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Kittydorylaimus gen. n. and *Kolodorylaimus* gen. n., two remarkable new genera of Dorylaimina (Nematoda)

By

I. ANDRÁSSY*

Abstract. Two new interesting genera of the suborder Dorylaimina are described from Africa. *Kittydorylaimus* gen. n. (with type-species *K. specialis* sp. n.) is unique in having a special combination of longitudinal cuticular ridges and shape of tail. *Kolodorylaimus* gen. n. (with type-species *K. vesiculosus* sp. n.) shows an unusual cellular-vesicular structure of intestine, a similar one not observed in dorylaims so far.

A wide scale of the most various morphological phenomena is known in dorylaimoid nematodes. Nevertheless, newer and newer forms are discovered from time to time which still give us a surprise in their morphology. As follows, two new terrestrial species of the suborder Dorylaimina are described from Africa (Tanzania, Kenya) which cannot be placed in any of the known genera. Because of their unusual characters, a new genus shall be proposed for either one of them: *Kittydorylaimus* gen. n. and *Kolodorylaimus* gen. n.

Kittydorylaimus gen. n.

Arctidorylaimidae (?). Body about 2 mm long, plump, strongly narrowing anteriorly. Cuticle very thick, provided with elevated longitudinal ridges. Head strongly offset, lips separate. Spear slightly sinuate, longer than labial width, but thinner than cuticle. Oesophagus gradually widening. Oesophageal gland nuclei well visible, and showing a special picture: D lying far behind the middle of oesophagus, AS_1 uncommonly close to D, hence very far from AS_2. Vulva longitudinal, female genital organ amphidelphic. Spicula dorylaimoid. Ventromedial supplements contiguous. Tail in both sexes short and blunt, in female and larvae with offset recurved tip, in male with bluntly rounded terminus.

Type-species: *Kittydorylaimus specialis* sp. n.

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Kittydorylaimus specialis sp. n.

(Figs. 1, 2 A–D and 3 A–E)

Holotype, female: L = 1.92 mm; a = 22; b = 4.1; c = 40; V = 52 %; c′ = 1.3.
Paratype, male: L = 2.03 mm; a = 22; b = 4.3; c = 54; c′ = 1.0.
Larva (L4): L = 1.35 mm; a = 21; b = 3.7; c = 21; c′ = 2.2.

Body about 2 mm long, fairly plump, 86–92 μm wide on its middle, strongly tapering anteriorly to a narrow lip region; body at posterior end of oesophagus 4.8–5.0 times as wide as head. Cuticle very thick, 10–12 μm on mid-body, seemingly consisting of 4–5 layers. In optical view, the common width of cuticles of both body sides amounts to nearly one-fourth of the entire body diameter. Cuticle surface marked by 36–38 well discernible longitudinal ridges which are somewhat reduced in number on neck and tail. The ridges begin at one to one and a half labial diameters posterior to head, and extend over the entire body; between the ridges the cuticle shows a fine transverse striation.

Labial region small, narrower than subsequent neck region, 16–17 μm wide and 5–6 μm high, sharply offset by a constriction. Head formed from rounded and separated lips bearing small papillae. Amphids funnel-shaped, about half as wide as neck at base of head.

Odontostyle dorylaimoid, slightly sinuate, 35–37 μm long and 3.5–4.0 μm thick, about 8 % of total oesophageal length, essentially longer (2.2–2.3 times) than labial diameter, but only half as thick as cuticle at the same level. Aperture one-third of spear length. Guiding ring simple and thin. Oesophagus 468–472 μm long, 23–24 % of body length, fairly muscular also in anterior half, gradually widening in 53–55 % of its length; cylindrus 220–240 μm long, moderately enlarged. Distance between posterior end of oesophagus and vulva only slightly (1.1 times) longer than oesophagus. Cardia conoid, 35–38 μm long. Intestine consisting of comparatively large cells giving a wavy contour to it. Prerectum 3.5 times, rectum 1.8 times as long as anal body width.

Oesophageal gland nuclei in Kittydorylaimus specialis

D = 60–62%	AS_1 = 6–8 %
	AS_2 = 32–40 %
	PS_1 = 62–63 %
K = 19–20 %	PS_2 = 63–64 %

All five oesophageal nuclei are well discernible, round, except for AS_2 which is oval. The „map" of the nuclei is very characteristic.[1] The dorsal nucleus (D) lies far behind the middle of oesophagus (in 14 % of the entire length of body); AS_1 is uncommonly close to D (at 17–23 μm only); AS_2 is located well anterior to the middle of the distance between D and posterior end of oesophagus; PS nuclei are at two-

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[1] The location of the dorsal nucleus is expressed as a percentage of the distance between anterior end of body and posterior end of oesophagus; the positions of the four subventral nuclei are given as the percentage of the distance between dorsal nucleus and posterior end of cylindrus. (See also Andrássy, 1998 a, p. 555–556, Fig. 2, and Andrássy, 1998 b, p. 165–170, Figs. 1–3.)

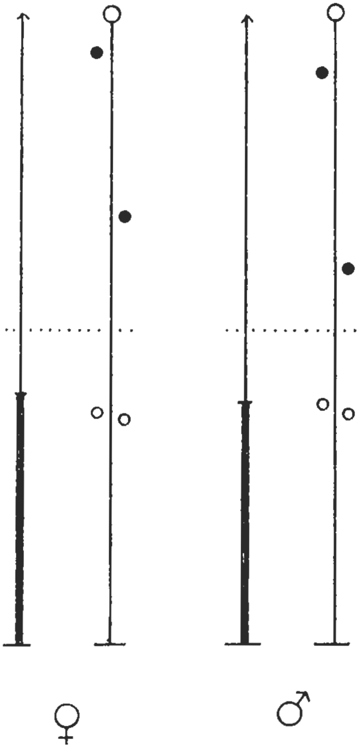

Fig. 1. Map of the oesophageal gland nuclei in a female and a male of *Kittydorylaimus specialis* sp. n. The left column of each specimen illustrates the comparative length of the glandularium, the right column shows the arrangement of the nuclei within the glandularium

third of the above distance, 66–70 μm from posterior end of oesophagus. K (position of AS_1 in percentage of the D–AS_2 distance) shows an unusually low value.

Vulva longitudinal, close to mid-body, its inner lips 20 μm wide, not sclerotized. Vagina 45 μm long. Reproductive system amphidelphic, occupying 37 % of body length; both branches lying on right side of the intestine. Anterior gonad 3.8 times, posterior 4.3 times as long as body width, or, anterior gonad 17 %, posterior 20 % of body length. Uterus on both ends tapering to an S-like tube, then expanding to a spermatheca. Ovaries reflexed close to vulva. Uterine eggs were not present.

Distance vulva–anus 18 times as long as tail. Female tail 50 μm, 2.6 % of entire length of body, showing the larval type, but being shorter, bluntly convex-conoid, with a small (6 μm) recurved tip.

Male gonad (from distal tip of anterior testis to cloaca) occupying 65 % of body length. Testes on the right side of intestine, each 3.8 times as long as body width, or 17 % of body length. Spermatozoa more or less oval, small, 4–5 μm, about 1/20 of body diameter. Spicula dorylaimoid, slender, 82 μm long; caput narrow, venter slightly swollen, sinus shallow, pes conoid-pointed; anterior half of spiculum somewhat longer than posterior. Comes slender. Adanal papillae close to cloaca.

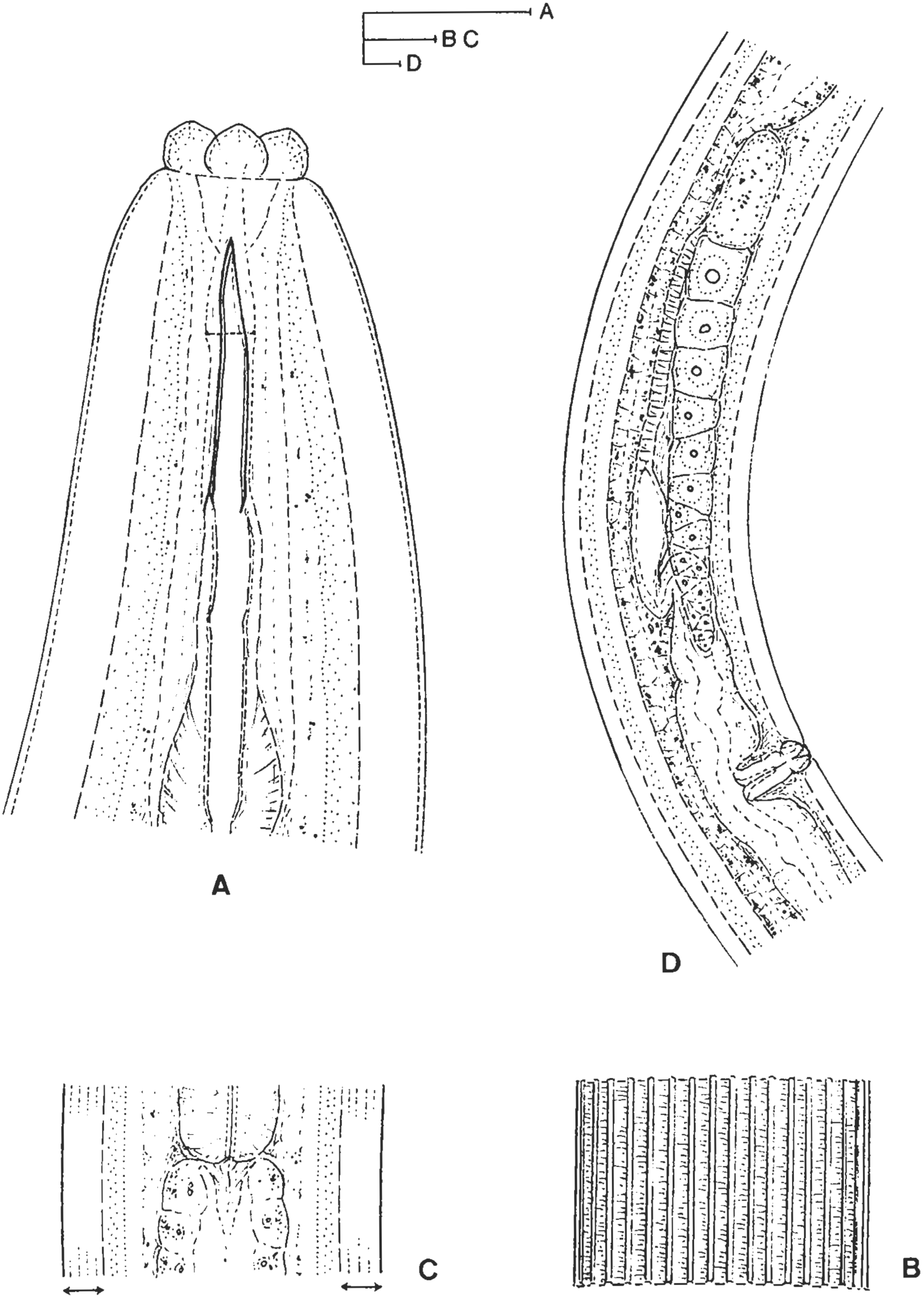

Fig. 2. *Kittydorylaimus specialis* sp. n. A: anterior end; B: cuticle surface with longitudinal ridges; C: how thick the cuticle is in comparison with body width: the cuticles of both sides together amount to about one-quarter body diameter; D: anterior female gonad and vulva. (Scale bars 20 µm each)

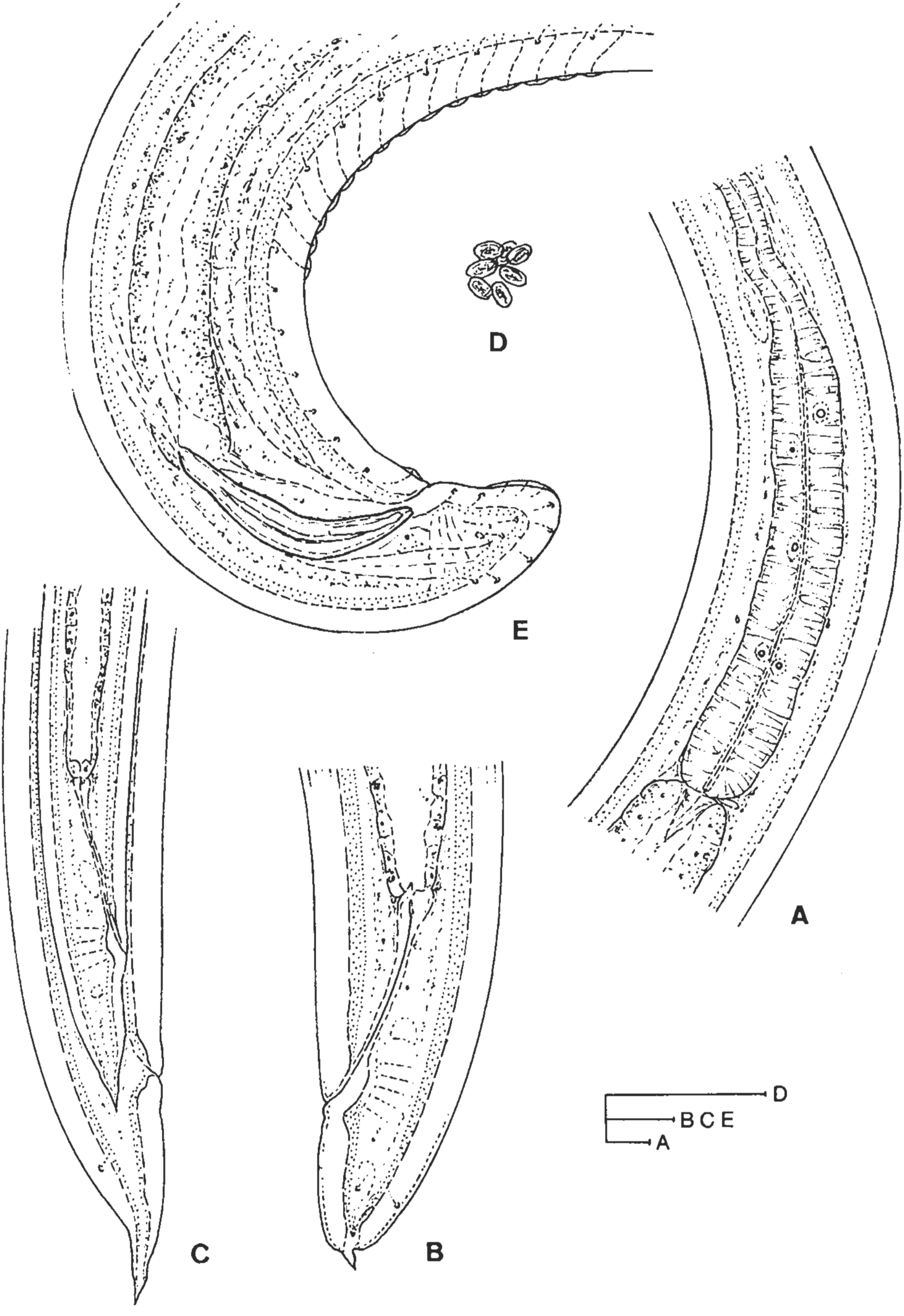

Fig. 3. *Kittydorylaimus specialis* sp. n. A: posterior region of oesophagus; B: female posterior end; C: posterior end of an L4 larva being under moulting (look at the tail and the still thin cuticle of the pre-adult in the exuvium); D: spermatozoa; E: male posterior end. (Scale bars 20 µm each)

Ventromedial supplements 15, contiguous, flat, occupying a distance of 118 µm. On the body region between the anteriormost supplement and cloaca, 15 pairs of small subventral papillae can be counted. A weak copulatory „pad" present. Prerectum beginning anterior to the supplements. Male tail 38 µm, 1.9 % of body length, bluntly conoid, with rounded terminus. It possesses a large ventral, subterminal „blister" (a similar feature can be observed on the male tails in the genus *Crocodorylaimus*). Caudal papillae 12 pairs.

