar fast lückenlos, wenn dort im Jahresdurchschnitt höhere Bodenfeuchtigkeit herrscht. Das ist in der Aue bei Sub Cetate der Fall (Niederschlagssumme > 700 mm) und aufgrund der bekannten Bindung der Art an feuchte Wiesen (Frenzel, 1936) zu erwarten. Feuchtigkeit und Streu (Nahrung) sind begrenzende ökologische Faktoren in der Aue, wo sich die beiden häufigsten Laubstreubewohner der Region (Zicsi, 1968), die eurytopen epigäischen Arten *D. octaedra* und *L. rubellus*, auf Auenrand bzw. Uferwall beschränken.

Ap. rosea hat in den untersuchten Auen, in denen sie ubiquitär ist, eine offensichtlich breite ökologische Valenz (Graff, 1953). Sie ist noch aktiv bei sehr geringer Bodenfeuchtigkeit (Volz, 1976; Edwards & Bohlen, 1996), ist der häufigste Mineralbodenbewohner der Region (Zicsi, 1968), einer der häufigsten in vielen ostmitteleuropäischen Auen (Bauer *et al.*, 1998; Pižl, 1998, 1999), und als geophage Art (Lee, 1985) eurytop. Die in deutschen Auen (Emmerling, 1995; Höser, 1994, 2009 *b*) dominante *Ap. caliginosa* tritt in den Kokel-Auen deutlich zurück. *O. lacteum* bevorzugt die feuchteren Böden (Volz, 1976; Bauer *et al.,* 1998), so auch in der Aue bei Sub Cetate. Ihr Rückgang mit dem Eintritt ins Planosol-Gebiet deutet auf eine Bindung an ökologische Faktoren, die aus den bewaldeten Gebirgsbraunerden oder wenigstens aus bestocktem Gelände in die Aue des Oberlaufs eingetragen wurden und in den überwiegend aus Planosolen stammenden Auenböden anscheinend nicht entwickelt sind. Dieses kann erklären, weshalb die Art weitgehend in den Auen am Mittel- und Unterlauf der Großen Kokel fehlt (Tab. 3-5), wie auch im flussfernen Streifen der Alt-Aue (Höser, 2009 *a*), der an die Vorkommen der Planosole des südlichen Kokel-Hochlandes grenzt (Conea *et al*., 1973).

Der hohen Stetigkeit zufolge, in der *P. opisthoductus* in den Auen bei Alma und Valea Lungă auftritt, bevorzugt er offensichtlich allochthones Bodensubstrat aus den umgebenden Planosolen, die über einem tonigen „tiefsitzenden Staukörper mit darauf sitzender Staunässe“ (Ganssen & Gračanin, 1972) Humus akkumulieren. Diese Beziehung weist auf Bindung an feine und kolloidale Humusstoffe hin. Allerdings scheint die mittels kolloidalem, quellfähigem Humus entstandene „Klebsandschicht“ (Franz, 1960) in der Aue bei Alma, wie auch der kolluviale Mineralboden der Hangschulter des Alt-Tales (Höser, 2009 *a*), lediglich suboptimal für die Art zu sein, die im feinsandigen Mull einer Auflandung von flussnahem Fluvisoliment am Mieresch (Höser, 2003) ihr Optimum hat.

Die grundwasserfernen, von *L. terrestris* und *P. tuberculatus* besiedelten Auenböden (Tab. 1, 3) gewährleisten vermutlich der erstgenannten Art den ihr angemessenen tiefgründigen Lebensraum bei großem Grundwasserflurabstand (Graff, 1953; Graefe *et al.,* 2002). Sie bieten dem *P. tuberculatus* die von ihm in der flussnahen Aue bevorzugte syngenetisch lessivierte Texturwechsellagerung (Höser, 2003), die sedimentationseigen ist.

Ap. georgii ist anscheinend an Böden auf umgelagertem Substrat gebunden, ungeachtet des aktuellen Entwicklungsstandes dieser Böden. Daher kommt sie auch auf weniger oft überfluteten, internen und daher eher texturell geschichteten Rändern von höheren (älteren) Auenterrassen vor (Tab. 4: Nr. 7). Somit kann diese Art wie *Ap. caliginosa* zu den Leitformen für die mehr durch Umlagerung als durch Perkolation geprägten Böden (Höser, 1993) gestellt werden.

Die ökologischen Valenzen für *A. leoni* entstehen offenbar infolge der terrestrischen Bodenbildung in der Talbodenfazies der Aue. Dafür spricht, dass die Nachweise der Art im Auenquerschnitt flusswärts ungefähr beim Übergang zur sichtbaren, die Bodenentwicklung hemmenden Sedimentzufuhr enden, wo nach Schirmer (1991) der Übergang zu C-M-Horizonten stattfindet (in Tab. 4: von Nr. 4 zu Nr. 3). Diese Valenzen für *A. leoni* basieren möglicherweise auf dem Bodenchemismus, der in Bereichen ohne wesentliche Sedimentzufuhr von der Hochflut in Gang gesetzt wird. Die betreffenden Bodenstandorte liegen in der Weichholzaue und Unteren Hartholzaue (Höser, 2003, 2010 *a*).

Bedeutung geschichteter Bodenprofile für Regenwürmer

Auch die Bodenschichtung als sedimentationseigener Prozess gewährt den Regenwürmern ökologische Valenzen. Sie ist in den hier untersuchten Auenböden Voraussetzung für das hängende Kapillarwasser der Texturwechsellagerungen (Mückenhausen, 1993), das *P. tuberculatus* (Tab. 3) und *P. thaleri* ermöglicht, Pessima der Bodenfeuchtigkeit an Schichtgrenzen zu überleben (Höser, 2000, 2003; Höser & Zicsi, 2009).

Bodenschichtung ist die Ursache festgestellter Überlappung der Vorkommen von *P. tuberculatus* und *P. opisthoductus* am selben Bodenstandort. Sie ergibt ökologische Vikarianz im geschichteten Bodenprofil, so dass jede Art in einer anderen Schicht desselben Profils lebt. Diese Schichtung und die mit ihr mögliche Vikarianz gründen sich möglicherweise auf eine lokale Änderung der Überflutungsdynamik (Höser, 2003) oder auf Unterschiede in der Herkunft des Fluvisoliments, bedingt durch stark wirksame lokale Niederschläge im hydrologischen Einzugsgebiet des Auenstandorts. Wahrscheinlich treten sie zumeist an den Grenzen der Verbreitung von Planosolen auf, wo in den Auen neben humusarmem Auenlehm auch Feinsandmull sedimentiert wird. Dafür sprechen aufgrund der Bodenkarte von Conea *et al.* (1973) die Nachweise von Überlappungen an der Großen Kokel bei Hoghilag (Tab. 3: Nr. 4 und Höser, 1998 *a*) und am Unterlauf des Mieresch, dort am Übergang zu den Löss-Vorkommen des Alfölds (Abb. 2 in Bronger, 1976) bei Şoimoş / Lipova (Höser, 2003). Diese ökologische Separation der beiden Arten ist bemerkenswert, da beide dieselben Bereiche der Gradienten von Textur und Bodenalter des Auenquerschnitts bewohnen (Höser, 1997).

Als ähnlicher Fall ökologischer Vikarianz wurde in ausreichend mit Bodenfeuchtigkeit versorgten Bereichen mitteldeutscher Auen gefunden, dass in einem texturell zweigeteilten Bodenprofil fossiler Auen *P. antipai* den feinkörnigen und *P. tuberculatus* den wenig gröber körnigen Teil bewohnt (Höser, 2008).

Bindungsrelevante Faktoren der Böden für Regenwürmer

Mit der hier angewandten zoologischen Feldmethode, das Vorkommen der Regenwurmarten im Auenquerschnitt quantitativ zu erfassen und mit beobachteten auffälligen Standortfaktoren in Beziehung zu setzen, können aufgrund von Ergebnissen aus mehreren Flussauen in erster Annäherung und im Sinne von Dunger (1998) drei für Regenwürmer wahrscheinlich bindungsrelevante Faktoren der Böden herausgestellt werden: die Tonverlagerung (Höser, 1986; relevant für *P. tuberculatus*), das damit verbundene Einwaschen kolloidaler Humusstoffe in den Boden (relevant für *P. opisthoductus*) und die sedimentationseigene texturelle Bodenschichtung (Höser, 2003; Höser & Zicsi, 2009; relevant für *P. tuberculatus* und *P. thaleri*). Naheliegend ist, unseren Ergebnissen zufolge der Bodenschichtung aufgrund ihrer doppelten Funktion als einem Requisit der ökologischen Isolation und der Bindung an das Habitat eine besondere grundlegende Bedeutung zuzuerkennen, die z.B. in Hinsicht auf die Gattung *Proctodrilus,* so auch *P. thaleri*, artliche Differenzierungen bestätigt.

Dank – Ich danke Herrn Prof. Dr. András Zicsi (Budapest) für Nachbestimmungen, Herrn Michael Höser für technische Assistenz im Freiland und Herrn Brian Hillcoat (Berlin) für die Übersetzung ins Englische. Herrn Dr. Peter Weber (†) und Frau Dr. Anikó Mitruly (Mediaş) bin ich für landeskundliche Informationen dankbar.

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Resurrection of the genus *Capitodiscus* Vitzthum, 1931 with description of *Capitodiscus admirandus* n. sp. from Croatia (Acari: Mesostigmata: Uropodina)

J. KONTSCHÁN[1]

Abstract. The genus *Capitodiscus* Vitzthum, 1931 bearing unique characters in the Uropodina mites, is resurrected. This genus is easy to recognize on the basis of the following characters: insertion of corniculi situated below level of insertions of h2; the pygidial shield bearing long setae. Diagnosis and systematic notes to this genus are given with the description of the second species, *C. admirandus* n. sp. from Croatia, which differs from *Capitodiscus venustus* (Berlese, 1884) in the position of sternal setae and the presence of a well sclerotised court around the genital opening.

Keywords. Acari, Uropodina, Capitodiscus, Discourella, synonymy.

INTRODUCTION

Berlese (1884) reported on an interesting, new Uropodina mite species from Italy with unique gnathosoma and large, strongly sclerotised body which was named as *Discopoma venusta* Berlese, 1884. On the basis of the extreme characters, Berlese (1917) later established a new subgenus *Discopoma (Cephalodiscus)* to accommodate this species, however this subgenus name proved to be a junior homonym of the marine Hemichordata genus (*Cephalodiscus* M'Inthios, 1882), hence Vitzthum (1931) established a new replacement name *Capitodiscus* Vitzthum, 1931.

Later, Hirschmann and Zirngiebl-Nicol (1964) placed *Capitodiscus venustus* into the genus *Discourella* Kramer, 1886 on the basis of cheliceral and gnathosomal appendages. Hirschmann (1972) divided the large and heteromorphous genus into several species groups, and placed *Discourella venusta* together with the newly described *Discourella salignifolia* Hirschmann, 1972 into the *venusta*-group. It seems that Hirschmann (1993) himself was not sure about the exact systematic position of the species because in his monograph this species was discussed separately from the other *Discourella* species.

In the last decade, several collecting trips were organized to the different countries of the Balkan peninsula (Fehér *et al.*, 2004), and several papers were published on the soil mesofauna collected in these expeditions (mites and springtails).

The springtail fauna was studied by Traser & Kontschán (2004) and Dányi (2010) resulted in description of a new species from Montenegro. Kontschán (2003 a,b, 2004, 2005, 2006, 2007 a,b, 2010) listed several Uropodina records and described a dozen of new species from the different countries of the Balkan peninsula, while Mahunka-Papp (2008, 2010) reported new occurrences and new species of Oribatid mites from the same region. The zerconid mite material was elaborated by Ujvári (2008, 2010 a,b,c, 2011) reporting several new species from the Balkan peninsula.

In 2008, a short expedition was organised to Croatia and Montenegro where soil samples were also collected, most of them in Montenegro and a few in Croatia. One of the Croatian samples contained a remarkable new species possessing several extreme characters similar to that of *Discourella venusta*.

On the basis of these unique characters which characterise the new species herewith described and present also on *Discourella venusta*, I propose to resurrect *Capitodiscus* Vitzthum, 1931 as a valid genus.

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MATERIAL AND METHODS

The single specimen was cleared in lactic acid and was drawn with the aid of a drawing tube. After the investigation the specimen was put in alcohol and deposited in the Hungarian Natural History Museum (Budapest).

Abbreviations used: h1-h4 hypostomal setae, St1-St5 sternal setae. Measurements are given in micrometres (µm), width of idiosoma was taken at level of coxae IV.

TAXONOMY

Capitodiscus Vitzthum, 1931

Discopoma Berlese, 1884: 5 (partim).
Discopoma (Cephalodiscus) Berlese, 1917: 12.
Cephalodiscus: Wiśniewski 1993: 373.
Capitodiscus Vitzthum, 1931: 144.
Discourella venusta-group Hirschmann 1972: 28, Wiśniewski & Hirschmann 1993: 28.

Diagnosis. Idiosoma oval, dorsally domed and strongly sclerotised. Dorsal and marginal shields separated completely, dorsal shield hypertrichous, caudal margin with numerous long and smooth setae. Submarginal shield present and anteriorly fused to dorsal shield, caudally wide and forms a pygidial shield which bearing several long and smooth setae. Genital shield of female linguliform, without anterior process. St1 and St2 marginally pilose. Tritosternum with narrow basis, tritosternal laciniae subdivided into three or four branches. Corniculi smooth, narrow, horn-like. Insertion of corniculi situated below on level of insertion of h2. Hypostomal setae h1 long, h2, h3 and h4 shorter than h1, every hypostomal setae marginally pilose. Epistome long, simple, or apically subdivided into two branches, basally serrate and apically pilose. Chelicerae without internal sclerotised node, digitus fixus and digitus mobilis bearing several large teeth.

Type species. Discopoma venusta Berlese, 1884 = *Capitodiscus venustus* (Berlese, 1884).

Remarks. Insertion of corniculi (situated below level of insertion of h2) and the presence of long setae on pygidial shield are unique peculiarities of the genera *Capitodiscus* and *Hutufeideria* Hirschmann & Hiramatsu, 1977 however, these two genera differ in several ways summarized in table 1.

Systematic position. I consider *Capitodiscus* as a valid, well-defined genus which easy to separate from the other similar genera (Table 1). I provisionally place the genus in the family Uropodidae on the basis of the following characters: absence of internal sclerotized node associated with levator tendon, absence of mushroom- or flower shaped sensory organ of fixed digit of chelicerae, long h1 setae and terminally smooth corniculi (Lindquist *et al.,* 2009). However the members of this family need revision.

Biology. On the basis of the numerous teeth on both digits of chelicerae, the *Capitodiscus* species seem to be carnivorous mites, which feed on other, weakly sclerotized mites, springtails, or other small invertebrates.

Table 1. Distinguishing characters between *Capitodiscus* and *Hutufeideria*

	Capitodiscus	***Hutufeideria***
Chelicerae		
Internal sclerotised node	absent	present
Large teeth on both digits	present	absent
Gnathosoma		
Corniculi	smooth	with one-five teeth
Idiosoma		
Membranous appendage on pygidial shield	absent	present
Submarginal shield	present	absent

Capitodiscus admirandus sp. nov.

(Figs. 1–14)

Material examined. Holotype female. Croatia, Konavli Mts., Ljuta (near Gruda), Ljuta Potok, at the Konavoski dvori watermill, 60 m, in a gallery forest, N42°32.076' E18°22.610' leg. Dányi, L., Fehér, Z., Kontschán, J. & Murányi, D. 07.X. 2008.

Diagnosis. Dorsal and ventral idiosoma covered by oval pits and bearing numerous marginally pilose setae. Surface of sternal shield smooth, with a strongly sclerotized court around genital opening of female. St1–3 marginally pilose, St4–5 smooth.

Female. Length of idiosoma 1120 µm, width 710 µm (n = 1). Shape oval, idiosoma dorsally domed and strongly sclerotized.

Dorsal idiosoma (Fig. 1). Dorsal and marginal shields separated completely. Marginal shield without ornamentation and bearing pilose setae (*ca.* 65–70 µm), except the anterior region which bears three pairs of smooth setae (*ca.* 50 µm) (Fig. 2). Holodorsal shield divided into a dorsal and a submarginal shield, the latter forms the pygidial shield. Submarginal shield smooth, bearing pilose setae (*ca.* 60–70 µm) (Figs 4–5), lateral margin of pygidial shield strongly sclerotised and bearing numerous smooth and long setae (*ca.* 80–90 µm) (Fig. 3). Dorsal shield with several pilose setae (*ca.* 50–55 µm) and covered by oval pits, caudal margin of dorsal shield with several long and smooth setae (*ca.* 80–90 µm). Membranous cuticle situated between dorsal and submarginal shields.

Ventral idiosoma (Fig. 6). Surface of sternal shield smooth, three pairs (St1–3) of pilose (*ca.* 35–45 µm) and two pairs of smooth (St4–5) (c*ca.* 30–40 µm) sternal setae present, St1 placed near anterior margin of sternal shield, St2 on level of anterior margin of genital shield, St3 on level of anterior margin of coxae III, St4 on level of posterior margin of coxae III, St5 near the basal edges of genital shield. Ventral shield covered by oval pits and bearing pilose setae (*ca.* 50–60 µm) (Fig. 7), adanal setae similar in shape and length to ventral setae, postanal setae absent. Near posterior margins of coxae IV one pair of large oval pit present. Genital opening with strongly sclerotised court which possesses an anterior process. Genital shield linguliform, anteriorly curved, its surface without sculptural pattern, but near margins the surface undulate. Stigmata situated between coxae II and III, peritremes not clearly visible. Tritosternum with vase-like basis, laciniae divided into three pilose branches (Fig. 8).

Gnathosoma (Fig. 9). Corniculi smooth, narrow, horn-like. Insertion of corniculi situated below level of insertions of h2. Hypostomal setae h1 long (*ca.* 105–110 µm) marginally serrate, h2 short (*ca.* 40–45 µm), margins with several spines, h3 short (*ca.* 40 µm) and marginally serrate, h4 short (*ca.* 40 µm) and pilose. Epistome not clearly visible. Chelicerae without internal sclerotized node, both digits bearing several large teeth (Fig. 10).

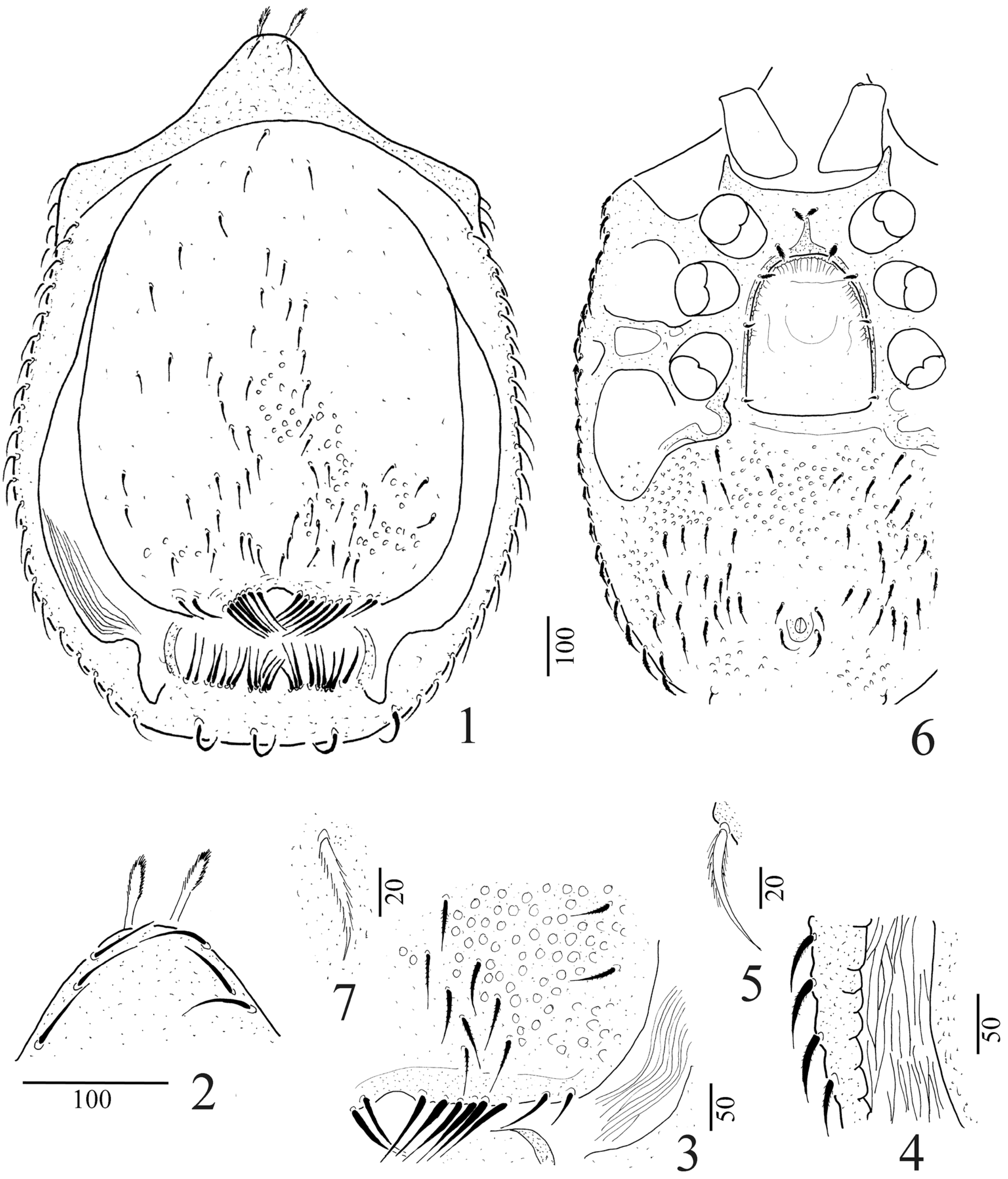
Legs (Figs 11–14). Leg I without ambulacral claws, all of legs with smooth and pilose setae.

Etymology. The name of the new species refers to the Latin word “admirandus” means admirable in English. The discovery of the second species of this genus was really admirable.

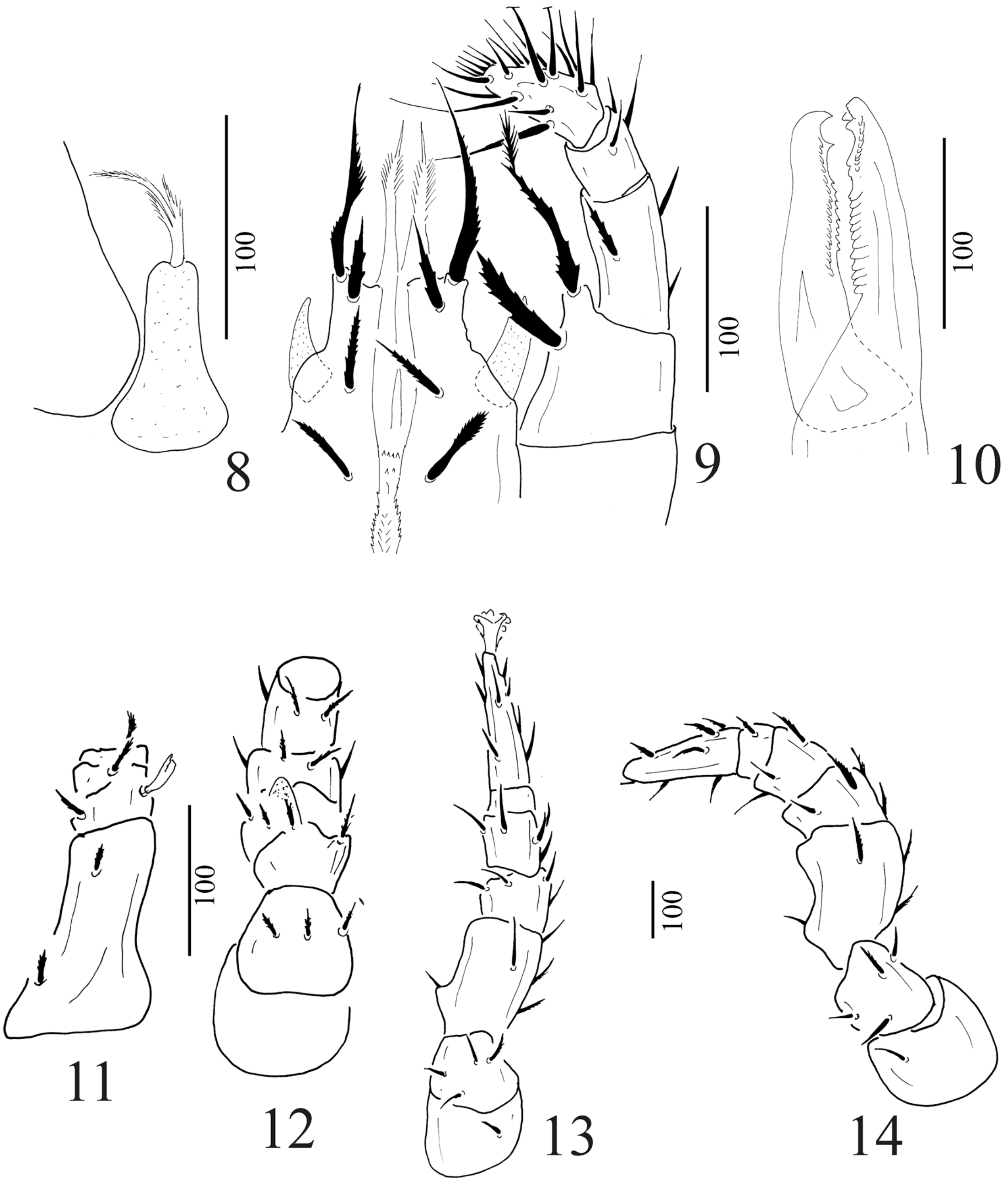
Remarks. The new species is easy to distinguish from *C. venustus* by the strongly sclerotized court around the genital opening which is missing in the latter species. Moreover, St1 and St2 are situated in the central region of the sternal shield in the new species. In contrary, these two sternal setae are placed near to the lateral margins of the sternal shield in *C. venustus*. The idiosoma is covered by irregular pits in the known species but the new species possesses oval pits on its body surfaces.

DISCUSSION

The extreme position of corniculi on the gnathosoma and the presence of long setae on the pygidial shield are synapomorphic characters



Figures 1–6. *Capitodiscus admirandus* sp. nov. 1 = dorsal view, 2 = apical region, 3 = caudal area of dorsal shield, 4 = margins of idiosoma, 5 = marginal seta, 6 = ventral view, 7 = ventral seta



Figures 8–14. *Capitodiscus admirandus* sp. nov. 8 = tritosternum, 9 = ventral view of gnathosoma and palp, 10 = chelicerae, 11 = first segments of leg I, 12 = leg II, 13 = leg III, 14 = leg IV (ambulacrum not illustrated)

states, which can only be found on these two species. These characters are missing from the other species of the former *venusta* species-group (*D. salignifolia* Hirschmann, 1972) hence this species remains in the genus *Discourella* but without an exact species group position. *Capitodiscus* is similar to the genus *Hutufeideria*, however this similarity can be result of convergent evolution, because the genus *Hutufeideria* belongs to the family Dinychidae (Lindquist *et al.,* 2009) which is characterized by the presence of internal sclerotized node on chelicerae. However, the internal sclerotized node is missing in *Capitodiscus* species therefore according to the present classification it belongs to the family Uropodidae.

The two *Capitodiscus* species occur in the Mediterranean region of Europe (Italy and Croatia). According to my supposition, other unknown species may inhabit this region as well; however these species seem to be very rare. Intensive collecting work need to be carried out in other regions of Southern Europe to find more species of this genus.

Acknowledgements – This research was supported by the Hungarian Scientific Research Fund (OTKA 72744).

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Opusc. Zool. Budapest, 2011, 42(1): 43–66

New and little known oribatid mites from Madagascar (Acari: Oribatida), III

S. Mahunka[1]

Abstract. Further survey of the newly studied and identified oribatids from Madagascar (Malagasy Republic) is given. Altogether 20 species are mentioned and listed from several sites in the island, 13 species of them are new to science and some other known only from few localities. Two species are recorded from Madagascar for the first time. With 50 figures.

Keywords. Taxonomy, moss mites, new species, new data, Malagasy Republic.

INTRODUCTION

In a series of papers I have been elaborating the oribatids of Madagascar (Mahunka, 2009a, b, c, 2010, 2011). I identified, described and discussed earlier numerous oribatid species deriving from different parts of the island. This part comprises mainly the species which were collected in Antsiranana and Toamasina Provinces by Dr. Tamás Pócs and in the Vohimana Reserve by Dr. Csaba Csuzdi. In this part I have also elaborated some small samples, which were acquired from the Balogh Collection. Some of them were poorly provided with exact data however, they contained several very interesting new species. Therefore their elaboration was justified (e.g. *Triteremella simpliseta* and *Peloribates* (*Peloribatodes*) *incompatibilis* spp. nov.).

In this part I give a list containing 20 species belonging to different oribatid families. Of them, 13 species are new to science: *Eohypochthonius robustus, Mesoplophora* (*M.*) *similis, Microtegeus zigzag, Schalleriella phaseola, Gustavia ornata, G. sineornata, Austrocarabodes semilunatus, Triteremella simpliseta, Eupelops costulatus, Oripoda attenuata, Chaunoproctus semirugosus, Peloribates* (*Peloribatodes*) *incompatibilis* and *Pergalumna nasifera* spp. nov., and some other rare or little known species, which are simultaneously new records for Madagascar (e.g. *Eremella induta* Berlese, 1913 and *Scheloribates mahnerti* Mahunka, 2008).

In this paper, as in the earlier ones, I follow the system of Norton & Behan-Pelletier (2009), Subías (2004, 2011) and besides I also use some works which were mentioned in my work on this theme (Mahunka, 2010). As is the earlier descriptions the morphological terminology follows Norton & Behan-Pelletier and other listed authors (e.g. Niedbala, 2001, 2004, 2008; Weigmann, 2006; Woas, 2002) in my previous publications.

Depositories. The material examined is deposited in the Hungarian Natural History Museum, Budapest (HNHM), and some paratypes and voucher specimens in the Muséum d'histoire naturelle de Genève (MHNG).

LOCALITIES

Afr–311: Madagascar, Ranomafana, E from Fianarautsaa, soil samples from litter of tropical rain forest, 24-26. September 1979. Leg. D. Balázs.

Afr–842: Madagascar, Andasibe (Perinet) Forest Reserve. Montane rainforest, 500 m E of the railway station on W slope of ridge near the aerial. 960 m. Coll. T. Pócs. 17 Narch 1990. (no. 90108).

Afr–872: Madagascar, Mont Papango, prés de Befolaka, III. 1959. Leg. AR.

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

Afr–921: Madagascar, Toamasina Province, Mananara Nord Biosphere Reserve and National Park. Lowland rainforest on the E slopes of Mahavoho Hill (very wet types along

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Manahovo River, with many tree ferns, palms and Pandanus ssp., less humid on slopes) at 220-300 m alt. 16°27'S, 49°46.9-47.5'E. Date: 14-15, Aug. 1998. Leg. T. Pócs. (No. 9878).