Two larvae were also observed, an L3 and an L4 larva. The number of the longitudinal ridges on mid-body was 24 in L3 and 34 in L4. In the larva L3, the functional spear amounted to 20 µm, the replacement (or better: succeeding) spear embedded in oesophageal tissues (for L4) to 28 µm; in the larva L4, the functional spear was 27 µm, the succeeding spear (for adult) 36 µm. The tail was broken on tip in L3 larva, in L4 it was unwounded, 68 µm, longer than two anal diameters, conoid with a sharp, slightly dorsally curved tip. The L4 larva was under moulting. It was very remarkable that the developing pre-adult (female) within the L4 had still a much thinner cuticle than the larve itself (Fig. 3 B); all that means that the cuticle must increase in thickness after hatching from the exuvium.

Holotype: female on the slide No. 12476/A; paratypes: a male and two young specimens, all deposited in the nematode collection of the Eötvös Loránd University.

Type locality: Matombo, Morogoro Region, southern Tanzania, detritus and soil around *Pandanus* sp., February 1987, collected by S. Mahunka and A. Zicsi.

Remarks. There are two families within the suborder Dorylaimina where the cuticle may possess longitudinal ridges: Dorylaimidae and Actinolaimidae. In Dorylaimidae the species of the type subfamily, Dorylaiminae are marked by these ridges, in Actinolaimidae the members of two subfamilies, Actinolaiminae and Brittonematinae show such phenomena. All representatives of these groups are characterized by a sexual dimorphism well expressed in the shape of tail: the tail is elongate-conoid to filiform in females and short and broadly rounded in males. About 60 species have been described or placed in the mentioned groups so far, more closely in the genera *Dorylaimus, Ischiodorylaimus* (Dorylaiminae), *Actinolaimus* (Actinolaiminae), *Brasilaimus, Actinca, Parastomachoglossa, Practinocephalus* (Brittonematinae).

In 1979 Mulvey and Anderson discovered a dorylaimoid nematode species in the Canadian Arctic, which was not to be placed under any genera of either Dorylaimidae or Actinolaimidae. This very interesting nematode provided with longitudinal ridges on cuticle, *Arctidorylaimus arcticus*, differed from every representative of the above mentioned subfamilies in having no sexual dimorphism in the tail; this latter was similar in both sexes: short, conoid, ventrally curved. Another difference – if perhaps not so essential – could be found in the ventromedial supplements of male: they were few in number and well separated from one another (not numerous, and nor contiguous or in fascicles grouped as in Dorylaimidae and Actinolaimidae). Since *Arctidorylaimus arcticus* did not appear to show a close relationship to either these families or any other ones of the Dorylaimina, Mulvey and Anderson suggested a new family, Arctidorylaimidae, for this Arctic species.

It shall be noted that, in their book, Jairajpuri and Ahmad (1992) still placed *Arctidorylaimus* under the family Dorylaimidae; they accepted Arctidorylaiminae as a subfamily only. Whereas, I was (1988, in revising the Dorylaimidae) and am of the definite opinion that *Arctidorylaimus* may not be shifted to Dorylaimidae; it is thus better to retain the family Arctidorylaimidae for it.

Well, the present new genus, *Kittydorylaimus* does not correspond to the criteria of either the family Dorylaimidae or the family Arctidorylaimidae. The special shape of the tail immediately distinguishes it from every species of both families. If we compare the new genus with the genera of Dorylaiminae, *Dorylaimus* Dujardin, 1845 and *Ischiodorylaimus* Andrássy, 1969, the following differences can be found as characteristic for it: the head is sharply offset, guiding ring simple, vulva longitudinal, tail in both sexes short, besides, the spermatozoa are very small and ovoid. And, what is also very important, the gland nuclei in the oesophageal cylindrus show a quite different pattern.

Kittydorylaimus resembles *Arctidorylaimus* Mulvey & Anderson, 1979 in having a longitudinal vulva and a short tail in both female and male. It differs however in a good number of characteristics from that, *viz.* in thickness of cuticle, labial region offset by a deep constriction, arrangement of oesophageal nuclei, shape of spermatozoa, number and arrangement of ventromedial supplements, as well as in shape of the tail. The taxonomic position of *Kittydorylaimus* is rather uncertain. Nevertheless, I do not want to erect a separate family or subfamily for it; it shall be placed for the moment in the family Arctidorylaimidae.

Kittydorylaimus specialis sp. n. is unique among the dorylaimoid nematodes not only in the combination of the cuticular ridges and the shape of tail, but also in the arrangement of the oesophageal gland nuclei. The very anterior position of the AS_1 and, as a consequence, the comparatively unusually long distance between it and its partner nucleus (AS_2) are highly characteristic for the new species (Fig. 1). In this respect, our nematode differs from every representative of the order Dorylaimida where the "map" of the oesophageal nuclei is known. Running through the fundamental work of Loof and Coomans on the oesophageal gland nuclei of Dorylaimina (1970), only a few members of the family Aporcelaimidae show a similar picture concerning the nuclei AS_1 and AS_2 *(Sectonema, Aporcelainuium).* However, the value of K is never so low in them (26 to 30 % as minimum) as in *Kittydorylaimus* (19–20 %).

It would be good to know what purpose the longitudinal ridges of cuticle serve? Their exact role is rather uncertain. Maybe they enlarge the surface of cuticle and make so respiration easier. An other possibility: they take part in locomotion. Longitudinal ridges predominantly occur in limnic species, but our new nematode is terrestrial!

Etymology. *Kittydorylaimus specialis* sp. n. was discovered in East Africa. The generic name, *Kittydorylaimus,* can be derived from the words *Kitty + Dorylaimus.* „Kitty" was the pet name of Kálmán Kittenberger (1881–1958), a well known Hungarian naturalist, animal collector and big game hunter in East Africa in the first decades of our century. The fascinating books on his wanderings in the former Tanganyika, Kenya, Uganda, Belgian Congo and Danakil Land had once belonged to the most favourite pieces of reading for the present author...

Kolodorylaimus gen. n.

Qudsianematidae (?). Body about 1.5 mm long, very plump. Cuticle moderately thick, smooth. Head small, sharply offset, lips separate. Amphids large. Spear slightly sinuate, slender, longer than labial diameter. Oesophagus quite suddenly expanded. Of the oesophageal gland nuclei, D lying posterior to oesophagus middle, AS_1 close to D. Intestine without discernible lumen, but consisting of unusually large vesiculose cells. Prerectum short. Female amphidelphic, vulva transverse, sclerotized. Uterus with two spheroid chambers. Spermatozoa elongate. Spicula dorylaimoid. Ventromedial supplements numerous. Tail similar in both sexes, short, conoid-rounded with small terminal peg.

Type-species: *Kolodorylaimus vesiculosus* sp. n.

Kolodorylaimus vesiculosus sp. n.

(Figs. 4, 5 A–D and 6 A–E)

Holotype, female: L = 1.47 mm; a = 21; b = 5.2; c = 54; V = 53 %; c′ = 0.9.

Females (n = 2): L = 1.34–1.43 mm; a = 20–22; b = 4.5–4.7; c = 49–52; V = 55–56 %; c′ = 0.9–1.0.

Male: L = 1.35 mm; a = 19; b = 4.7; c = 43; c′ = 0.8.

Body hardly 1.5 mm long, very plump, on mid-body 65–70 µm wide, strongly tapering to the anterior end. Cuticle smooth, 1.8–2.0 µm thick on most part of body, 4 µm thick on the preanal region and somewhat thicker on tail. Head strongly offset by a constriction, 15–16 µm wide, lips well separate with conspicuous papillae. Body at posterior end of oesophagus 3.5–4.2 times wider than head. Amphid funnel-shaped, nearly as wide as 3/4 corresponding neck diameter.

Odontostyle slightly but perceptibly sinuate, slender, 23–26 µm long, or 8–10 % of oesophagus length, 1.5–1.7 times as long as labial diameter, as thick as or somewhat thicker than cuticle at the same level. Aperture larger than 1/3 spear length. Oesophagus 280–312 µm long, 19–22 % of body length, weaving in its anterior half then quite suddenly enlarged in 51–56 % of its length. Cylindrus moderately wide, 126–143 µm long. Cardia hemispherical. All oesophageal gland nuclei conspicuous. D behind the middle of oesophagus (in 10–12 % of entire length of body); AS_1 much closer to D than to AS_2, the latter posterior to the middle of

Oesophageal gland nuclei
in Kolodorylaimus vesiculosus

D = 58-63 %	AS_1 = 14-16 %
	AS_2 = 55-58 %
	PS_1 = 70-74 %
K = 25-28 %	PS_2 = 73-75 %

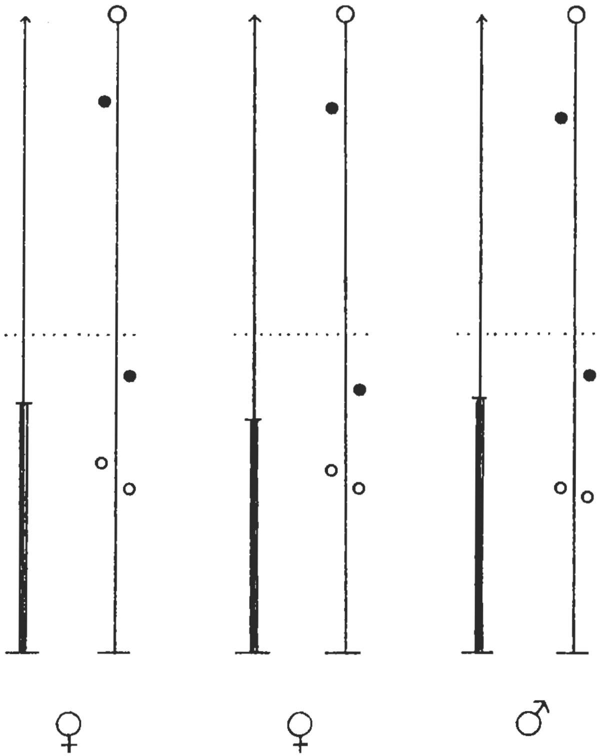

Fig. 4. Map of the oesophageal gland nuclei in two females and a male of *Kolodorylaimus vesiculosus* sp. n. The left column in each specimen illustrates the comparative length of the glandularium, the right column shows the arrangement of the nuclei within the glandularium

cylindrus, by far closer to PS_1–PS_2 than to its partner, the AS_1; PS nuclei 33–37 µm from posterior end of oesophagus. K value low. Distance between oesophagus terminus and vulva 1.5–1.7 times longer than the oesophagus itself.

The most striking morphological phenomenon can be seen in the structure of intestine. With exception of the prerectum, the intestine does not show a visible lumen at all, but it is composed of uncommonly large vesiculose cells. These cells begin in form of smaller (about 10 µm) bladders posterior to cardia, become then larger to very large (to 40, even 50 µm) in most part of intestine. At the prerectum they become smaller again, and appear like numerous small ovoid blisters. The specimens observed, thus females, male and juveniles, all showed, without exception, the same striking structure of intestine. Prerectum short, 1.5–1.8 times, rectum 1.4–1.6 times anal body width.

Vulva transverse, with 9–11 µm wide, strongly sclerotized inner lips. Vagina 25–27 µm, about 1/3 body width long. Amphidelphic. The exact structure of the female genital organ is difficult to observe owing to the dominant structure of the intestine. Uterus consisting of two 40–50 µm long spheroid chambers separated by a constriction from each other, filled with spermatozoa in each female. Gonads of medial length, ovaries reflexed. Uterine eggs not observed.

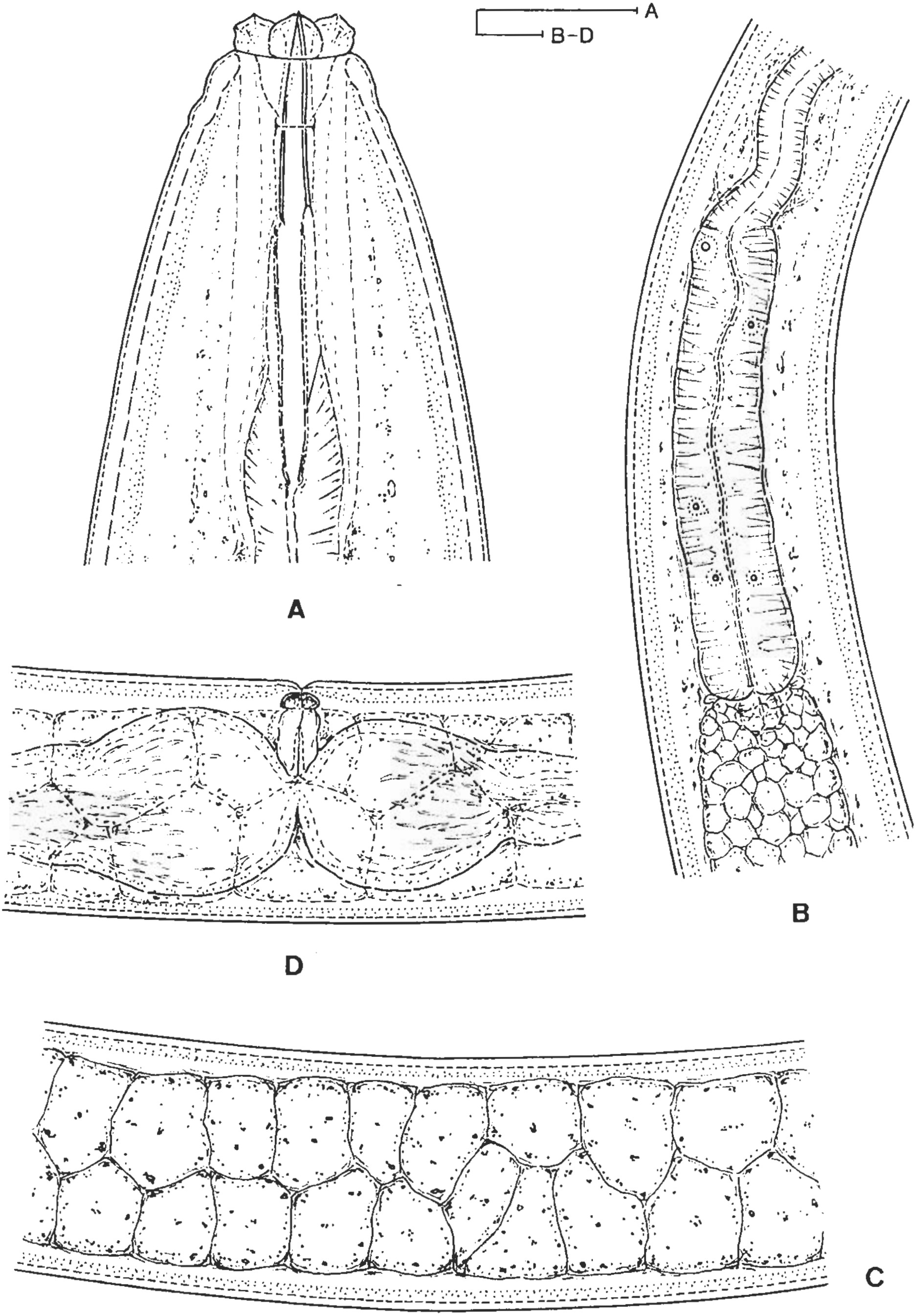

Fig. 5. *Kolodorylaimus vesiculosus* sp. n. A: anterior end; B: posterior region of oesophagus; C: midbody showing the large intestinal cells; D: vulval region (intestinal cells only slightly indicated, in the validity they are much more strongly expressed). (Scale bars 20 µm each)