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 Nat. Park and the Antananarivo Toamasina road, 2 km W of Anevoka village, at 1080-1214 m alt. 18°57.8'S, 48°27.5'E. Date: 26. August 1998. Leg. T. Pócs (No. 9890).

Afr–996: Madagascar, Vohimana reserve, primary forest. 17. 04. 2008. Leg. Cs. Csuzdi.

Afr–JB1: Madagascar, Peyrieras, Causse de Kelifelly. Forest humus and litter fom dry forest. 20-30. 11. 1974. Leg. D. Smith.

Afr–JB2: Madagascar, Mangabé Island, Antongie Bay. Primary rain forest, rotten wood. 19. February, 1977. Leg. WL & DL Brown.

Afr–JB3: Madagascar, Andasibe (Perinet). February 1977. Leg. WL Bown.

LIST OF THE NEWLY IDENTIFIED SPECIES

HYPOCHTHONIIDAE Berlese, 1910

Eohypochthonius robustus sp. nov.

MESOPLOPHORIDAE Ewing, 1917

Mesoplophora (Mesoplophora) similis sp. nov.

LOHMANNIIDAE Berlese, 1916

Paulianacarus nodosus Balogh, 1961
Locality: Af –JB3.

MICROTEGEIDAE Balogh, 1972

Microtegeus zigzag sp. nov.

MICROZETIDAE Grandjean, 1936

Schalleriella phaseola sp. nov.

DAMAEOLIDAE Grandjean, 1936

Fosseremus quadripertitus (Paoli, 1908)
Locality: Afr–JB2, First record for Madagascar.

GUSTAVIIDAE Oudemans, 1900

Gustavia ornata sp. nov.
Gustavia sineornata sp. nov.

CARABODIDAE C. L. Koch, 1835

Austrocarabodes semilunatus sp. nov.

OPPIIDAE Sellnick, 1937
Lanceoppia madagascarensis Mahunka, 2002
Locality: Afr–917
Oppiella nova (Oudemans, 1902)
Localities: Afr–917, Afr–JB3.
Oxyoppiella punctulata Mahunka, 1997
Locality: Afr–917

EREMELLIDAE Balogh, 1961

Eremella induta Berlese, 1913
Locality: Afr–917. First record for Madagascar.
Tritoremella simpliseta sp. nov.

PHENOPLELOPIDAE Petrunkevich, 1955

Eupelops costulatus sp. nov.

ORIPODIDAE Jacot, 1925

Oripoda attenuata sp. nov.

CALOPPIIDAE Balogh, 1961

Chaunoproctus semirugosus sp. nov.

SCHELORIBATIDAE Jacot, 1935

Scheloribates mahnerti Mahunka, 2008
Locality: Afr–JB2. First record for Madagascar.

HAPLOZETIDAE Grandjean, 1936

Peloribates (*Peloribatodes*) *incompatibilis* subgen. nov., sp. nov.

GALUMNIDAE Jacot, 1925

Pergalumna nasifera sp. nov.

DESCRIPTIONS

Eohypochthonius robustus **sp. nov.**

(Figures 1a–d)

Diagnosis. Rostrum elongate, rounded. Rostral setae setiform, lamellar setae phylliform, directed backwards, interlamellar setae spun-shaped, their peduncle conspicuously long, directed backwards. All setae smooth, surface of exobothridial region distinctly punctuate and/or foveolate. Notogastral setae – except setae *e* in the scissure – phylliform, robust. Surface of notogaster with irregular pattern. The number and form of the setae in the genitoanal region are typical for this genus.

Material examined. Holotype: Madagascar, Ranomafana, E from Fianarautsaa, 24–26. September 1979. Leg. D. Balázs. (Afr–311). 2 paratypes from the same sample. Holotype (1818-HO-11) and 1 paratype (1818-PO-11) are deposited in the HNHM, 1 paratype in MHNG.

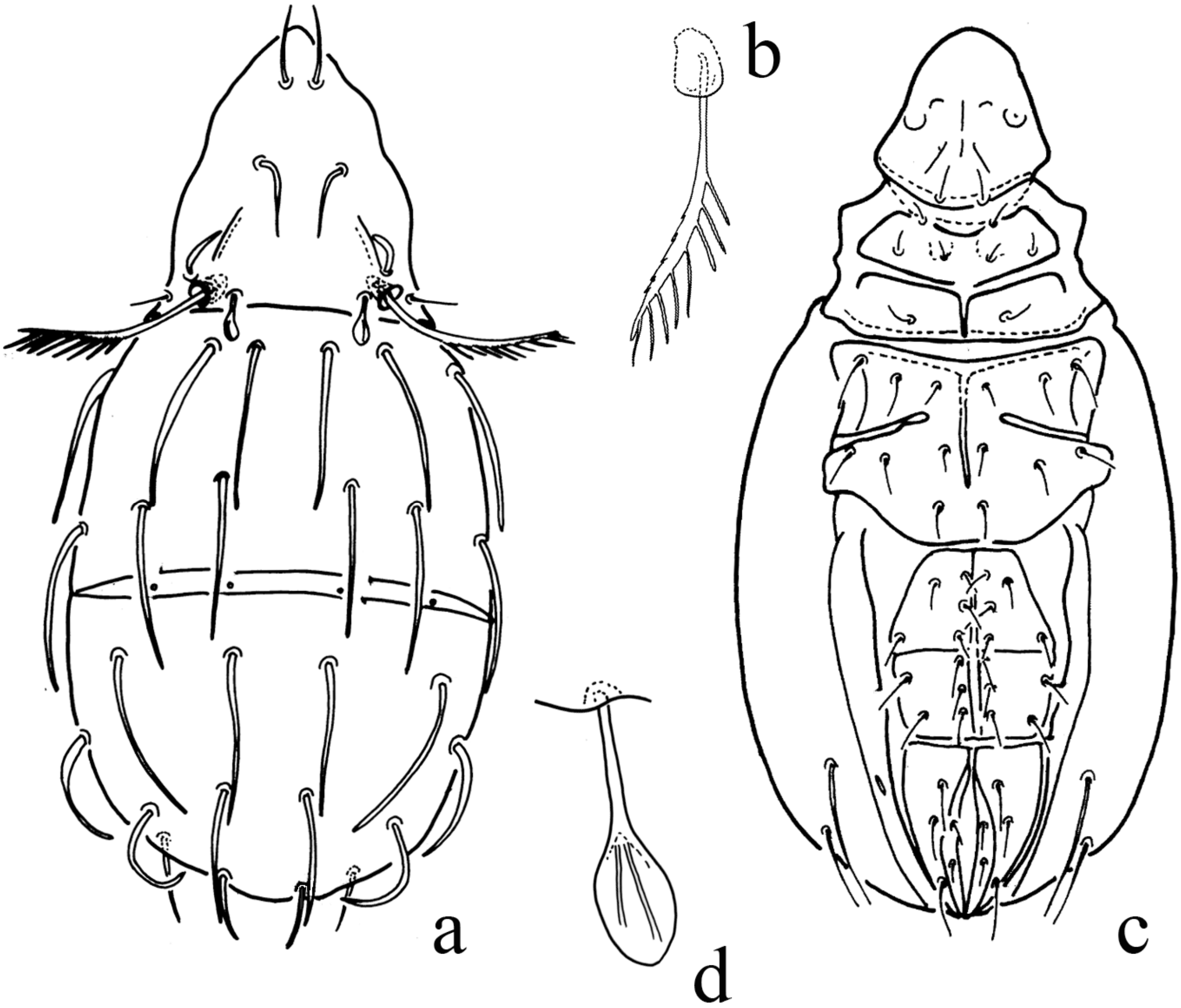

Figure 1. *Eohypochthonius robustus* sp. nov. a: body in dorsal view, b: sensillus, c: body in ventral view, d: interlamellar seta

Measurements. Length of body: 316–327 μm, width of body: 158–164 μm.

Prodorsum. Rostral apex rounded. Prodorsal setae varying, rostral setae setiform, lamellar setae phylliform, interlamellar setae spoon-shaped, strongly broadened, anterior exobothridial setae short, distinctly dilate, posterior exobothridial setae thin, simple, setiform. Peduncle of interlamellar setae conspicuously long, reaching over anterior margin of notogaster. Characteristic prodorsal surface pattern consists of small fveolae and ribs. Sensillus pectinate, with 9-10 obtuse branches.

Notogaster. Whole surface distinctly punctuate, some weak ribs also observable. Notogastral setae except setae *e* long, phylliform, sometimes broadened distally. Their median vein is well observable. Setae f_1 much longer than the distance between the insertion of setae f_1 and h_1.

Ventral parts. Whole surface with similar pattern as the dorsal surface. All setae very thin, simple.

Remarks. The new species is well characterised by the form of the interlamellar setae, by the robust, and long notogastral setae, and by the distinctly punctuate and foveolate surface. The form of the interlamellar setae is unique in this genus, otherwise the new species is closest to *Eohypochthonius salicifolius* Hammer, 1980 and *E.*

magnus Aoki, 1977. However, the form of the interlamellar setae in both earlier described species completely differs from the new one.

Etymology. Name refers the long and broadened notogastral setae.

Mesoplophora (Mesoplophora) similis sp. nov.

(Figures 2a–d)

Diagnosis. Whole body surface well punctuate. Prodorsum with lateral carinae, all prodorsal setae smooth. Sensillus strong, setiform, with 12–14 long cilia. Hysterosoma with undulate and lineate posterolateral margin bearing 8 pair of long, distinctly smooth setae. Among them setae *c* much thinner than setae *e*. Seven pairs (with 1+6 position) of genital setae, one pair of minute aggenital, two pairs of genital and 9 pairs of "adanal" setae on the "ventral plate" are present. All setae smooth.

Material examined: Holotype Madagascar, Andasibe (Perinet) Forest Reserve. 17 March, 1990. Coll. T. Pócs (90108) (Afr-842). 4 paratypes from the same sample. Holotype (1819-HO-11) and 3 paratypes (1819-PO-11) deposited in the HNHM, 1 paratype in MHNG.

Measurements. Length of prodorsum: 216–237 µm, length of hysterosoma: 208–310 µm, height of notogaster: 216–227 µm.

Prodorsum. Rostrum pointed, prodorsal surface well punctuate, its posterior margin lineate. All prodorsal setae – except exobothridial one – well developed, rostral setae shorter than lamellar and interlamellar setae. All setae entirely smooth. Sensillus setiform, directed backwards, thicker than the prodorsal setae and bearing 12–14 long cilia. They are distinctly longer than the diameter of sensillus.

Lateral part of podosoma. Lateral carinae fine, hardly observable, running from the posterior border of prodorsum to the lateral rim.

Hysterosoma. Conspicuously rounded. Lateral and posterior margin undulate and finely lineate or striate. This part with eight pairs of setae, varying in form and length. All setae smooth. Setae $c_1 – c_3$ much thinner than the posterior ones, especially setae e_1 and e_2 distinctly thicker than the anterior setae. Setae c_1 (50 µm) distinctly shorter than c_2 (72 µm) or c_3 (65 µm).

Ventral parts. Genital plates with 7 (1+6) pairs of setae, 3 pairs in anterior position longer than the remaining 4 posterior pairs. Anal plates with 2 pairs of setae, anterior ones much shorter than posterior setae. One pair of minute aggenital setae, arising far anteriorly. Ventral plate with 9 pairs of setae with different length, all smooth, without any cilia.

Remarks. There are only two species of *Mesoplophora (Mesoplophora)* group known from the Ethiopian Region (Niedbała, 2001). None of them were collected from Madagascar. This new species is closely related to both Ethiopian species but differs from *M.* (*M.*) *africana* Balogh, 1958 in the entirely smooth setae on the whole body and in the ratio of hysterosomatal setae, and furthermore differs from *M.* (*M.*) *invisitata* Niedbała, 1983 by the presence of aggenital setae, the form of the long lateral carinae and the much longer cilia on the sensillus.

Etymology. The species name refers to the close relationships of the other Ethiopian species.

Microtegeus zigzag sp. nov.

(Figures 3a–c)

Diagnosis. Body surface covered by irregular, mostly granulate cerotegument. Rostral apex narrow, elongated, reaching over the widely rounded lamellar cusps. Rostral setae arising near to rostral apices, on the lamellar surface. Interlamellar setae minute, behind them a pair of S-shaped ribs is observable. Sensillus very large, its head with speculate surface. Humeral process well observable. Notogastral surface undulate, with a granulate apostolic-cross-shape formation. Ten pairs of simple notogastral setae present. Epimeral region well sclerotised, apodemes and epimeral borders well observable, their margin mostly zigzag shape. A pair of well developed apophysis is present in aggenital position. Epimeral setal formula: 3 – 1 – 3 – 3. Genitoanal setal formula: 5 – 1 – 2 – 3.

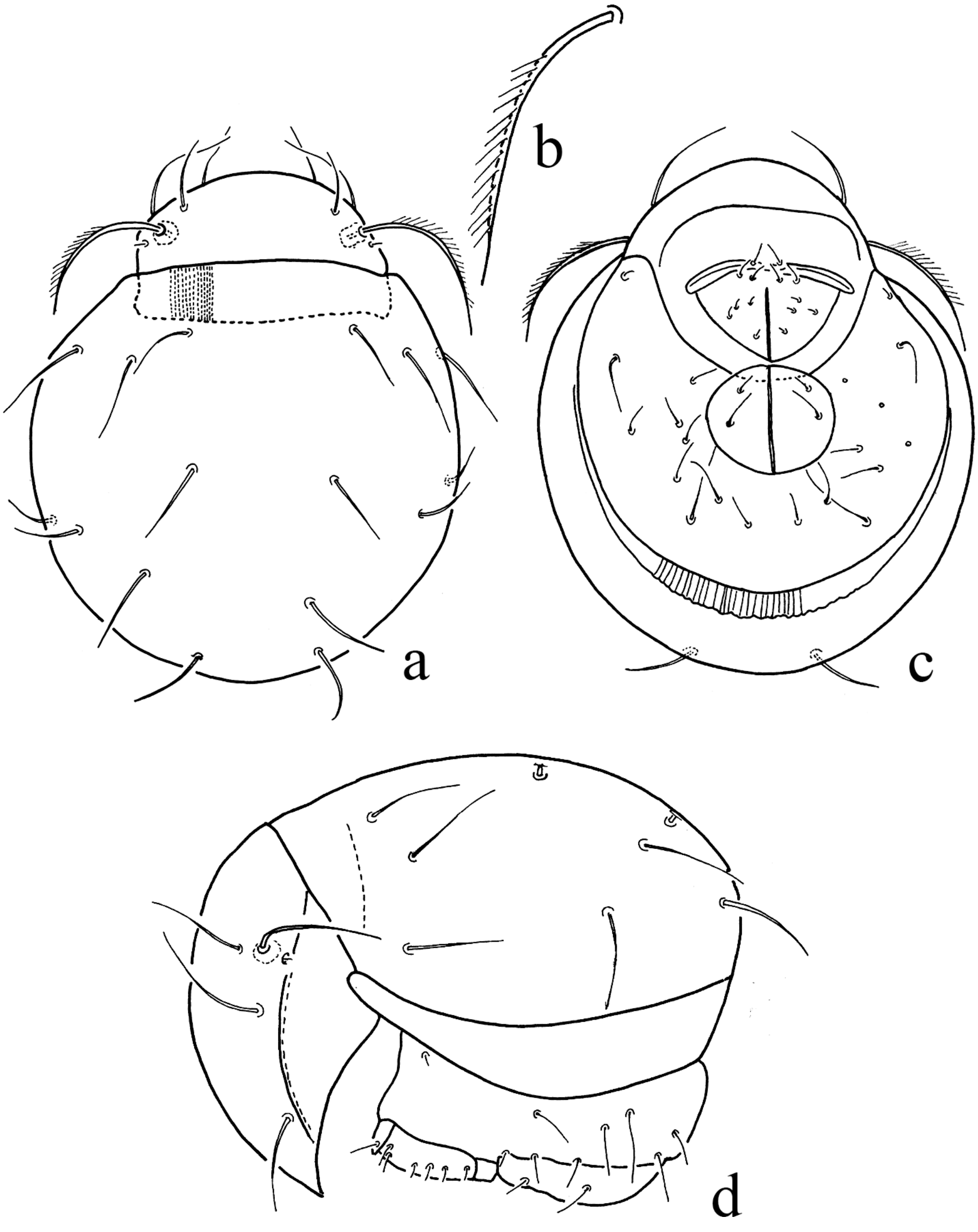

Figure 2. *Mesopolophora* (*Mesoplophora*) *similis* sp. n. a: body in dorsal view, b: sensillus, c: body in ventral view, d: body in lateral view

Material examined. Holotype: Madagascar, Andasibe (=Périnet) Province. February 1977. Leg. W. L. Brown, 1 paratype from the same sample. Holotype (1820-HO-11) deposited in the HNHM, 1 paratype in MHNG.

Measurements. Length of body: 496–561 µm, width of body: 250–278 µm.

Prodorsum. Rostrum elongated, rostral setae arising far from the rostral apex, on lateral side of prodorsum, slightly arched inwards. Lamellae wide, rounded distally, with a nearly triangular apophysis on their basal part, directed medially. Lamellar setae much longer and thicker than rostral setae. Interlamellar surface finely granulate, with a pair of drop shaped tubercle basally. Interlamellar setae very short and thin or only their alveoli observable. Peduncle of sensillus short, its head conspicuously large, with rounded, undulate, pellicular margin.

Notogaster. Anterior margin of notogaster slightly excavate medially. Humeral process well observable, their margins granulate. Notogastral surface with two pairs of short transversal crests anteriorly (apostolic cross-shaped), and the whole surface undulate, divided by a double dagger shape formation, this part granulate, other surface nearly smooth. Ten pairs of short, thin notogastral setae present.

Lateral part of podosoma. Pedotecta I small, behind it a polygonal surface visible. Undulate notogastral surface well observable in lateral view.

Ventral parts. Epimeral region well chitinised, all epimeral borders and apodemes well visible, epimeres well separated from each other. *Ap. 3* not touching medially, sternal one also divided in two parts in this region. All epimeral borders characteristically zigzag-shaped. All epimeral setae minute. Pedotecta II-III bifurcate, discidium small, like tubercle. Posterior margin of epimeral region with large apophysis (S_4) in opposite position. The posterior part of apophysis continuing long crest directed backwards. Surface of ventral plate well granulate. Genitoanal setal formula 5 – 1 – 2 – 3. No setae in preanal position, lyrifissures *iad* in direct adanal position.

Remarks. The new species belongs to the group of species which are well characterised by the 5 pairs of genital setae. On the basis of the undulate notogastral surface the new species resembles *Microtegeus undulatus* (Berlese, 1916) (Hammer 1977), however, the forms of the other sculpture of the notogaster and prodorsum are clearly different.

Etymology. The species name refers to the peculiar epimeral borders, which are characteristically zigzag-shaped.

***Schalleriella phaseola* sp. nov.**

(Figures 4a–c)

Diagnosis. Rostrum wide, with distinct conical apex, which is beak-shaped in lateral view. Lamellae truncate, with minute apices on their inner and outer anterior margin. They not touching medially, a narrow translamella located near to basal part. A pair of bean-pod-shaped appendages present between the lamellae anteriorly. Rostral setae thick, lamellar, and interlamellar setae short, simple, last ones arising on the lamellar surface. Sensillus long, setiform, directed forward, bearing long cilia. Notogastral surface with characteristic pattern of cerotegument. Pteromorpha with 2–3 minute teeth. All notogastral setae short, thin. Coxisternal region with U-shaped borders (*bo. 2* and *bo. sej.*) anteriorly and a very wide transversal one posteriorly. All epimeral setae minute or very short, setae in ventral region also short.

Material examined. Holotype: Madagascar, Vohimana reserve. 7. 04. 2008. Leg. Cs. Csuzdi (Afr–996). Holotype (1821-HO-11) deposited in the HNHM.

Measurements. Length of body: 210 μm, width of body: 157 μm.

Prodorsum. Prodorsum wide, truncate, with a distinct median apex. Lamellae also wide, but not touching medially, therefore median part of prodorsum not covered by them. Inner margin of lamellae dilated medially, a narrow translamella also observable. Apical part of lamellae bearing 2–3 minute teeth on their inner or outer margin, lamellar setae arising also on anterior margin. Rostral setae thick, all others prodorsal setae thin, simple, setiform. Interlamellar setae arising on the basal surface of lamellae comparatively near to notogastral margin. Sensillus long, thin setiform, directed forwards, well ciliate mostly in its outer margin.

Notogaster. Wide, its anterior margin convex, complete medially. A pair of distinct hollows observable in latero-marginal position. Pteromorpha comparatively small, its surface ornamented by some longitudinal and transversal lines. Anterolateral margin with some teeth. Notogastral surface ornamented with a characteristic pattern consists from cerotegument granules. Nine pairs of short and fine notogastral setae present.

Lateral part of podosoma. Tutorium wide, triangular. Pedotecta I large, with striate dorsal margin. Pleural carina well developed, this region distinctly granulate. Circumpedal carina not reaching to the margin of ventral plate.

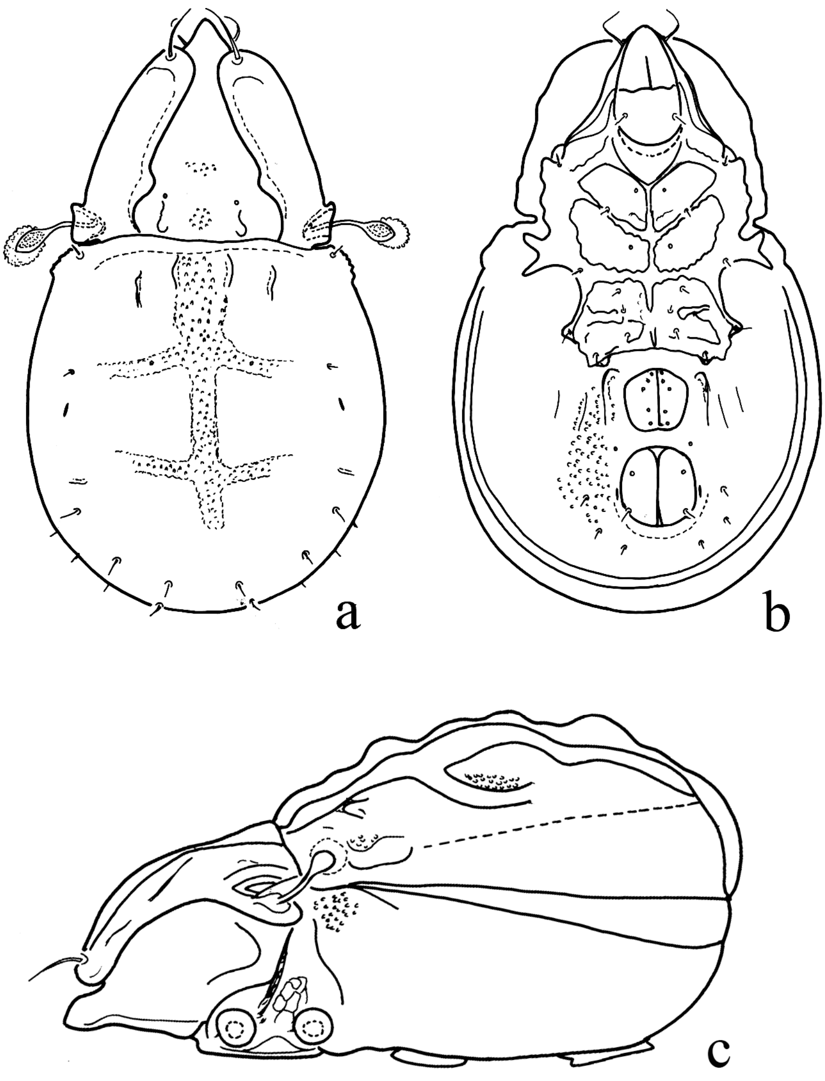

Figure 3. *Microtegeus zigzag* sp. nov. a: body in dorsal view, b: body in ventral view, c: body in lateral view

Ventral parts. Setae *h* arising very near to each other, near to the anterior margin of mentum. Apodemes and epimeral borders – except the short U-shaped (*bo. 2* and *bo. sej.*) epimeral borders and the broad band in front of genital aperture (*bo. 4*) – weakly developed. All epimeral setae short or minute, sometimes only their insertion visible. Some granules present on the surface of *bo. 4*. All other ventral surface smooth. Genital and anal aperture framed by weak lines. Genito-anal setal formula: 6 – 1 – 2 – 3. Genital setae longer than the others.

Legs. All legs monodactylous.

Remarks. The new species is well characterised by the robust rostral setae and the phaseolus-shaped interlamellar appendage. These features were previously not known in this genus.

Etymology. Named after the presence of bean pod-shaped appendage of the prodorsum.

Gustavia ornata **sp. nov.**

(Figures 5a–g)

Diagnosis. Whole surface of body ornamented by foveolae and ribs. Rostrum simple. Lamella well developed, with long cusp laterally, continu-

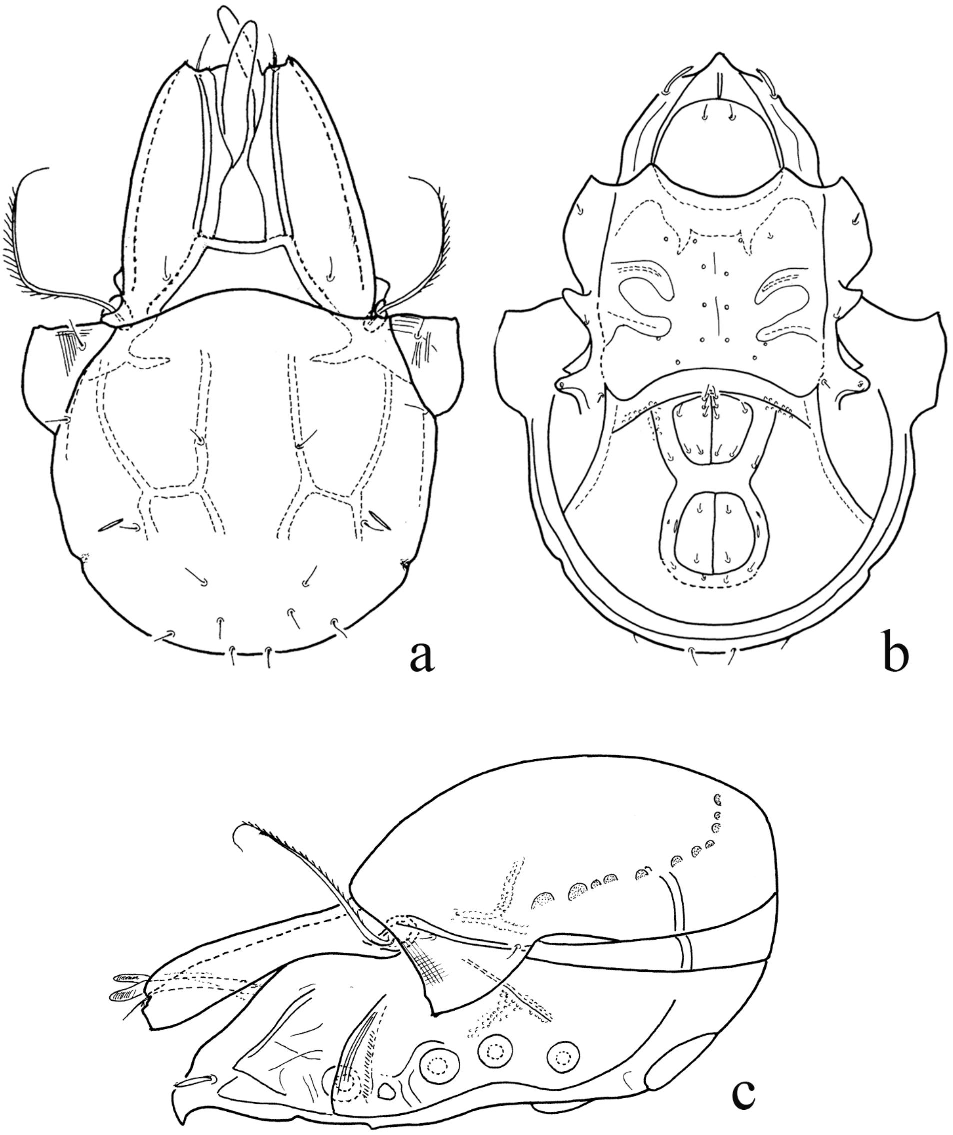

Figure 4. *Schalleriella phaseola* sp. nov. a: body in dorsal view, b: body in ventral view, c: body in lateral view

ing in prolamella with strong apex, bearing rostral seta. Tutorium present, its cusp well observable. Interlamellar setae long, bothridium opened laterally, sensillus long, with dilated head, with some short spines unilaterally. Dorsosejugal scissure absent. Seven pairs of setal alveoli and three pairs of setae present on notogaster, all hardly observable. Heart-shaped epimeral formation in the sternal region and two pairs of strong *ap. 2* and *ap. sej.* and two pairs of weak apodemes present. Circumpedal carina narrow, short, directed medially. Six pairs of genital setae, lyrifissures *iad* located far anteriorly. All legs tridactylous.

Material examined. Holotype: Madagascar, Toamasina Province. Maromizaha forest. 26. August 1998. Coll. T. Pócs (No. 9890). Holotype (1822-HO-11) deposited in the HNHM.

Measurements. Length of body: 507 µm, width of body: 392 µm.

Prodorsum. Rostrum simple covered by the prolamellae, which connected with the lamellae, ending in large, wide, spiniform cusps bearing the short and erect rostral setae. A fine transversal line (translamella?) between them also present.