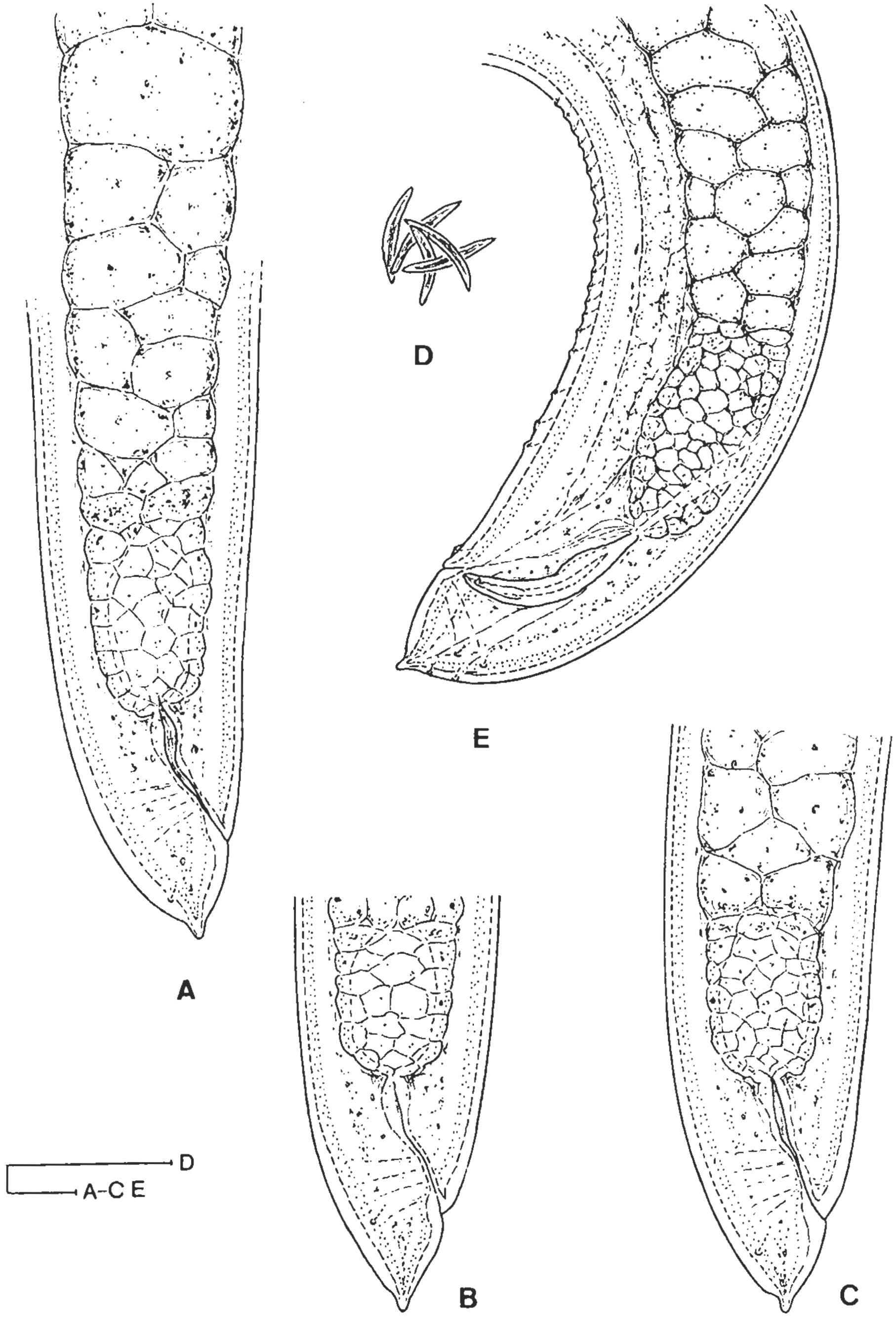

Fig. 6. *Kolodorylaimus vesiculosus* sp. n. A-C: variation in female posterior end; D: spermatozoa; E: male posterior end. (Scale bars 20 µm each)

Distance between vulva and anus 21–24 times as long as tail. Female tail short, 26–28 µm, 1.8–2.0 % of body length, conoid-rounded with a small mammiform tip, which is either straight or a little bent dorsad.

Testes two. Spermatozoa elongate, fusiform. Spicula dorylaimoid, slender, only slightly sclerotized, 56 µm long; caput narrowing, venter slightly widening, sinus shallow. Comes 14 µm long, distally hook-like. Ventromedial supplements 20, small, in most part contiguous or close to one another, the posterior three ones more separated, the posteriormost one levelling with spicula. Tail of male similar to that of female, 30 µm, 2.2 % of body length, with small mammiform tip.

Holotype: female on the slide No. 11669/A; paratypes: 2 females, 1 male and 4 juveniles, deposited in the author's collection at the university.

Type locality: Ukunda, Diani Persian Mosque, eastern Kenya, moss from a stone, September 1985, collected by S. Mahunka.

Remarks. The most peculiar morphological character for this nematode is the quite uncommon appearance of the intestine. Its vesicular-cellular structure can very well be observed also by low magnification. I am sure in it that this intestinal structure is no artificial product (by conservation or wrong preservation), namely: *a)* every specimen observed does show a quite similar picture of intestine; *b)* all the specimens of other dorylaimoid nematodes found in the same moss sample (*Mesodorylaimus* and *Eudorylaimus* spp.) have a simple, tubular appearance of intestine with the usual, finely expressed cellular structure. In the course of my half-a-century-old praxis on nematodes, I could never have observed such a phenomenon!

The new genus, *Kolodorylaimus* gen. n. shows certain affinities to the genera of the family Qudsianematidae, however, it differs from them not only in having that peculiar structure of the intestine, but also in the slender, sinuate spear, the shape of which is strange for this group. In addition, the ratio between the oesophagus nuclei AS_1 and AS_2 (Fig. 4), the shape of spermatozoa as well as the arrangement of the ventromedial supplements all distinguish our nematode from the general type of Qudsianematidae. In spite of these special characters, I would not like to propose a separate family or subfamily for *Kolodorylaimus vesiculosus,* but I place it provisionally under the family Qudsianematidae.

Etymology. The generic name can be derived from the words *Kolo(n) + Dorylaimus,* where the Greek word *„κωλον"* means: intestine. The species name *„vesiculosus"* (Latin) means: possessing bladders or vesicles.

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On the family Micreremidae Grandjean, 1954 (Acari, Oribatei)

By

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Abstract. A short review of the family Micreremidae (Acari) is presented, and a new genus, *Mexiceremus* gen. n. is suggested. Identification keys to four genera and eleven known species of the family are given. Oribatid mites have traditionally been regarded as inhabitants of the soil, ground litter or moss, but recently they are recognized as an important components of the acarine fauna of forest canopies as well. The species of Micreremidae obviously belong to this latter group.

The family Micreremidae was erected by Grandjean (1954). The type and sole genus was in that time *Micreremus* Berlese, 1908 with the type-species *Eremaeus brevipes* Michael, 1888. The present paper gives a short description of the family and the four genera, and lists the species. An identification key to the generic and specific taxa is added.

Micreremidae Grandjean, 1954

Notogaster with three pairs of areae porosa and 14 pairs of notogastral setae. Notogaster distending bilaterally to ventral side. Dorsosejugal suture present. Sensillus short with small stalk and globular head. Genital plates with four pairs of setae. Aggenital setae usually absent (with one exception). Adanal setae ad_3 and fissurae *iad* preanal in position. Adanal setae ad_1 and ad_2 behind one after the other (with two exceptions). Legs tridactyle. Mostly arboreal animals. – Four genera:

Micreremus Berlese, 1908

Aggenital setae absent. Adanal setae ad_1 and ad_2 postanal, behind one after the other. Adanal setae ad_3 and fissurae *iad* in preanal position. All notogastral and prodorsal setae short, setiform. Interlamellar region with a distinct lath-structure:

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an arched transverse ridge issuing from bothridium, arched across interlamellar setae and deriving several short ridges between interlamellar setae. Notogaster consisting of either strong, polygonal pattern or large, shallow depressions without sharp borders. – Seven species:

M. africanus Balogh, 1963
M. brevipes (Michael, 1888) – Type species.
M. faviger Mahunka, 1983
M. florens Mahunka, 1983
M. longisetosus Mahunka, 1986
M. macrofissura Hammer, 1979
M. subglaber Ito, 1982

Fenichelia Balogh, 1970

Aggenital setae absent. Adanal setae ad_1 and ad_2 postanal, behind one after the other. Notogaster dorsally with 12 pairs of phylliform, densely aciculate setae, ventrally with two pairs of fine setiform setae (setae p_2 and p_3). Interlamellar and lamellar setae slightly phylliform, densely aciculate. Notogaster with strong web-structure. – Two species:

F. biroi Balogh, 1970 – Type species.
F. latipilosa Mahunka, 1983

Porofenichelia Mahunka, 1985

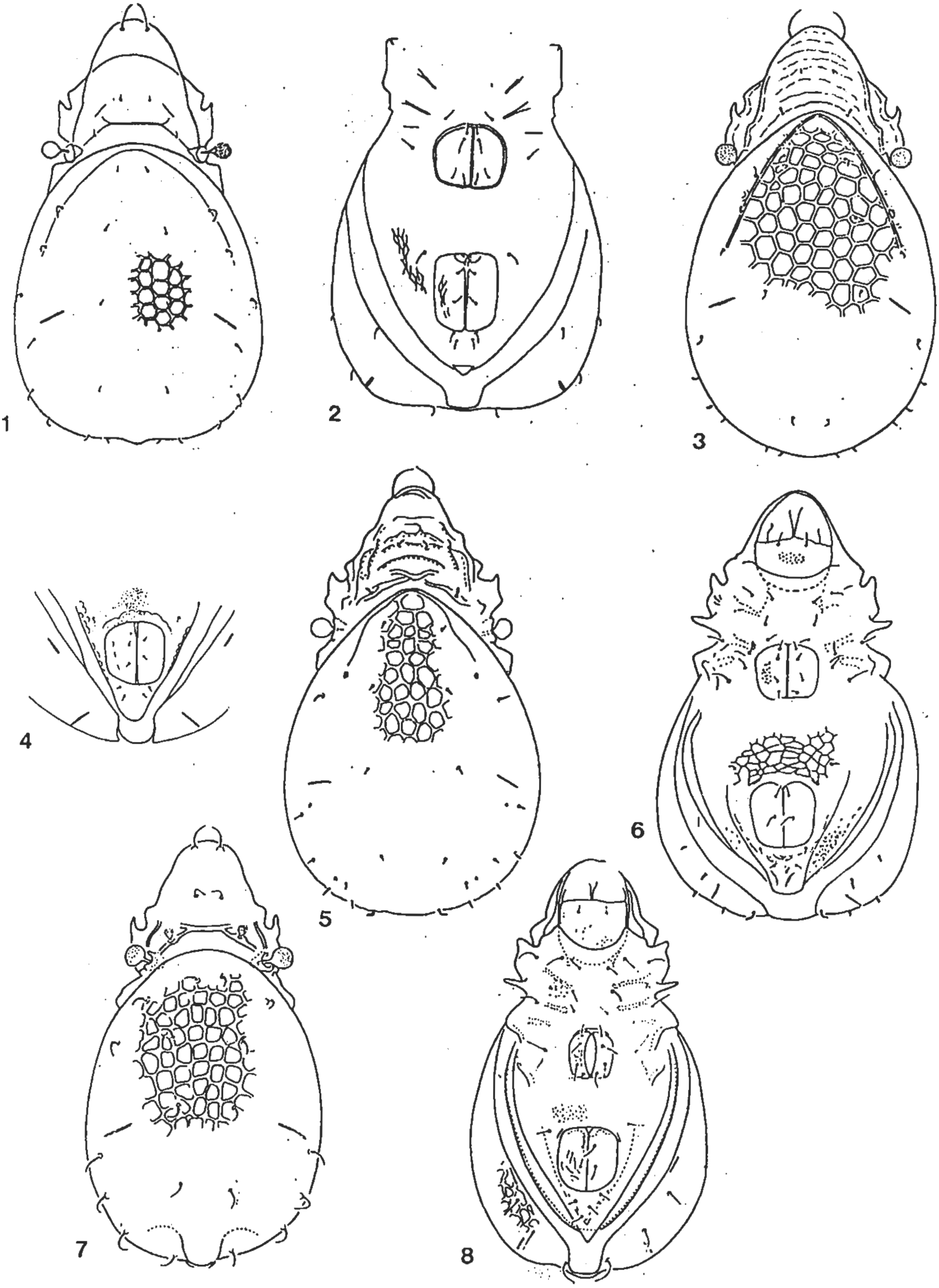
Aggenital setae absent. Adanal setae ad_1 in postanal, ad_2 in adanal, ad_3 in preanal position. Notogastral setae c_1 close to each other: distance c_1-c_1 much shorter than c_2-c_2. Notogastral setae phylliform, small. Notogaster with large foveolae. – One species:

P. porosa Mahunka, 1985 – Type species.

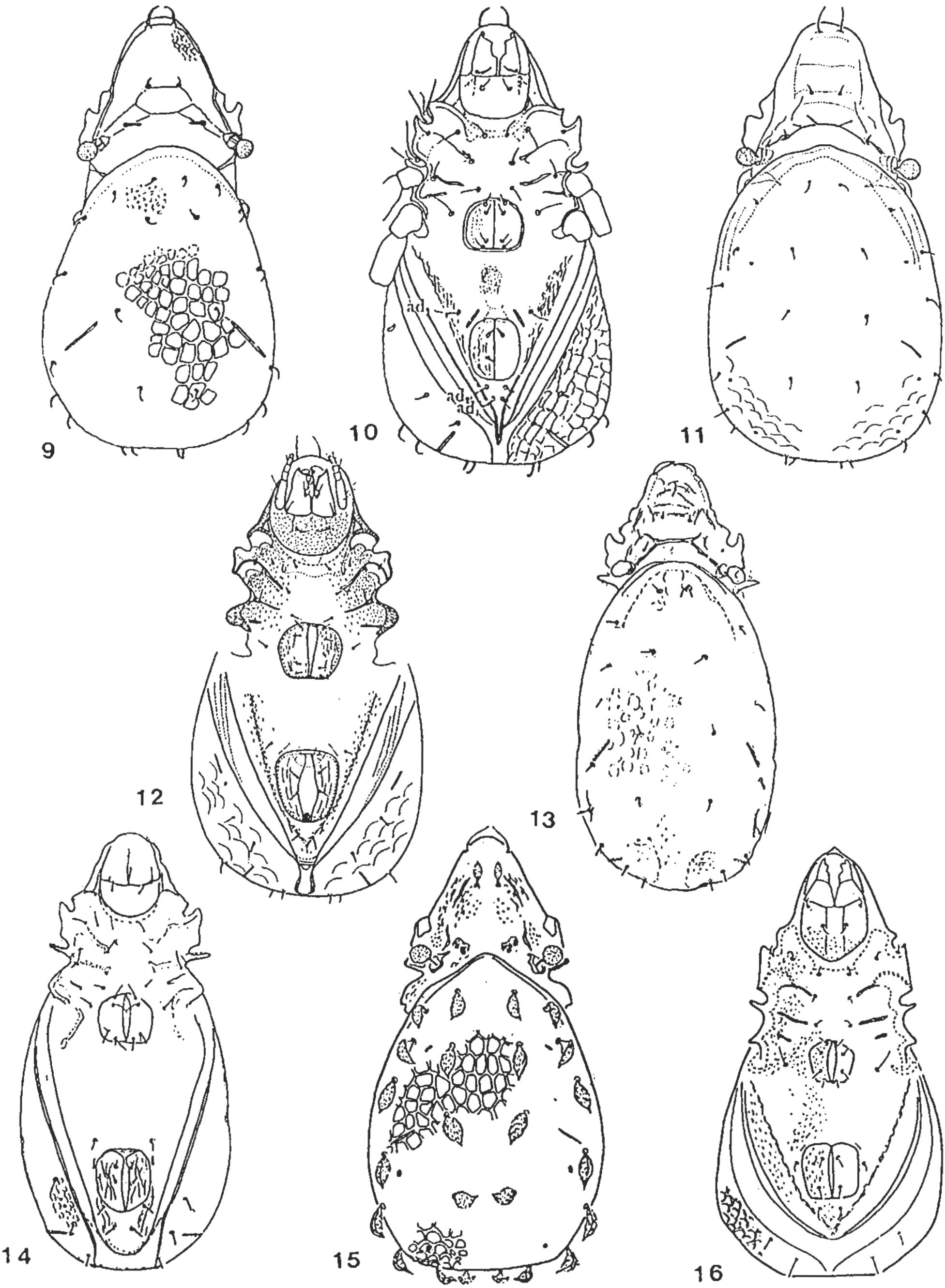
Mexiceremus gen. n.