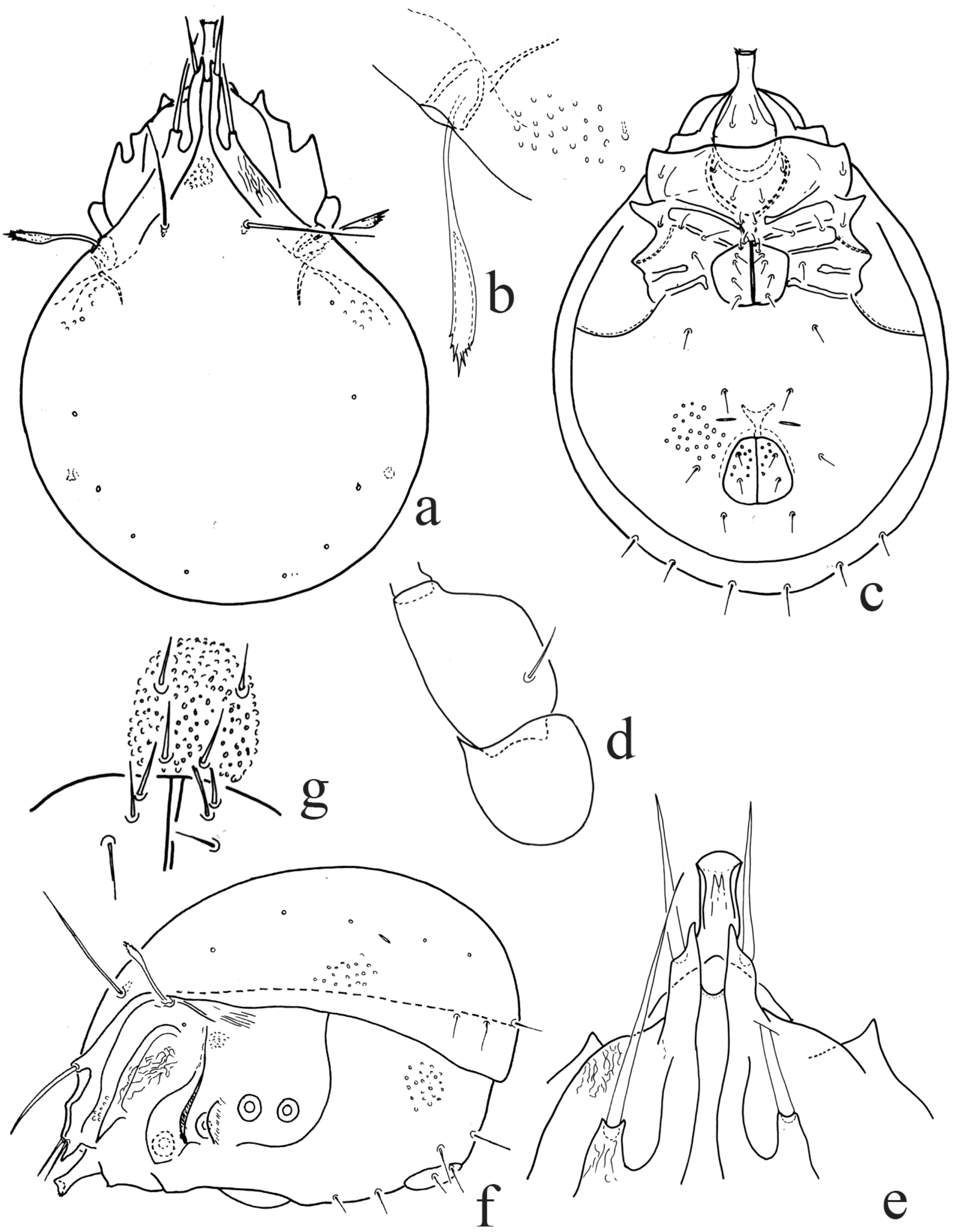

Figure 5. *Gustavia ornata* sp. nov. a: body in dorsal view, b: sensillus, c: body in ventral view, d: trochanter of leg IV, e: rostral region, f: body in lateral view, g: epimeral surface in front of genital aperture

Lamellar cusps short, well separated from the lamellae, with distinct ornamentation consists from fine ribs and rugae. Lamellar setae long, setiform, reaching far over the rostrum. Interlamellar setae longest of all prodorsal setae. Sensillus directed outwards, with long peduncle and well separate head bearing some short spines at its distal end.

Notogaster. Dorsosejugal scissure absent. Ten pairs of notogastral setae, 7 dorsal pairs represent only by their alveoli, 3 pairs in posteromarginal position comparatively long, but well observable only in ventral view. Setae p_1 much longer than other two posteromarginal setae. All notogastral features hardly visible on account of the ornamentation.

Lateral part of podosoma. Tutorium long, curved basally, with long, blunt distal cusp. Pedotectum I large, Pedotectum II scale-shaped. Surface of the lateral region partly rugose, partly foveolate-punctate.

Ventral parts. Subcapitulum diarthric, with well developed characteristic rutellar tube. Surface of the mentum with some foveolae. Setae *h* arising near to each other. Epimeral region well sclerotised, its surface except for a small field in front of genial aperture smooth. Anteromedian epimeral formation heart-shaped. Apodemes *3* and *ap. 4* shorter than the others, sejugal apodemes and apodemes *2* reaching to genital aperture. Discidium and circumpedal carina weakly developed, latter reaching to the lateral margin of ventral plate, directed medially. Surface of ventral and anal plate distinctly foveolate, genital plate smooth. Genitoanal setal formula: 6 – 1 – 2 – 3. Genital setae arranged in parallel longitudinal rows, setae g_1 the longest, g_6 the shortest of all. Among the adanal setae ad_3 located far anteriorly, in front of the lyrifissures *iad*. Setae ad_1 located in postanal position.

Legs. All legs tridactylous and heterodactylous. Femora of legs II-IV with blade like formation ventrally, trochanter II and IV with sharply pointed dorsal spur.

Remarks. The new species is characterised by the well ornamented dorsal and ventral surface, and by the form of lamellae and prolamellae. Both features are unique in the genus and well distinguish the new species from all heretofore known *Gustavia* Kramer, 1877 species.

Etymology. The species name refers to the sculpture consisting of different type of foveolae on the body surface.

Gustavia sineornata sp. nov.

(Figures 6a–d)

Diagnosis. Whole body surface smooth. Rostrum simple. Lamellae well developed. Lamellar cusp long, located laterally, its inner part continuing with long prolamella, with long apex, bearing rostral setae. Lamellar cusp bearing longer lamellar setae. Tutorium present, its cusps well observable. Interlamellar setae long, bothridium opened laterally, sensillus long, with slightly dilated, narrow head, ending in conspicuously long, distal setiform spines. Dorsosejugal scissure absent. Nine pairs of setal alveoli and one pair of setae present on notogaster. Gnathosoma typical for the family. Apodemes and epimeral borders weakly developed, *ap. 2* and *ap. sej.* stronger than the others. Circumpedal carina narrow, directed medially. Six pairs of genital setae, lyrifissures *iad* and setae ad_1 located far anteriorly from the anal aperture. All legs tridactylous.

Material examined. Holotype: Madagascar, Peyrieras, Causse de Kelifelly. 20–30. 11. 1974. Leg. D. Smith. Holotype (1823-HO-11) deposited in the HNHM.

Measurements. Length of body: 507 µm, width of body: 392 µm.

Prodorsum. Rostrum simple. Lamellae well developed, lamellar cusp located laterally, bearing long lamellar seta. It is connected with the prolamellae, ending in large, wide, spiniform cusps, bearing the short and erect rostral setae. A fine transversal line (translamella?) between them also present. Lamellar setae long, setiform. Sensillus directed outwards, with long peduncle, narrow head with 2–3 short bristles and ending in a very long, setiform distal part.

Notogaster. Dorsosejugal scissure absent. Ten pairs of notogastral setae, 9 dorsal pairs represent only by their alveoli, 1 pair in posteromarginal position comparatively long, but well observable only in ventral view. Setae p_2 and p_3 represented only by their insertion.

Lateral part of podosoma. Tutorium long, curved basally, with long, distal cusp. Pedotectum I large, Pedotectum II scale-shaped.

Ventral parts. Epimeral region well sclerotised. Apodemes 3 and *ap. sej.* long, touching medially or reaching to the genital aperture. Circumpedal carina present, weakly developed,

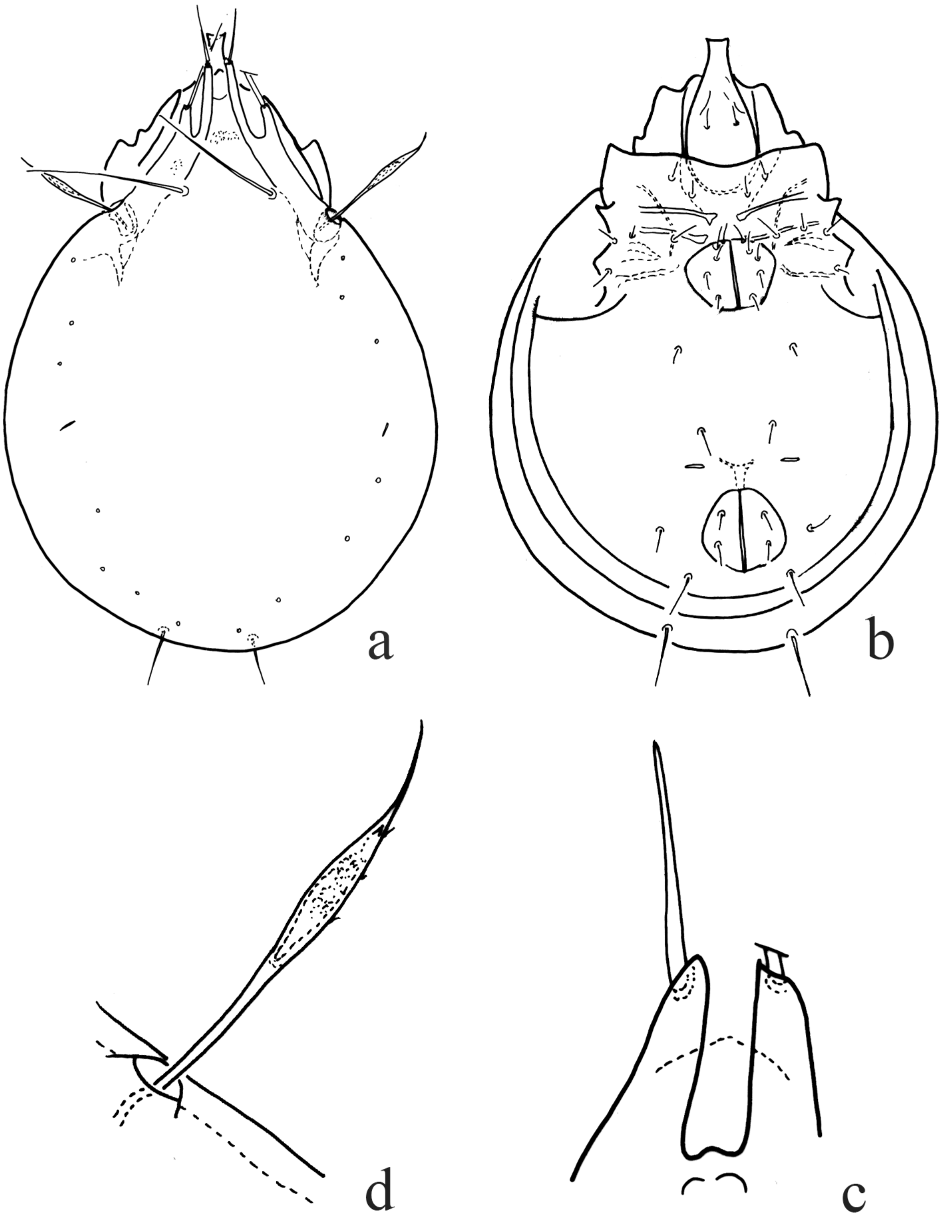

Figure 6. *Gustavia sineornata* sp. nov. a: body in dorsal view, b: body in ventral view, c: lamellar cusp, d: sensillus

reaching to the lateral margin of ventral plate, medially not connecting with discidium. Surface of ventral, genital and anal plate smooth. Genito-anal setal formula: 6 – 1 – 2 – 3. Genital setae arranged in parallel longitudinal rows, setae g_1 the longest, g_6 the shortest of all. Among the adanal setae ad_3 located far anteriorly, in front of lyrifissures *iad*. Setae ad_1 located in postanal position, much longer than setae ad_2, setae ad_3 shortest of them.

Legs. All legs tridactylous and heterodactylous. Femora of legs II–IV with blade like formation ventrally, trochanter II and IV with sharply pointed dorsal spur.

Remarks. The new species is well characterised by the shape of lamellae and prolamellae and furthermore by the sensillus. These characteristic shapes are rare in this genus and their combination distinguishes well the new species from all heretofore known *Gustavia* Kramer, 1877 species. See also the preceding new species.

Etymology. The species name refers to similarities with the preceding newly described species.

Austrocarabodes semilunatus sp. nov.

(Figures 7a–d)

Diagnosis. Rostrum wide, rounded. Lamellae and translamella well developed. Rostral setae antlers-shaped, lamellar setae nearly bacilliform, with blunt distal end, arising medially on the translamella. Interlamellar setae inserted on the weakly foveolate interlamellar surface, directed outwards, phylliform. Basal part of this region with a semilunar-shaped depression medially. Sensillus long, setiform, with recurved distal end, slightly dilated medially. Median part of notogastral tectum undulate, a small humeral process observable. Notogastral surface irregularly alveolate. Fourteen pairs of phylliform notogastral setae, 4 posterolateral pairs of them smaller than setae in anteromedian position. Epimeral and ventral plate well sculptured, all epimeres and epimeral borders observable. All setae in ventral parts – except adanal ones – simple, thin and setiform. Adanal setae slightly dilated basally. Genitoanal setal formula: 4 – 1 – 2 – 3.

Material examined. Holotype: Madagascar, Peyrieras, Causse de Kelifelly. 20–30. 11. 1974. Leg. D. Smith. 2 paratypes from the same sample. Holotype (1824-HO-11) and 1 paratype (1824-PO-2011) deposited in the HNHM, 1 paratype in the MHNG.

Measurements. Length of body: 408–490 μm, width of body: 228–300 μm.

Prodorsum. Surface of lamella finely punctuate, interlamellar surface mostly smooth, some ribs present in its basal part. A semilunar depression present medially, in front of the notogastral margin. Lamellae long with blunt apex, rostral setae directed inwards, antler-shaped. Translamella well developed, bearing lamellar setae arising on tubercle originating in translamella. Interlamellar setae phylliform. Shorter than lamellar setae, directed outwards. Sensillus long, strongly recurving, well barbed.

Notogaster. Dorsosejugal tectum of notogaster distinctly undulate, medially strongly convex. Well protruding angular humeral process present. Notogastral surface irregularly foveolate. Notogastral setae short, phylliform, with well developed median veil. Their surface distinctly barbed. Median setae nearly equal in length and shape, four posteromarginal setae smaller than others.

Lateral part of podosoma. Tutorium well observable, without true apex. Strongly curved, its dorsal margin undulate. Pedotectum I very large, acetabulum of leg I completely covered.

Ventral parts. Epimeral and ventral region well sclerotised, all apodemes and epimeral borders well visible. Median border of epimeres I characteristically curved, between sejugal apodemes a triangular spot observable medially. *Bo. 4.* convex, very wide, continuing posteriorly in wide crests. Ventral plate bearing also some large curved crests, especially strong rib present in front of the anal aperture. Epimeral setae varying in length, setae *1a*, *1c*, *2a* and *3a* short, all others much longer. Genitoanal setal formula: 4 – 1 – 2 – 3. Adanal setae slightly broadened basally.

Legs. Femora of leg III and IV with broad ventral keel.

Remarks. The new species is well characterised by the undulate anterior notogastral tectum and the characteristic semilunar feature. These features are unique in the genus *Austrocarabodes* Hammer, 1966.

Etymology. Named after the characteristic depression on the basal part of the prodorsum.

Trireremella simpliseta sp. nov.

(Figures 8a–c)

Diagnosis. Whole body surface covered by thick cerotegument layer, which mostly consists of granules. Because of them the body margin

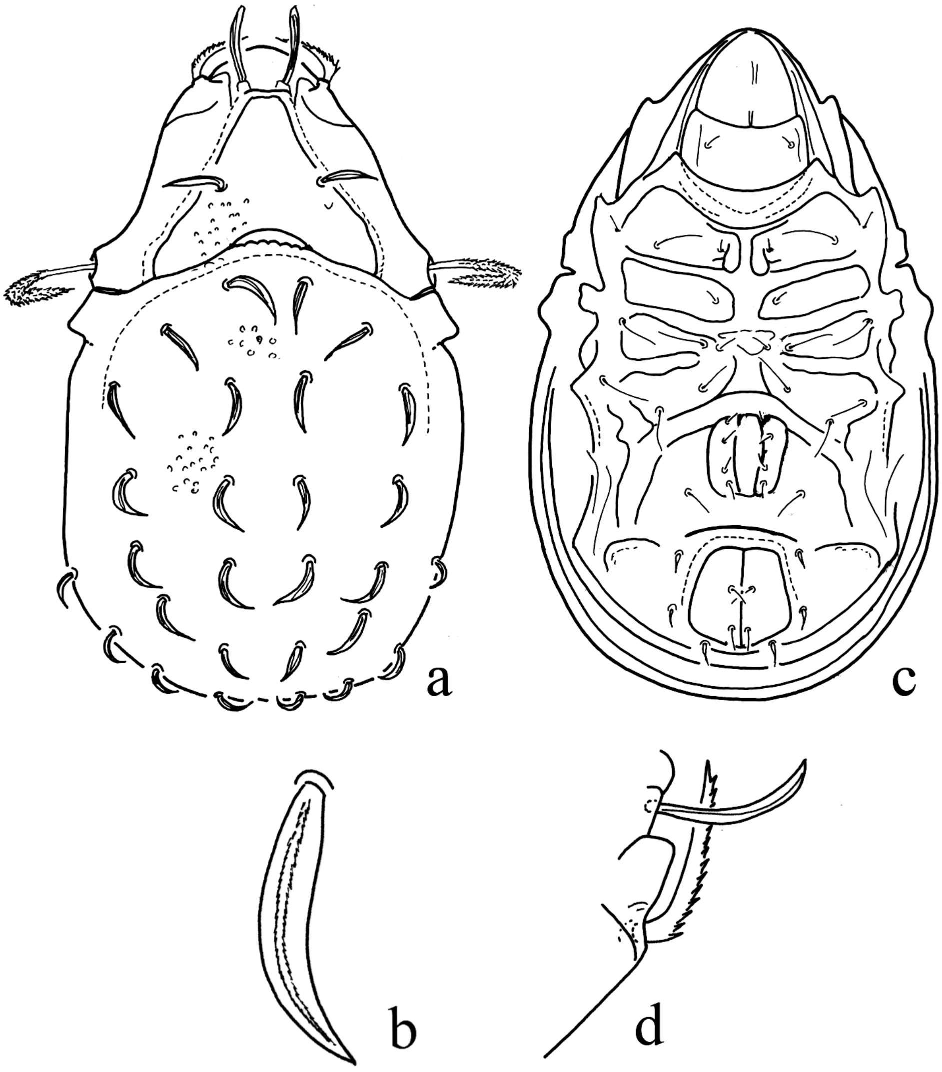

Figure 7. *Austrocarabodes semilunatus* sp. nov. a: body in dorsal view, b: body in ventral view, c: rostral part of prodorsum, d: rostral seta

seems to be undulate. Rostrum widely rounded. Costulae well developed, curved outwards, bearing lamellar setae. A pair of well developed lateral carina also present. Peduncle of sensillus thin, its head phylliform, dilate, its surface distinctly barbed. Ten pairs of simple, setiform notogastral setae, seven pairs of them arising in one row along the lateral margin. Three pairs of setae located in marginal position. Apodemes and epimeral borders weakly developed, not touching medially. All epimeral setae short, hardly observable. Genitoanal setal formula: 5 – 1 – 2 – 3. Legs tridactylous, lateral claws much thinner than median one.

Material examined. Holotype: Madagascar, Peyrieras, Causse de Kelifelly. 20–30. 11. 1974. Leg. D. Smith. 2 paratypes from the same sample. Holotype (1825-HO-11) and 1 paratype (1825-PO-11) deposited in HNHM, 1 paratype in MHNG.

Prodorsum. Surface of prodorsum well granulate, these are slightly smaller, than notogastral ones. All prodorsal setae thin, setiform, rostral setae shorter than the lamellar one, interlamellar setae shortest of all. Costula and lateral carina forms a characteristic median pattern. Bothridium opened dorsally. Sensillus with short, thin pe-

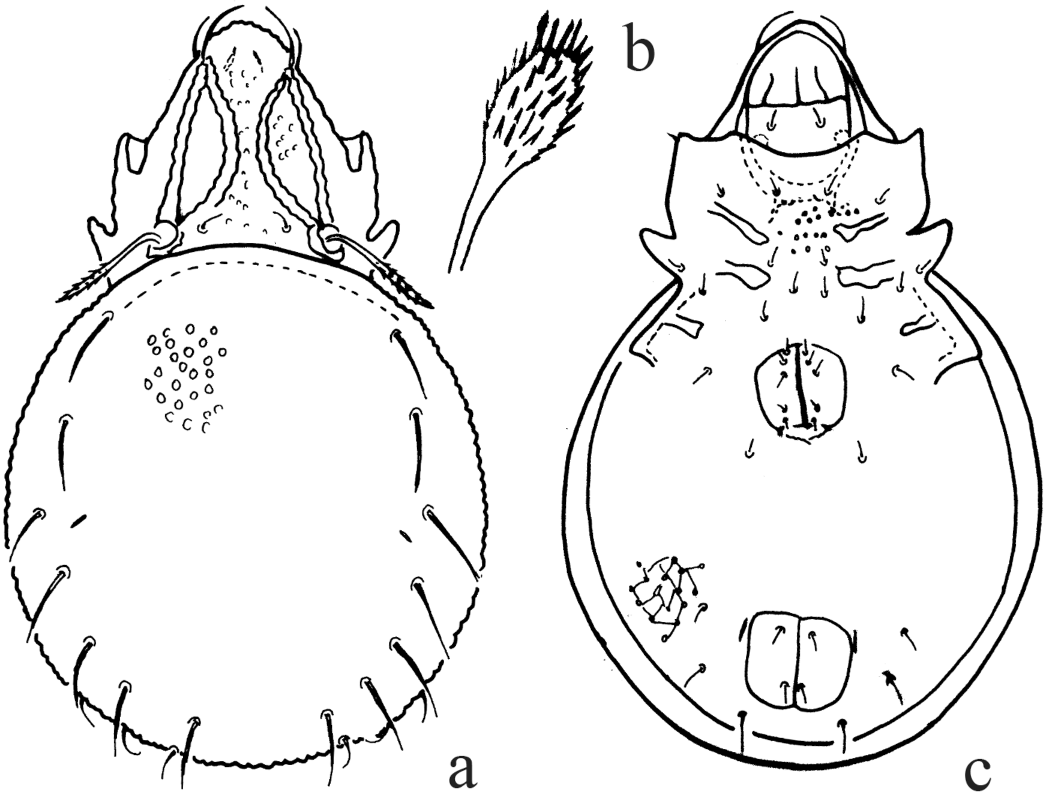

Figure 8. *Triteremella simpliseta* sp. nov. a: body in dorsal view, b: sensillus, c: body in ventral view

duncle and well dilate, rounded head. Its surface covered with bristles or short cilia.

Notogaster. Anterior margin gradually convex. Among the ten pairs of notogastral setae 7 pairs arising in a row along the lateral margin of notogaster. All setae simple, setiform, hardly ciliate. Three pairs of notogastral setae in postero-marginal position (p_1–p_3) slightly longer than the others.

Lateral part of podosoma. Tutorium weakly developed, short, without cusp.

Ventral parts. Surface also granulate. Granules on the ventral plate mostly connected by fine line. Epimeral region weakly sclerotised, apodemes and epimeral borders mostly short, not touches medially. Epimeral setae very short and thin, owing to distinct cerotegument hardly observable. Epimeral setal formula 5 – 1 – 2 – 3. Five pairs of genital setae arising in longitudinal rows, all very short. Lyrifissures *iad* also hardly observable, among adanal setae ad_1 slightly longer than ad_3.

Remarks. On the basis of the number of claws and the shape of cerotegument the new species is well classified into the genus *Triteremella* Kunst, 1971 (Subias 2011). It stands nearest to *T. ensifera* (Balogh et Mahunka, 1968) comb. nov. described from Argentina. The new species is well distinguished from the heretofore known species of this genus by the number of genital setae (6 in other species) and the form of the prodorsal pattern (costulae), which is completely different in the other species.

Etymology. The species name refers to the shape of the notogastral setae.

Eupelops costulatus sp. nov.

(Figures 9a–d)

Diagnosis. Whole surface covered with cerotegument, which forms a characteristic pattern. Rostrum elongate, slightly obtuse. Interlamellar setae leaf-shaped, comparatively narrow, not covered prodorsum. Sensillus elongate, lanceolate,

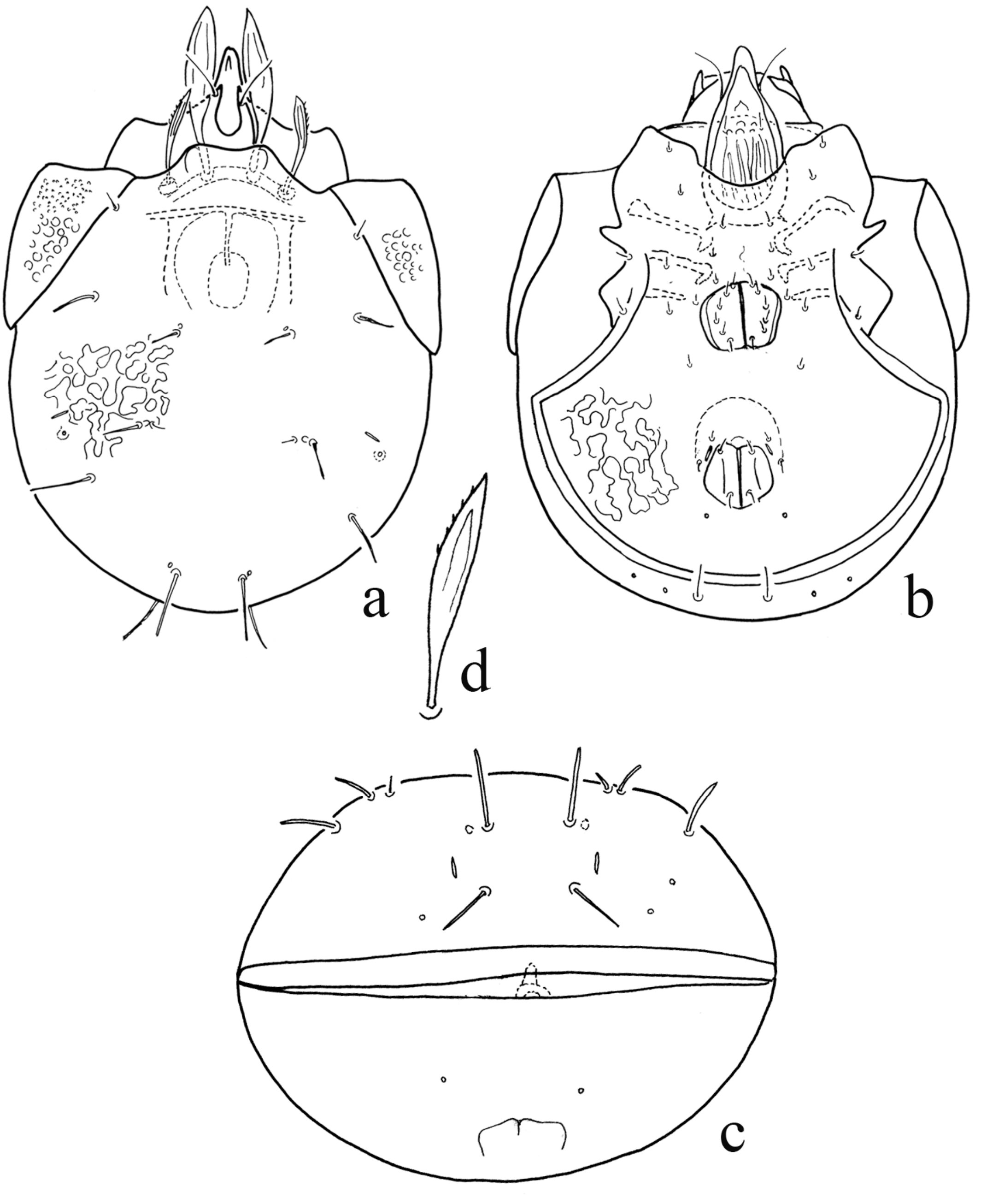

Figure 9. *Eupelops costulatus* sp. nov. a: body in dorsal view, b: body in ventral view, c: body in posterior view, d: sensillus

with pointed apex. Ten pairs of notogastral setae, two pairs of them minute or represented as setal alveoli (setae p_2 and p_3). Setae *lp* and h_3 arising very near to each other, immediately to areae porosae A_1. Setae c_2 and *lp* thin, and much shorter than the bacilliform remaining setae. Subcapitulum with longitudinal crests, in front of them some shell-shaped features present. Epimeral setal formula 3 – 1 – 2 – 3. Ventral plate covered with irregular pattern of cerotegument. Genital plates smooth, anal plates with one pair of longitudinal crests. Genitoanal setal formula: 6 – 1 – 2 – 3. All setae short, adanal setae ad_1 in postanal, ad_3 in preanal position. Lyrifissures *iad* located at anterior corner of anal aperture. All legs tridactylous.

Material examined. Holotype: Madagascar, Vohimana reserve. 7. 04. 2008. Leg. Cs. Csuzdi (Afr–996). Holotype (1826-HO-11) deposited in the HNHM.

Measurements. Length of body: 454 μm, width of body: 352 μm.

Prodorsum. Prodorsum wide, rostral apex slightly rounded. Lamellae fused basally, form a wide interlamellar region. Rostral and lamellar setae simple, both finely roughened. Interlamellar setae long, comparatively narrow, with short bristles laterally. They do not cover the prodorsal surface. Sensillus reaching over the anterior margin of notogaster, saliciform, with sharply pointed distal end, barbed marginally.

Notogaster. Notogaster rounded, slightly longer than wide. Surface covered with irregular cerotegument layer, surface of the pteromorphae foveolate medially, punctuate anteriorly. Anterior margin of notogaster forming two distinct lobes. Four pairs of small porose areas present, *Aa* situated near to setae *lm*, A_1 between setae *lp* and h_3. Some setae (c_2 and *lp*) thin, setiform, some other bacilliform and finely ciliate or barbed. Setae h_1 longest of all, setae p_1 distinctly shorter than h_2. Setae p_2 and p_3 minute or reduced, only their insertions observable.

Lateral part of podosoma. Exobothridial setae minute. Tutorium well discernible, with sharply pointed apex.

Ventral parts. Apodemes and epimeral borders typical for the genus. Epimeral setae short, some of them hardly or uncertainly observable. Circumpedal carina well developed, wide. Ventral plates covered with similar cerotegument as the notogaster with larger smooth median fields. Genital aperture larger than anal one, surface of preceding aperture smooth, anal plates bearing a well developed longitudinal crest. Lyrifissures *iad* located near to anterior corner of anal aperture, setae ad_3 distinctly in front of these lyrifissures. Area porosae postanalis absent.

Legs. All legs triangular, strong heterodactily present.

Remarks. The new species is well characterised by the form and position of notogastral setae, the ornamentation of the subcapitulum and by the form of sensillus. On this basis it is closest to *Eupelops foveolatus* Engelbrecht, 1975 (see Grobler, 1989) however, the head of sensillus is fusiform, widely rounded in *foveolatus* (Engelbrecht 1975: fig. 4), the interlamellar setae are also very wide and the subcapitulum is without shell-shaped sculpture (which is present in the new species). The longitudinal crest is lacking from the anal plates in *foveolatus* but it is present in the new species.

Etymology. Named after the longitudinal crests of the anal plates.

***Oripoda attenuata* sp. nov.**

(Figures 10a–c)

Diagnosis. Rostrum very wide slightly rounded, without distinct apex. Lamellae and praelamellae well developed, rostral and lamellar setae arising on them. All prodorsal setae very fine, smooth. Bothridium covered by the notogaster, anterior part of sensillus free. Anterior margin of notogaster nearly straight or slightly undulate. Pteromorphae simple. Notogastral surface smooth anteriorly and distinctly punctuate posteriorly. Ten pairs of short and fine notogastral setae and 4 pairs of round sacculi present. Ventral plate partly and anal plates wholly punctuate, like the notogaster. Genito-anal setal formula 2 – 1 – 2 – 3. Genital and aggenital setae simple, anal and adanal setae very long, extremely curved, flagellate. All legs tridactylous.