Aggenital setae present. Adanal setae ad_1 in postanal, ad_2 in adanal, ad_3 in preanal position. Distance c_1-c_1 equal to distance c_2-c_2. Notogastral setae densely setulose. Interlamellar setae and lamellar setae densely setulose like notogastral setae. Notogastral setae p_2 and p_3 only sparsely setulose. – One species:

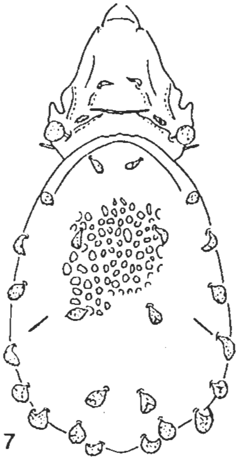
M. rafaelinus (Mahunka & Palacios-Vargas, 1995) comb. n. – Type species.



Figs. 1–8. 1–2: *Micreremus brevipes* (Michael, 1988) (after Mahunka, 1963). – 3–4: *Micreremus africanus* Balogh, 1963 (after Balogh, 1963 and Mahunka, 1983). – 5–6: *Micreremus faviger* Mahunka, 1983 (after Mahunka, 1983). – 7–8: *Micreremus longisetus* Mahunka, 1986 (after Mahunka, 1986)



Figs. 9–16. 9–10: *Micreremus macrofissura* Hammer, 1979 (after Hammer, 1979). – 11–12: *Micreremus subglaber* Ito, 1982 (after Ito, 1982). – 13–14: *Micreremus florens* Mahunka, 1983 (after Mahunka, 1983). – 15–16: *Micreremus biroi* Balogh, 1970 (after Balogh, 1970)



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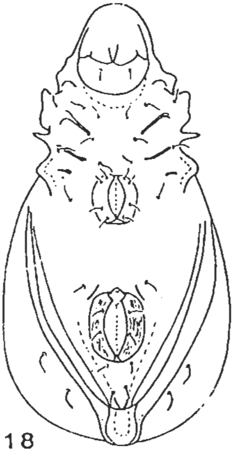

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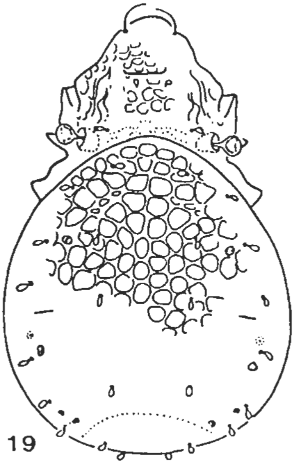

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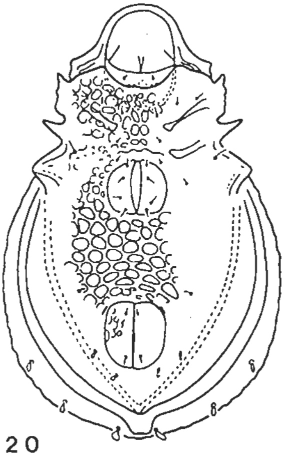

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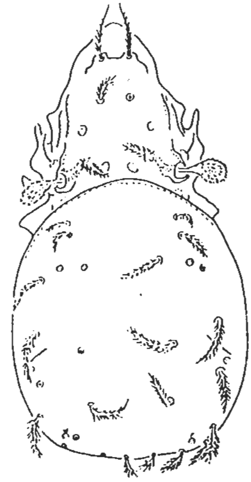

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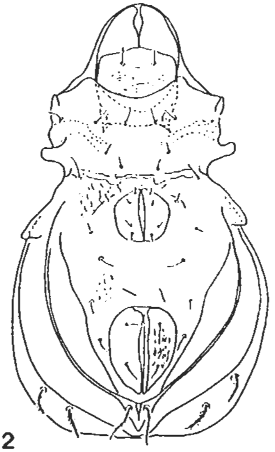

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Figs. 17–22. 17–18: *Fenichelia latipilosa* Mahunka, 1982 (after Mahunka, 1982). -19–20: *Porofenichelia porosa* Mahunka, 1985 (after Mahunka, 1985). - 21–22: *Mexiceremus rafaelius* Mahunka & Placios-Vargas, 1995 (after Mahunka and Palcios-Vargas, 1995)

Identification key to the species of Micreremidae

1 (2) Aggenital setae present; adanal setae ad_1 in postanal, ad_2 in adanal, ad_3 in preanal position; notogastral setae c_1 far from each other: distance c_1-c_1 equal to c_2-c_2; notogastral setae, like interlamellar and lamellar setae, setiform, densely setulose. L: 230 µm. – Mexico.

Mexiceremus rafaelinus (Mahunka & Placios-Vargas, 1995)

2 (1) Aggenital setae absent; notogastral setae c_1 close to each other: distance c_1-c_1 much shorter than c_2-c_2.

3 (4) Adanal setae ad_1 in postanal, ad_2 in adanal, ad_3 in preanal position; notogastral setae phylliform, small, smooth. Notogaster ornamented with large foveolae. L: 324 µm. – South Africa.

Porofenichelia porosa Mahunka, 1985

4 (3) Adanal setae ad_1 and ad_2 postanal, behind one after the other; notogastral setae either setiform and smooth, or phylliform and densely aciculate.

5 (8) Notogatral setae (except small, setiform setae p_2 and p_3 on ventral side) phylliform and densely aciculate.

6 (7) Prodorsum without transversal lath in interlamellar region. L: 304 µm. – Papua New Guinea.

Fenichelia biroi Balogh, 1970

7 (6) Prodorsum with well developed transversal lath in interlamellar region. L: 322 µm. – Ethiopia.

Fenichelia latipilosa Mahunka, 1983

8 (5) All notogastral setae setiform, short and smooth.

9 (12) Notogaster without strong polygonal structure, only with shallow depressions (by optical microscope they are very difficult to see, only in the lateral and posterior inclined parts are conspicuous in dorsal aspect).

10(11) Notogaster elongate, twice as long as wide; notogastral setae straight, almost spiniform. L: 240 µm. – Ethiopia.

Micreremus florens Mahunka, 1983

11(10) Notogaster less elongate, ratio L:W = 72:50. L: 260–300 µm. – Japan.

Micreremus subglaber Ito, 1982

12 (9) Notogaster with strong, polygonal structure.

13(14) Interlamellar setae broadly phylliform, densely aciculate; posterior part of notogaster near its margin with a large rounded tubercle. L: 280 µm. – South Africa.

Micreremus longisetosus Mahunka, 1986

14(13) Interlamellar setae bacilliform or setiform, never phylliformly dilated; posterior margin of notogaster without large tubercle.

15(16) Fissure *im* on notogaster abnormally long: as long as or longer than half a distance of setae *dm-lp*. L: 270 μm. - Java.

Micreremus macrofissura Hammer, 1979

16(15) Fissure *im* on notogaster normal, shorter than half a distance of setae *dm-lp*.

17(18) Anal and ventral plate with polygonal web-like structure. L: 302 μm. - Ethiopia.

Micreremus faviger Mahunka, 1983

18(17) Anal and ventral plate without polygonal web-structure.

19(20) Interlamellar setae stick-shaped; dorsosejugal suture parabolic. L: 290 μm. - Equatorial Africa. *Micreremus africanus* Balogh, 1963

20(19) Interlamellar setae setiform or spiniform. L: 300-315 μm. - Palearctic.

Micreremus brevipes (Michael, 1988)

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Opusc. Zool. Budapest, XXXI, 1998

A new earthworm species, *Dendrobaena rothschildae* sp. n. from Israel, and comments on the distribution of *Dendrobaena* species in the Levant (Oligochaeta: Lumbricidae)

By

CS. CSUZDI*, T. PAVLÍČEK** and E. NEVO***

Abstract. A new earthworm species, *Dendrobaena rothschildae* sp. n. is described from Israel. A zoogeographical analysis of *Dendrobaena* species being autochthonous in Israel is presented.

Our recent knowledge of earthworm species in the Eastern Mediterranean and of their distribution is far from complete (Omodeo & Rota, 1989). No systematic earthworm surveys have been carried out in Israel and the surrounding countries so far (Pavlíček and Csuzdi, 1999). All registered records resulted from a few occasional and sporadic samples organized as a by-product of other field activities (e.g. insect collecting).

In the course of evolutionary-ecological researches conducted at Lower Nahal Oren, Mt. Carmel, Israel (summarized by Nevo, 1995, 1997), also earthworms had been studied for two years. The results showed a relatively high species amplitude as well as large ecological and genetic differences in the different biotopes (Pavlíček et al., 1996, and unpublished). These results inspired us to launch a more intensive investigation of earthworm fauna of Israel and the Sinai Peninsula. Thus, in Israel about 1500 earthworm specimens from nearly 60 localities have been collected. In the Sinai no representatives of the genus *Dendrobaena* could be observed.

Of the material, taxonomic and zoogeographical analyses of species of the genera *Dendrobaena* and *Bimastos* occurring in Israel have been completed (Csuzdi & Pavlíček, 1999). Also several juvenile *Dendrobaena* specimens showing morphological differences from the others were found, but unfortunately no adults were available to determine them at species level. Lately, several adult and preadult specimens were collected, and a new species, *Dendrobaena rothschildae* sp. n. was found which is described below.

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Dendrobaena rothschildae Csuzdi & Pavlíček sp. n.

External characteristics. Holotype: length 60 mm, diameter just after the clitellum 5 mm. Number of segments 122. Preadult Paratypes 35–42 mm long and 4 mm wide just after the clitellum. Pigmentation dark violet. Prostomium tanylobous. First dorsal pore at the intersegmental furrow 5/6. Setae unpaired. Setal formula at segment XL: *aa:ab:bc:cd:dd* = 22:11:18:8:47. Three pairs of spermathecal pores present in furrows 8/9, 9/10 and 10/11, somewhat above the setal line *d*. Male pores on the segment XV were juxtaposed to glandular papillae and occupied also a part of the neighbouring segments. Nephridial pores irregularly alternated between setal line *b-d*. Clitellum constantly at segments XXVIII–XXXVI. Tubercula pubertatis in the segments XXX–XXXIV, *1/n* XXXV. Genital papillae on *cd* XI and XII. Genital setae of *cd xi* 0.82–0.9 mm long, spear-shaped with 0.46–0.48 mm long longitudinal grooves.

Internal characteristics. There are no septa thickened. Free testes and funnels paired in segments X–XI. Seminal vesicles present in segments and XII. Epididymis lacking. Spermathecae with short stalk localized in segments IX, X, XI, and with external openings above the setal line *d*. Calciferous lamellae present in segments X–XIII; in segment XII a strongly developed diverticulum was present. Paired lateral hearts present in segments VI–XI; the last pair smaller than the others. Nephridial bladders biscuit-shaped (*octaedra* type). Crop in segments XV–XVI, and gizzard in segments XVII–XVIII. Typhosolis large, anchor-shaped. Longitudinal muscle layers of pinnate type.

As for its morphology, the new species seems to be close to *Dendrobaena samarigera* (Rosa, 1893), but *D. samarigera* does not possess receptaculae seminis and tubercula pubertatis which are present in *D. rothschildae*. Presence of three pairs of receptacula seminis is quite rare among *Dendrobaena* species. Such a number was recorded in *D. octaedra* Eisen, 1874 and *D. alpina diplotritheca* Kvavadze, 1972; *D. rothschildae* sp. n. shows, however, different morphological characters from both mentioned species.

Type material: *Holotype:* Z/12998, Israel, south of Bet-She'an, near the crossroad to Haifa; leg. T. Pavlíček, II. 28. 1998. *Paratypes:* Z/12999, 2 ex.; Z/12913, 7 ex., Israel, south of Bet-She'an, near the crossroad to Haifa; leg. T. Pavlíček, II. 28. 1998. Z/12953, 2 ex., Israel, Jordan valley, Tel el Hama; leg. T. Pavlíček, III. 06. 1998.

The new species is dedicated to Professor Miriam Rothschild in appreciation of her enormous contribution on behalf of biodiversity on our Planet.

Distribution of *Dendrobaena* species known in Israel

Eleven *Dendrobaena* species have been recorded from Israel hitherto. Most of them are endemic to the Israeli part of the Levant, to Levant and Eastern Mediterranean. (Zoogeographically, the Levant includes northern and central Israel, Lebanon and a part of Syria.) Only two species, *D. veneta veneta* (Rosa, 1886) and *D. hortensis* (Michaelsen, 1890) are cosmopolitan. Unfortunately, there are still some taxonomic and zoogeographical problems which do not allow to state accurately the distribution of *Dendrobaena* species in Israel.

Fig. 1. Distribution of *Dendrobaena byblica* species complex

First, there are certain problems regarding the species *Dendrobaena byblica* (Rosa, 1893). This species shows a circum-Mediterranean distribution, but it represents probably a superspecies complex of various sibling species (Fig. 1). Differently from *D. byblica* and the above-mentioned two cosmopolitan species, all other Israeli species of the genus *Dendrobaena* are generally distributed in the East Mediterranean or at least in a part of it. Seemingly, an East Mediterranean distribution is indicated in *D. hauseri* (Zicsi, 1973). The original description of this species was based on material collected in Turkey. Subsequently, it was also recorded in Israel (Zicsi, 1985; Csuzdi & Pavlíček, 1999). However, the latter specimens possess a number of seminal vesicles different from the Anatolian ones, their taxonomic status is therefore uncertain (Fig. 2). A similar problem is associated with the distribution of *D. semitica* (Rosa, 1893). This species was described from Palestine (Est del Giordano and Mesraah = Mezra'ah, Lebanon), and subsequently it has been recorded in Turkey (Omodeo, 1952; Omodeo & Rota, 1989, 1991). Furthermore, important morphological differences were found between specimens originating from Turkey and Israel. Omodeo and Rota (1991, p. 180) characterized the Turkish specimens as follows: *cl:* 24–33, *tb:* 30–32, last hearts in segment 10, receptacles' external openings on line *c.* It may be supposed that the specimens from Turkey are closely related to *D. semitica,* the differences in the position of clitellum and tubercular bands (original description: *cl:* 26–33, *tb:* 31–33) indicate, however,

Fig. 2. Distribution of *Dendrobaena hauseri*

that they might still belong to another species or, at least, subspecies. If our supposition is correct, the distribution of *D. semitica* would be limited to the Levant only (Fig. 3).

In our opinion, the distribution of *D. orientalis* Černosvitov, 1940 is also problematic. The original description was based on specimens collected in Palestine (Rosh Pinna, now: Israel). There is however a similar species, *D. ressli* (Zicsi, 1973); it was described from Turkey. Perel (1979) considered *D. ressli* a synonym of *D. orientalis*. In lack of Perel's specimens collected in Armenia or of a new material, this problem cannot be solved yet. If the receptacles of Armenian specimens described as

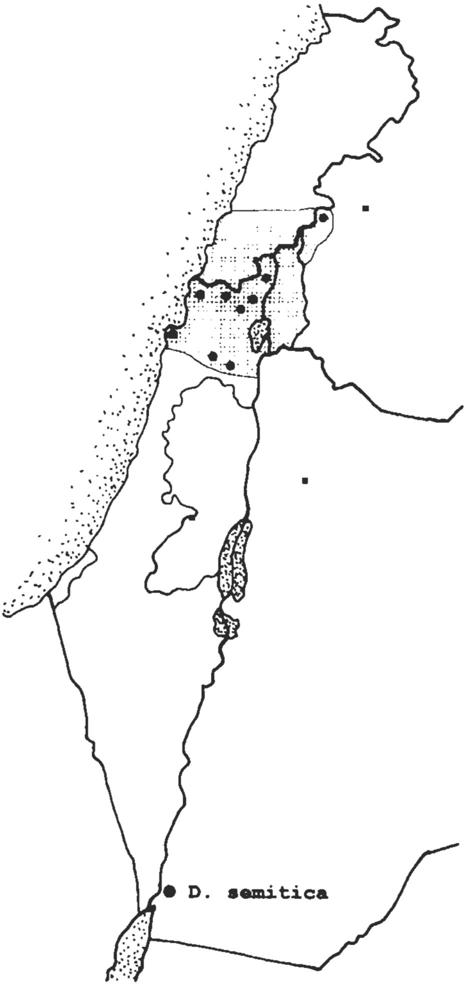

Fig. 3. Distribution of *Dendrobaena semitica*

D. orientalis have external openings on line *d*, they would belong to *D. ressli.* Thus, the distribution of *D. orientalis* would also be restricted to the Levant (Fig. 4). If the receptacles' openings are on line *c*, the two names must be regarded as synonyms and *D. orientalis* would have a wider East Mediterranean distribution from Israel up to Armenia.

The remaining 5 species (*Dendrobaena negevis* Csuzdi & Pavlíček, 1999; *D. nevoi* Csuzdi & Pavlíček, 1999; *D. rothschildae* sp. n.; *D. samarigera* (Rosa, 1893) and *D. veneta kervillei* (Michaelsen, 1910) are endemic to the Levantine part of Israel (Figs. 5–6).

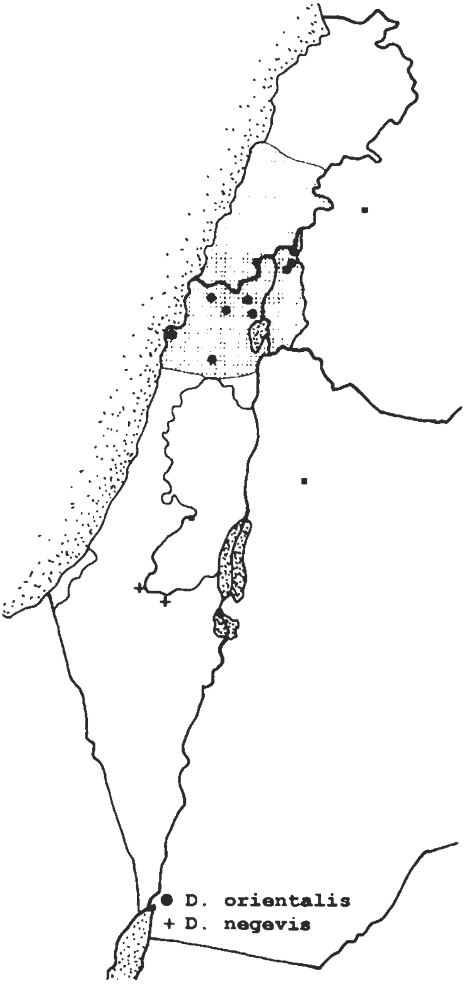

Fig. 4. Distribution of *Dendrobaena orientalis* and *D. negevis*

The presence of the above-mentioned three vicarious sister-taxa may presumes a historical relationship in the earthworm fauna between Israel and Anatolia on the one hand, but the great number of endemisms of *Dendrobaena* species in Israel (64%) supposes a long independent history of both regions on the other hand.

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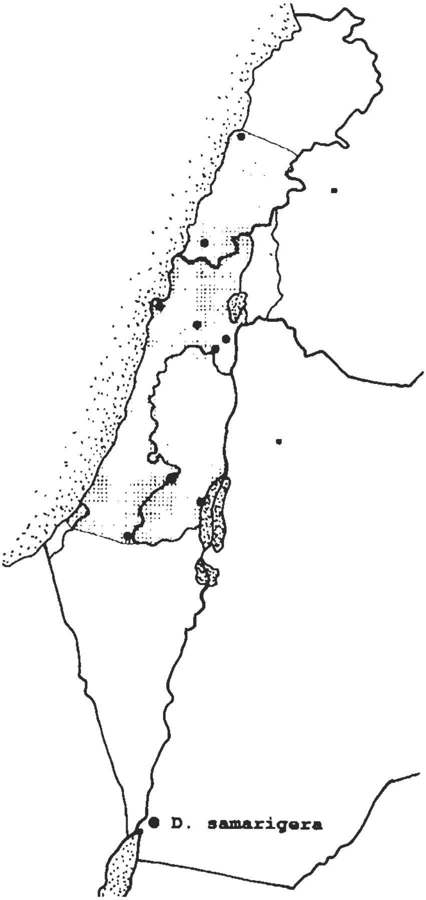

Fig. 5. Distribution of *Dendrobaena samarigera*

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Fig. 6. Distribution of *Dendrobaena nevoi, D. rothschildae* sp. n. and *D. veneta kervillei*

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The enchytraeid fauna (Annelida, Oligochaeta) of accumulated debris along the shore of Lake Balaton, and seasonal dynamics of the species

By

K. DÓZSA-FARKAS*

Abstract. The enchytraeid fauna and their seasonal dynamics along the shoreline of the largest shallow lake of Europe, Lake Balaton was investigated. A total number of 19 species belonging to 9 genera were found. Dominant species were ***Enchytraeus christenseni, E. buchholzi, Henlea ventriculosa, H. perpusilla*** and in the wet habitat ***Marionina riparia*** and ***M. argentea.*** Enchytraeids inhabiting dryer, accumulated, thick debris yielded a maximal value of 193500 ±59602 specimen/m² in October 1997 and 217900 ± 10872 specimens/m² in July 1998. In the wet debris the abundance was some hundred or thousand specimens/m². In the nearby soil behind the debris it was lower. However, the number of species was higher in the soil. The abundance of enchytraeids showed a seasonal decline in winter.

Lake Balaton is the largest shallow lake of Europe situated in the Transdanubium (western part of Hungary), at an altitude of 104.8 m above the Adriatic Sea level (Herodek et al., 1988). One part of the primary production is washed ashore (termed debris) along the natural shoreline and is biologically decomposed after a while. The other part decays in the water and increases the eutrophication of the lake. Contiguous natural water fronts disappeared during the last years, many of them were filled up and paved. Thus, development of debris has been hampered noticeably. In other words, organic detritus from the Lake cannot get out to the shore any more, or if any storm throws it out to the stones of the shoreline, it dries out very fast, or the next more powerful wave carries it back to the water again. Only few parts of the shoreline were preserved in natural condition usually bordering some of the beaches.

The objectives of our research were: *1)* to establish the quantity of detritus ashore by the waves on the shore, *2)* to record enchytraeid species inhabiting the debris of different condition, *3)* to determine the dominant elements of the enchytraeid fauna and *4)* to ascertain the seasonal dynamic of these animals.

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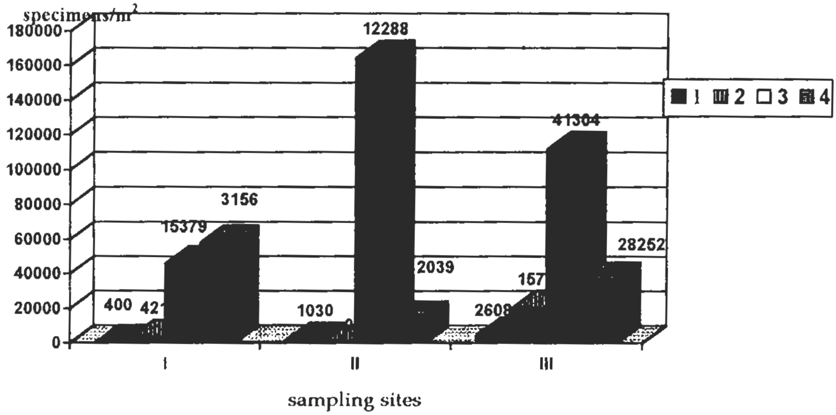

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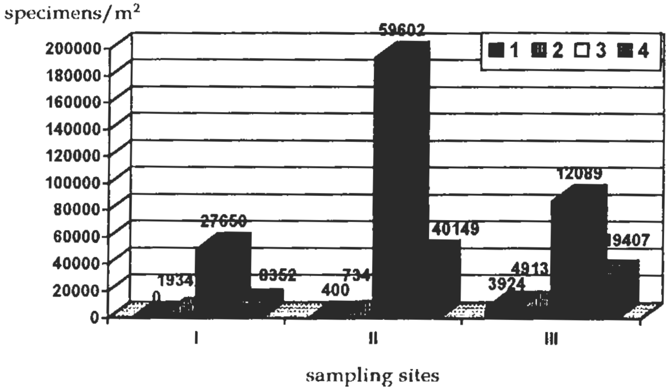

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Figs. 1-2. Abundance of enchytraeids at three sampling sites (I-II-III) and in different types of debris and soil (1-2-3-4). August and October, 1997. (Numbers above bars: SD)

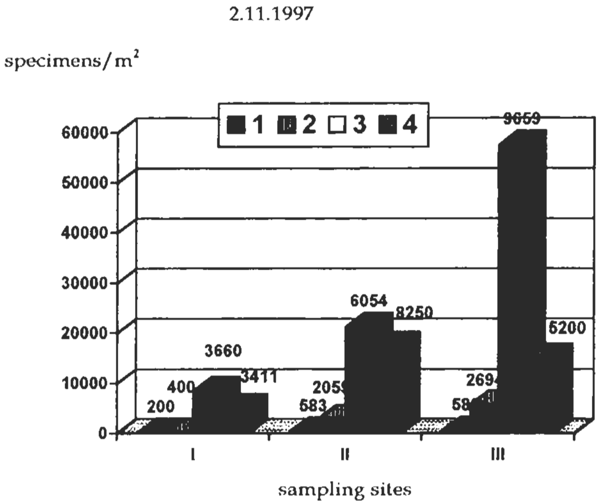


Fig. 3. Abundance of enchytraeids at three sampling sites (I-II-III) and in different types of debris and soil (1-2-3-4). November, 1997. (Numbers above bars: SD)

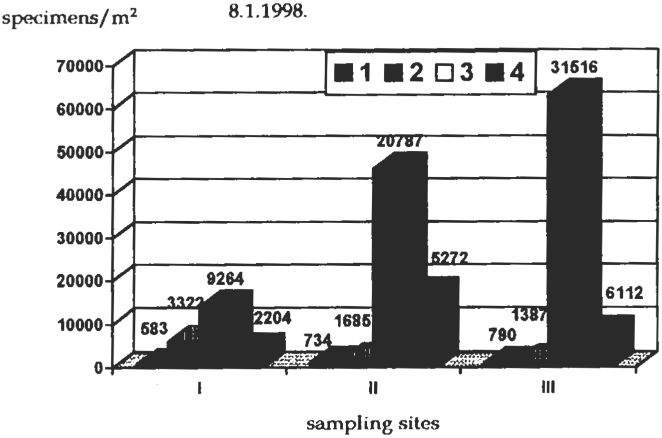
Materials and methods

Our investigations were carried out during the period from August 1997 to November 1998. Samples were taken seven times in approximately every season. The three localities of our research were situated at the southern part of the Lake, where the water was quite shallow: in Balatonszárszó 2 km removed from each other (sampling sites I and II) and near Balatonberény (III). There are holiday homes at the localities I and II, 20 m away from the shore, whereas locality III is free of any houses. All the three sampling sites are situated in the reeds, interrupted by bathing access, where the water ashore large quantities of detritus (rising to max. 50 cm). The samples were taken with the usual enchytraeid sampler (20 cm² surface, 5 cm depth) along a 3 m wide water-shore transect of the debris of three different conditions: *1.* detritus-water interface at the waterline, *2.* wet debris deposited at the edge of shore, *3.* drier, thickly accumulated debris and one sample was obtained from the soil behind the debris *(4).*

The samples were transported in polyethylene bags to the laboratory, where the worms were extracted by O'Connor's method and identified alive. In addition, we investigated also the aquatic oligochaetes, but they were identified only at family (Tubificidae, Lumbriculidae, Naididae) or class level (Aeolosomatida).

Obtaining quantitative samples was impossible from the debris of macrovegetation put out to the paved shoreline by the waves.

8.1.1998.



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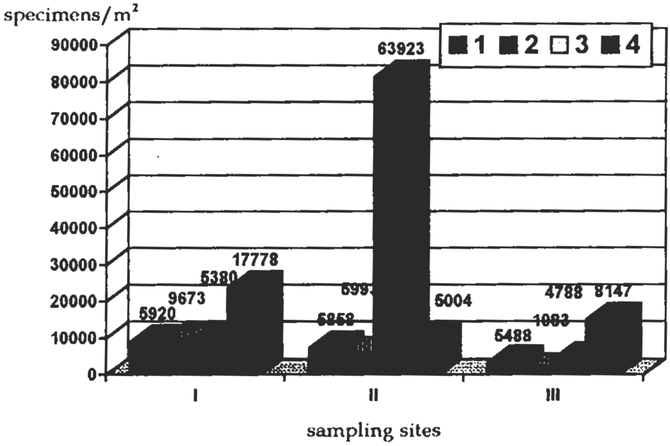
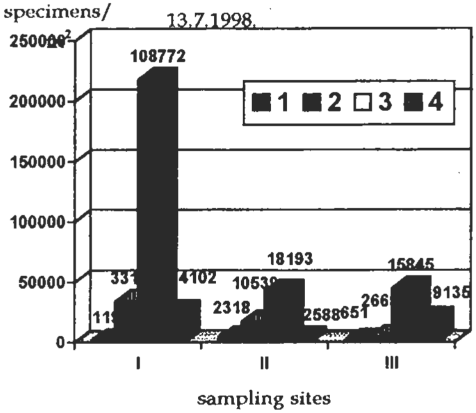
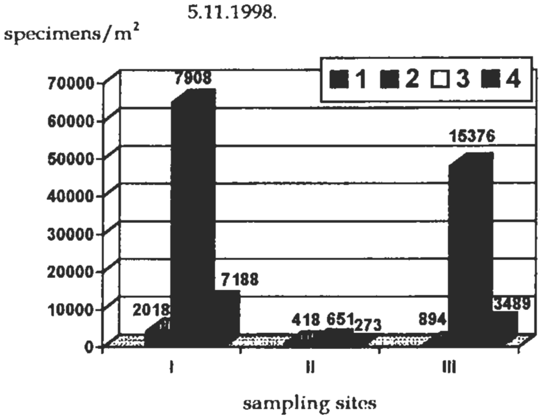


Figs. 4–5. Abundance of enchytraeids at three sampling sites (I-II-III) and in different types of debris and soil (1-2-3-4). January and April, 1998. (Numbers above bars: SD)





Figs. 6–7. Abundance of enchytraeids at three sampling sites (I-II-III) and in different types of debris and soil (1-2-3-4). September and November, 1998. (Numbers above bars: SD)

Results

The 19 recorded enchytraeid species were as follows:

Achaeta pannonica Graefe, 1989
Buchholzia appendiculata (Buchholz, 1862)
Cognettia glandulosa (Michaelsen, 1888)
Cernosvitoviella minor Dózsa-Farkas, 1990
Enchytraeus buchholzi Vejdovsky, 1879
Enchytraeus bulbosus Nielsen & Christensen, 1963
Enchytraeus christenseni Dózsa-Farkas, 1992
Enchytraeus lacteus Nielsen & Christensen, 1961
Fridericia bulbosa (Rosa, 1887)
Fridericia galba (Hoffmeister, 1843)
Fridericia paroniana Issel, 1904
Fridericia sp.
Hemifridericia parva Nielsen & Christensen, 1959
Henlea heleotropha (Steph., 1922)
Henlea nasuta (Eisen, 1878)
Henlea perpusilla Friend, 1911
Henlea ventriculosa (d'Udekem, 1954)
Marionina argentea (Michaelsen, 1889)
Marionina riparia Bretscher, 1899

Comparing with earlier investigation made along the Lake's shore (Dózsa-Farkas, 1995), we found two species new for this area (*Enchytraeus lacteus* and *Fridericia* sp.), however, four formerly unusual species were not present this time.