Material examined. Holotype: Madagascar, Mangabé Island, Antongie Bay. Primary rain forest, rotten wood. 19. February, 1977. Leg. WL & DL Brown. (Afr–JB2). 1 paratype from the same sample. Holotype (1827-HO-11) deposited in the HNHM, 1 paratype in MHNG.

Measurements. Length of body: 437–459 μm, width of body: 200–208 μm.

Prodorsum. Rostral part widely rounded, rosral surface nearly smooth. All prodorsal setae – except the very short exobothridial ones – very thin, fine, smooth. Their ratio ro < le < in. Prodorsal surface irregularly punctuate. Bothridium completely covered by the antero-lateral notogastral tectum, head of sensillus partly visible in dorsal view. Surface of sensillus distinctly barbed.

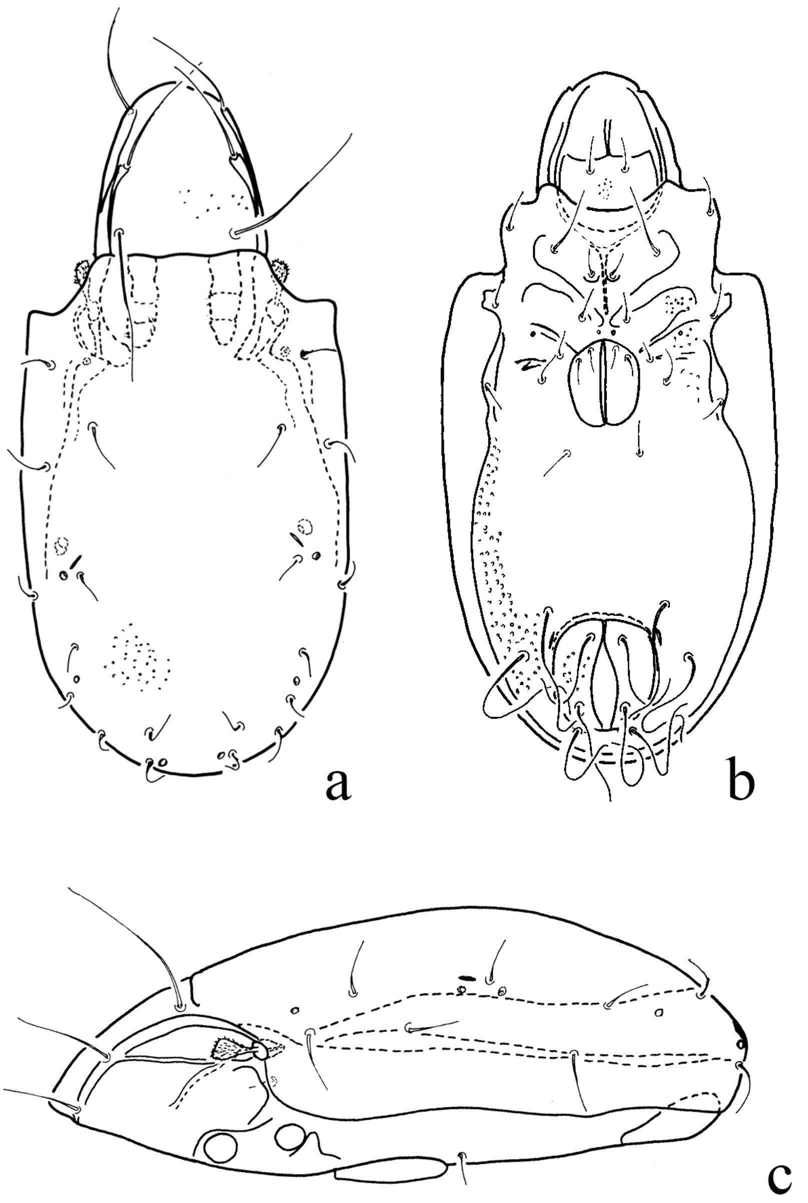

Figure 10. *Oripoda attenuata* sp. nov. a: body in dorsal view, b: body in ventral view, c: body in lateral view

Lateral part of podosoma. Praelamella continued from lamella, both well developed. Narrow sublamella and weak tutorium also observable. Rostral and lamellar setae arising on the surface of lamella or praelamella. Exobothridial setae short, fine, much shorter than the other prodorsal setae. Pedotecta I and II small, discidium hardly protruding laterally.

Notogaster. Anterior margin of notogaster nearly straight, or slightly undulate. Pteromorphae not protruding anteriorly, simple. Dorsophragma extremely long consists of 3–4 parts. Notogastral surface smooth anteriorly and distinctly, irregularly punctuate in the posterior part. Ten pairs of short, mostly simple, and thin notogastral setae and 4 pairs of round sacculi well observable. Lyrifissures *im* located in front of insertion of setae *lp*.

Ventral parts. Epimeral region weakly punctuate, median part smooth, lateral part with distinct sculpture. Ventral plate distinctly punctuate posteromarginally, genital surface smooth, anal surface rarely punctuate. Apodemes thin their pattern similar to the genus, *ap. sej.* directed to the genital aperture. Epimeral setal formula 3 –1– 2 – 2, 3c and 4c not visible. Genital and aggenital setae simple, short. Genito-anal setal formula: 2 – 1 – 2 – 3. All anal and adanal setae very long, curved or flagelliform, all very thin, smooth. Lyrifissure *iad* located near to anterior corner of the anal aperture.

Legs. All legs tridactylous, weakly heterodactylous.

Remarks. The new species is well characterised by the very thin and long prodorsal setae, the nearly straight anterior notogastral margin and the punctuate dorsal and ventral surface. On this basis the new species stands nearest to *Oripoda sumonyii* Mahunka, 1985. However, the rostrum of *O. sumonyii* is excavate and the anoadanal setae short, not flagellate.

Etymology. Named after the very long and very thin, smooth prodorsal setae.

Chaunoproctus semirugosus sp. nov.

(Figures 11a–d)

Diagnosis. Rostrum wide, conical, medially with slightly rounded apex. Its surface with polygonal pattern. Rostral setae long, setiform, arising in the long tutorial apices. Lamellae and translamella wide, with short lamellar apices. Lamellar setae longer than interlamellar ones, both distinctly ciliate. Sensillus short with capitate head. Dorsosejugal margin complete. Notogaster ornamented by large foveolae. Ten pairs of bacilliform, well ciliate setae, and four pairs of small, porose area present. Ventral plate and surface of anal plates with foveolae. Sejugal apodeme well developed, composing transversal band. Epimeral border and apodemes 3–4 hardly visible or absent. Genitoanal setal formula: 3 – 1 – 2 – 3. All legs tridactylous.

Material examined. Holotype: Madagascar, Antsiranana Province, Nosy Komba Island. 29. July, 1998. Coll. T. Pócs (Afr–917). Holotype (1828-HO-11) deposited in the HNHM.

Measurements. Length of body: 394 µm, width of body: 296 µm.

Prodorsum. Rostrum wide, with slightly rounded apex. Its surface covered with distinct, polygonate sculpture, reaching to translamella. Rostral setae arising laterally, conspicuously far from each other, very long, reaching over the rostral apex, thin, setiform. Lamellae and translamella well-developed, all of them nearly equally thick. Lamellae with short, but distinct apices, bearing long, lamellar setae. Interlamellar setae slightly longer than the lamellar ones, both pair bacilliform and well ciliate. Interlamellar region without special sculpture. Sensillus short, with short capitate head.

Lateral part of podosoma. Tutorium long, with distinct head bearing the long and thin rostral seta. Pedotecta I large.

Notogaster. Whole surface ornamented by large alveoli, their diameter larger than the distance between them. Anterior margin of notogaster convex, complete medially. Ten pairs of bacilliform, well ciliate notogastral setae, and four pairs of small porose areas present on the notogaster. The latter mostly smaller than the alveoli. Setae $p_1 - p_3$ shorter than the setae in median position.

Ventral parts. Surface of subcapitulum and genital plates nearly smooth, all other part ornamented by smaller (epimera 1–2, or anal plates) or larger foveolae or alveoli of varying shape and dimension. Short part of apodemes 1 and sejugal apodemes well developed, sejugal apodemes form a conspicuously thick transversal band, directed slightly posteriorly to genital aperture. Genital aperture framed by a characteristic border, directed to the anal plates. Epimeral borders and apodemes on epimera 3 and 4 hardly observable or absent. All epimeral setae simple and short. Genitoanal setal formula: 6 – 1 – 2 – 3. Lyrifissure *iad* small, located near to anterior corner of anal aperture.

Legs. All legs tridactylous.

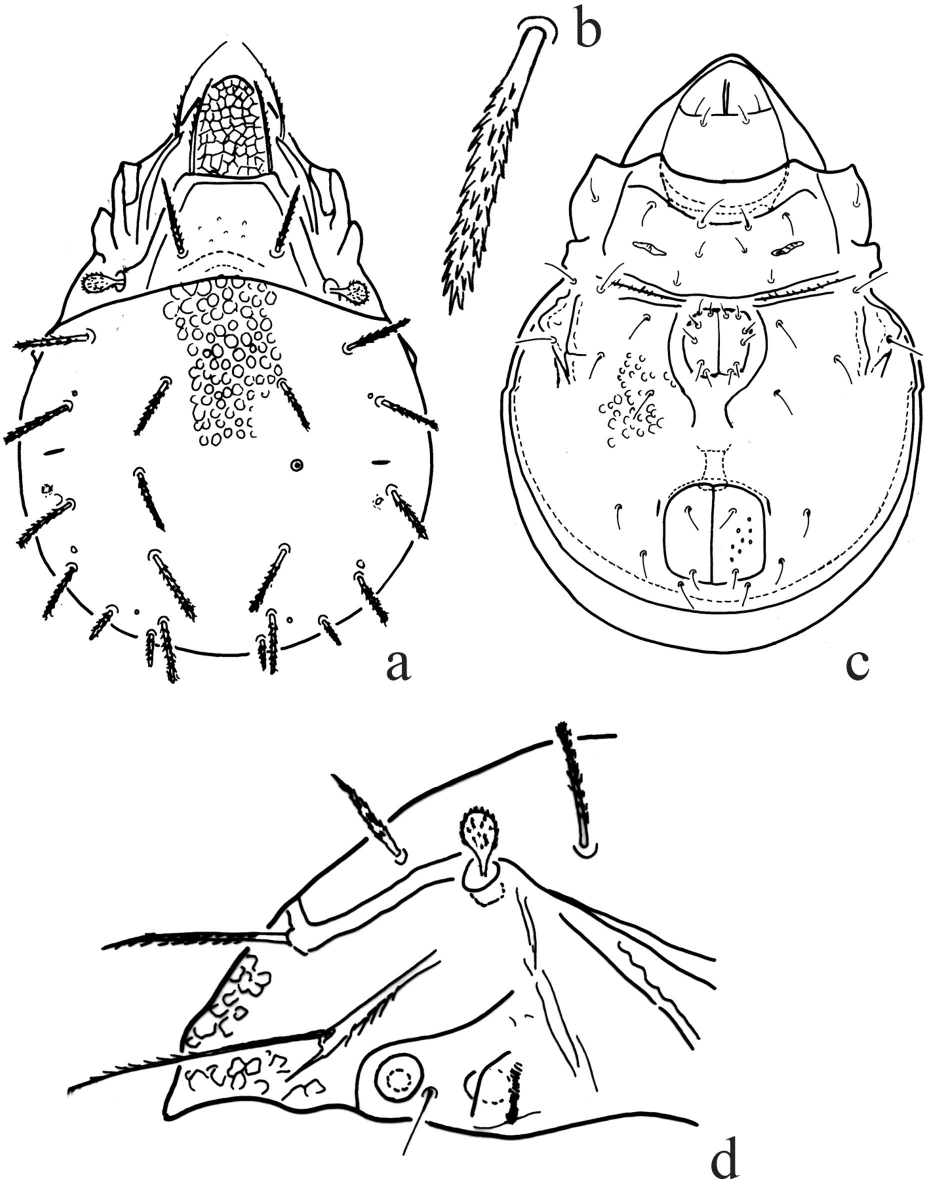

Figure 11. *Chaunoproctus semirugosus* sp. nov. a: body in dorsal view, b: notogastral seta, c: body in ventral view, d: body in lateral view

Remarks. The new species is well characterised by the robust, bacilliform and distinctly ciliate notogastral setae, the thin and long rostral and comparatively long but thickened lamellar and interlamellar setae and the body sculpture. The new species is closest to *C. rugosus* (Mahunka, 1992) however, well differ from it by the much larger alveoli of the notogaster, the complete dorsosejugal margin of the notogaster and by the characteristic border surrounding the genital aperture, directing to the anal ones.

Chaunoproctus rugosus (Mahunka, 1992) was the type species of the erroneously established genus (*Chaunoproctellus* Mahunka, 1992) (see Mahunka 1992: 696). The examination of the type species made the former error evident; instead of 2 this species possesses 3 pairs of adanal setae.

Etymology. The species name refers to the nearest similar species.

Peloribates (Peloribatodes subgen. nov.*)*

Diagnosis. Family Haplozetidae Grandjean, 1936, similar to *Peloribates* Berlese, 1908 species. Lamella short, prolamella absent, sublamella weakly developed. Tutorium well developed bearing rostral setae. Fourteen pairs of notogastral setae, four pairs of simple sacculi present. Apodemes and epimeral borders weakly developed. Genitoanal setal formula: 4 – 1 – 2 – 3.

Type species. *Peloribates (Peloribatodes) incompatibilis* sp. nov.

Remarks. The new subgenus is distinguished from the nominate subgenus by the number of genital setae (5 pairs in the nominate subgenus), and by the anterodorsal toqoth on tibia II (absent in nominate form).

Peloribates (Peloribatodes) incompatibilis sp. nov.

(Figures 12a–d)

Diagnosis. Rostral part triangular, rostral apex rounded, beak-shaped in lateral view. Lamella short, prolamella absent, sublamella very short, bearing long, setiform lamellar setae. Tutorium well-developed, rostral setae arising on its distal end. Interlamellar setae distinctly shorter than rostral ones. Sensillus comparatively long directed outwards and backwards, peduncle thin, its head small. Notogastral and pteromorpha surface smooth. Fourteen pairs of nearly equal, straight, slightly erectile notogastral setae, and four pairs of small and simple sacculi observable. Only sejugal apodemes distinctly developed. All epimeral setae minute. Ventral and genital plates smooth, anal plate distinctly foveolate. Genitoanal setal formula: 4 – 1 – 2 – 3. All legs tridactylous. Femur II with strong, triangle dorsal tooth and a lateroventral thorn. Three of the above listed features do not characterise the so far known *Peloribates* Berlese, 1908 species. Therefore establishing a new subgenus seems to be well founded.

Material examined. Holotype: Madagascar, Peyrieras, Causse de Kelifelly. 20–30. 11. 1974. Leg. D. Smith. Holotype (1829-HO-11) deposited in the HNHM.

Measurements. Length of body: 448 µm, width of body: 303 µm.

Prodorsum. Wide, triangular, its apex slightly rounded. Surface smooth, lamellae conspicuously short, bearing the long lamellar setae. Rostral setae shorter than lamellar ones, both pairs setiform, ciliate. Interlamellar setae slightly bacilliform, straight. Much shorter than preceding ones. Peduncle of sensillus long, curved, its head fusiform, surface with pattern.

Lateral part of podosoma. Rostrum beak shaped in lateral view. Prolamella absent, a very weak, short sublamella observable. Tutorium well developed, without sharp distal apex, bearing rostral seta.

Notogaster. Dorsosejugal scissure complete, convex. Notogastral surface smooth. Dorsophragma and pleurophragma conspicuously narrow. Fourteen pairs of nearly equal length, mostly straight, slightly bacilliform, and finely barbed notogastral setae. Four pairs of small, simple sacculi present.

Ventral parts. Surface except that of anal plates smooth. Apodemes and epimeral borders weakly observable, only sejugal apodemes distinct and a short part of *ap. 2* and *ap. 3* well visible. All epimeral setae minute. Discidium with transversal plate, custodium strongly bent outwards. Circumpedal carina long well curved to the lateral margin of the ventral plate. Genital plate smooth, anal plate distinctly foveolate. Genitoanal setal formula 4 – 1 – 2 – 3. Genital setae slightly longer than the short aggenital, anal and adanal setae. Among the adanal setae ad_1 in postanal, ad_3 in preanal position.

Legs. All legs triheterodactylous. Surface of all legs smooth. Femur of leg II and leg IV with well developed ventral keel, femur of leg II with a sharply pointed, triangular anterodorsal tooth and a peculiarly large lateroventral apophysis.

Remarks. See the remarks after the description of the new subgenus.

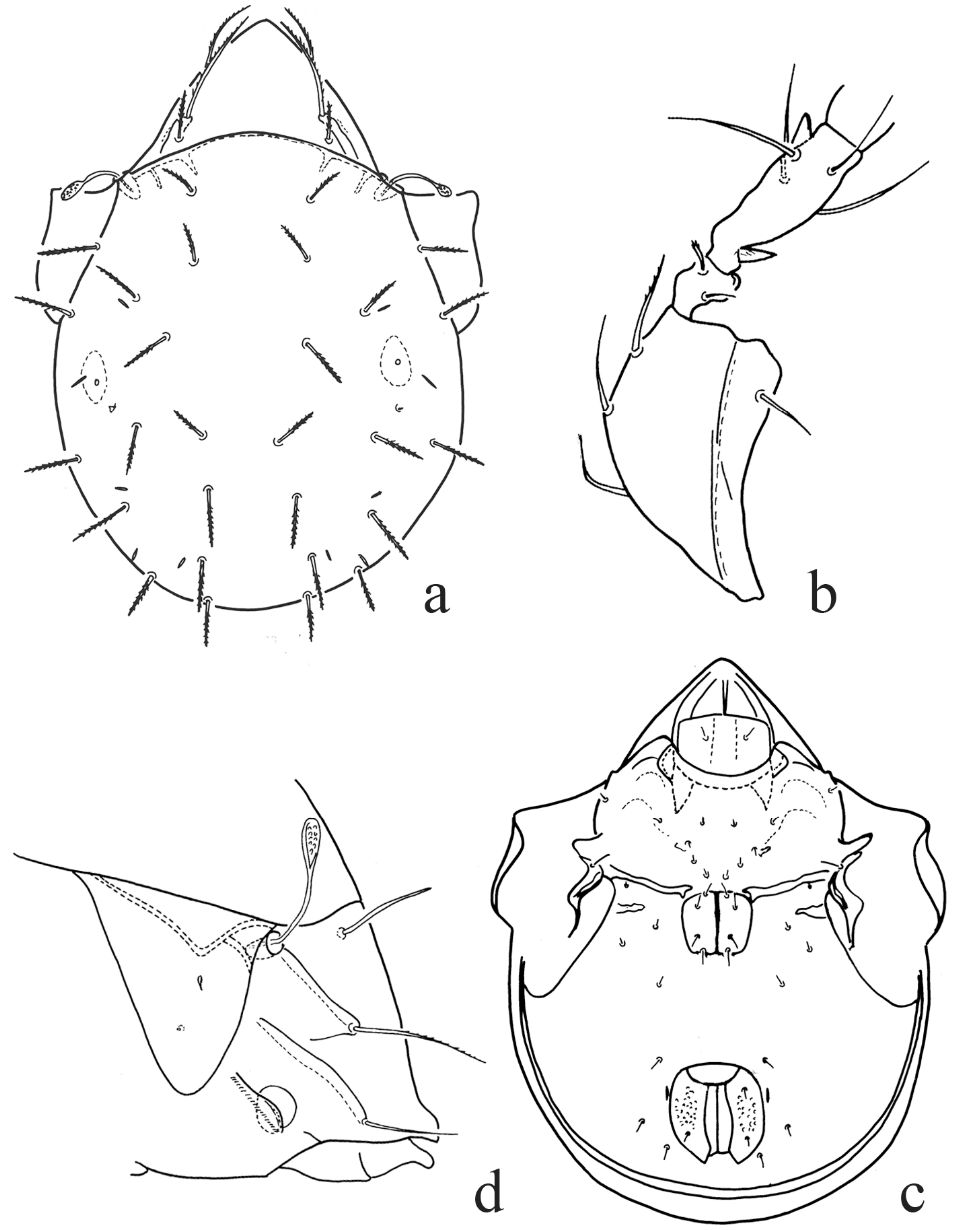

Figure 12. *Peloribates* (*Peloribatodes*) *incompatibilis* subgen. nov., sp. nov. a: body in dorsal view, b: trochanter, genu and tibia of leg II, c: body in ventral view, d: anterior part of body in lateral view

Etymology. The species name refers to the problematic relationship of the new and the formerly described species (within the genus).

Pergalumna nasifera sp. nov.

(Figures 13a–c)

Diagnosis. Rostrum with characteristic, nasiform median part, it is beak-shaped in lateral view. Prodorsal surface distinctly punctate. Lamellar and sublamellar lines well-developed, setae *le* distinctly located between lines L and S. Interlamellar setae long, longest of all. Ratio of prodorsal setae: in > le > ro. Sensillus directed backwards, simple, setiform. Dorsosejugal suture interrupted medially, its short basal part directed to insertion of interlamellar setae. Ten pairs of setal alveoli and three pairs of equally large areae porosae. Epimeral setae comparatively long, well observable. Six pairs of genital setae, 2 pairs arising along the anterior margin. Aggenital, anal and adanal setae minute. Postanal area porosa absent.

Material examined. Holotype: Madagascar, Andasibe (=Périnet) Province. February 1977. Leg. W. L. Brown, 3 paratypes from the same sample. Holotype (1830-HO-11) and 2 paratypes (1830-PO-11) deposited in the HNHM, 1 paratype in MHNG.

Measurements. Length of body: 661–742 μm, width of body: 513–567 μm.

Prodorsum. Anterior part of prodorsum very wide, rounded, however, a short, well separated nasiform protuberance emerging from the anterior margin. This part is well observable in dorsal view. Prodorsal surface distinctly punctuate, dots arranged mostly in longitudinal lines. Lamellar and sublamellar lines well-developed running parallel. Prodorsal setae well-observable, interlamellar setae longest and strongest, rostral setae the shortest and thinnest of all. Sensillus long, filiform, smooth, directed backwards. Sejugal porose areas not observable.

Notogaster. Dorsosejugal furrow missing medially, its short lateral parts directed to the insertion of interlamellar setae. The whole dorsal surface well-punctuated, pteromorphae also with strong, radiate sculpture. Three pairs of small porose areas and ten pairs of insertion of notogastral setae well observable. All porose areas small, nearly rounded and approximately equally sized. Areae porosae *Aa* located conspicuously medially, far from the lateral margin of notogaster.

Lateral part of podosoma. The anterior margin of prodorsum steeply concave in lateral view. Lamellar and sublamellar lines running parallel, close each to other

Ventral parts. Entire surface punctuated, the dots arranged in different direction in short lines. Epimeral region weakly sclerotised, 2–3 pairs of larger spots present. Epimeres not touching medially, apodemes and epimeral borders typical for the genus. Epimeral setae, except *1a,* are represented only by their alveoli. Six pairs of short genital setae, two pairs arising on the anterior margin of the genital plates, others located in longitudinal rows. Aggenital, adanal setae short, anal setae slightly longer. Postanal area porosa absent.

Legs. All legs tri- and heterodactylous.

Remarks. The *Pergalumna* Grandjean, 1936 species collected in the Malgas Region were surveyed in an identification key by Mahunka (2011). The main character for the identification of the species groups are the number and position of notogastral porose areas, the form of the sensillus and the length of the interlamellar setae. The new species belongs to the group that is characterised by 3 pairs of the porose areas, the setiform sensillus and the long interlamellar setae. However, it is well-distinguished from the other similar species firstly by the very characteristic form of the rostrum, by the body surface consisting of punctuate lines and the median position of area porosa *Aa*. This combination is not known to exist in other species in this group. The new species stands nearest to *P. mauritii* Mahunka, 1978 however, the new species is distinguished from *mauritii* by the nasiform rostral part, the very strong sculpture of the body and by the larger distance of the porose area *Aa* (much smaller in *mauritii*).

Etymology. The species is named after its nasiform rostral part of the prodorsum.

Acknowledgements – This research was sponsored by the Hungarian Scientific Research Fund (OTKA 45889) and the French Institute of Biodiversity (IFB) Fauna-M project. I should like to thank Dr. Tamás Pócs and Dr. Csaba Csuzdi for collecting the very interesting soil samples. My sincere thanks to Dr. Csaba Csuzdi for his assistance in preparing my manuscript and to my wife Mrs. Luise Mahunka-Papp for the drawings. I also thank Dr. Tibor Fuisz for reviewing the English text of my paper.

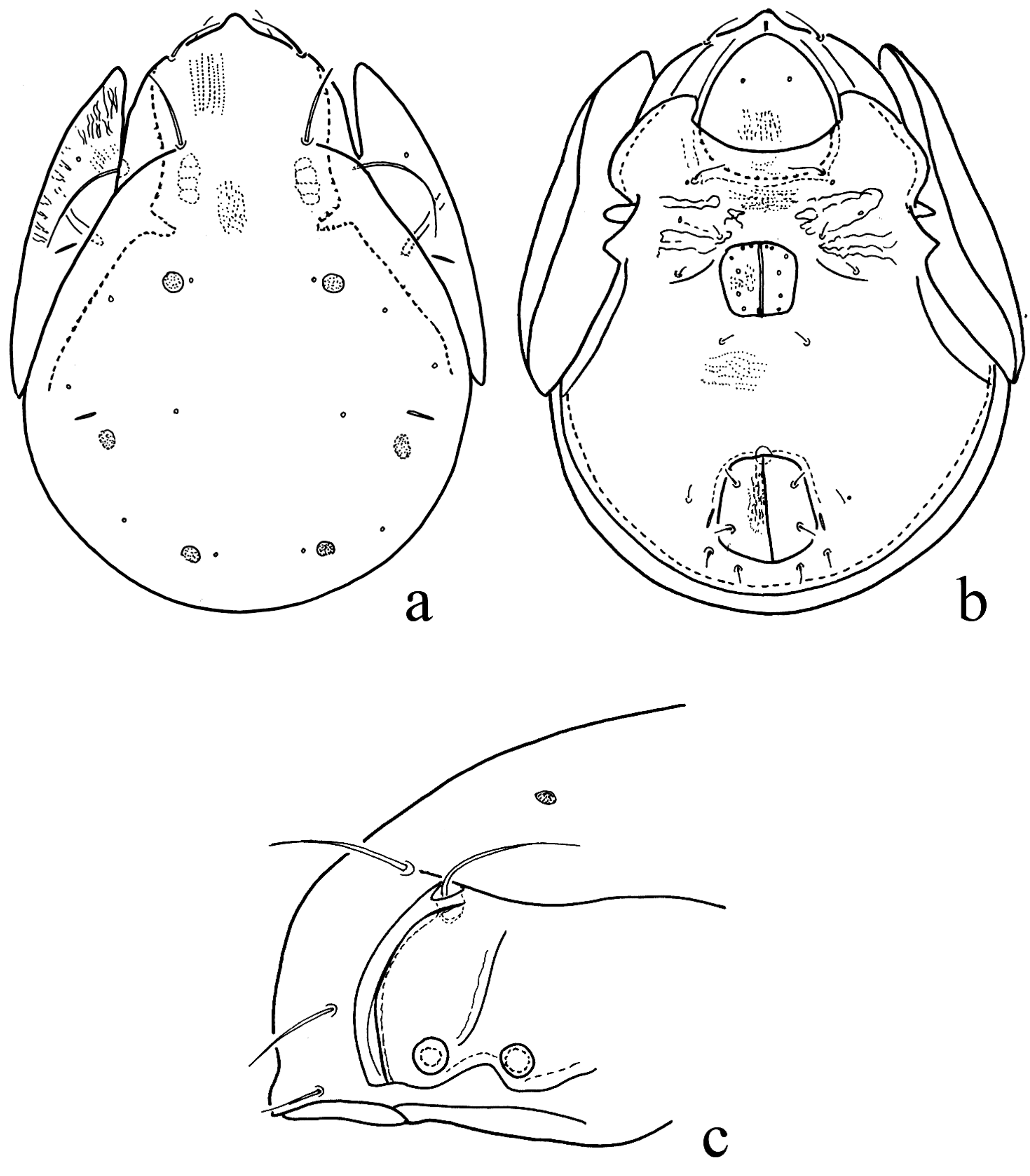

Figure 13. *Pergalumna nasifera* sp. nov. a: body in dorsal view, b: body in ventral view, c: body in lateral view

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The earthworm fauna of the Karancs-Medves Landscape Protection Area (Oligochaeta, Lumbricidae)

T. SZEDERJESI[1]

Abstract. Researches carried out in the Karancs-Medves Landscape Protection Area resulted in recording altogether eighteen earthworm species and subspecies, of which the Central European montane *Fitzingeria platyura montana* (Černosvitov, 1932) reaches its westernmost distribution in the Karancs Mts. in Hungary. Using the recent and literature data, a hierarchical cluster analysis was carried out to reveal the zoogeographical relations of the Hungarian mountain regions.

Keywords. Karancs-Medves, Hungary, earthworm fauna, zoogeography.

INTRODUCTION

Karancs-Medves Landscape Protection Area, established in 1989, is situated on the northern part of Hungary, along the Hungarian-Slovakian border. It consists of two geographically different parts. The laccolith of the Karancs was formed as a result of andesite volcanic activity. The Medves is part of the Nógrád-Gömör basaltic field, including the largest basalt plateau of Central Europe. The extension of the whole area is 6709 hectares, its highest point is the similarly called peak of the Karancs (729 m).

The invertebrate fauna of the area is imperfectly known. There are information only on certain groups like molluscs (Garami, 2003), centipedes (Dányi, 2006) and millipedes (Korsós, 1997) because the earlier researches rather focused on nature conservation goals (Harmos *et al.,* 2001). Although the earthworm fauna of Hungary is quite well known, the Karancs-Medves region seemes to be an exception, we had only sporadic data from the area. The former surveys concerned only on the marginal parts of the region (Zicsi, 1968, 1991; Csuzdi & Zicsi, 2003).

The aim of the present work is on the one hand to summarize the results of the earlier and recent studies carried out in the Karancs-Medves Landscape Protection Area and on the other hand to examine the zoogeographical relations of the region.

MATERIAL AND METHODS

Earthworms were collected by the diluted formalin method (Raw, 1959), by digging and hand-sorting and searching under the bark of fallen logs. The specimens were killed in 96% ethanol, fixed in 4% formalin and transferred into 75% ethanol several days later.

Information on the collecting sites (Fig. 1.) are given where it was possible. Unfortunately there are no accurate data on the collecting localities for many earlier samplings. Abbreviations of the collectors names are as follows: MP - Mária Pobozsny, AZ - András Zicsi, LD - László Dányi, TSZ - Tímea Szederjesi. HNHM Z/numbers refer to the registration numbers of the Hungarian Natural History Museum.

We compared the earthworm fauna of the Karancs-Medves with mountains of the Northern Hills (Börzsöny, Mátra, Bükk, Zemplén) and the Transdanubian Medium Mountains (Pilis, Bakony), Kőszeg, Sopron and Mecsek Mts. with hierarchical cluster analysis. We used the information theory method (minimum pooled entropy in new cluster) implemented in the SYN-TAX 2000 software (Podani, 2001).

Samplings were carried out at the following localities:

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1. Karancslapujtő, 01.04.1967. leg. MP & AZ
2. Bárna, 21.03.1968. leg. MP & AZ
3. Cered, 21.03.1968. leg. MP & AZ, 12.12.1979. leg. AZ
4. Mátraszele, 21.03.1968. leg. MP & AZ; oak forest, 19.09.2002. leg. LD
5. Ickós Fountain, Salgótarján, Medves Mts., beech-hornbeam forest, N48°09,343’ E19°53,537’, 10.04.2009., 14.04.2009. leg. TSZ
6. Csoma Stream, Salgótarján, Medves Mts., beech-hornbeam forest near the Slovakian border, stream bank, N48°09,793’ E19°53,754’, 10.04.2009., 19.04.2009., 22.11.2009. leg. TSZ
7. Várberek Stream, Salgótarján, Medves Mts., beech-hornbeam forest, stream bank, N48°09,229’ E19°51,142’, 21.04.2009. leg. TSZ
8. Zagyva Spring, Salgótarján, Medves Mts., beech-hornbeam forest, N48°08,430’ E19°52,233’, 23.04.2009. leg. TSZ
9. Gortva Valley, Salgótarján, Medves Mts., beech forest, stream bank, N48°08,162’ E19°53,488’, 06.04.2010. leg. TSZ
10. Kőkút-Bükk, Salgótarján, Medves Mts., beech-hornbeam forest near the Slovakian border, N48°08,648’ E19°54,630’, 06.04.2010. leg. TSZ
11. Guliba Hill, Karancslapujtő, Karancs Mts., beech forest, stream bank, N48°09,995’ E19°45,838’, 10.09.2009., 27.10.2009. leg. TSZ
12. Leső Valley, Karancsberény, Karancs Mts., beech-hornbeam forest, stream bank, N48°11,158’ E19°47,260’, 28.10.2009., 06.12.2009. leg. TSZ
13. Karancs Saddle, Salgótarján, Karancs Mts., beech forest, N48°09,223’ E19°47,183’, 08.10.2010. leg. TSZ

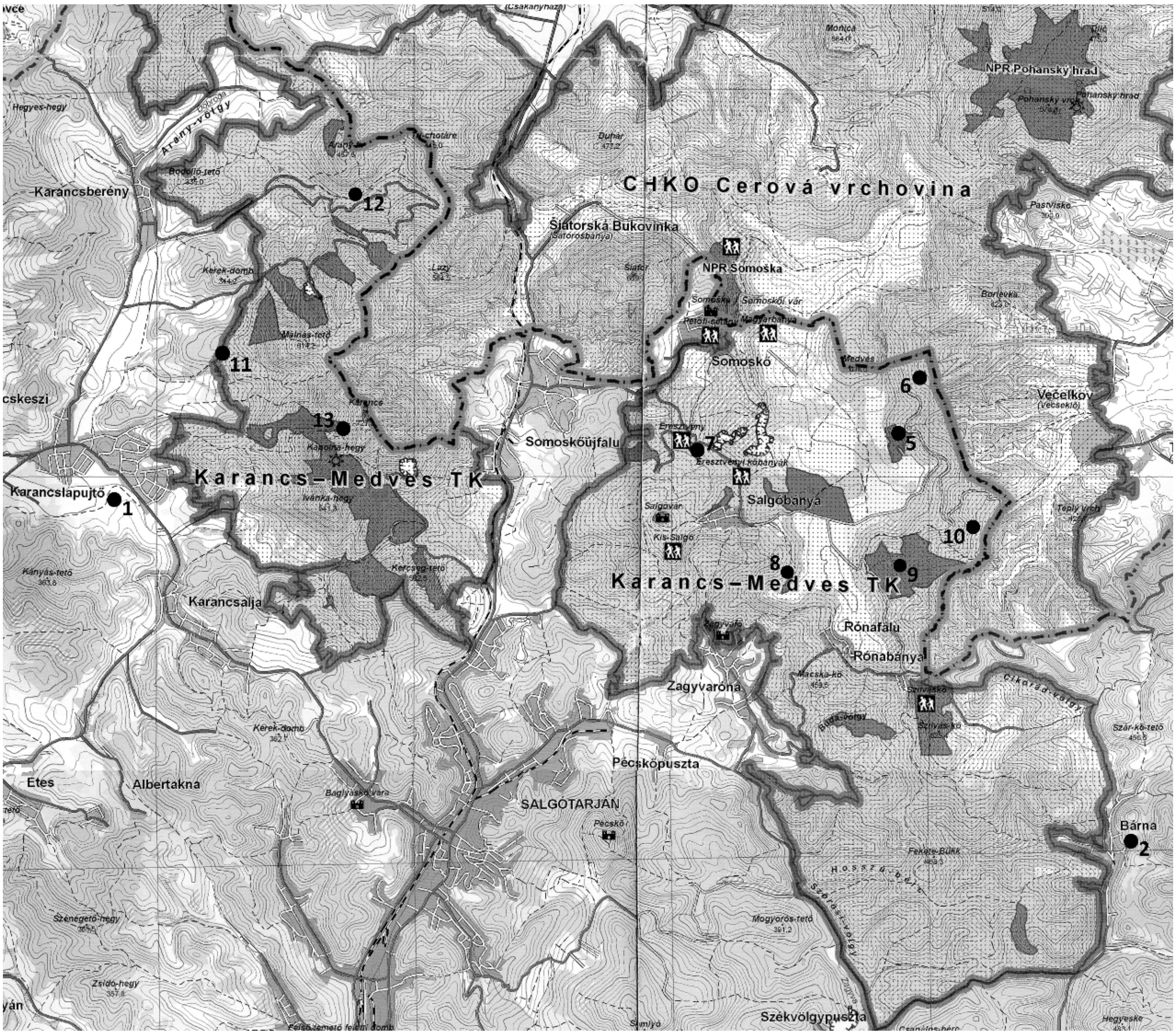

Figure 1. Sampling localities in the Karancs-Medves Landscape Protection Area (No. 3 and 4 not included).

RESULTS

Allolobophora chlorotica chlorotica (Savigny, 1826)

Locality. Karancslapujtő (HNHM Z/5253): 3 ex., 01.04.1967. MP & AZ (Zicsi 1968).

Aporrectodea caliginosa (Savigny, 1826)

Localities. Karancslapujtő (HNHM Z/5254): 1 ex., 01.04.1967. MP & AZ; Bárna (HNHM Z/5895): 2 ex., 21.03.1968. MP & AZ; Cered (HNHM Z/9102): 2 ex., 12.12.1979. AZ (Zicsi, 1991).

New records. Leső Valley: 1 ex., 28.10.2009. TSZ; 3 ex., 06.12.2009. TSZ.

Aporrectodea georgii (Michaelsen, 1890)

Localities. Karancslapujtő (HNHM Z/5253): 2 ex., 01.04.1967. MP & AZ (Zicsi 1968).

New record. Várberek Stream: 1 ex., 21.04.2009. TSZ.

Aporrectodea handlirschi (Rosa, 1897)

New records. Leső Valley: 1 ex., 28.10.2009. TSZ; 3 ex., 06.12.2009. TSZ; Gortva Valley: 3 ex., 06.04.2010. TSZ; Karancs Saddle: 1 ex., 08.10.2010. TSZ.

Aporrectodea jassyensis (Michaelsen, 1891)

Localities. Karancslapujtő (HNHM Z/5252): 1 ex., 01.04.1967. MP & AZ (Zicsi 1968); Mátraszele (HNHM Z/5888): 2 ex., 21.03.1968. MP & AZ (Zicsi, 1991).

Aporrectodea rosea (Savigny, 1826)

Localities. Karancslapujtő (HNHM Z/5249): 2 ex., 01.04.1967. MP & AZ (Zicsi, 1968); Mátraszele (HNHM Z/5887): 4 ex., 21.03.1968. MP & AZ; Bárna (HNHM Z/5901, 5905, 5907): 7 ex., 1 ex., 1 ex., 21.03.1968. MP & AZ; Cered (HNHM Z/5908): 3 ex., 21.03.1968. MP & AZ; (HNHM Z/9100) 7 ex., 12.12.1979. AZ (Zicsi 1991).

New records. Ickós Fountain: 1 ex., 10.04. 2009. TSZ; Csoma Stream: 1 ex., 10.04.2009. TSZ; 9 ex., 19.04.2009. TSZ; 18 ex., 22.11.2009. TSZ; Várberek Stream: 2 ex., 21.04.2009. TSZ; Zagyva Spring: 5 ex., 23.04.2009. TSZ; Guliba Hill: 3 ex., 10.09.2009. TSZ; 6 ex., 27.10.2009. TSZ; Leső Valley: 8 ex., 28.10.2009. TSZ; 6 ex., 06.12.2009. TSZ; Gortva Valley: 3 ex., 06.04.2010. TSZ.

Dendrobaena octaedra (Savigny, 1826)

Localities. Bárna (HNHM Z/5898): 1 ex., 21.03.1968. MP & AZ; (HNHM Z/5904) 1 ex., 21.03.1968. MP & AZ; Cered (HNHM Z/9104): 1 ex., 12.12.1979 AZ (Zicsi 1991).

New records. Csoma Stream: 11 ex., 09.04. 2009. TSZ; Leső Valley: 1 ex., 06.12.2009. TSZ.

Dendrodrilus rubidus rubidus (Savigny, 1826)

New records. Ickós Fountain: 1 ex., 10.04. 2009. TSZ; Csoma Stream: 1 ex., 22.11.2009. TSZ; Leső Valley: 1 ex., 28.10.2009. TSZ.

Eisenia lucens (Waga, 1857)

New record. Mátraszele (HNHM Z/14425): 1 ex., 19.09.2002. LD.

Eiseniella tetraedra (Savigny, 1826)

Locality. Cered (HNHM Z/9103): 1 ex., 12.12. 1979. AZ (Zicsi, 1991).

Fitzingeria platyura depressa (Rosa, 1893)

Localities. Mátraszele (HNHM Z/5891): 3 ex., 21.03.1968. MP & AZ; Bárna (HNHM Z/5894, 5902): 1 ex., 2 ex., 21.03.1968. MP & AZ; Cered (HNHM Z/9099): 5 ex., 12.12.1979. AZ (Zicsi, 1991).

New record. Leső Valley: 2 ex., 29.10.2009. TSZ; 2 ex., 06.12.2009. TSZ.

Fitzingeria platyura montana (Černosvitov, 1932)

New records. Ickós Fountain: 1 ex., 14.04. 2009. TSZ; Leső Valley: 1 ex., 28.10.2009. TSZ.

Lumbricus polyphemus (Fitzinger, 1833)

New records. Ickós Fountain: 1 ex., 04.14. 2009. TSZ; Csoma Stream: 1 ex., 19.04.2009. TSZ; Zagyva Spring: 1 ex., 23.04.2009. TSZ; Leső Valley: 2 ex., 06.12.2009. TSZ; Kőkút-Bükk: 1 ex., 06.04.2010. TSZ.

Lumbricus rubellus Hoffmeister 1843

Localities. Karancslapujtő (HNHM Z/5256): 1 ex., 01.04.1967. MP & AZ (Zicsi 1968); Mátraszele (HNHM Z/5890): 1 ex., 21.03.1968. MP & AZ (Zicsi, 1991).

New records. Csoma Stream: 1 ex., 19.04. 2009. TSZ; Várberek Stream: 1 ex., 21.04.2009. TSZ; Guliba Hill: 1 ex., 10.09.2009. TSZ; Leső Valley: 1 ex., 28.10.2009. TSZ; 1 ex., 06.12.2009. TSZ; Gortva Valley: 1 ex., 06.04. 2010. TSZ; Karancs Saddle: 1 ex., 08.10.2010. TSZ.

Octolasion lacteum (Örley, 1881)

Localities. Karancslapujtő (HNHM Z/5255): 1 ex., 01.04.1967. MP & AZ (Zicsi 1968); Mátraszele (HNHM Z/5893): 1 ex., 21.03.1968. MP & AZ; Bárna (HNHM Z/5900, 5906): 4 ex., 21.03. 1968. MP & AZ; Cered (HNHM Z/5909): 1 ex., 21.03.1968. MP & AZ (Zicsi, 1991).

New records. Ickós Fountain: 1 ex., 14.04. 2009. TSZ; Csoma Stream: 2 ex., 10.04.2009. TSZ; 2 ex., 19.04.2009. TSZ; 6 ex., 22.11.2009. TSZ; Várberek Stream: 7 ex., 21.04.2009. TSZ; Guliba Hill: 1 ex., 10.09.2009. TSZ; Leső Valley: 2 ex., 28.10.2009. TSZ; 1 ex., 06.12.2009. TSZ.

Octodrilus transpadanus (Rosa, 1884)

Localities. Mátraszele (HNHM Z/5892): 1 ex., 21.03.1968. MP & AZ; Bárna (HNHM Z/5903): 21.03.1968. MP & AZ (Zicsi,1991).

New record. Guliba Hill: 1 ex., 10.09.2009. TSZ.

Proctodrilus opisthoductus Zicsi, 1985

Localities. Karancslapujtő (HNHM Z/5250): 1 ex., 01.04.1967. MP & AZ; Bárna (HNHM Z/5897): 1 ex., 21.03.1968. MP & AZ; Cered (HNHM Z/9101): 2 ex., 12.12.1979. AZ (Zicsi, 1985);

New record. Várberek Stream: 1 ex., 21.04. 2009. TSZ.

Proctodrilus tuberculatus (Černosvitov, 1935)

Locality. Mátraszele (HNHM Z/5889): 2 ex., 21.03.1968. MP & AZ (Zicsi, 1991).

DISCUSSION

Out of the 58 earthworm species and subspecies known in Hungary (Csuzdi, 2007), altogether 18 were recorded from the Karancs-Medves Landscape Protection Area. Following the distribution types given by Csuzdi & Zicsi (2003), eight of the species found (*A. chlorotica, Ap. caliginosa*, *Ap. rosea*, *D. octaedra*, *Dd. rubidus rubidus*, *Eis. tetraedra, L. rubellus, O. lacteum*) are peregrine, widely introduced. *Ap. georgii* shows an Atlanto-Mediterranean distribution. The remaining species form two characteristic groups. *Ap. handlirschii*, *Ap. jassyensis, Oc. transpadanus* and *P. tuberculatus* possess a Trans-Aegean distribution. The other group is formed by the Central-European species. The presence of *P. opisthoductus* and the subspecies *F. platyura depressa* was previously demonstrated from the area, while *L. polyphemus* and *F. platyura montana* are new records for the Karancs-Medves. *F. platyura montana* shows a Central European montane distribution, it occurs in the Western and Eastern Carpathians. In Hungary it is found only in the higher regions of the Northern Middle Mountains, and reaches the westernmost point of its range in the Karancs Mts. This subspecies was also recorded from the Cerová Vrchovina, Slovakia (Janičina, 1995) which forms a continuous geographical unit with the Medves Mts. *E. lucens* also possesses a Central European montane distribution. This species prefers a special habitat it lives under the bark of fallen logs. The only *E. lucens* data is from the southern part of the Karancs-Medves

LPA, and despite of the intensive search, this species hasn't been found from other regions. The most probable reason for this can be the lack of deadwood in the area.

According to the results of the hierarchical cluster analysis (Fig. 2), the earthworm fauna of the Karancs-Medves shows highest similarity with the neighbouring Mátra Mts. The cluster of the Börzsöny and Pilis Mts. can be explained with their common history. These mountains formed a geographically continuous region until the change of the flow direction of the ancient Danube that reached its current location with breaking through the Visegrád Mts. at the end of the Pleistocene (Karátson, 2002). The presence of the Eastern-Alpine *Octolasion montanum* (Wessely, 1905) and the endemic *Allolobophora gestroides* Zicsi 1970 can be emphasized from both areas. The nearby position of the Bükk and Zemplén Mts. is probably due to their relative geographical closeness and common presence of such species like *F. pl. montana.*

The other clade is formed by the western-southwestern mountains. The earthworm fauna of the Bakony and Mecsek Mts. proved to be very similar, sharing numerous collective species of which the Atlanto-Mediterranean *Dendrobaena cognettii* (Michaelsen, 1903) reaches its northernmost distribution in the Bakony Mts. in Hungary. The closeness of the Alps has its influence on the Sopron and Kőszeg Mts. that can be well characterized with the Eastern-Alpine (*Dendrobaena vejdovskyi* (Černosvitov, 1935)) and the Southern-Alpine (*Aporrectodea sineporis* (Omodeo, 1952)) elements and with the presence of the Illyric *Dendrobaena ganglbaueri* (Rosa, 1894).

Acknowledgements. My thanks are due to the Directorate of the Bükk National Park for the permit to collect samples in the Karancs-Medves LPA. I am grateful to Dr. Csaba Csuzdi for his continuous help in my work.

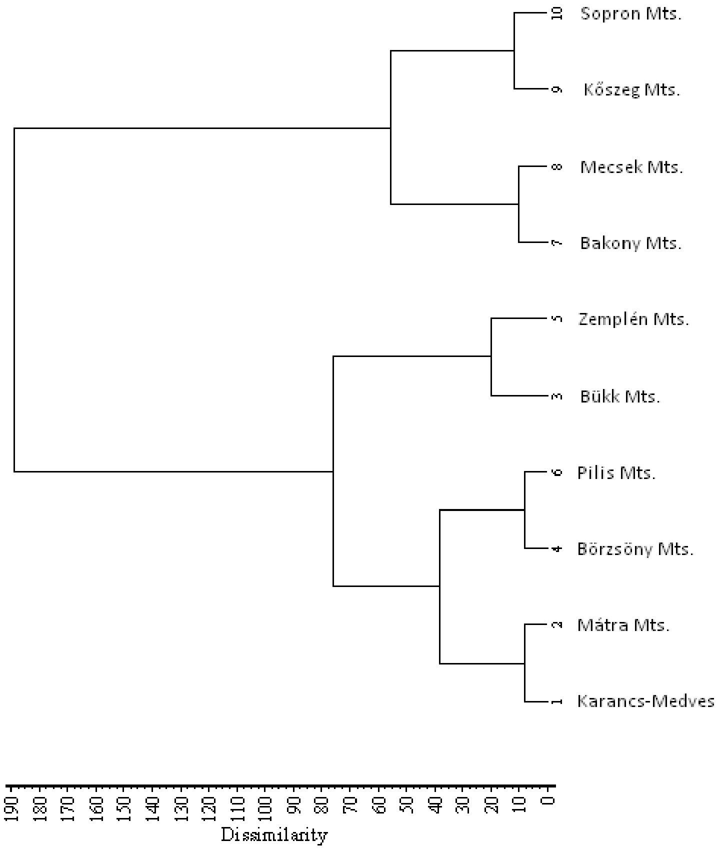

Figure 2. Faunistic similarity of the Hungarian Middle Ranges on the basis of the earthworm fauna

Table 1. Earthworm fauna of the investigated Middle Ranges in Hungary

	Karancs-Medves	Mátra	Bükk	Börzsöny	Zemplén	Pilis	Bakony	Mecsek	Kőszeg	Sopron
A. chlorotica	+	+	+	+	+	+	+	+	+	+
A. gestroides	0	+	+	+	0	+	0	0	0	0
A. leoni	0	0	0	+	+	+	0	0	0	0
A. mehadiensis	0	0	+	0	0	0	0	0	0	0
Ai. eiseni	0	0	0	0	0	0	0	+	0	0
Ap. caliginosa	+	+	+	+	+	+	+	+	+	+
Ap. georgii	+	+	+	+	+	0	0	0	0	0
Ap. handlirschi	+	+	+	+	+	+	+	+	0	0
Ap. jassyensis	+	+	+	+	0	0	+	+	0	0
Ap. rosea	+	+	+	+	+	+	+	+	+	+
Ap. sineporis	0	0	0	0	0	0	0	0	0	+
Ap. dubiosa	0	+	0	0	+	0	0	0	0	0
D. auriculata	0	0	+	+	+	+	+	+	+	0
D. cognettii	0	0	0	0	0	0	+	+	0	0
D. ganglbaueri	0	0	0	0	0	0	0	0	+	0
D. octaedra	+	+	+	+	+	+	+	+	+	+
D. vejdovskyi	0	0	0	0	0	0	0	0	+	0
Dd. r. rubidus	+	+	+	+	+	+	+	+	+	+
E. lucens	+	+	+	+	+	0	0	0	0	0
E. spelaea	0	0	0	0	0	0	0	0	+	+
Eis. t. tetraedra	+	+	+	+	+	+	+	+	+	+
F. pl. platyura	0	0	+	+	0	0	+	0	+	+
F. pl. depressa	+	+	+	+	+	+	0	+	+	+
F. pl. montana	+	0	+	0	+	0	0	0	0	0
L. baicalensis	0	0	0	0	0	0	0	0	+	0
L. polyphemus	+	+	+	+	0	+	+	+	+	+
L. rubellus	+	+	+	+	+	+	+	+	+	+
O. lacteum	+	+	+	+	+	+	+	+	+	+
O. montanum	0	0	+	+	0	+	0	0	0	0
Oc. compromissus	0	0	0	0	+	0	0	0	0	0
Oc. transpadanus	+	+	+	+	+	+	+	0	0	0
P. antipai	0	+	0	+	+	+	0	0	+	0
P. opisthoductus	+	+	0	+	0	+	+	+	0	0
P. tuberculatus	+	+	+	+	+	+	0	+	+	+

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Opusc. Zool. Budapest, 2011, 42(1): 75–93

Comparative study on the taxonomic relevance of gnathosomal structures in the family Zerconidae (Acari: Mesostigmata)

ZS. UJVÁRI[1]

Abstract. Taxonomic relevance of hypostomal, subcapitular, epistomal and cheliceral characters within the family Zerconidae is discussed with remarks on ontogeny, sexual-, individual- and interspecific variability of these characters. The general structure and chaetotaxy of the hypostome and subcapitulum is one of the most invariant among gnathosomal parts, only the shape of hypostomal, capitular and palp trochantral setae seem to have diagnostic relevance. A method is proposed for description of relative robustness of chelicerae. The importance of observation of subcapitular, hypostomal and cheliceral morphology is emphasized by the example of *Syskenozercon* and *Rotundozercon*. A more careful typified system of the epistome morphology (which was previously considered as a character of generic importance) in the known Zerconidae taxa is presented.

Keywords. Acari, Zerconidae, gnathosoma, ontogeny, sexual differences, taxonomic value.

INTRODUCTION

Taxonomic characterization of Zerconidae is based on quite a few structures in comparison with other Mesostigmata genera. The most frequently used characters are the idiosomal chaetotaxy, adenotaxy, sculpturing pattern (with dorsal cavities) and the shape of ventral shields and peritreme (see Ujvári, 2010, 2011), while legs and gnathosoma are rather neglected. Up to now, the descriptive paper of Athias-Henriot (1976) is the most detailed in respect to the former body parts and provides the most complete description of a Zerconidae species so far. However, early observations proposed that there is no significant variability in leg- and gnathosomal characters within Zerconidae (with the exception of the epistome which is a structure of very diverse shape, therefore is frequently illustrated in descriptive Zerconidae literature). These observations left their mark on the subsequent Zerconidae literature and served as a basis for nowadays trend, that zerconid species can sufficiently and satisfactorily be described on the basis of idiosomal characters.

The generalized description of gnathosomal structures and legs firstly appeared in the monograph of Halašková (1969a) and subsequently in the summarizing work of Błaszak (1974). Both authors assert that only the shape of tectum is diagnostic, and only in case of a couple of species or at the level of genera (while Halašková also found that *Z. (Z.) arcuatus* possesses distinctive, special chelicerae).

Following the interpretation of the former authors, many information can be found on the epistomes (and rarely on the chelicerae) of different zerconid species and genera in the subsequent papers (e.g. Błaszak, 1981, 1984; Halašková, 1969b, 1977, 1979; Petrova, 1979; Solomon, 1984; Călugăr, 2001/2003), but nor legs, neither capitular structures were observed thenceforth.

The aim of this paper is to review selected gnathosomal structures of Zerconidae with special interest to individual and intraspecific morphological variability and with remarks on their appropriateness in taxonomic characterization.

MATERIAL AND METHODS

This study is based in part on the examination of the slide-mounted Zerconidae-material of the Soil Zoology Collection, Hungarian Natural History Museum (HNHM), Budapest and also on the data and illustrations of gnathosomal structures available in the literature. Original drawings were made with the aid of a drawing tube. Scanning micrographs were taken in the HNHM, Budapest, with a Hitachi S-2600N scanning electron mic-

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roscope (specimens investigated were sputter coated with gold-palladium).

Specimens of the following genera and subgenera were available for study in the HNHM (abbreviations used along the text in brackets): *Amerozercon* Halašková, 1969 (*A.*), *Aquilonozercon* Halašková, 1979 (*Aq.*), *Aspar* Halašková, 1977 (*As.*), *Bakeras* Błaszak, 1984 (*Ba.*), *Blaszakzercon* Kemal & Koçak, 2008 (*Bn.*), *Boreozercon* Diaz-Aguilar & Ujvári, 2010 (*Bo.*), *Carpathozercon* Balan, 1991 (*Ca.*), *Echinozercon* Błaszak, 1975 (*E.*), *Eurozercon* Halašková, 1979 (*Eu.*), *Hypozercon* Błaszak, 1981 (*H.*), *Kaikiozercon* Halašková, 1979 (*K.*), *Koreozercon* Halašková, 1979 (*Ko.*), *Macrozercon* Błaszak, 1975 (*Ma.*), *Mesozercon* Błaszak, 1975 (*Me.*), *Microzercon* Błaszak, 1975 (*Mi.*), *Mixozercon* Halašková, 1963 (*M.*), *Parazercon (Parazercon)* Trägårdh, 1931 [*P. (P.)*], *Parazercon (Formosella)* Ujvári, 2011 [*P. (F.)*], *Prozercon* Sellnick, 1943 (*P.*), *Rotundozercon* Ujvári, 2011 (*R.*), *Skeironozercon* Halašková, 1977 (*S.*), *Zercon (Zercon)* C. L. Koch, 1836 (*Z.*), *Zerconella (Zerconella)* Willmann, 1953 [*Za. (Za.)*] and *Zerconella (Metazercon)* Błaszak, 1975 [*Za. (M.)*].

Further useful information was found in the Zerconidae-literature on hypostome, chelicerae or epistome of the following genera: *Blaszakiella* Sikora & Skoracki, 2008 (*Bl.*), *Bledas* Halašková, 1977 (*B.*), *Caurozercon* Halašková, 1977 (*C.*), *Krantzas* Błaszak, 1981 (*Kr.*), *Lindquistas* Błaszak, 1981 (*L.*), *Monozercon* Błaszak, 1984 (*Mo.*) and *Syskenozercon* Athias-Henriot, 1976 (*Sy.*). Drawings about different structures of these genera were made after Athias-Henriot (1976), Błaszak (1981, 1984), Błaszak *et al.* (1997) Halašková (1969a, 1969b, 1977, 1979), Ma (2002), Petrova (1979), Sikora & Skoracki (2008) and Skorupski & Luxton (1996).

Unfortunately there is no reliable information on the gnathosomal structures of *Aleksozercon* Petrova, 1978, *Cosmozercon* Błaszak, 1981, *Indozercon* Błaszak, 1978, *Neozercon* Petrova, 1977, *Paleozercon* Błaszak, Cokendolpher & Polyak, 1995, *Parhozercon* Błaszak, 1981, *Xenozercon* Błaszak, 1976 and *Zercon (Icozercon)* Błaszak, 1979 therefore these taxa are not included in this evaluation.

OBSERVATIONS ON GNATHOSOMAL STRUCTURES OF ZERCONIDAE

Ventral region of gnathosoma (subcapitulum, hypostome and palp trochanter)

Basic organisation (Figs 1 a–b). Gnathosoma is a characteristic, highly specialized body region of mites. It is composed of the subcapitulum, the hypostome, the pedipalps, the chelicerae, the labrum and the epistome. Basally, the coxae of palps are connected to the idiosoma; their medial extension and coalescence of ventral portions forms the subcapitulum, the floor of the gnathosomal tube. The subcapitulum anteroventrally continues in the hypostome. A pair of chelicerae can be found between the palps, above the stome, these are the primary organs of food acquisition and usually are retractible. Below the chelicerae (but above the stome) sits the labrum. Dorsally, the gnathosoma is roofed by the epistome.

From a ventral view, the surface of subcapitulum, hypostome, palps and chelicerae are visible (Figs 1 a–b). Hypostome is prolonged anteromedially by the internal malae, and anterolaterally carries a pair of corniculi. The hypostome bears three pairs of hypostomal setae (*h1–3*), while the subcapitulum carries a single pair of capitular setae (*h4*). The situation of these setae is characteristic for the family Zerconidae: setae *h1* between the insertions of corniculi, *h2* posterior to *h1*, *h3* lateral to *h2*, *h4* posterior to *h3*. Basically these setae constitute two pairs of rows parallel to the body axis: rows *h1–h2* and *h3–h4*. A subcapitular groove is found along the central surface of the subcapitulum, which consists of several horizontal lines of phylliform cuticular structures. These phylliform structures are often hard to recognize by light microscopy, and usually it seems that the subcapitular groove is divided by transverse indentations (*Q*-lines, after Hirschmann 1959).