Species composition and seasonal changes were determined in the debris of different decomposition stages. The dominance values yielded in tables 1-5 present the results from October 1997 and all the investigated seasons in 1998. *Buchholzia appendiculata* turned to be an extremely dominant species. Its outstandingly high dominance is probably a consequence of the unusual way of its reproduction: the fragmentation. Enchytraeid species with such a reproduction strategy may effectively colonise new habitats (Dózsa-Farkas, 1996). In thick debris deposits (3) we often estimated its nearly 40 % dominance. In favourable seasons, e.g. July, it even had a dominance of 92 % at site I (Szárszó). A considerable number of cosmopolitan species of wet shorelines rich in organic material such as *Enchytraeus christenseni*, *E. buchholzi*, *Henlea ventriculosa* and *H. perpusilla* occurred in the debris. Dominant species of the wet samples were *Marionina riparia* and *M. argentea.*

Investigation of the enchytraeids' quantitative distribution (Figs. 1-7) revealed that they play a subordinated role in the wet debris habitat. Mostly some hundred or thousand specimens could be found per m^2 with quite uneven distribution and high standard deviation. Maximal abundance values were found in 1997 at Balatonberény (area III/2 in August: 20,200 ± 15,728 specimens/m^2) and in 1998 at Balatonszárszó (area I/2 in April: 9100 ± 5920 specimens/m^2). Aquatic oligochaete families (Naididae, Lumbriculidae, Tubificidae) were present in similarly low abundance in this environment (400–1100 specimens/m^2). An interesting gradation of Aeolosomatida population was estimated in summer 1998, although the abundance value was 45,400 ± 46,259 specimens/m^2 in sampling site I, with quite an uneven distribution. We didn't meet such a mass abundance last year.

The amount of enchytraeids considerably increases in the organic detritus, deposited in thick strata (3). Their abundance generally fluctuates between 10,000 and 100,000 specimens/m^2, but it reached an outstanding maximum in October 1997 at sampling site II (193,500 ± 59,602 specimens/m^2) (Fig. 2), and in July 1998 at sampling site I (217,900 ± 10,872 specimens/m^2) (Fig. 6). These facts suggest that enchytraeids play an important role in the decomposition of organic material. In the soil behind the debris, we measured lower abundance values, fluctuating between 5000 and 58,000 specimens/m^2 in 1997 (Figs. 1–3) and 4000–25,500 specimens/m^2 in 1998 (Figs. 4–7). In the soil, the total number of enchytraeids was lower, however, the number of species was the highest with 15 ones, in contrast to the 8–11 species in the debris; the latter fact shows that the soil seems to be a different habitat type for them. Moreover, *Achaeta pannonica* and *Enchytraeus bulbosus* occurred exclusively in the soil samples (Tables 1–5). *Fridericia* sp. – resembling *F. ratzeli* (Eisen, 1872) as well as *F. sacculata* Bell, 1936 described from Canada – was also recorded only in the soil samples, but a more detailed description requires further research.

During the winter months, the abundance of enchytraeid population diminished, the only habitat where they thrived was the thicker debris with specimen numbers per m^2 63,100 ± 28,189 (site III, 8. January 1998) (Fig. 4), and 64,900 ± 7,908 (site I, 5. November 1998) (Fig. 7), respectively. Significant drop of temperature may serve as an explanation for this decrease. The samples taken on the 5th of November were influenced by an extraordinary phenomenon. The water line of Balaton was unusually high because of the heavy rainfall and inundated a part of the sampling area, therefore it was impossible to take samples from the debris in the water (first habitat). The most remarkable changes due to the uncommon weather occurred at sample site II, which was reflected excellently in our results (Fig. 4).

In stormy, rainy weather the macrophyte-vegetation washed ashore in the paved shoreline contained roughly the same dominant enchytraeid species as the debris in the natural shorelines. However, in summer the sunlight dried up or the waves washed back the vegetation quickly, thus the enchytraeid fauna's qualitative composition was strongly affected by the latter facts.

Discussion

A remarkable number of enchytraeids was observed in the debris found on the shores of Balaton. thus these worms must have an important role in the decomposition of organic material. This theory was supported by a previous experiment on food consumption, where one *Helena nasuta* specimen consumed daily 156 ± 15 μg leaf of rotting reed, while *H. ventriculosa* consumed 33 ±12 μg/day/specimen (own data, yet unpublished). The results of the quantitative study revealed that in this habitat type species of largest dominance are *Buchholzia appendiculata, Enchytraeus christenseni, E. buchholzi, Henlea ventriculosa* and *Henlea perpusilla.* Dominant species in the moist debris were *Marionina riparia* and *Marionina argentea.* Furthermore, we concluded that the debris's fauna differs from that of the soil, since in the latter more *Fridericia* species occurred among the dominant *Enchytraeus* species. Putting out the organic material on the shore (according to our still unpublished observations, its amount could reach 87 to 230 kg detritus/month in a 100 m stretch of the shore) and its decomposition outside of the water demonstrate the Lake's self-cleaning ability. The artificial stone barriers, breakwaters prevent this process, thus, decaying organic material remains in the water increasing eutrophication. Its consequences are clearly visible: the stones along the artificial shoreline (near the Balatonberény sampling site) are densely covered with an alga, *Cladophora* sp. in summer.

Acknowledgements. The investigation was made in the frame of the Balaton Program supported by the Prime Minister's Office of Hungary.

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Table 1. Dominance values (%) of enchytraeid species in the different types of debris in the three sampling sites (16 November, 1997) (1. detritus in the water, 2. wet debris, 3. drier debris, 4. soil)

Species	1	2	3	4	1	2	3	4	1	2	3	4
Achaeta pannonica												
Buchholzia appendiculata		+	21	+		20	90	61		+	21	+
Cognettia glandulosa						+						
Cernosvitoviella minor									+	+	+	
Enchytraeus buchholzi		11	14	+			+	17		+	10	10
Enchytraeus bulbosus												
Enchytraeus christenseni		+	14	+	20		+	+	20	30	8	13
Enchytraeus lacteus												
Enchytraeus sp. juvenil												
Fridericia bulbosa												+
Fridericia galba					+							+
Fridericia paroniana												
Fridericia sp.												
Fridericia sp. juvenil												
Hemifridericia parva		+					+					
Henlea heleotropha			+	+			+	+		+	+	+
Henlea nasuta			+				+	+			+	+
Henlea perpusilla		+	10	+			+	12	10	15	29	41
Henlea ventriculosa		27	28	+		53	+		+	16	15	19
Marionina argentea		+	10	+			+	+	+	+	+	+
Marionina riparia		30	+	61	20				57	24	17	+

Table 2. Dominance values (%) of enchytraeid species in the different types of debris in the three sampling sites (8. 1. 1998.) (1. detritus in the water, 2. wet debris, 3. drioer debris, 4. soil)

Species	1	2	3	4	1	2	3	4	1	2	3	4
Achaeta pannonica												
Buchholzia appendiculata		13	49	12			47	26			58	12
Cognettia glandulosa												
Cernosvitoviella minor	+	+			+	+				+		
Enchytraeus buchholzi		+	22	19	27	+	+	13	20	14	+	+
Enchytraeus bulbosus				+				+				+
Enchytraeus christenseni	+	23	+	17	27	26	+	11	30	29	+	20
Enchytraeus lacteus				+								
Enchytraeus sp. juvenil		+				+	+	+	10		+	+
Fridericia bulbosa				+			+	+			+	+
Fridericia galba			+	+			+	+				+
Fridericia paroniana				+				+				+
Fridericia sp.				+				+				+
Fridericia sp. juvenil			+	+			+	+			+	+
Hemifridericia parva			+				+	+				+
Henlea heleotropha			+				+				+	+
Henlea nasuta			+				+	+			+	+
Henlea perpusilla		+	+	+		10	15	18			+	+
Henlea ventriculosa		43	+	+		15	20	+		+	22	+
Marionina argentea		+	+	14	18	21	+	+	20	+	+	10
Marionina riparia	67	+			+	10	+		20	21		

Table 3. Dominance values (%) of enchytraeid species in the different types of debris in the three sampling sites (1.4.1998.)(1. detritus in the water, 2. wet debris, 3. drier debris, 4. soil)

Species	1	2	3	4	1	2	3	4	1	2	3	4
Achaeta pannonica				+				+				+
Buchholzia appendiculata		+	16	24		20	71	39		+	+	25
Cognettia glandulosa												
Cernosvitoviella minor	+	+	+		+	+				+		+
Enchytraeus buchholzi	+	14	18	14	+	10	+	+	+		+	+
Enchytraeus bulbosus				+				+				+
Enchytraeus christenseni	21	28	25	10	23	25	+	+	31	36	27	21
Enchytraeus lacteus				+								
Enchytraeus sp. juvenil	+			10	27	15	+	+				+
Fridericia bulbosa				+			+					+
Fridericia galba			+	+			+	+				+
Fridericia paroniana				+			+					+
Fridericia sp.				+				+				+
Fridericia sp. juvenil			+	+			+	+				+
Hemifridericia parva			+	+			+	+				+
Henlea heleotropha			+				+	+				+
Henlea nasuta				+				15			+	+
Henlea perpusilla	+	+	11	+	+	+	+	11			27	+
Henlea ventriculosa	+	21	13	+	+	+	+	+	11	14	25	+
Marionina argentea	16	17	+	+	10	+	+	+		29	+	+
Marionina riparia	29	+			21	+	+		54	+		

Table 4. Dominance values (%) of enchytraeid species in the different types of debris in the three sampling sites (13. 7. 1998.) (1. detritus in the water, 2. wet debris, 3. drier debris, 4. soil)

Species	1	2	3	4	1	2	3	4	1	2	3	4
Achaeta pannonica				+								+
Buchholzia appendiculata		38	92	+		+	46	27	+	10	28	4
Cognettia glandulosa						+	+					
Cernosvitoviella minor	+	+				+	+		15	+	+	
Enchytraeus buchholzi		+	+	16		13	+	45	23	+	+	+
Enchytraeus bulbosus				69							+	1
Enchytraeus christenseni	12	+	+	+	51	37	+	12		25	15	2
Enchytraeus lacteus				+								
Enchytraeus sp. juvenil												
Fridericia bulbosa				+								+
Fridericia galba												
Fridericia paroniana				+								+
Fridericia sp.				+							+	+
Fridericia sp. juvenil				+								+
Hemifridericia parva			+									
Henlea heleotropha		+	+	+								
Henlea nasuta		+	+	+								+
Henlea perpusilla		+	+			+	+	+		+	+	+
Henlea ventriculosa		12	20	+	26	13	+		15	17	30	+
Marionina argentea	+	26			14	18	26	+	31	+	10	+
Marionina riparia	62	+			+	+	+		+	25		

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Effect of the habitat fragmentation on the structure of small mammal (Rodentia, Insectivora) communities in Kis-Balaton Natural Conservation Area, Hungary

By

J. FARKAS , Z. CZIRÁK* and S. FORCZEK**

Abstract. Our aim was to demonstrate the differences between small mammal communities in various study areas, which formed same, large, homogeneous habitats previously. The investigation was carried out in the islands of Kis-Balaton Natural Conservation Area, which belongs to Balaton-felvidék National Park. We applied the Capture-Mark-Recapture method to study small mammal fauna. 14 species of Rodentia and Insectivora were detected. Diversity and density of small mammal fauna depend on the size of the fragments and the vegetation structure of the localities. We found the most individuals in large, mosaic-type habitats. The rate of mice, voles and shrews in different study areas strongly differ from each other.

While the ecological role of small mammals has been investigated for a long time by many authors (Batzli, 1975; Flemming, 1975; Golley, 1975), only scarce information is available on the animal communities of large areas, which were broken into fragments earlier. Sometimes, to form an opinion of the small mammals role is very difficult, because the number of individuals can extremely change year by year. Effect of the changing of the population size on the habitat is especially important in those localities, like our study areas.

Well known, that the food preference of rodents depend on the species itself and the supply of food (Hjalten, 1996). The effect of the consumption of plants is very different in a field, a forest, an opened or closed ecosystem etc. This effect is very strong in small islands, which are isolated from their surroundings.

While rodents are mainly plant eater, insectivores feed on smaller animals only, so their role is different from that of rodents. Though, the food supply is not indifferent for them. They prefer their food depending on species (Bellocq, 1994). They are important member of the food chain.

We assumed that the various small mammal species were fragmented into more or less closed populations according to the fragmentation of the previously

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continuous habitat. The isolations went and are going through different events, so the new characteristic features of the populations have been developed as the result of adaptation to the new environmental factors. In the present work, we made a comparison between small mammal communities of such as isolations, which differ from each other in the size and rate of fragmentation.

Sampling sites and methods

The investigation was carried out in two parts of so called "I. cycle" of Kis-Balaton Natural Conservation Area. This place is a large, shallow lake, the reservoir of Zala River, with numerous islands, extended from a few square meters to some hectares. We trapped animals in some islands, on the shore of the reservoir and in a large mosaic-type area, close to the other study areas. The islands stand out about 2 m high from the water. Most of them are degraded habitats. Their vegetation is dominated by weeds, mainly by *Erygeron canadensis.* The smaller habitats are as follows:

I/1. Planted forest in Fekete Island. - It is a large area connected to the mainland by dam. This locality was used as a control to the islands. Dominant trees of the forest are *Populus, Betula* and *Sambucus.* This area is bordered on a large reeds and a meadow.

I/2. Small size (1-10 m^2) members of the row of islands, situated between Fekete Island and Nagyrada. There are one or two willow (*Salix*) or locust (*Robinia*) trees and bushes (*Sambucus*).

I/3. Medium size (100-300 m^2) members of the row of islands. - Vegetation of this area is similar to I/2 study areas, only the number of trees and bushes is larger.

I/4. The largest (about 4 ha) member of the row of island. Dominant plants are *Quercus, Populus, Betula, Robinia, Sambucus, Crataegus.* Area with an extensive reed belt.

I/5. Dam, at right angles to the row of island. An area of reeds, sedges, grasses and willow trees.

I/6. Shore of the reservoir close to Nagyrada. This is a mainly forested area with reeds.

II. Area for comparison. - Large, mosaic-type area between the reservoir and Zalavár. One part is covered by trees (*Quercus, Betulus, Fraxinus, Populus*) and bushes (*Sambucus, Cornus*), the second one by sedges, grasses and weeds (*Erygeron canadensis*). The size of the quadrate was about 1.2 ha.

We applied the Capture-Mark-Recapture method during our investigation. Each of traps was baited by a piece of toast spiced with onion. Distance between two traps was 15 m in study areas I/1, I/4, I/5 and II, and smaller in study areas I/2 and I/3, because of the smaller size of the island, but the number of traps of surface unit was same in every localities. Corn seeds were put into the trap to reduce the mortality. Traps were checked 3-5 times daily depending on the weather and the activity of the animals. Trapped animals were narcotized by diethyl-ether during the treatment. Several parameters of animals, for example length of body, legs and tail, weight, state of sex etc. were recorded. Animals were marked by cut fingers method.

Results and discussion

Altogether, 14 small mammal species were detected (Table 1).