Ontogeny (Figs 2a–e). Larvae of Zerconidae bear only two pairs of hypostomal setae (Fig. 1 a), *h1* and *h2*, while the palp trochanter lacks both ventral setae. The remaining hypostomal and capitular setae (*h3*, *h4*) appear in protonymphal

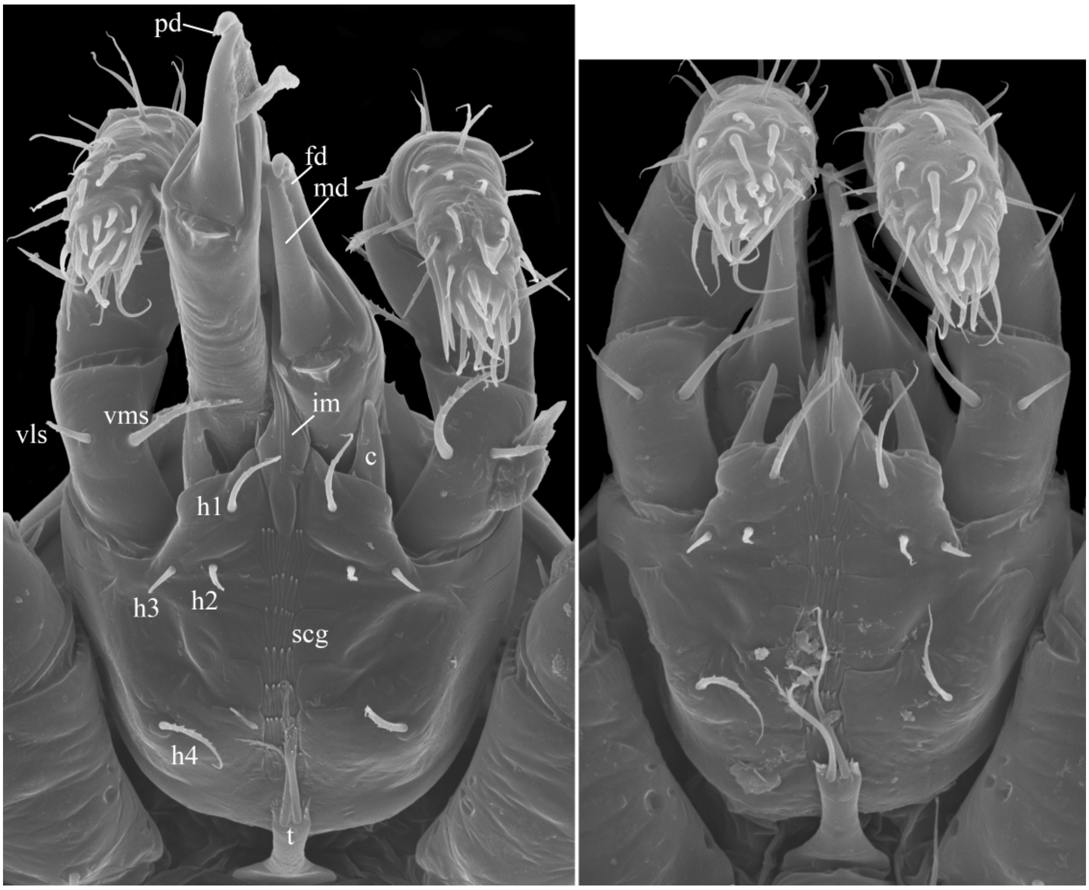

Figure 1. Ventral view of gnathosoma of *Z. (Z.) albanicus* Ujvári, 2010 (SEM photos): a = female, b = male

stage (Fig. 2 b) with one of the palp trochantral setae, the other pair of palp trochantral setae appears in deutonymphal stage (Fig. 2 c). Proportion of length of hypostomal and palp trochantral setae is approximately constant however the complexity of their shape develops during ontogeny. On protonymphs of each species observed setae *h1–4* and palp trochantral setae are simple, while setae *h4* become always serrate in adults of each genera. However both *h1* and ventrolateral palp-trochantral setae may become finely serrate in adult stage, which seems to be characteristic for species of larger size. The subcapitular groove and phylliform structures are hard to recognize on the ventral surface of larval gnathosoma. Distinct phylliform structures firstly appear in protonymphs, on caudoventral surface of subcapitulum, anterior *Q*-lines appear only in deutonymps, and the series become complete only in adults. Corniculi and internal malae are basically similar in each development stages however length of the bifurcate anterocentral appendices and complexity of marginal dentation of internal malae grows through the ontogeny.

Sexual differences (Figs 2 d–e_3, 3 a–f). Differences between female and male may occur only in the shape of proper hypostomal and palp trochantral setae (and evidently in size of gnathosoma). For example, ventrolateral palp trochantral setae and *h1* are smooth in male (Fig. 2 d) of *S. tricavus*, but finely serrate in female (Figs $e_{1–3}$).

Intraspecific variability (Figs 2 $e_{1–3}$). Number of *Q*-lines of subcapitular groove seems to be the only character of intraspecific variation of the ventral region of gnathosoma. According to Hirschmann (1959) and Karg (1993) 7 pairs of denticulate and a single pair of simple *Q*-line is characteristic for Zerconidae, however Halašková

(1969a) did not find the first, simple *Q*-line, instead she found that there is another, extra, denticulate *Q*-line between $Q_{4\text{-}5}$. Both conceptions suggest that basically 8 transverse *Q*-lines are to be found in the family. However, after the observation of many specimens it seems that this number shows variation even within a population, therefore it is quite an unstable character. For example females of *S. tricavu*s usually have 6–8 *Q*-lines.

Interspecific variability (Figs 4 a–g). The most conspicuous difference among Zerconidae species and genera is the size of gnathosoma. Shape of corniculi and internal malae, position and proportion of length of setae *h1–4* are similar in almost each species and genera: corniculi horn-like; internal male with a pair of bifurcate antero-central appendices and with serrate margins; setae *h*1 elongate, situated medial to insertions of corniculi; *h2* nearly as long as *h1*, positioned posterior to *h1*; *h3* shorter than *h2*, lying lateral to it; *h4* elongate, posteriorly to *h3*. However, it is most interesting, that *Syskenozercon* seems to be different from these standards, since, on the basis of Athias-Henriot's (1976) drawings it has smooth internal malae with not bifurcating appendices and setae *h2* and *h4* are significantly shorter than *h3* which is nearly as long as *h1*. *Sy. kosiri* seems to be the only species of the family which differs from the general zerconid type on the basis of the former hypostomal and subcapitular characters.

Shape of *h1-4* and ventral palp trochantral setae are characteristic at species level, but show only minute differences with only two recognized character states: smooth and serrate. This variation is found only in setae *h1* and ventrolateral palp trochantral setae. In general it seems that complexity and conspicuousness of serration of these setae grow with the size of setae. As the proportion of length of these setae is nearly constant in each Zerconidae (except *Syskenozercon*) and the size of these correlates positively with the size of idiosoma, the larger a species is, the larger gnathosomal setae it has, of which *h4* and ventromedial palp trochantral setae are the longest and thickest, and always are serrate. Setae *h1* are also approximately as long as the formers, but slimmer. The ventrolateral palp trochantral setae are often also thick, even though shorter than the formers, therefore conspicious serration of these setae often characterize larger species. The *h2–3* setae are slim, and shorter than the other subcapitular setae and seem to be smooth on most of the species.

As the number of *Q*-lines is a character of remarkable intraspecific variation, it is pointless to mention it in interspecific context, even if on the basis of the figures (e.g. Figs 4 b, c, f, g) it seems that some of the genera (e.g. *Mesozercon*, *Mixozercon*, *Syskenozeron* and *Zerconella*) have characteristicly less transverse lines, which may be due to the study of a single or very few specimens.

Taxonomic value. As a conclusion, the ventral region of gnathosoma bears very few useful characters to consider in taxonomy and classification of Zerconidae. The size of gnathosoma is in positive correlation with the size of idiosoma, shape of corniculi and internal malae, proportion of length of setae *h1–4* are mostly invariant (except for *Syskenozercon*), number of *Q*-lines crossing the subcapitular groove varies between 5 and 8 and cannot be used for discrimination of species or genera. The only relevant character is the shape of *h1-4* and palp trochantral setae, which present only a couple of character-combinations. Moreover, smoothness or pilosity of these setae is often not easy to detect by light microscopy, only scanning electronmicroscopy offers a reliable way, therefore the general usefulness of these characters is ambiguous.

Chelicerae

Basic organisation. The three-segmented chelicerae are well-developed, relatively slender in Zerconidae, and always possess a simple dorsal seta. Both digits bear a couple of large, recurved teeth, which suggest together with the slenderness

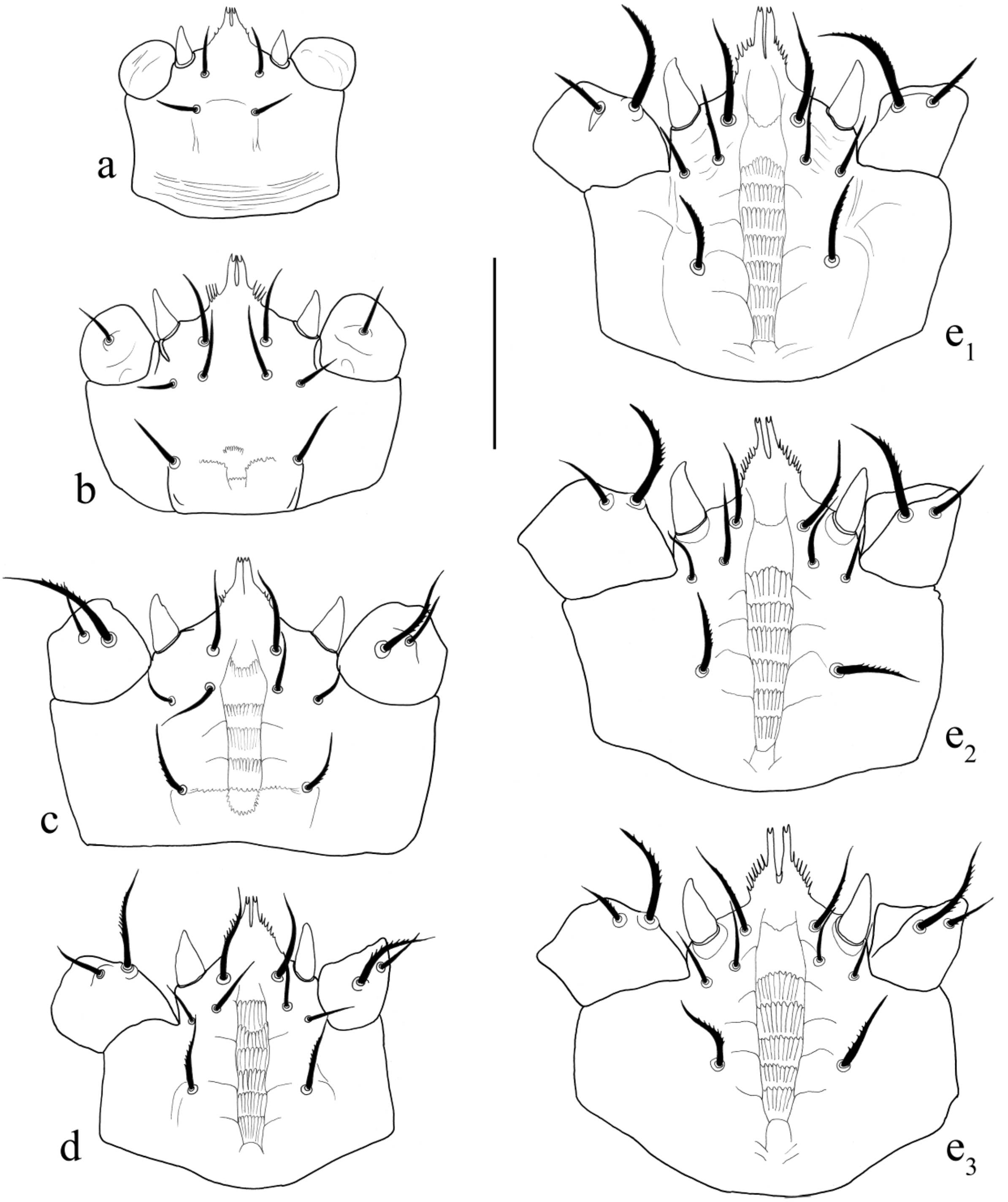

Figure 2. Ontogeny of ventral region of gnathosoma in *S. tricavus* Błaszak, 1982 (ventral view): a = larva, b = protonymph, c = deutonymph, d = adult male, e_{1-3} = adult female

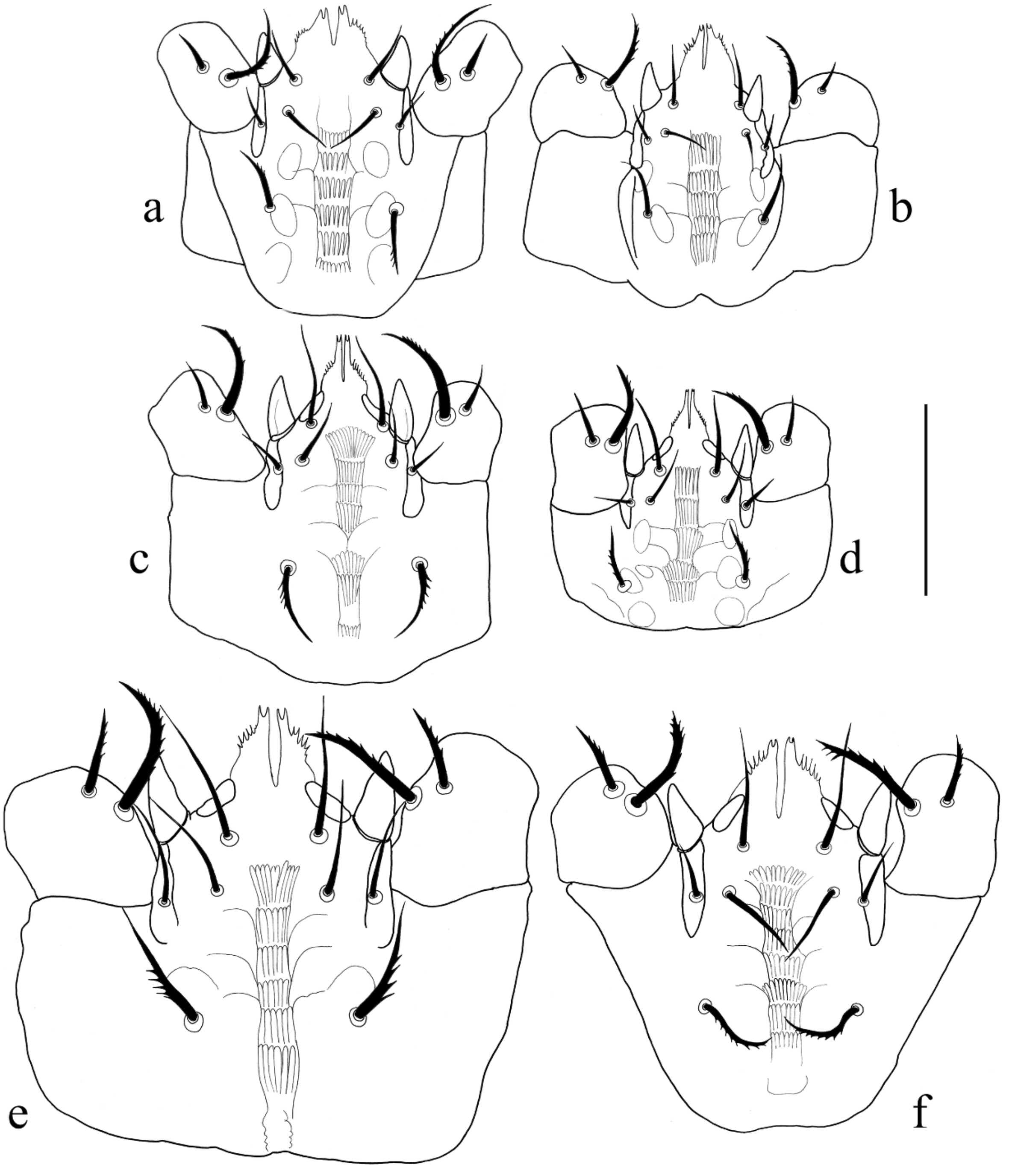

Figure 3. Ventral region of gnathosoma of different Zerconidae genera (both sexes, ventral view): a = *P. (F.) mirabilis* Ujvári, 2011, female, b = *P. (F.) mirabilis* Ujvári, 2011, male, c = *P. dominiaki* Błaszak, 1979, female, d = *P. dominiaki* Błaszak, 1979, male, e = *R. shuriken* Ujvári, 2011, female, f = *R. shuriken* Ujvári, 2011, male

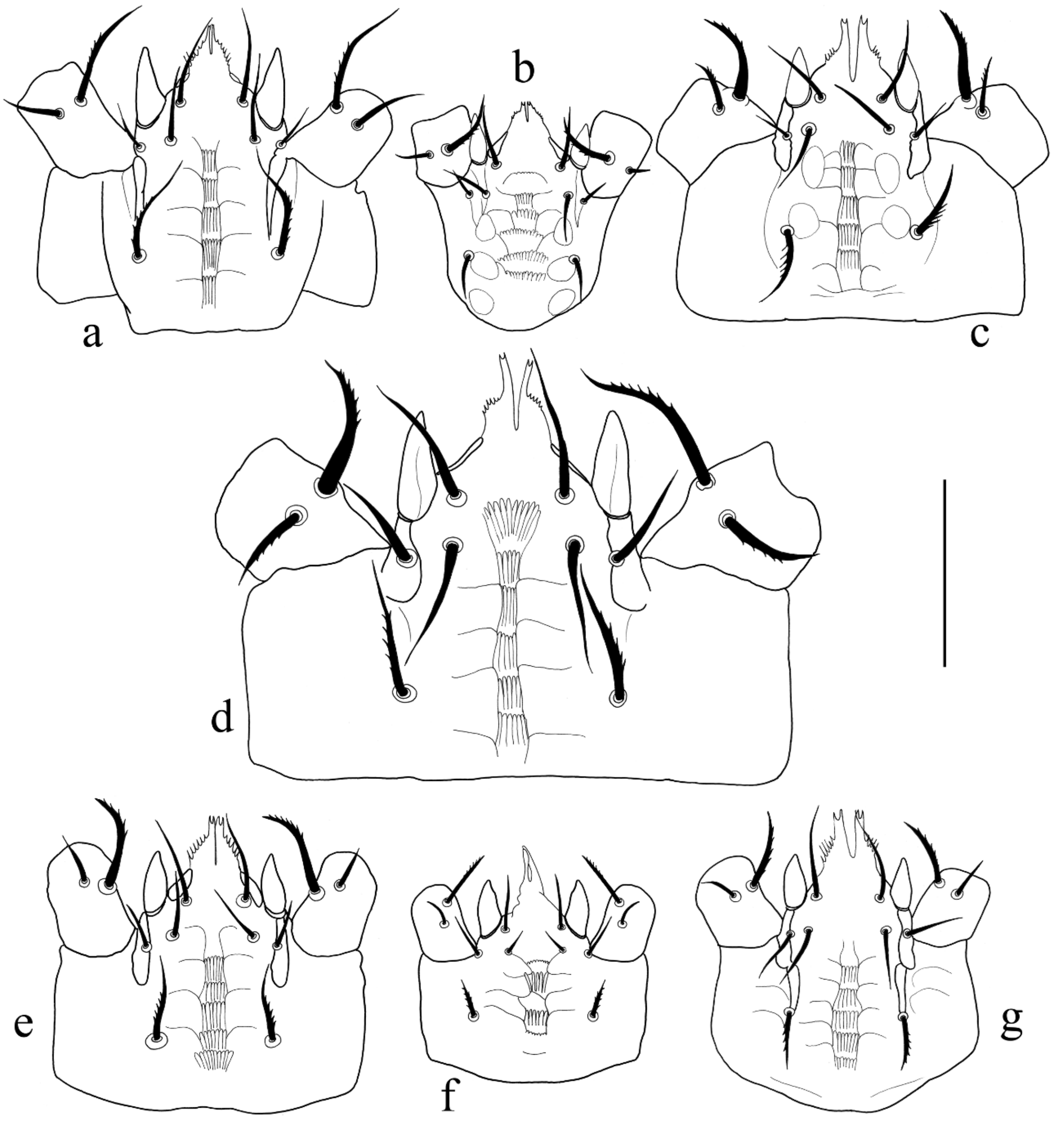

Figure 4. Ventral region of gnathosoma of different Zerconidae genera (females, ventral view): a = *Z. (Z.) serenus* Halašková, 1969, b = *Me. plumatus* (Aoki, 1966), c = *M. borealis* Diaz-Aguilar & Ujvári, d = *Z. (Z.) thulium* Athias-Henriot, 1980, e = *P. dramaensis* Ujvári, 2011, f = *Sy. kosiri* Athias-Henriot, 1976, g = *Za. (M.) lobata* Ujvári, 2010

that zerconid mites primarily feed on Nematodes (Karg, 1993). The movable digit has always fewer teeth than the fixed one. Movable digit of male does not bear any spermatophoral processes. As Halašková (1969a) indicates, there is a small, vestigial, hyaline structure on the fixed digit of chelicerae, between the first and second tooth, lateral to the line of teeth, which is homologous with pilus dentilis of other Mesostigmata. Unfortunately there are no SEM photos to support or disprove the presence of pilus dentilis in Zerconidae, however my personal observations suggest that this anterior knob is more likely homologous with cheliceral teeth.

Ontogeny (Figs 5 a–e). Chelicerae are well-developed and similar in each stage, only the length of segments and their robustness change during ontogeny. Dorsal seta is present in each stage.

Sexual differences (Figs 5 d–e, o–p, s_1–t_2, $6a_1$–b). Both fixed and movable digits of chelicerae are shorter and more slender in males than in females. Besides, Călugăr (2004/2006) found that the terminal part of the fixed digit is bifurcated in males of *Prozercon* and *Zercon* species she investigated. This fact is supported herein by other species and genera, and seems to be a general feature in the family.

Intraspecific variability (Figs 5 $n_{1–2}$, $s_{1–3}$, $t_{1–2}$, $6a_{1–3}$, $d_{1–2}$, $e_{1–2}$, $f_{1–2}$). There is considerable variation in length of digits, even within a population, as it was observed for example in *P. similis* females (Figs $s_{1–3}$), where length of movable digit varies between 23–28 µm (n = 15, mean = 25 µm, SD = 1.55 µm). Number of teeth on the movable digit of *P. similis* is 4 in general, and varies between 4–6, on the fixed digit this number is most often 5, and varies between 5–8.

Interspecific variability (Figs 5 e–v, 6 a–i). Shape and appearance of chelicerae is very similar in most of the Zerconidae genera and species. Minimum, maximum and avarage number of teeth of both digits show also similar values in most of the species. Comparing a typical *Zercon* (Figs 6 c–f) with a *Prozercon* (Figs 5 n–u) species, it seems that the major distinguishing feature of chelicerae is their size. Species of larger size possess larger chelicerae, which are similar in shape of digits and shape/number of large, recurved teeth to those of the smaller species. Therefore nor the number of teeth, neither the general appearance of the digits are characteristic for most of the Zerconidae genera and species.

There are however species which posses special chelicerae, different from those having the general type (Figs 5 e–v, 6 c–f). There is a type which bears large teeth on both digits, with a number of 4–6 on each (similarly to the general type), but the digits have a characteristic elongate, slim shape (Figs 6 h–i) in contrast to the more robust chelicerae observed in most of the genera. The elongate, slim cheliceral digits with large teeth are characteristic for a small group of *Zercon* species [including *Z. (Z.) lischanni* (Fig. 6 h) and *Z. (Z.) arcuatus* (Fig. 6 i)], supporting that these species are closely related and constitute a special group within the genus which is corroborated by the dorsal chaetotaxy and adenotaxy as well.

With respect to the chelicerae, the most extreme member of the family is the monotypic genus *Rotundozercon* (Figs 6 a–b). Its cheliceral digits are long, slim, and possess approximately twice as many teeth than that of any other species (where these structures were observed). Moreover, most of these teeth are extremely small. Besides the large terminal teeth, only a single large, revurved tooth can be found in females, on the proximal part of digits, but it seems to be absent in males. Behind the terminal hook of the movable digit, 8–10 very small teeth are sitting in a row, while 10–12 of these can be observed on the fixed digit. Terminal part of fixed digit possesses 3–5 longer teeth in a small area in both sexes (tripartite in males, in contrast to the general bifurcate form of other zerconids). According to the unique shape of chelicerae, *Rotundozercon* very likely has a special diet among Zerconidae.

Taxonomic value. Characterization and figures of chelicerae are lacking from most of the descriptive literature of Zerconidae. In contempt of the remarkable individual variability (experienced in size of cheliceral digits and number of teeth) and the paucity of interspecific differences, these structures may carry important informations, which can be useful for discrimination of species and even classification of higher level taxa. The instance of *R. shuriken*, *Z. (Z.) arcuatus* and *Z. (Z.) lischanni* supports that it is important to make

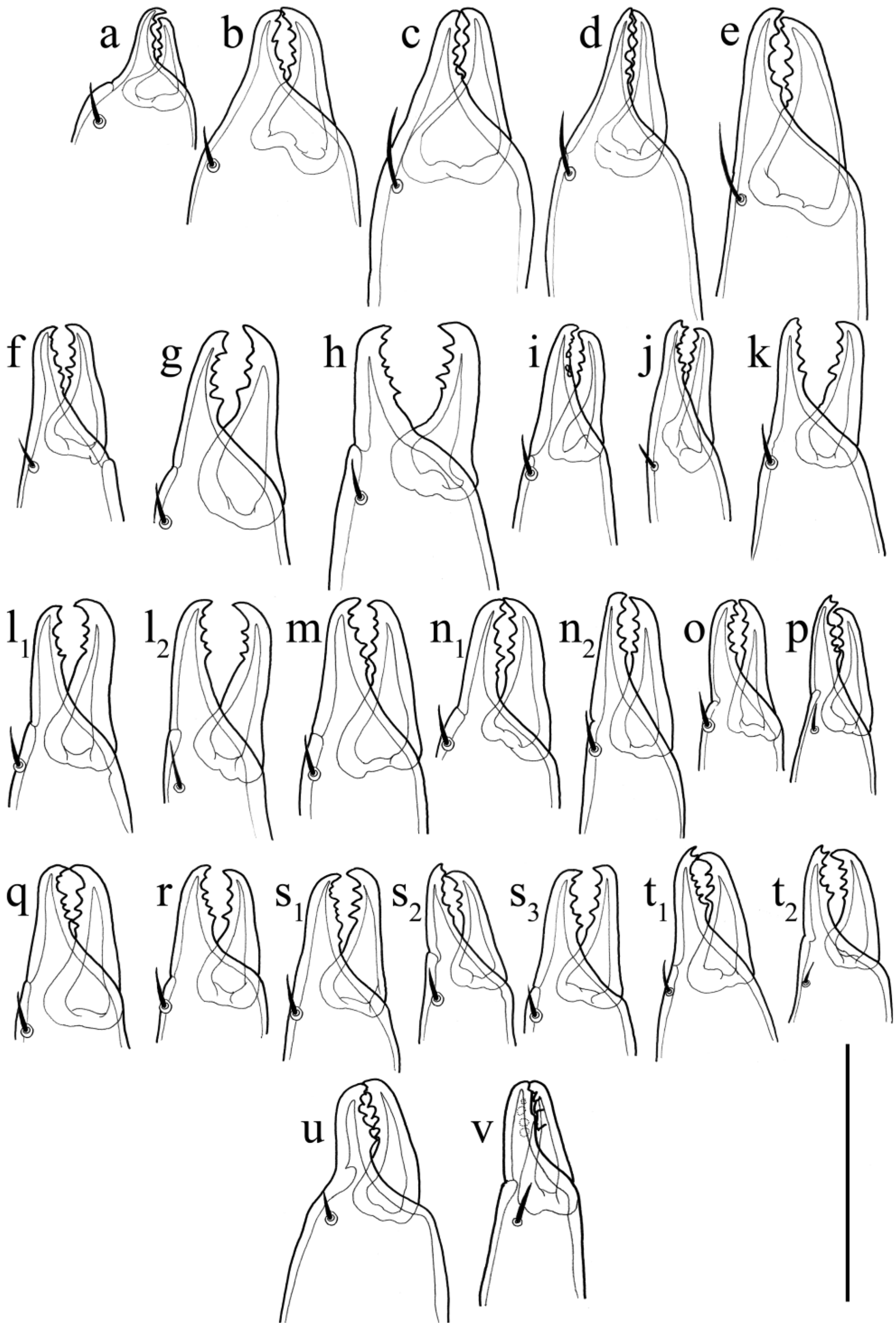

Figure 5. a–e: Ontogeny of chelicerae in *S. tricavus* Błaszak, 1982: a = larva, b = protonymph, c = deutonymph, d = adult male, e = adult female; f–v: chelicerae of different Zerconidae: f = *Bo. emendi* Diaz-Aguilar & Ujvári, 2010, female, g = *Ca. tuberculatus* (Košir, 1974), female, h = *H. macleani* Błaszak, 1981, female, i = *Ko. bacatus* Halašková, 1979, female, j = *M. albertaensis* Diaz-Aguilar & Ujvári, 2010, female, k = *M. borealis* Diaz-Aguilar & Ujvári, 2010, female, l_{1-2} = *P. (F.) mirabilis* Ujvári, 2011, female, m = *P. (P.) radiatus* (Berlese, 1910), female, n_{1-2} = *P. carpathicus* Balan & Sergienko, 1991, female, o = *P. fimbriatus* (C. L. Koch, 1839), female, p = *P. fimbriatus* (C. L. Koch, 1839), male, q = *P. kochi* Sellnick, 1943, female, r = *P. kunsti* Halašková, 1963, female, s_{1-3} = *P. similis* Balan, 1992, female, t_{1-2} = *P. similis* Balan, 1992, male, u = *P. verruciger* Mašán & Fenďa, 2004, female, v = *Sy. kosiri* Athias-Henriot, 1976, female

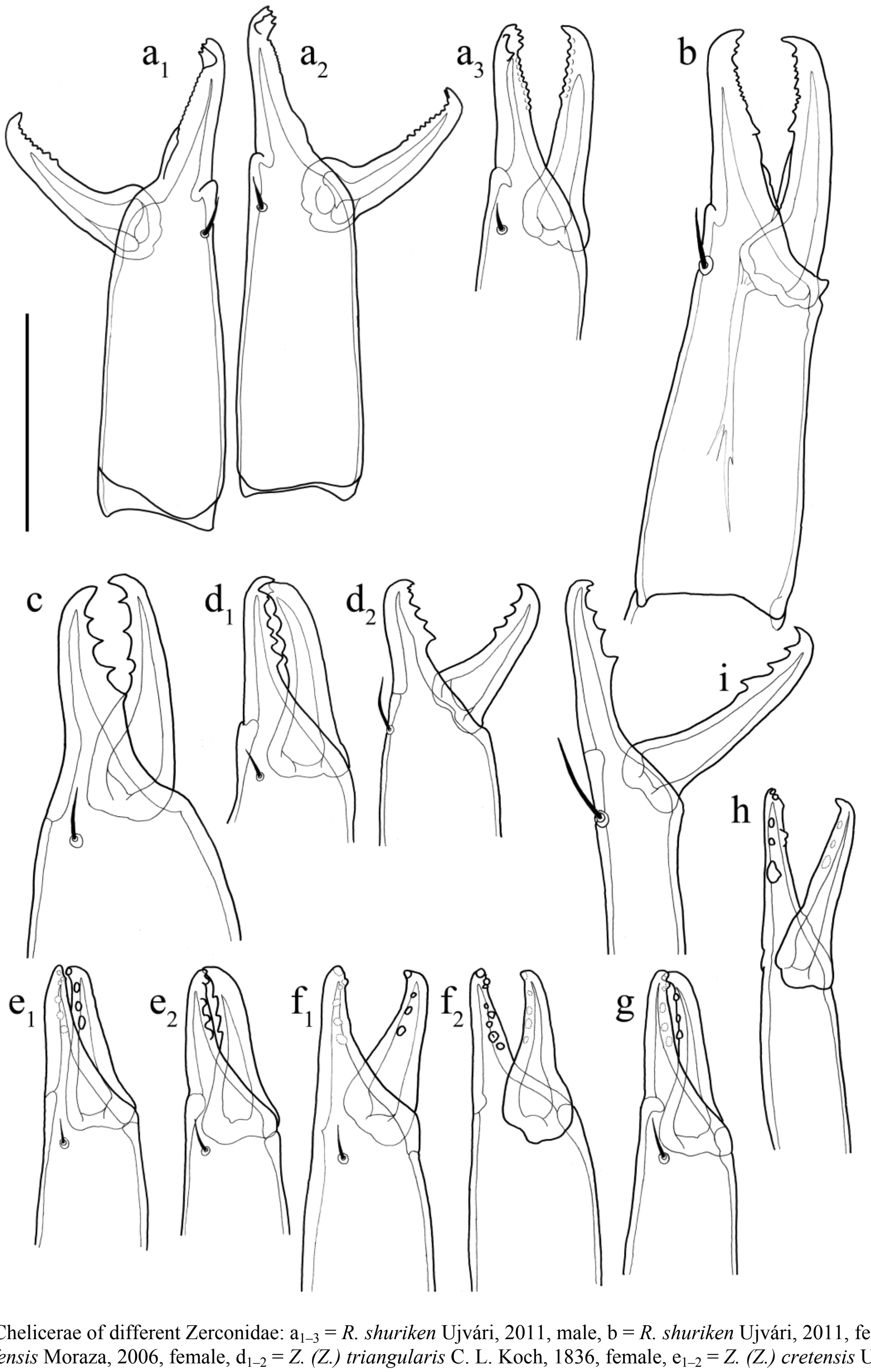

Figure 6. Chelicerae of different Zerconidae: $a_{1–3}$ = *R. shuriken* Ujvári, 2011, male, b = *R. shuriken* Ujvári, 2011, female, c = *Z. (Z.) tenerifensis* Moraza, 2006, female, $d_{1–2}$ = *Z. (Z.) triangularis* C. L. Koch, 1836, female, $e_{1–2}$ = *Z. (Z.) cretensis* Ujvári, 2008, female, $f_{1–2}$ = *Z. (Z.) schweizeri* Sellnick, 1944, female, g = *Z. (Z.) tsoi* Ujvári, 2011, female, h = *Z. (Z.) lischanni* Schweizer, 1961, female, i = *Z. (Z.) arcuatus* Trägårdh, 1931, female

an effort to observe and describe chelicerae of each new species of Zerconidae. For a correct description it would be neccessary to give the following measurements: average length and largest width of movable digit of chelicerae (with standard deviation). On the basis of the proportion value calculated from former data, a relative robustness of chelicerae can be given, which may serve as a good morphometric character.