Significant differences were found in terms of population size and diversity among the sites studied. The greatest number of the species and individuals were found in the extensive study areas II and I/1. Considerably fewer species occurred on the small (I/2) and the medium (I/3) sized islands. Population size were also smaller in these islands compared to the other areas. There was a significant difference in community of small mammals between the small islands and the other areas. To make a comparison among the habitats, the highest similarities were found between the large island (study area I/4) and the close study area I/6. This fact

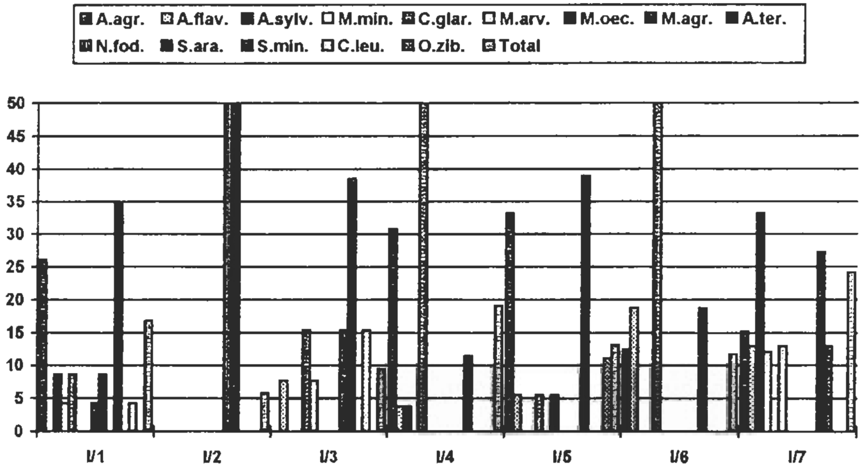

Fig. 1. Rate of the species in different study area

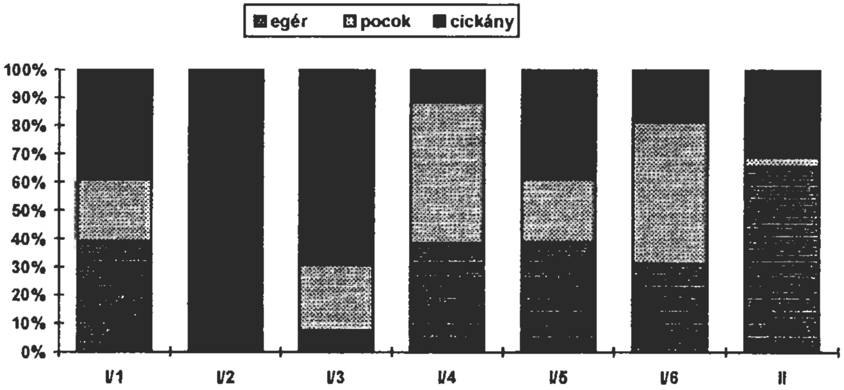

Fig. 2. Rate of mice, voles and shrews in different study areas

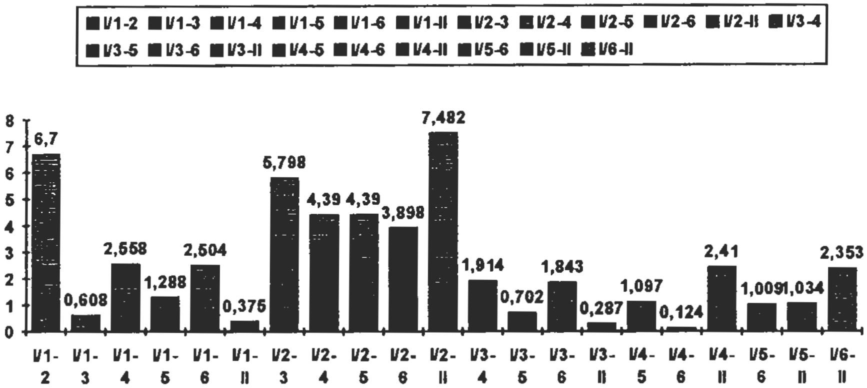

Fig. 3. Differences (t-value) among the study areas

Table 1. Rodentia and Insectivora fauna in study areas

Species	Study area						
	I/1.	I/2.	I/3.	I/4.	I/5.	I/6.	II.
Apodemus agrarius Pallas	+	-	-	+	+	+	+
Apodemus flavicollis Melchior	-	-	+	+	+	+	+
Apodemus sylvaticus Linné	+	-	-	+	-	-	+
Micromys minutus Pallas	+	-	-	-	-	-	+
Clethrionomys glareolus Schreber	+	-	+	+	+	+	-
Microtus arvalis Pallas	-	-	+	-	-	-	+
Microtus oeconomus Pallas	-	-	-	-	+	-	-
Microtus agrestis Linné	+	-	-	-	-	-	-
Arvicola terrestris Linné	+	-	-	-	-	-	-
Neomys fodiens Pennant	-	+	+	-	-	-	-
Sorex araneus Linné	+	+	+	+	+	+	+
Sorex minutus Linné	-	-	-	-	-		+
Crocidura leucodon Hermann	+	-	+	-	-	-	-
Ondatra zibethicus Linné	-	-	-	-	+	-	-
Number of species	8	2	6	5	6	4	7

Explanation: - non-existing species, + existing species, I/1.-II. habitats as mentioned in the text

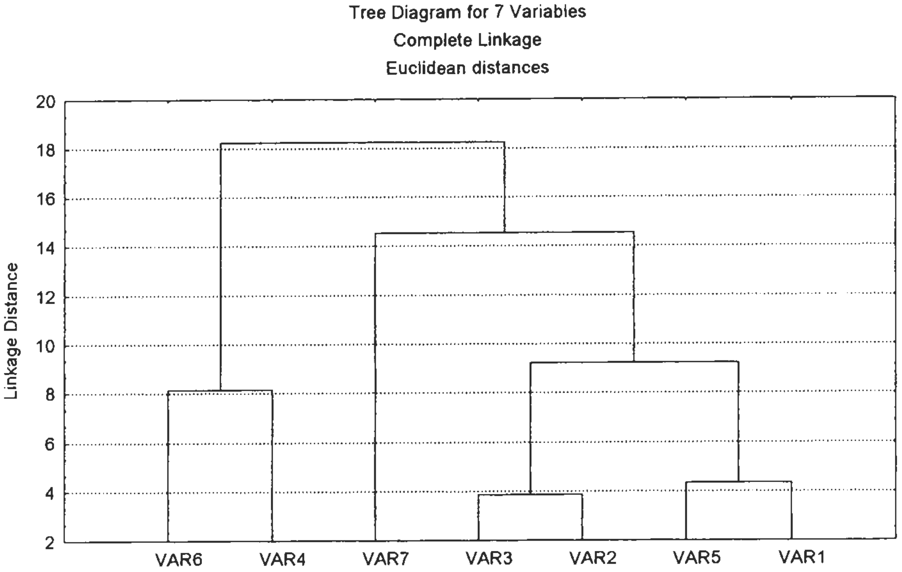

Fig. 4. Results of the cluster analysis. VAR1: study area I/1; VAR2: study area I/2; VAR3: study area I/3; VAR4: study area I/4; VAR5: study area I/5; VAR6: study area I/6; VAR7: study area II

suggests that stable population of several small mammal species can survive on islands of extensive areas. Mice, voles and shrews have different feeding strategies. This is demonstrated in Fig. 2. Only shrews were found on the small islands. Besides water shrews, common shrews were trapped also. Mice and voles feeding mainly on plants could not find food enough in these areas. They had died or migrated away from these areas. On the other hand, insectivores can find food enough for them, because flying insects always migrate to the small islands. On medium sized islands mainly voles occurred beside shrews. Voles feed predominantly on plant materials (e. g. roots, buds) as well as on seeds, whereas mice consume mainly seeds. It is well-known that many rodents collect and store food for winter. This is impossible on small islands due to the limited food sources. The similarity between the large island (study area I/4) and the offshore area of the reservoir (study area I/6) manifests in this respect, too. This similarity may result from two reasons. Firstly, stable populations of small mammals may have survived in the large islands after the area have been flooded. Secondly, there might be migration between the two areas. However, this latter has not been supported by the recent trapping. The proportion of mice is highest in areas covered by trees (study areas II, I/1). The rates of mice, voles and shrews were very similar in study areas I/1 and I/5, which were close to each other, but represent different types of habitat. It is possible to refer to the fact, that the dams are used by small mammals as ecological corridor.

Data were also analyzed by NuCoSa and Statistic Program packages. Results obtained from cluster analysis suggest the segregation of the mosaic-type study area II and the small islands (study area I/2). The large island (study area I/4) shows similarity to the shore (study area I/6) and the dam (study area I/5).

Finally, we concluded that the small mammal fauna of the small and medium sized islands are very vulnerable. For example, in spite of the former years, on the small islands no mammals were trapped in 1998, and the number of the captured animals in the medium sized island were also smaller. The diversity and density was the highest in the large mosaic-like areas. Dams, joining the fragmentation take part of a very important role as ecological corridors.

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Ecofaunistical investigations of Collembola, Araneae and Coleoptera in mosaic-like habitats in the Cinege Valley, Hungary

By

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Abstract. The structure and ecology of Collembola, Araneae and Coleoptera communities were investigated in different habitats of Cinege Creek valley (South of Lake Balaton, West Hungary) during 1992-94. The aim was - depending on the result of the investigation - to establish a separate local nature conservation and recreation area. The study area consists of 16 smaller habitats, which differ from each other in the composition of the vegetation and the water regime of the soils. Animals were collected from the selected sampling sites using mainly two different methods: *1)* Separating animals with the Berlese method from A-horizon-soil and the litter. *2)* Using pitfall traps containing ethylene glycol. Both species diversity and the frequency of occurrence (abundance) were highest in the oak-forest (study area VI) and in the reeds (study area I), while the lowest on the area with horsetails and sedges (study area II). The community structures of collembolans, beetles and spiders in these different habitats were compared. The species compositions clearly reflected the microclimatic characters of the individual habitats. At the same time, also some rare species were identified from this area. The study area as a less polluted natural environment can be considered available for selection a conservation territory. It seems to be especially important to protect these particular mosaic-like habitats for sustaining their high animal taxonomic and functional biodiversity.

Nowadays, Hungary has only few areas which are considered completely or nearly free from human influence. These nearly intact regions are usually far from each other and often show a mosaic-like arrangement. It is of particular importance to find those ones, which are situated in or around densely populated areas and to become acquainted with their wildlife and ecological relationships. Lake Balaton is the most popular recreation area in Hungary. Our study site is located in the neighborhood of Siófok town, one of the significant centers along the Balaton coast. The main purpose of our study was to decide, whether the investigated area was worth establishing a local nature conversation area or not. For this purpose we made a faunistic analysis focusing on the following three arthropod groups: Collembola, Araneae and Coleoptera.

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Materials and methods

Site description

The investigated area lies south of Siófok, in a valley, stretching from north to south 6000 meters long. It is about 400-600 meters wide. The heart of the 300 ha region is the Cinege Creek, which is cut by eleven fishing ponds formed by swelling up the creek. The neighboring landscape is characterized by consecutive rows of hills and valleys. The planned nature conversation area comprises the bottom of the Cinege Creek valley and the facing slopes, which are not steeper than 10 %. The climate is mild warm and moderately wet. The number of sunny hours per year varies between 2000 and 2500. The annual mean temperature during the vegetation period reaches 17.4 °C. The annual mean temperature of the hottest summer day is 33.5 °C, while that of the coldest winter day is –15.5 °C. The annual precipitation is about 650 mm from which 350-380 mm comes down in the vegetative period. The area is covered with snow usually during 32 days a year. The most typical direction of the wind is north-western. The average windspeed is about 3 m/sec. The watershed of the creek is quite small, altogether 19 km. The headwater is situated in the would be nature conservation area. The creek flows directly into the Balaton. The lowest pond made up in the creek is overgrown with aquatic plants and reed, thus the deposition and purification of the water is rather intensive.

Soil

The area of interest is covered mostly by soil developed on loess bedrock of the Pleistocene, Baranya-Somogy-Tolna Loess Formation which is of variable thickness. Ramann-type, brown, forest soils occur on the slopes of the hills; whereas, chernozem soil types occur in the valleys (flat lying lands). The different soil types are a result of differences in hydro-geological conditions.

Flora

The Cinege Valley is a fairly diverse, beautiful landscape, comprising several phytocoenoses of great value, situated along the banks of the creek and ponds, in the depressions of the valley and in the fields and woodlands among the ponds. These phytocoenoses can be arranged into larger categories in which the animals have been investigated.

List of study areas characterized by their prevailing phytocoenoses and their relation to human effects (some characteristic plant species are given as example); FHI: phytocoenosis free from human influence, NC: phytocoenosis proposed for natural conservation, MHD: phytocoenosis exposed to moderate human disturbance

I area: Large reeds and swamp. - Lemno-Spirodeletum FHI, Myriphyllo-Potamogenetum FHI, Scirpo-Phragmitetum austro-orientale NC, Sparganietum erecti FHI, Spargranio-Glycerietum FHI, Caricetum acutiformis-ripariae FHI. - *Lemna minor, Hydrocharis morsus-ranae, Myriophyllum spicatum, Iris pseudacorus, Thelypteris palustris, Sparganium erectum, Glyceria maxima, Carex riparia, Caltha palustris, Equisetum palustre, Calystegia sepium, Sium latifolium.*

II area: Steppe. - Arrhenatheretum elatioris MHD, Astragalo-Festucetum rupicolae FHI. - *Adonis vernalis, Pulsatilla grandis, Festuca rupicola, Chrysopogon gryllus, Euphorbia segueriana, Stipa capillata, Astragalus austricus.*

III area: Gallery forest with willow and poplar trees. - Salicetum albae-fragilis FHI, Fraxino-Ulmetum FHI. - *Rubus caesius, Dryopteris filix-mas, Dryopteris carthusiana, Myosotis sparsiflora, Myosoton aquaticum.*

IV area: Scrub forest. -Agrostio-Typhoideum FHI, Astragalo-Festucetum rupicolae FHI. - *Ficaria verna, Violoa odorata, Physalis alkekengi, Humulus lupulus, Circae lutetiana, Festuca rupicola, Euphorbia segueriana, Crataegus monogyna.*

V area: Meadow. - Cirsio cani-Festicetum pratensis FHI, Agrostetum stoloniferae FHI, Alopecuretum pratensis FHI, Deschampsietum caespitosae FHI. - *Colchicum autumnale, Cirsium canum, Arrhenatherum elatius, Alopecurus pratensis, Pastinaca sativa, Hypochoeris radicata, Lathyrus pratensis, Serratula tinctoria, Centaurea jacea, Deschampsia caespitosa.*

VI area: Deciduous forest. - Quercetum petraeae-cerris FHI. - *Pulmonaria mollissima, Pulmonaria obscura, Silene vulgaris, Geum urbanum, Stellaria holostea, Carex sylvatica, Ajuga reptans, Campanula trachelium, Aethusa cynapium, Brachypodium sylvaticum.*

Collectings

We collected samples from suitable places using mainly two different methods: *1)* The majority of the animals was collected using pitfall traps. These were put at six different habitats as mentioned above. At all habitats, five pieces of 2 dl plastic glasses were placed in five meter distance from each other. The glasses were filled up with ethylene glycol. The traps were emptied monthly. If it was necessary, we used the isolation method of salting. The collected material was stored in 70% methanol until examination. *2)* We collected samples of soil and leaf litter from which the animals were isolated using the Berlese method. Sometimes we used singling and sweeping techniques.

Results

During 1993-94 several collecting trips were organized to the area. As a result of our investigations, a list of species was compiled. To identify the species we used the following books: Gisin, 1960; Fjellberg, 1980; Dunger, 1994; Horvatovich, 1974; Jones, 1983; Locket & Millidge, 1986; Loksa, 1969, 1972, 1981; Roberts, 1985; Sauer & Wunderlich, 1985.

Collembola

Nearly 1500 specimens of 41 Collembola species were collected from the study areas. There were considerable differences between the sampled habitats regarding the number of families and species as well as the individual abundance. The differences were primarily the function of humidity and diversity of the habitats. The richest families were Entomobryidae and Isotomidae. Study area I proved to be

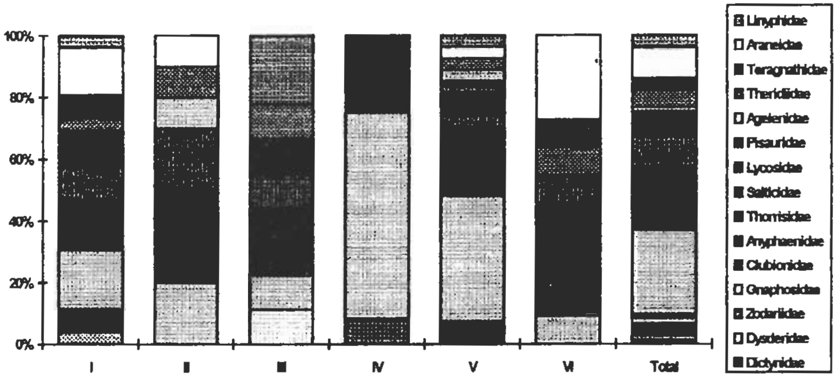

Fig. 1. Species composition of the Collembola families in different habitats

the most diverse one, for it consisted of more smaller habitats. The most abundant species were *Podura aquatica, Isotomurus palustris* and *Hypogastrura denticulata.*

Only seven species were found in area II (steppe). This area was dry during summer and only moderately wet during the rest part of the year. The most abundant species was *Isotoma notablis* which prefers dry fields. We could collect only a few specimens of the remaining species.