Epistome

Basic organisation. The epistome (or tectum) is a well developed, anteromarginally serrate or spiny plate in Zerconidae which roofs the gnathosoma.

Ontogeny (Figs 7 a_1–x_3). Complete ontogeny of epistome was available to observe only on *Mixozercon*, *Parazercon*, *Skeironozercon* and *Zercon* species. It seems that there is no difference between genera in shape of epistome of proper stages, up to deutonymphs, the different, characteristic shapes appear only in adults (it was supported also by incomplete ontogenetic series of many other genera). In most of the specimens observed, there are four conspicuous, prolonged anterior processes on larvae, protonymphs and deutonymphs as well, of which the medial pair is longer than the lateral [sometimes one or three medial processes can be observed (Figs b_2, v_3)]. In species, where adults possess a single medial process besides the lateral pair, the two medial processes of deutonymphs seem to have a common 'root', as a single medial process with a wide basis and a deep distal incision between the two long tips.

Sexual differences (Figs 9 a–j). There is a great individual variation in shape of epistome of each Zerconidae species however no such differences were found so far which are characteristic for sexes.

Intraspecific variability (Figs 8 a_1–l_3). Epistome of different species was often described or figured earlier by proper authors (e. g. Halašková, 1969b and Petrova, 1979), but its strong individual variability was emphasized only by Halašková (1969a). Despite of her former observations, Halašková (1977) continued to give a general description of epistome of the new species found in North America, avoiding the fact of variability, therefore, based on her descriptions it may seem that some *Zercon* species characteristicly have bifurcate medial process on epistome, others have tripartite medial process (suggesting that it a specific character). Unfortunately it is not true, and can be misleading if taken into account in identification.

Other authors regarded the shape of epistome as a character of generic distinction (e.g. Błaszak, 1984), which is a more careful way to take this feature into account in taxonomy. But omitting to observe this character on many specimens can also be misleading, even on generic level, as it is discussed below.

The most conspicuous target of intraspecific variation is the anterocentral region of epistome. Looking at a couple of *Z. (Z.) triangularis* specimens (Figs. 8 a_{1-8}), it becomes obvious that its elongate, middle process may take various forms (even within a population), and its distal structure (simple, bifurcate or tripartite) is not characteristic for the species. Adults of *Mixozercon* species show similar variability, with an extreme form found in *M. albertaensis* (Fig. 8 b_1), where the base of the central part is wide, and its apical region is divided into three major serrate spines, of which the central is bifurcating. The variations observed are most intereresting in *Z. (Z.) lischanni*: epistome of some specimens possesses a single, apically bifurcate medial process (Fig. 8 f_1), but on most of the specimens it bears two elongate medial processes besides the lateral pair which is atypical within the genus.

In some species/genera, the appearance of the two anterolateral processes is also a character of variability, as it can be observed in *Bakeras* and *Prozercon* species (Figs 8 j_1-l_3). Most often the expression of anterior serration of epistome varies within a population too: *Z. (Z.) clairae* serves as a fair example, regarding margins of the middle process of epistome, which may bear small, barely conspicuous (Fig. 7 d_3), or large, acuminous teeth (Fig. 7 d_2).

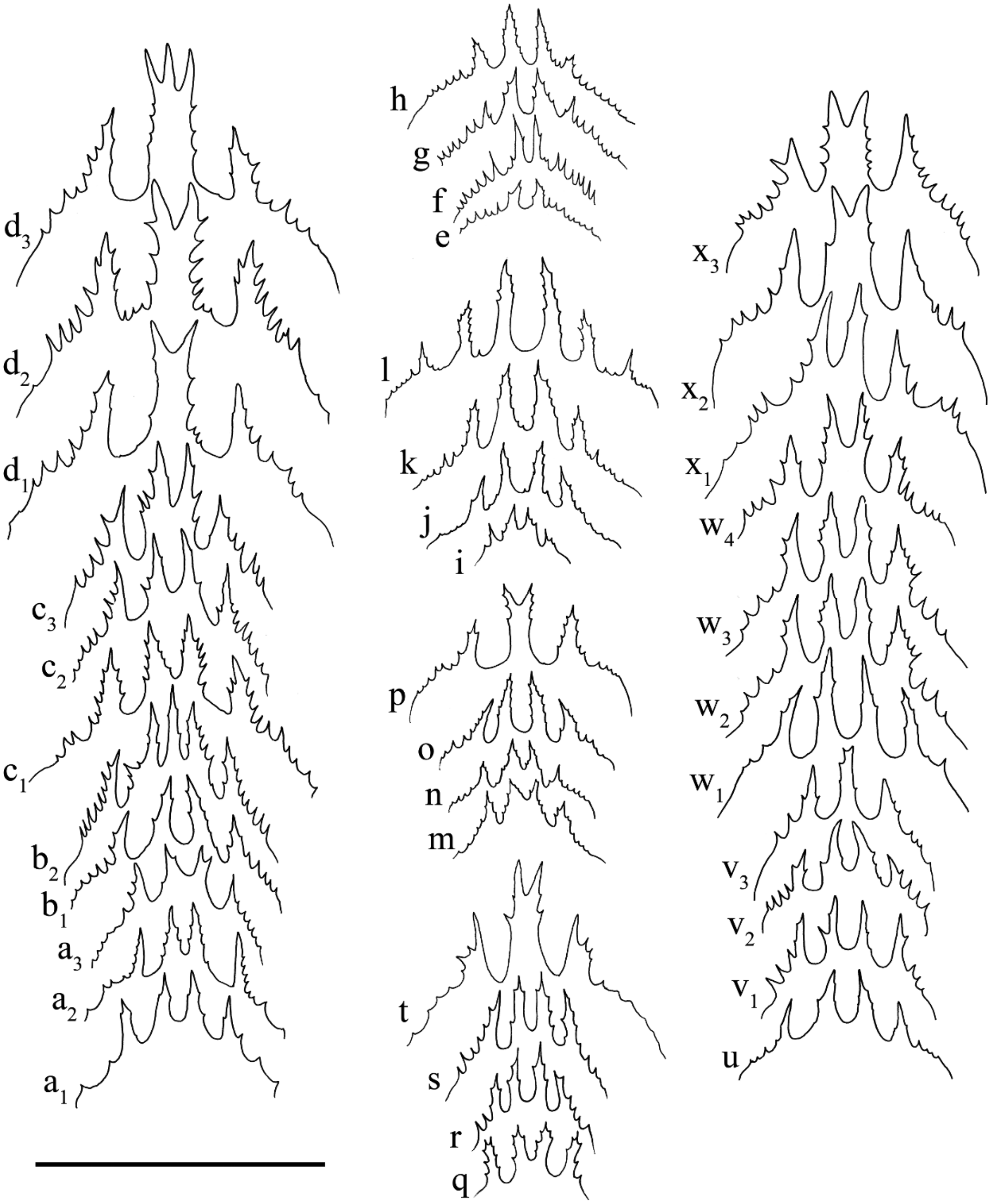

Figure 7. Ontogeny of epistome in different Zerconidae: a–d: *Z. (Z.) clairae* Halašková, 1977: $a_{1–3}$ = larva, $b_{1–2}$ = protonymph, $c_{1–3}$ = deutonymph, $d_{1–3}$ = adult female; e–h: *P. (F.) mirabilis* Ujvári, 2011: e = larva, f = protonymph, g = deutonymph, h = adult female; i–l: *S. tricavus* Błaszak, 1982: i = larva, j = protonymph, k = deutonymph, l = adult female; m–p: *M. albertaensis* Diaz-Aguilar & Ujvári, 2010: m = larva, n = protonymph, o = deutonymph, p = adult female; q–t: *Z. (Z.) carpathicus* Sellnick, 1958: q = larva, r = protonymph, s = deutonymph, t = adult female; u–x: *Z. (Z.) berlesei* Sellnick, 1958: u = larva, $v_{1–3}$ = protonymph, $w_{1–4}$ = deutonymph, $x_{1–3}$ = adult female

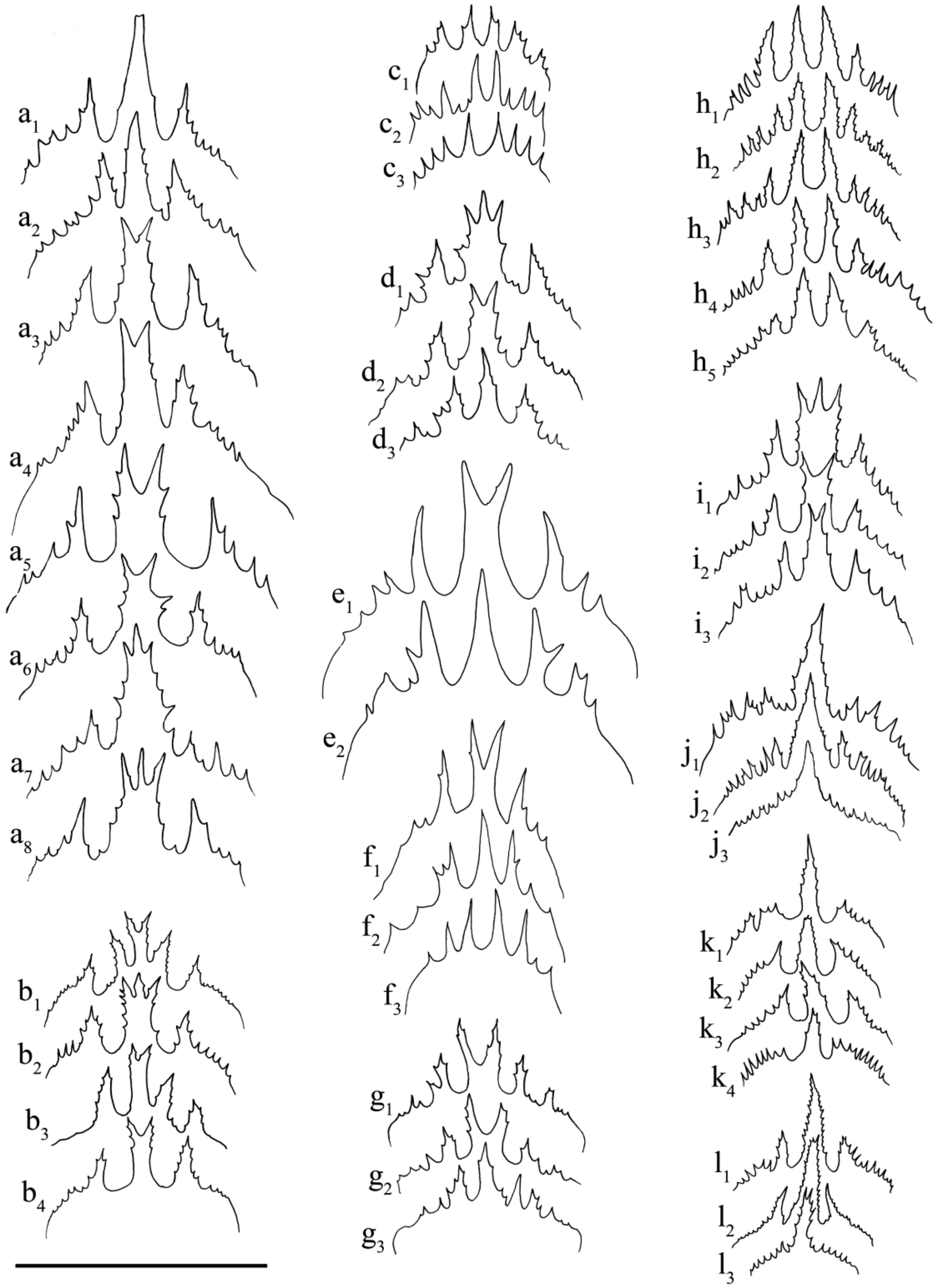

Figure 8. Intraspecific variation of epistome in different Zerconidae species (females): a_{1-8} = *Z. (Z.) triangularis* C. L. Koch, 1836, b_{1-4} = *M. albertaensis* Diaz-Aguilar & Ujvári, 2010, c_{1-3} = *Z. (Z.) arcuatus* Trägårdh, 1931, d_{1-3} = Z. (Z.) *peltatus* C. L. Koch, 1836; e_{1-2} = Z. (Z.) *tenerifensis* Moraza, 2006, f_{1-3} = *Z. (Z.) lischanni* Schweizer, 1961, g_{1-3} = *Za. (M.) lobata* Ujvári, 2010, h_{1-5} = *P. (P.) radiatus* (Berlese, 1910), i_{1-3} = *Z. (Z.) spatulatus* C. L. Koch, 1839, j_{1-3} = *Ba. opiparus* Błaszak, 1984, k_{1-4} = *P. similis* Balan, 1992, l_{1-3} = *P. tragardhi* Halbert, 1923

Interspecific variability (Figs 9 k–ai, 10 a–ab, 11 a–al). As the epistome presents a wide spectrum of individual variability, it is difficult to determine interspecific or intergeneric differences.

Typical epistomes of *Zerconella* species (Figs 9k–o) are quite similar in appearance, each posses four large, serrate processes, of which the medial pair is significantly longer than the lateral pair. After a more careful examination, two major types can be distinguished within the former genus: the first type has less and smaller anterolateral spines, while the incision between their medial processes is reaching approximately half the distance between tips and bases of these (Figs 9 l–m); in the second type, there are more and longer anterolateral spines, while the incision between the medial processes reaches almost up to the bases of latter (Figs 9 k, n–o).

Species of the genus *Mixozercon* (Figs 9 p–t) are more similar to each other in shape of epistome: each possess a long, anteromedial process, which is often bifurcate, a pair of smaller anterolateral process with remarkable serration, and a couple of anterolateral spines lateral to the former structures. These characters are, however, similar to those found in most *Zercon* species.

Species of the genus *Caurozercon* (Figs 9 u–y) also possess a long anteromedial, and two, smaller, anterolateral processes, and the species seem to be different for the first sight based on the shape of the distal region of anteromedial process (simple or bifurcate), and the expression/length of anterolateral processes. Unfortunately there is no information about individual variability of epistome of these species, but considering that these characters vary in other genera these presumably are also useless for distinction of *Caurozercon* species as well.

Prozercon species (Figs 9 z–ai) bear a long, anterocentral process, which is densely serrate and its tip is often simple (rarely bifurcate or tripartite), besides two, significantly shorter anterolateral processes and many anterolateral spines

The largest Zerconidae genus, *Zercon*, is a bit different. While most of its species (Figs 10 a–ab) characteristicly have an epistome similar to those of *Mixozercon*, some *Zercon* species are easy to distinguish. The epistome of one of the largest, *Z. (Z.) tenerifensis* (Figs 8$e_{1–2}$) is quite simple, lacks the fine serration, possesses only smooth processes and some larger spines (in contrast to the distinct serration observed in most *Zercon* species). Another group generally has an epistome atipycal for the genus [*Z. (Z.) arcuatus* (Figs 8 $c_{1–3}$), *Z. (Z.) lischanni* (Figs 8 $f_{1–3}$)], as its species usually have two anteromedial and two anterolateral processes (each simple), however a few specimens of those may possess only three anterior processes, similarly to the typical members of the genus. The case of *Z. (Z.) arcuatus* and *Z. (Z.) lischanni* is a perfect example to illustrate that such variability may exist on the level of individuals which was previously used for generic distinction.

As a matter of fact, it is quite hard to define correct groups on the basis of epistomal characters within Zerconidae. Considering the epistome types most frequently found in different species, the following four major morphotypes can be distinguished: *Prozercon*-, *Zercon*-, *Parazercon*- and *Rotundozercon*-type (named after the genus with the largest species-richness or widest distribution).

The *Prozercon*-type (Figs 11 a–i) possesses a single, apically tapering anteromedial process, the apex of which is usually undivided, and comprises mostly nearctic genera, such as *Bakeras*, *Krantzas*, *Macrozercon* etc. besides the palearctic *Prozercon*.

The *Zercon*-type (Figs 11 l–u) possesses a single, slender anteromedial process, which is apically nearly as wide as basally, and usually apically divided into 2–3 spines. It is the most the most widespread form among Zerconidae.

The *Parazercon*-type (Figs 11 v–ak) is similar to the common form possessed by the larvae, protonymphs and deutonymphs of each Zerconidae, bears four anterior processes, each

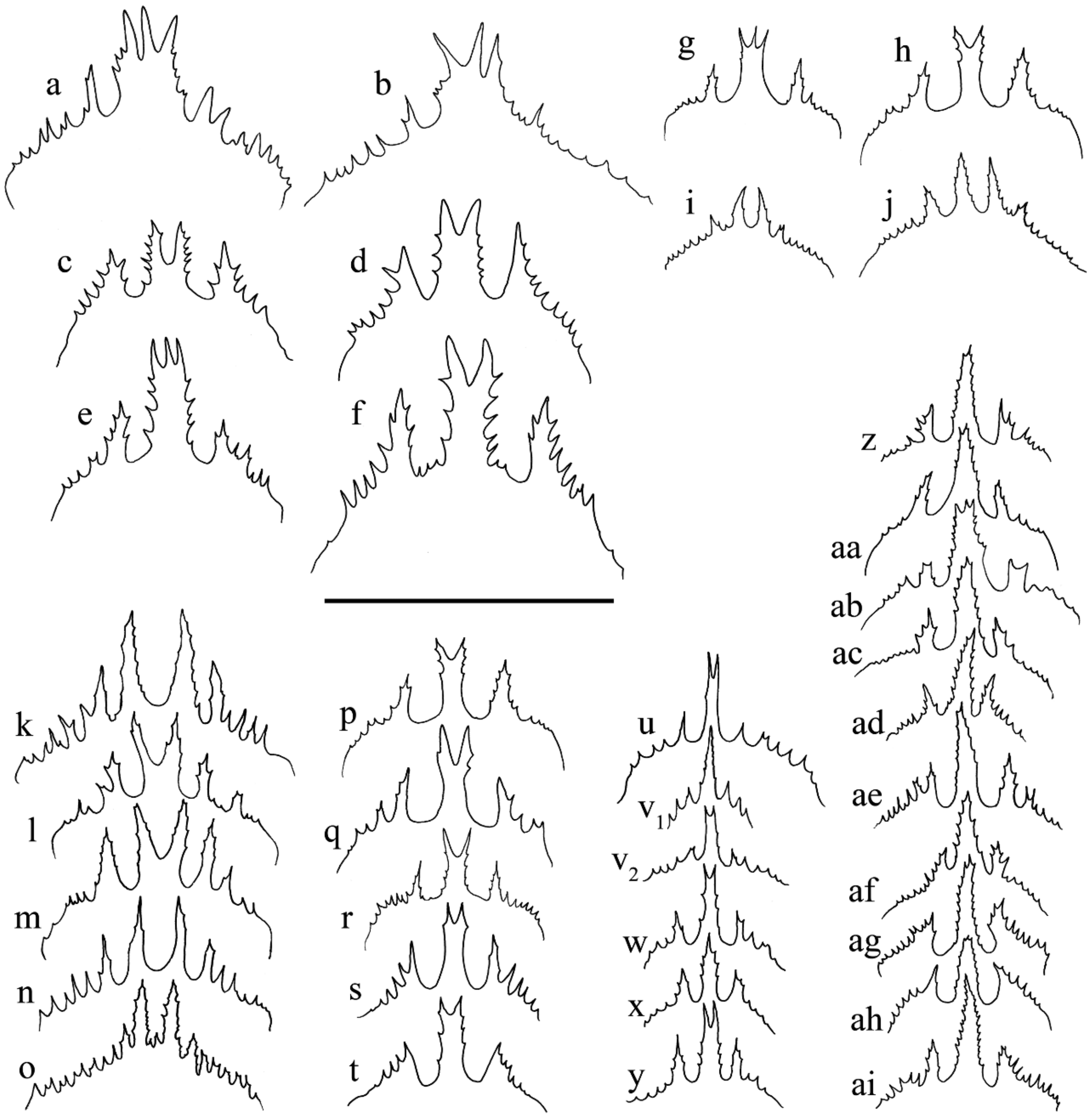

Figure 9. a–j: Comparison of epistomes of both sexes in different Zerconidae: a = *R. shuriken* Ujvári, 2011, male, b = *R. shuriken* Ujvári, 2011, female, c = *Z. (Z.) berlesei* Sellnick, 1958 male, d = *Z. (Z.) berlesei* Sellnick, 1958 female, e = *Z. (Z.) clairae* Halašková, 1977 male, f = *Z. (Z.) clairae* Halašková, 1977 female, g = *M. albertaensis* Diaz-Aguilar & Ujvári, 2010 male, h = *M. albertaensis* Diaz-Aguilar & Ujvári, 2010 female, i = *P. (F.) mirabilis* Ujvári, 2011, male, j = *P. (F.) mirabilis* Ujvári, 2011, female; k–aj: interspecific variation of epistome in different Zeconidae genera (females): k = *Za. (M.) athiasae* (Błaszak, 1975), l = *Za. (M.) lobata* Ujvári, 2010, m = *Za. (Za.) leitnerae* Willmann, 1953, n = *Za. (M.) mahunkai* (Halašková, 1979), o = *Za. (M.) rafalskii* (Błaszak, Kaczmarek & Lee, 1997), p = *M. albertaensis* Diaz-Aguilar & Ujvári, 2010, q = *M. borealis* Diaz-Aguilar & Ujvári, 2010, r = *M. jasoniana* Diaz-Aguilar & Ujvári, 2010, s = *M.* sp., t = *M. sellnicki* (Schweizer, 1948), u = *C. duplexoideus* Ma, 2002, $v_{1–2}$ = *C. duplex* Halašková, 1977, w = *C. similis* Petrova, 1979, x = *C. smirnovi* Petrova, 1979, y = *C. triplex* Petrova, 1979, z = *P. bulbiferus* Ujvári, 2011, aa = *P. cambriensis* Skorupski & Luxton, 1996, ab = *P. carpathofimbriatus* Mašán & Fenďa, 2004, ac = *P. fimbriatus* (C. L. Koch, 1839), ad = *P. graecus* Ujvári, 2011, ae = *P. kochi* Sellnick, 1943, af = *P. morazae* Ujvári, 2011, ag = *P. sellnicki* Halašková, 1963, ah = *P. similis* Balan, 1992, ai = *P. tragardhi* Halbert, 1923

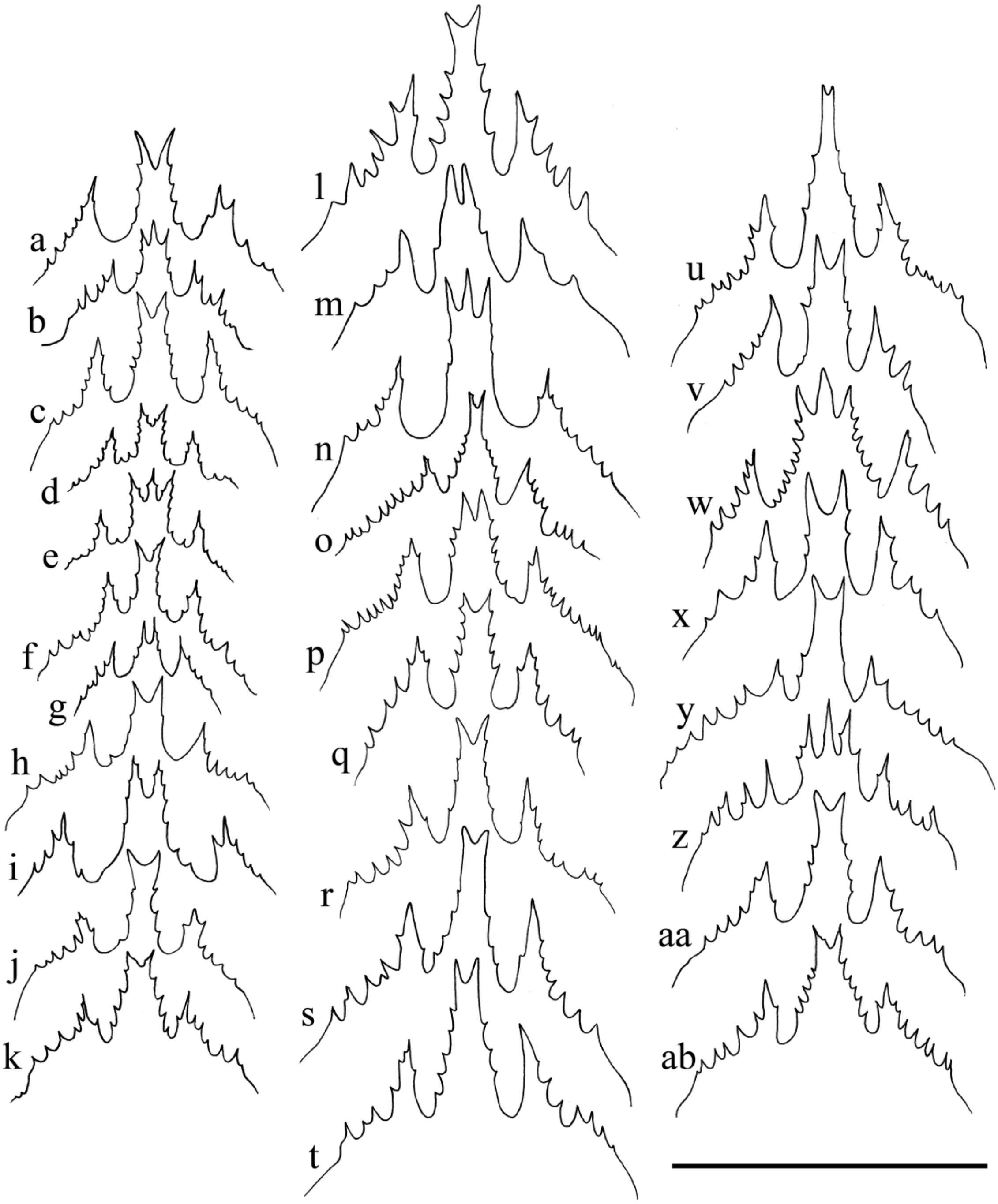

Figure 10. Interspecific variation of epistome within the subgenus *Zercon (Zercon)* C. L. Koch, 1836: a = *Z. (Z.) alaskaensis* Sellnick, 1958, b = *Z. (Z.) asaphus* Błaszak, 1976, c = *Z. (Z.) canadensis* Halašková, 1977, d = *Z. (Z.) carolinensis* Halašková, 1969, e = *Z. (Z.) columbianus* Berlese, 1910, f = *Z. (Z.) insolitus* Halašková, 1969, g = *Z. (Z.) kevani* Halašková, 1977, h = *Z. (Z.) lindquisti* Halašková, 1977, i = *Z. (Z.) michaeli* Halašková, 1977, j = *Z. (Z.) romagniolus* Sellnick, 1944, k = *Z. (Z.) szeptyckii* Błaszak, 1976, l = *Z. (Z.) baloghi* Sellnick, 1958, m = *Z. (Z.) berlesei* Sellnick, 1958, n = *Z. (Z.) clairae* Halašková, 1977, o = *Z. (Z.) comatus* Halašková, 1969, p = *Z. (Z.) cretensis* Ujvári, 2008, q = *Z. (Z.) gerhardi* Halašková, 1979, r = *Z. (Z.) schweizeri* Sellnick, 1944, s = *Z. (Z.) sylvii* Solomon, 1982, t = *Z. (Z.) vacuus* C. L. Koch, 1839, u = *Z. (Z.) gurensis* Mihelčič, 1962, v = *Z. (Z.) hungaricus* Sellnick, 1958, w = *Z. (Z.) kontschani* Ujvári, 2007, x = *Z. (Z.) montigenus* Błaszak, 1972, y = *Z. (Z.) plumatopilus* Athias-Henriot, 1961, z = *Z. (Z.) rafaljanus* Błaszak & Łaniecka, 2007, aa = *Z. (Z.) serenus* Halašková, 1969, ab = *Z. (Z.) tsoi* Ujvári, 2011

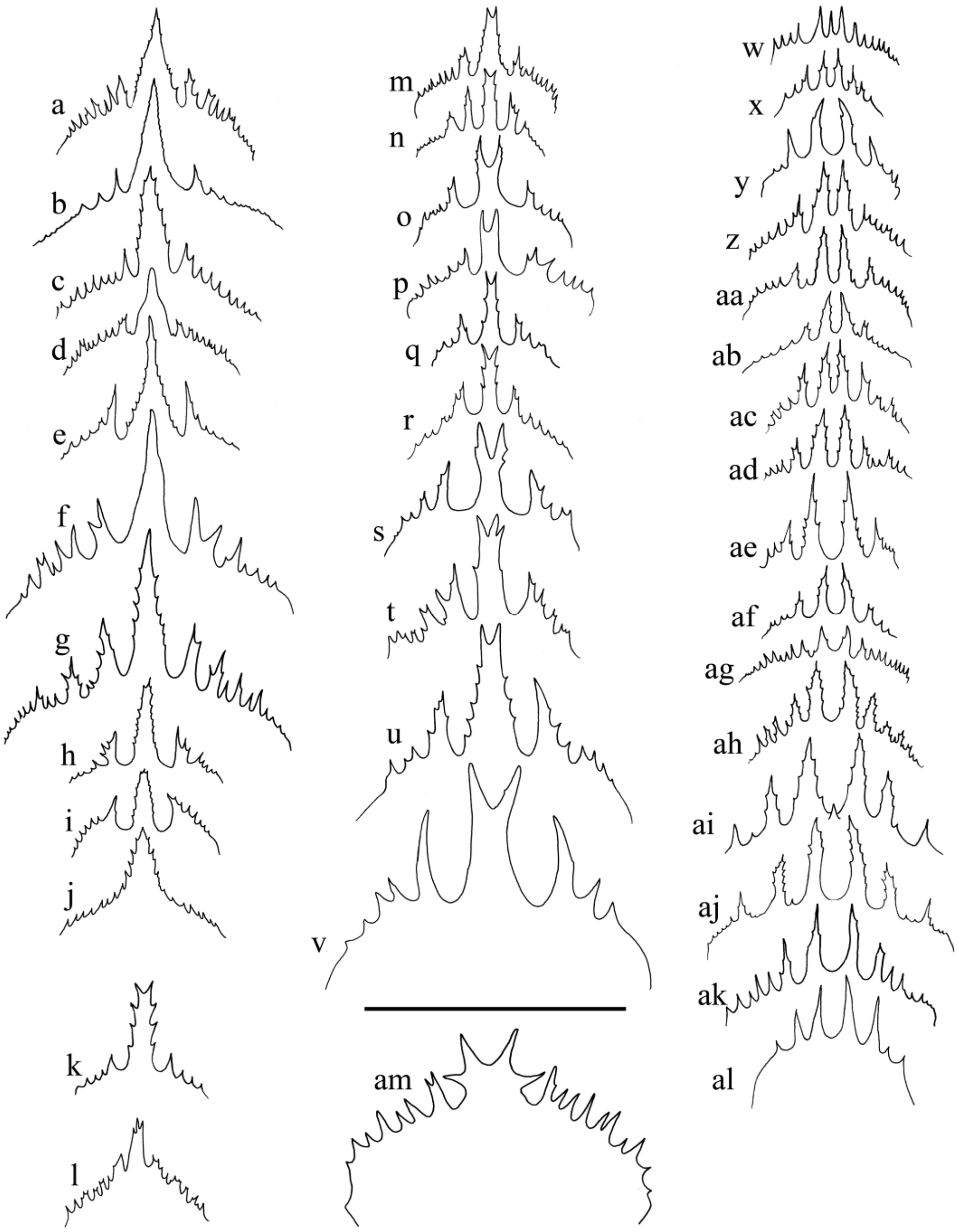

Figure 11. Epistomes of different Zerconidae genera (females): a-j: *Prozercon*-type: a = *Ba. opiparus* Błaszak, 1984, b = *Bl. americana* Sikora & Skoracki, 2008, c = *E. orientalis* Błaszak, 1975, d = *Kr. mirificus* Błaszak, 1981, e = *L. amythetes* Błaszak, 1981, f = *Ma. praecipuus* (Sellnick, 1958), g = *Ma.* sp., h = *P. bulbiferus* Ujvári, 2011, i = *P. similis* Balan, 1992, j = *Cosmozercon setosus* Błaszak, 1981, k = *B. hesperius* Halašková, 1977, l = *Sy. kosiri* Athias-Henriot, 1976; m–v: *Zercon*-type: m = *A. suspiciosus* Halašková, 1969, n = *Bn. pulcher* (Błaszak, 1984), o = *Bo. emendi* Diaz-Aguilar & Ujvári, 2010, p = *Ca. tuberculatus* (Košir, 1974), q = *C. similis* Petrova, 1979, r = *H. macleani* Błaszak, 1981, s = *M. borealis* Diaz-Aguilar & Ujvári, 2010, t = *Mo. aciculatus* Błaszak, 1984, u = *Z. (Z.) vacuus* C. L. Koch, 1839, v = *Z. (Z.) tenerifensis* Moraza, 2006; w–al: *Parazercon*-type: w = *Aq. desuetus* Halašková, 1979, x = *As. anisotrichus* Halašková, 1977, y = *As.* sp., z = *Eu. aquilonis* Halašková, 1979, aa = *Eu. pacificus* Halašková, 1979, ab = *K. mamillosus* Halašková, 1979, ac = *K. peregrinus* Halašková, 1979, ad = *Ko. bacatus* Halašková, 1979, ae = *Me. coreanus* Błaszak, 1975, af = *Me. plumatus* (Aoki, 1966), ag = *Mi. californicus* (Sellnick, 1958), ah = *P. (P.) radiatus* (Berlese, 1910), ai = *S. embersoni* Halašková, 1977, aj = *S. tricavus* Błaszak, 1982, ak = *Za. (M.) mahunkai* Halašková, 1979, al = *Z. (Z.) lischanni* Schweizer, 1961; *Rotundozercon*-type: am = *R. shuriken* Ujvári, 2011

apically tapering with undivided apex, and comprises mostly East Asian and North American genera, such as *Mesozercon*, *Parazercon*, *Eurozercon* and *Skeironozercon*. Moreover, this type of epistome is possessed by a small, European group of the genus *Zercon*.

The *Rotundozercon*-type (Fig. 11 al) is fairly unique by the single, wide, robust, anteromedial process, which is apically divided into 3–4 spines, and it is characteristic only for the monotypic Taiwanese genus.

Taxonomic value. Epistome is astructure showing greatest variability on the gnathosoma however, the remarkable intraspecific variability hardens the determination of its proper use as a valuable character. Rarely, it is applicable for distintion of species, but mostly the species are similar in shape of epistome within a genus. As it was discussed above, it is hard to distinguish even genera by their epistome, due to its variability. The most careful way to characterize Zerconidae is to classify their epistome according to the four general types mentioned above. Therefore the importance of this gnathosomal structure can be questioned regarding taxonomic characterization, but the special case of the group of *Zercon* comprising e.g. *Z. (Z.) arcuatus* and *Z. (Z.) lischanni* supports that it can be used succesfully as an interesting distinctive feature. I suggest to disscuss these characters in detail in describing new taxa. With due forsight for their variation observing a large amount of specimens is needed.

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Opusc. Zool. Budapest, 2011, 42(1): 95–98

First record of *Promyialges uncus* (Vitzthum, 1934) in Slovakia (Acarina: Epidermoptidae) with new host record

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Abstract. In this paper the feather mite *Promyialges uncus* (Vitzthum, 1934) is recorded for the first time in Slovakia. Specimens were found on nestlings of *Turdus merula* Linnaeus, 1758 and in nests with nestlings of *Hirundo rustica* Linnaeus, 1758, where mite specimens were observed on the wings of lousefly *Ornithomya avicularia* Linnaeus, 1758. Description of the mite positioning on louseflies and number of eggs laid supported by drawings are given. Samples collected on nestlings of *T. merula* as hosts are recorded for the first time. We also confirm that louseflies are successful vectors of feather mites among birds.

Keywords. Astigmata, feather mites, lousefly, phoresy, *Turdus merula*.

INTRODUCTION

Feather mites are permanent ectosymbionts living on the feathers of birds. Cohort Astigmatina, suborder Oribatida consists of 37 families, belonging into two superfamilies: Analgoidea and Pterolichoidea. Three families of dust mites (previously separated as the superfamily Pyroglyphoidea) were commingled with superfamily Analgoidea (O'Connor, 2009). The feather mite *Promyialges uncus* (Vitzthum, 1934) belongs to family Epidermoptidae Trouessart, 1892, subfamily Epidermoptinae (Mironov *et. al.*, 2005). They are world-wide distributed and associated with most avian orders (Fain, 1965; Dabert & Mironov, 1999). These mites are mainly living on ventral or dorsal surface of wing or tail feathers, or on the bird's skin. They are feeding on bacteria, fungal spores or on oil impregnating the feathers (O'Connor, 1982), and some species of the mite subfamily Epidermoptinae even burrow into the upper skin layers of their avian hosts and cause lesions on skin or dermatitis (Evans *et al.*, 1963; Fain, 1965). Feather mites can be transmitted between two birds by body contact however, they are unable to leave their host and crawl for longer distances. Therefore external factors, such as phoretic insects, are mainly responsible for the transmission.

Promyalges uncus is known from several sites in Belgium, France, Germany and Great Britain. Several specimens supposedly belonging to this species were also found in Denmark, Sweden and some additional sites in Great Britain (Dubinin 1953; Fain, 1965). Here we present the first record of *P. uncus* in Slovakia and also a new host, *Turdus merula,* according to the available literature.

MATERIAL AND METHODS

The material was collected from two sites within the Bratislava city. Mite specimens were obtained manually and stored in 75% ethanol. Before identification the specimens were mounted on permanent microscopic slides, using the Liquido de Swan medium. The material was identified according to Fain (1965). Louseflies were obtained using exhauster and stored in 75% ethanol, later identified according to Chvála *et al.,*

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(1980). Pictures were drawn using a Zeiss stereomicroscope, ZeissCam 3Mp camera and Axio Vision ver. 4.7.

RESULTS

Promyialges uncus **(Vitzthum, 1934)**

Microlichus uncus Vitzthum, 1934: 1-20., Collart 1934: 1-6., Thompson 1936: 315-320., Cooreman 1944: 8-9., Büttiker 1948: 481., 1949: 76., Johnsen 1948: 288. and 290., Ash and Hughes 1952: 753-757., Bequaert 1953: 143-145.
Myialges (Promyialges) uncus: Fain 1965: 67-69.
Promyialges uncus Fain 1964: 186., Gaud & Atyeo 1996: 63.

Material examined. Slovakia, Sad Janka Kráľa, (N 48.136153^0, E 17.108384^0) 12.vii.2008, nestlings of *Turdus merula* Linnaeus, 1758, 2 specimens, leg. Jamriška, Lučeničová., Slovakia, Zoological garden in Bratislava, (N 48.161567^0, E 17.072883^0) 24.vii.2008, nestlings of *Hirundo rustica* Linnaeus, 1758, 8 specimens attached on two of the louseflies., Slovakia, Zoological Garden in Bratislava, 18.viii.2008, nestlings of *Hirundo rustica*, 4 specimens attached on louseflie., Slovakia, Zoological garden in Bratislava, 15.v.2009, nestlings of *Hirundo rustica*, 2 specimens attached on louseflie.

Diagnosis. Body of female wide and oval, with rounded hysterosoma. Idiosoma 345 µ long. Coloration is pale-yellow, sclerotized shields are darker. Propodosomal shield wide and triangle-shaped. Side shields of propodosoma and hysterosoma are small. Fine striation of some body parts may be observed, especially on the dorsal body side (Fig. 1). All epimera free, coxal fields not developed. Two pairs of very long setae (d–5 and l–5) present on posterior margin of idiosoma (projecting dorsally).

Characteristics, distinguishing *P. uncus* from similar species are as follows. Body is small (idiosoma about 350 µm long). Hysterosomal shield clearly divided in two separated parts, which are longer then wide. Epimera I not fused, but connected by means of a small transversal stripe (Fig. 2). Epigynum not extending beyond epimera II (Fain, 1965).

DISCUSION

Here we present the first record of *P. uncus* from Slovakia and also a new host *T. merula* according to the available literature. The 16 specimens of *P. uncus* (Fig. 1) were recorded as follows: two specimens were on nestlings of *T. merula* in Sad Janka Kráľa, and 14 specimens were associated to wings of *Ornithomya avicularia* Linnaeus, 1758, recorded on nestlings of *H. rustica* in the Zoological garden of Bratislava. Altogether 12 specimens of *O. avicularia* were collected and four of them were carrying mites on their wings. Two specimens of the *P. uncus* were on the lower side of each fly-wing surrounded by group of eggs. So there were four specimens on each fly. In one case there were just two mite specimens, each separately on one fly-wing.

The average number of eggs laid on louse fly-wing was from 18 to 28 (mean 22.86, SD 2.93) while the total number of eggs in mite clutches on both flies was 320 eggs. No sucking disc and no body plates were found on the surface of the egg. The body itself was milk white but transparent and sometimes with visible juveniles in it. Pair of mites, each surrounded by group of eggs, was situated proximally on the lower surface of each wing in area bounded by Cu1+1A wing vein from the inferior margin and by R4+5 wing vein superiorly. The first specimen was situated nearby, under the cross vein h and the second one was abreast of the cross vein m-cv (Fig. 3). No male adults were recorded. Faded wing veins were around attachment place of mite females.

Phoresy of mites on insects is a well-known phenomenon. Most frequently, mites‘ phoresy is registered on beetles, but it is recorded on many other groups of insects, including Diptera as well. Many authors divide phoretic mites into two groups. First group includes species, which are found phoretic only sporadically, and don’t show any specific affinity for different groups of insects. Mites in the second group frequently show

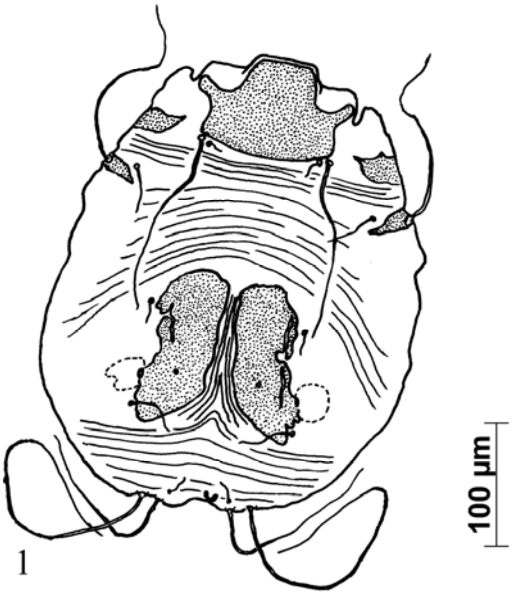

Figure 1. *Promyialges uncus*. Female from the lower wing surface. Dorsal view of the body

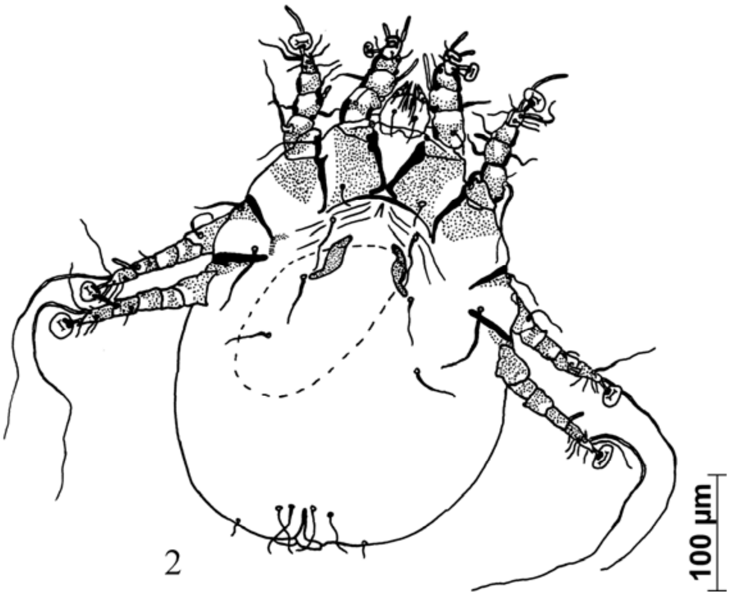

Figure 2. *Promyialges uncus*. Ventral view of the body with egg

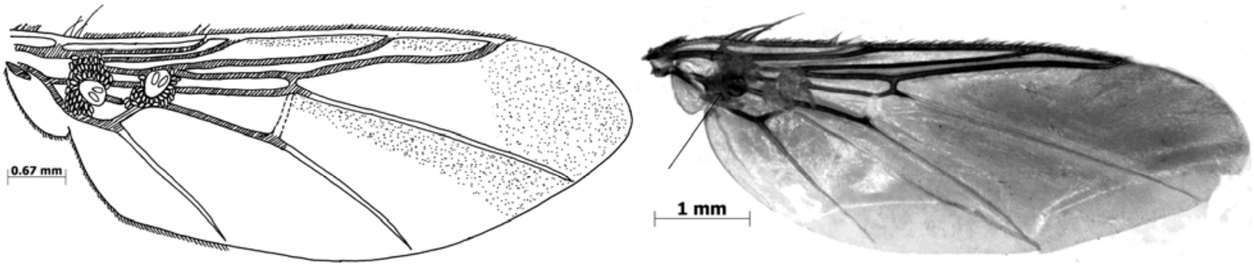

Figure 3. Mite position on the lower side of the wing. Mite females coupled with group of eggs on the proximal part of the wing

host specificity. There is a clear feedback between the mite and its carrier (Mašán, 1993). Thompson (1936) recorded occurrence of *P. uncus* on louse-fly *Ornithomyia fringillina* Curtis, 1836 from sites in Brussels (Belgium) and Marseille (France) – 17 females and 281 eggs were found on a sample of 9 flies. Dubinin (1953) mentioned the fact that part of the wing veins fades out around attachment place of mite females. Probably because mites suck hemolymph from veins, and their salivary secreta partially decompose pigment and chitin of wing veins. Büttiker (1948) found clusters of eggs (belonging to *P. uncus*) attached on the louse fly *O. biloba* Dufour, 1827 and Ash & Hughes (1952) found this species on *O. avicularia* in England and Sweden.

There has been no record of *P. uncus* from Slovakia yet, and only little is known about its biology. Only egg stage and adult females are known (Dubinin, 1953; Fain, 1965). We collected samples on nestlings of *T. merula* in Sad Janka Kráľa in Bratislava and specimens carried on the wings of the *O. avicularia* on nestlings of *H. rustica* in the Zoological garden in Bratislava. We recorded four flies carrying adult female *P. uncus* coupled with eggs. Therefore we can suggest that louse flies are playing an important role in transmitting feather mites among birds. Informations on this relationship can help us to understand better its ecology such as distribution in a given locality. It is a question if louse flies are specific carriers, or these mites can also be transmitted by other diptera associated with bird nests, like bird-blow flies. If louse flies are specific carriers, their presence in a habitat is essential for the distribution of *P. uncus* among birds. Further researches should be carried out to answer questions about the prevalence of infection on louse flies and for better understanding its ecology.

Acknowledgement – We thank to anonymous referees for their comments on an earlier draft of this paper. Many thanks to Peter Mašán from Slovak Academic of Sciences, Department of Medical Entomology and to Peter Fenďa from Faculty of Natural Sciences, Comenius University, Department of Zoology for their help with identification. This work was supported by VEGA .1/0124/09.

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Opusc. Zool. Budapest, 2011, 42(1): 99–102

Nematodes from rocky grassland in Börzsöny Mountains, Hungary

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Abstract. This paper reports on investigations carried out on soil inhabiting nematodes living in andesitic rock regions of Börzsöny Mountains. Seventeen species are listed. *Heterodorus arcuatus* (Thorne, 1939), new to the fauna of Hungary, is described and illustrated in detail.

Keywords. Börzsöny Mts., Hungary, Nematoda, species list, new records.

The nematode fauna of Börzsöny Mountains belonging to Transdanubian Middle Range in Hungary has scarcely been studied. In December 2009, the present author collected several soil samples in two andesitic (volcanic rocky) regions, namely in Szürke Hill and Ördög Hill.

MATERIAL AND METHODS

Nematodes were extracted using the Baermann's funnel method, fixed in FAA, processed to anhydrous glycerine by a slow method, and mounted on permanent slides. Measurements were taken by ocular micrometer, curved structures were measured along the medial line. Morphometrics included de Man's indices and most of the usual measurements. The location of the oesophageal gland nuclei is expressed according to Andrássy (1998). Drawings were made with aid of a drawing tube.

LIST OF THE COLLECTED SPECIES

The observed seventeen nematode species are as follows.

Cephalobidae

Acrobeles ciliatus von Linstow, 1877. – Ördög Hill, soil from closed rock grassland.

Criconematidae

Criconemoides informis (Micoletzky, 1922) Taylor, 1936. – Szürke Hill, soil from closed rock grassland.

Monhysteridae

Geomonhystera villosa (Bütschli, 1873) Andrássy, 1981. – Ördög Hill, soil from open rock grassland.

Plectidae

Plectus velox Bastian, 1865. – Szürke Hill, soil from open and closed grasslands. Ördög Hill, soil from open and closed grasslands.

Tripylidae

Tripylina arenicola (de Man, 1880) Brzeski, 1963. – Szürke Hill, soil from closed and open rock grasslands, Ördög Hill, soil from closed and open rock grasslands.

Amphidelidae

Paramphidelus hortensis (Andrássy, 1961) Andrássy, 1977. – Ördög Hill, soil from closed rock grassland.

Qudsianematidae

Eudorylaimus bombilectus Andrássy, 1962. – Szürke Hill, soil from open and closed rock grasslands.

Aporcelaimidae

Aporcelaimellus alius Andrássy, 2002. – Szürke Hill, soil from open and closed rock grasslands, Ördög Hill, soil from open and closed rock grasslands.

Aporcelaimellus krygeri (Ditlevsen, 1928) Heyns, 1965. – Szürke Hill, soil from opened and close rock grasslands, Ördög Hill, soil from open and closed rock grasslands.

Aporcelaimellus medius Andrássy, 2002. – Szürke Hill, soil from open and closed rock grasslands, Ördög Hill, soil from closed rock grassland.

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Aporcelaimellus obtusicaudatus (Bastian, 1865) Altherr, 1868. – Szürke Hill, soil from open rock grassland.

Qudsianematidae

Allodorylaimus granuliferus (Cobb, 1983) Andrássy, 1986. – Szürke Hill, soil from open and closed rock grasslands, Ördög Hill, soil from open and closed rock grasslands.

Paraxonchiidae

Paraxonchium laetificans (Andrássy, 1956) Altherr & Loof, 1969. – Szürke Hill, soil from open and closed rock grasslands, Ördög Hill, soil from open and closed rock grasslands.

Mylonchulidae

Mylonchulus brachyuris (Bütschli, 1837) Cobb, 1917. – Szürke Hill, soil from open and closed rock grasslands, Ördög Hill, soil from open and closed rock grasslands.

Mononchidae

Clarkus papillatus (Bastian, 1865) Jairajpuri, 1970. – Ördög Hill, soil from open grassland.

Coomansus parvus (de Man, 1880) Jairajpuri & Khan, 1977. – Ördög Hill, soil from open rock grassland.

Nordiidae

Heterodorus arcuatus (Thorne, 1939) Andrássy, 2009. – Szükre Hill, soil from open and closed rock grasslands, Ördög Hill, soil from open and closed rock grasslands.

DESCRIPTION

One of the nematode species observed in the Börzsöny Mountains proved to be new to the fauna of Hungary. Its detailed description is herewith provided.

Heterodorus arcuatus (Thorne, 1939) Andrássy, 2009 (Fig. 1 A–F)

Females (n = 13): L = 1.16–1.50 mm; a = 23–27; b = 4.7–5.7; c = 23–34; c’ = 1.4–1.9; V = 48–55%.

Males (n = 8): L = 1.28–1.46 mm; a = 23–27; b = 4.4–5.3; c = 24–27; c’ = 1.3–1.8.

Body moderately slender, C- or J-shaped (especially male) after fixation. Body cylindrical, tapering. Cuticle 2.5–3.0 µm thick at anterior region, 3.0–4.0 µm at mid-body and 4.5–6.0 at tail. Its outer layer thinner than the inner, with very fine transverse striations. Lateral hypodermal chords about one-fourth of body diameter at mid-body. Lateral pores obscure. Lip region 12–14 µm wide, 2.6–3.0 times as broad as high, rather rounded. Offset by shallow constriction, lips amalgamated. Labial papillae slightly protruding above labial contour. Amphids cup-shaped, opening at level of cephalic constriction and 6.5–7.5 µm wide or occupying slightly more than half of lip region diameter. Cheliostom a truncate cone, with no particular differentiation. Odontostyle thin, straight, with distinct walls and narrow lumen, 17.5–21 µm long, 1.5–1.6 times as long as lip region diameter. Aperture small one-eighth to one-seventh of total length. Odontophore rod-like, lacking of any specialisation, 32–36 µm long, 1.6–1.8 times as long as odontostyle. Guiding ring double, at 14.5–16.0 µm or 1.2–1.3 lip region diameter from anterior end. Pharynx 250–280 µm long, pharyngeal expansion 35–40 % of total oesophagus length. Base of pharyngeal expansion surrounded by faint membrane-like structure. Pharyngeal gland nuclei located as follows: D = 68–71; AS_1 = 27–28; AS_2 = 28–30; PS_1 = 48–52; PS_2 = 51–53. Cardia rounded-conoid, wider than long, 13–16 × 8–11 µm.

Female. Female genital system didelphic-amphidelphic, both branches equally and well developed. Vulva transverse with sclerotised lips. Ovaries reflexed, relatively well developed, 64–82 µm (anterior) and 68–89 µm (posterior) long with oocytes arranged in a single row except near the tip. Oviduct joining ovary subterminally, 76–87 µm (anterior) 81–98 µm (posterior) long. Sphincter distinct, located between oviduct and uterus. Uterus 61–76 µm (anterior) 68–79 µm (posterior) long, bipartite. Vagina extending inwards two-fifth of corresponding body diameter, encircled proximally by cuticularization. *Pars proximalis vaginae* 11–12 µm long with almost straight walls, encirled by muscles. *Pars re-*.

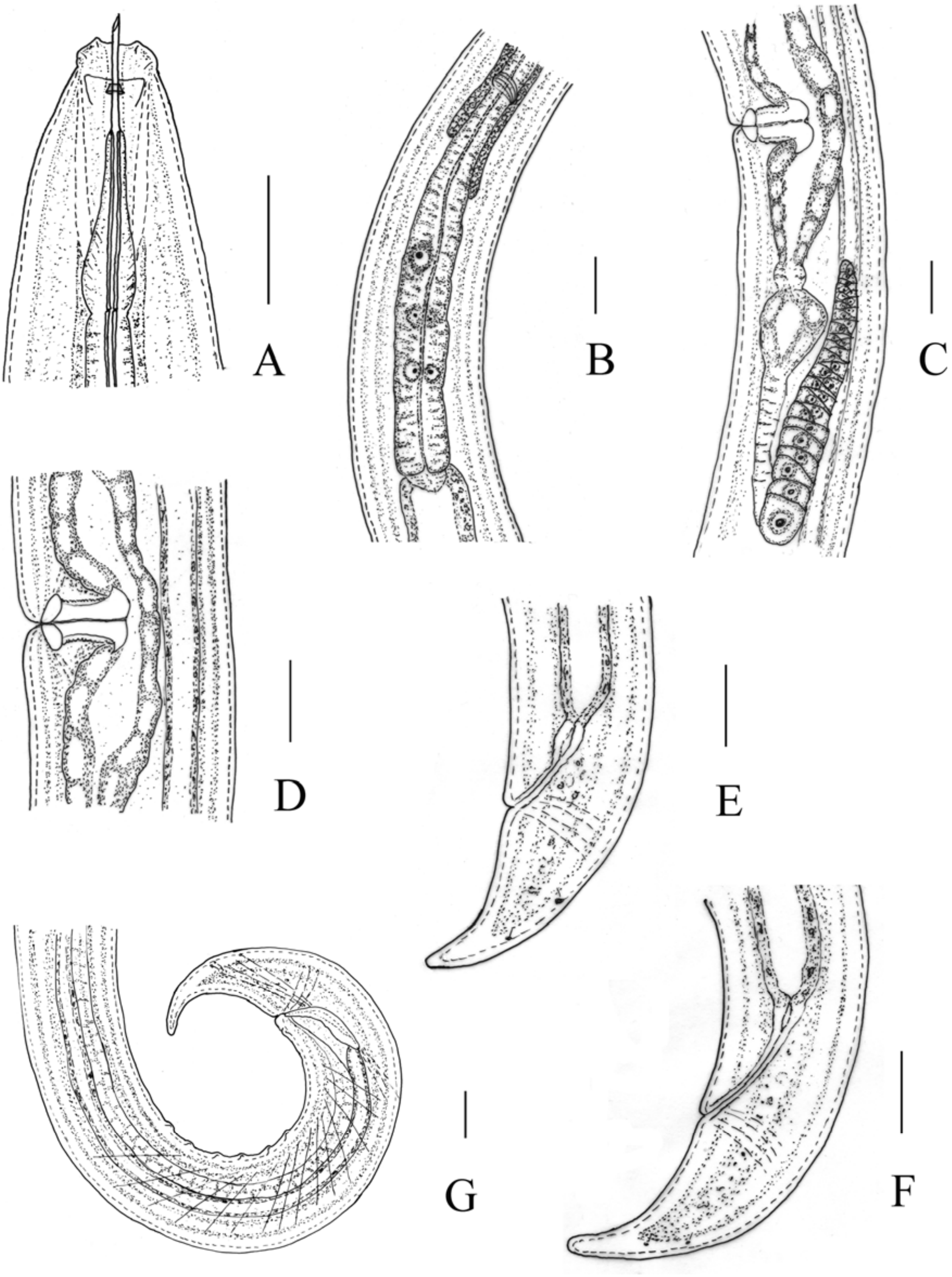

Figure 1 . *Heterodorus arcuatus*. A: anterior end; B: posterior pharyngeal region; C: part of female genital organ; D: vulval region; E–F: female posterior end; G: male posterior end. (Scale bars = 20 µm)

fringens vaginae with two well developed trapezoid clerotised pieces, each measuring 4 × 6,5–7 µm high. *Pars distalis vaginae* 4.5–5.5 µm long. Prerectum 72–100 µm long, 2.2–3.2 times, rectum 25–35 µm long, 0.9–1.3 times the anal body diameter long. Uterine eggs measuring 78 × 38 µm. Anal body width 25–34 µm. Tail 48–58 µm or 1.6–2.0 anal body width, long conoid with finely rounded tip. Two pairs of caudal pores at the middle of tail, one subdorsal, another lateral.

Male. General morphology similar to female, but with posterior body region more ventrally curved, often G-shaped after fixation because of presence of copulatory muscles. Genital system diorchic, with opposite testes. Spicula 41–44 µm long, *ca* equal to 1.3–1.6 anal body diameters, dorylaimoid, relatively slender, ventrally curved. Lateral guiding pieces simple, one-fourth as long as spicula. Supplements consisting of the usual adanal pair and six spaced ventromedian ones; posterior supplements anterior to the range of spicula. Tail conical, similar to female, 44–50 µm long, ventrally curved with finely rounded terminus. Two caudal pores on each side.

Remarks. The Hungarian material fits well to the original description by Thorne (1939) and the recent redescription by Guerrero and Peña-Santiago (2007) based on type specimens, although some minor differences have been observed.

Body length of Hungarian individuals can be somewhat shorter than in American specimens (L = 1.16–1.50 mm *vs* L = 1.5–1.9 mm), rectum shorter (25–35 µm *vs* 34–45 µm), odontophore longer (32–36 µm, 1.6–1.8 times as long as odontostyle *vs* 24–31 µm, 1.3–1.4 times odontostyle length) and tail shorter (48–58 µm *vs* 62–80 µm). Andrássy (1958, 1959), Zullini (1970) and Ciobanu *et al.* (2010) reported European specimens with shorter tail (49–62 µm) which fit well to the Hungarian individuals.

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