In the areas III, V and VI the number of species was similar, but the composition of species differed strongly. The abundance of the common species was various according to the habitat.

Comparison of the species composition in different areas clearly shows that the similarity primarily depends on the humidity of the area. The largest similarities were seen between areas VI and V, VI and IV, I and III. The largest difference turned out to be between study areas II and III.

Araneae

For the spiders, study area IV was found to be the richest both in species and families. This habitat was an undisturbed grassy glade surrounded by dense hawthorn shrubbery. The highest species and individual abundance was represented by the Gnaphosidae compared with the remaining 12 families. Such outstanding participation of the Gnaphosidae was experienced also in the steppe (area II), where this family made up 67% of the total individual abundance, with a large number of rare thermophil and xerophil species, such *as Oxyptila nigrita, Micaria fulgens, Microlepis dives, Zelotes villicus, Z. pygmaeus, Z. petrensis, Z. electus.* These species were very abundant as well. However, in the steppe only three

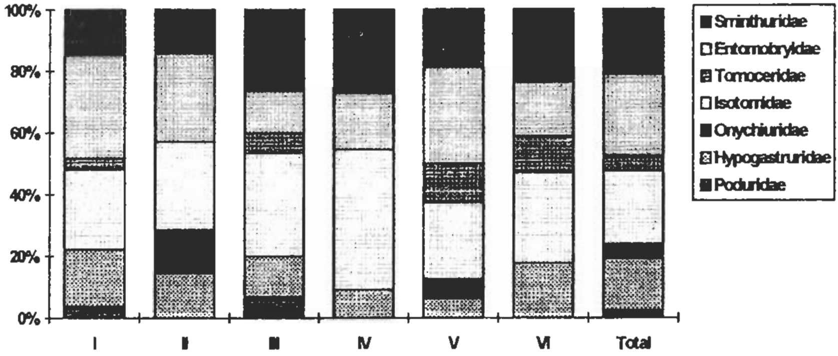

Fig. 2. Species composition of the Araneae families in different habitats

more families were detected. Both the differences and similarities between areas II and IV can be explained with the origin of the scrub forest, which developed from a steppe-like habitat, through arising of the shrubbery. The middle part of study area IV hosts a lot of steppe-inhabiting species (see the high ratio of Gnaphosidae), on the other hand it provides new habitats, thus appearing various different families just like web-spinning families (Theridiidae, Araneidae, Linyphiidae, Dictynidae), for which the shrubs offer an important supporting system; or species of the genera *Agelena, Mangora, Xysticus,* which do not tolerate the hot and arid microclimate of the steppe.

As a habitat, the reeds (study area I) proved to be also rich, with high individual abundance, though none of the detected families occurred with outstanding species diversity, nevertheless the family composition was fairly diverse. Neither areas III (gallery forest) and V (meadow) nor area VI (deciduous forest) comprised very high species and individual abundances, but the trapped material differed considerably according to the habitat type: in study area III some hygrophil species occurred (*Trochosa ruricola, Diplostyla concolor, Zelotes pedestris*), while in area VI *Zilla diodia, Araniella cucurbitina, Enoplognatha ovata* were found.

Studying the similarities of species composition, we can see that there are large differences among the different habitats. The low values of the Jaccard indices result from the low numbers of species in some areas and the presence of euryoec species.

Coleoptera

Regarding the composition of the beetle fauna, the reeds (area I) proved to be a significant habitat. Most of the beetle families turning up in the course of the examination were found there, most numerous one being the Carabidae. Further

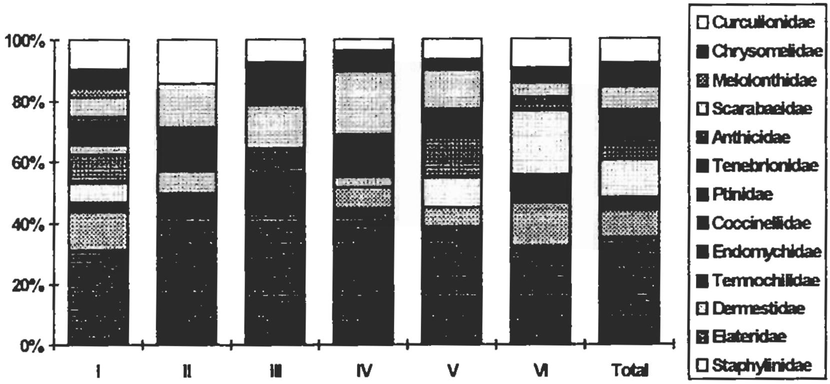

Fig. 3. Species composition of the Coleoptera families in different habitats

families with high individual abundance were the Silphidae, Catopidae and Dermestidae. Among the carabids *Calathus fuscipes* and *C. melanocephalus* were prevailing; both are euryoec and eurytop species. The high diversity values in the reeds were due to the marginal situation of this type of vegetation, thus straying specimens from different habitats could also occur in our traps.

Altogether six beetle families with 14 species were determined in the steppe (area II). 44% of the total number of the species found here belonged to the carabids. Relatively rich families were Tenebrionidae, Scarabaeidae and Curculionidae. The most abundant species of the Tenebrionidae was *Opatrum sabulosum.* The most frequent carabids were *Calathus fuscipes* and *Pseudoophonus rufipes,* further *Harpalus anxius,* which latter prefers dry and sunny habitats.

The less favourable microclimate of area II provides less ecological niches for the inhabitant species, thus the lower diversity value is not surprising.

The least families of beetles were found in study area III. 65% of the 14 species found here belonged to the carabids. The most abundant species were *Carabus nemoralis* and *Abax nemoralis.* Both of them prefer forest habitats, so they possibly migrated from the forest into this rather wet area. The diversity of area IV (scrub forest) was higher than areas II and III but not as high as those of areas I and VI. We found 29 species of 9 families here. The most abundant species were *Geotrupes vernalis, Calathus fuscipes* and *Carabus convexus.*

Study area V was similar to area VI but the number of species was a little bit higher here. In addition to Carabidae, families Staphilinidae, Elateridae and Scarabeidae were also frequent (10-10%). The most abundant species was *Calathus fuscipes.*

In area VI (deciduous forest) we found only 9 families but the number of species was the highest (42) here. The rate of Carabidae decreased (33%) and the rates of Staphilinidae (21%) and Silphidae (14%) increased. It is interesting that the most abundant species of Scarabaeidae was *Geotrupes stercorosus* and not *G. vernalis.*

We collected a lot of specimens of *Carabus convexus, Abax paralellepipedus* and *Pterostichus oblongopunctatus,* too.

Largest similarities were found between the areas VI and V as well as areas V and IV. The largest difference was between areas VI and II.

Conclusions

The result of our investigation proved that the small but diverse mosaic-like habitats could preserve a lot of valuable species. We found some protected species as *Carabus convexus, C. coriaceus, C. germani, C. granulatus, C. nemoralis, C. schendreli, C. ullrichi.* Others (*Zelotes civicus, Zelotes hermanni, Abax paralellepipedus, Pterostichus oblongopunctatus, Micaria/Micariolepis dives, Oxyptila nigrita*) indicate the conditions and value of the area. The smaller microhabitats offer good circumstances for the different species. Here the diversity could be high. The most important environmental factors were the humidity and the vegetation of the area.

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Table 1. Similarities of species compositions of Collembola (cj: Jaccard Index; 27, ...: number of specimens)

Study area	I	II	III	IV	V	VI
I	27	5	14	6	12	10
II	cj = 0.172	7	1	4	3	5
III	cj = 0.500	cj = 0.047	15	5	9	8
IV	cj = 0.187	cj = 0.285	cj = 0.238	11	10	11
V	cj = 0.387	cj = 0.238	cj = 0.409	cj = 0.588	16	13
VI	cj = 0.294	cj = 0.263	cj = 0.333	cj = 0.647	cj = 0.650	17

Table 2. Similarities of species compositions of Araneae (cj: Jaccard Index; 26, ...: number of specimens)

Study area	I	II	III	IV	V	VI
I	26	2	3	0	4	2
II	cj = 0,057	11	1	1	6	2
III	cj = 0,094	cj = 0,053	9	1	3	2
IV	cj = 0	cj = 0,048	cj = 0,053	11	3	0
V	cj = 0,08	cj = 0,182	cj = 0,088	cj = 0,083	28	3
VI	cj = 0,057	cj = 0,100	cj = 0,111	cj = 0	cj = 0,083	11

Table 3. Similarities of species compositions of Coleoptera (cj: Jaccard Index; 32, ...: number of specimens)

Study area	I	II	III	IV	V	VI
I	32	7	4	11	12	7
II	cj = 0.179	14	1	8	5	4
III	cj = 0.095	cj = 0.037	14	7	5	8
IV	cj = 0.220	cj = 0.228	cj = 0.194	29	12	7
V	cj = 0.235	cj = 0.125	cj = 0.125	cj = 0.250	31	15
VI	cj = 0.102	cj = 0.075	cj = 0.163	cj = 0.107	cj = 0.254	43

Table 4. The Collembola species and number of specimens in the different habitats

Species	Study areas						
	I	II	III	IV	V	VI	Total
Poduridae	53	-	34	-	-	-	87
Podura aquatica Linné	53	-	34	-	-	-	87
Hypogastruridae	165	8	86	11	8	61	339
Hypogastrura denticulata (Bagnall)	131	-	68	-	-	-	199
Hypogastrura luteospina Stach	-	-	-	-	-	12	12
Hypogastura vernalis (Carl)	6	-	-	-	-	-	6
Xenilla maritima Tullberg	-	-	-	11	8	17	36
Friesea mirabilis (Tullberg)	12	-	18	-	-	-	30
Anurida tullbergi Schött	5	-	-	-	-	-	5
Neanura conjuncta (Stach)	11	8	-	-	-	32	51
Onychiuridae	-	3	-	-	7	-	10
Tullbergia quadrispina (Börner)	-	3	-	-	-	-	3
Onychiurus campatus Gisin	-	-	-	-	7	-	7
Isotomidae	104	23	31	33	39	66	296
Folsomia nana Gisin	18	-	6	-	13	23	60
Folsomia candida (Willem)	7	-	7	2	6	11	33
Isotomiella minor (Schäffer)	-	2	-	5	-	3	10
Isotomina bipunctata Axelson	4	-	-	-	-	-	4
Proisotoma crassicauda (Tullberg)	2	-	-	-	-	-	2
Proisotoma minuta (Tullberg)	18	-	3	14	17	22	74
Isotoma notabilis (Schäffer)	-	21	-	8	-	-	29
Isotoma viridis Bourlet	13	-	-	4	3	7	27
Isotoma olivacea Tullberg	-	-	4	-	-	-	4
Isotomurus palustris (Müller)	42	-	11	-	-	-	53
Tomoceridae	37	-	31	-	18	44	130
Tomoceris vulgaris (Tullberg)	37	-	31	-	11	27	106
Tomocerus minor (Lubbock)	-	-	-	-	7	17	24
Entomobryidae	164	8	2-	9	34	27	262
Entomobrya handschini Stach	2	-	-	-	6	-	8
Entomobrya lanuginosa (Nicolet)	16	-	-	-	-	-	16
Entomobrya marginata (Tullberg)	31	4	-	-	2	-	37
Entomobrya multifasciata (Tullberg)	24	-	-	-	-	-	24
Orchesella flavescens (Bourlet)	18	-	3	-	4	-	25
Orchesella cincta (Nicolet)	-	-	-	-	3	-	3
Pseudosinella wahlgreni (Börner)	-	-	-	2	-	7	9
Heteromurus nitidus (Templeton)	7	-	-	-	-	-	7
Lepidocyrtus lanuginosus (Gmelin)	31	-	17	-	11	2	61
Lepidocyrtus cyaneus Tullberg	22	4	-	7	8	18	59
Lepidocyrtus paradoxus Uzel	13	-	-	-	-	-	13
Sminthuridae	82	15	39	8	28	93	265
Sminthurides aquaticus (Bourlet)	41	-	31	-	-	-	72
Sminthurides pumilis (Krausbayer)	3	-	2	-	-	-	5
Sminthurides malmgreni (Tullbergi)	22	3	-	-	-	-	25
Bourletiella insignis (Reuter)	4	-	-	5	19	27	55
Sminthurus lubbocki Tullberg	-	-	2	1	3	32	38
Dicyrtoma fusca (Lucas)	-	-	4	2	6	11	23
Dicyrtoma ornata (Nicolet)	12	-	-	-	-	-	12
Neelus minimus Willem	-	12	-	-	-	23	35

Table 5. The Araneae species and number of specimens in the different habitats

Species	Study areas						
	I	II	III	IV	V	VI	Total
Atypidae					4		4
Atypus piceus Sulzer	-	-	-	-	4	-	
Amaurobiidae	3						3
Titanoeca schineri L.Koch	3	-	-	-	-	-	
Dictynidae	2				1		3
Dictyna arundinacea Linné	1	-	-	-	-	-	
Dictyna latens Fabricius	-	-	-	-	1	-	
Dictyna uncinata Thorell	1	-	-	-	-	-	
Dysderidae			1				1
Harpactea rubicunda C.L.Koch	-	-	1	-	-	-	
Zodariidae				3			3
Zodarion germanicum C.L.Koch	-	-	-	3	-	-	
Gnaphosidae	11	4	3	39	35	2	94
Drassodes pubescens Thorell	3	2	-	-	4	-	9
Haplodrassus signifer C.L.Koch	1	-	-	-	-	-	1
Haplodrassus silvestris Blackwall	-	-	-	-	1	-	1
Zelotes apricorum L.Koch	2	-	-	-	-	-	2
Zelotes aurantiacus Miller	-	-	-	-	6	-	6
Zelotes civicus Simon	-	-	-	3	-	-	3
Zelotes electus C.L.Koch	-	-	-	15	-	-	15
Zelotes hermanni Chyzer	-	-	-	-	5	-	5
Zelotes latreillei Simon	-	-	-	-	4	-	4
Zelotes longipes L.Koch	-	-	-	-	13	-	13
Zelotes pedestris C.L.Koch	4	2	3	-	5	2	16
Zelotes petrensis C.L.Koch	-	-	-	-	3	-	3
Zelotes praeficus L.Koch	-	-	-	5	1	-	6
Zelotes pusillus C.L.Koch	-	-	-	1	-	-	1
Zelotes pygmaeus Miller	-	-	-	-	1	-	1
Zelotes subterraneus C.L.Koch	-	-	-	-	1	-	1
Zelotes villicus Thorell	-	-	-	-	3	-	3
Micaria fulgens Walckenaer	-	-	-	1	1	-	2
Micaria pulicaria Sundevall	1	-	-	-	-	-	1
Micaria romana L.Koch	-	-	-	1	-	-	1
Clubionidae	2		3	2	1	1	9
Clubiona sp. juv.	2	-	-	-	1	-	3
Agroeca brunnea Blackwall	-	-	-	-	-	1	1
Phrurolithus festivus C.L.Koch	-	-	3	2	-	-	5
Anyphaenidae						1	1
Anyphaena accentuata Walckenaer	-	-	-	-	-	1	1
Thomisidae	12	4	3	5	5	3	32
Hariaeus sp. juv.	-	-	-	-	1	-	1
Miumenops tricuspidatus Fabricius	-	1	-	-	-	-	1
Xysticus erraticus Blackwall	-		-	-	1	-	1
Xysticus kochi Thorell	-	2	-	-	1	-	3
Oxyptila nigrita Thorell	-	-	-	2	1	-	3
Oxyptila praticola C.L.Koch	5	-	3	-	1	2	11
Philodromus albidus Kulczynski	-	-	-	-	-	1	1
Thanatus formicinus Clerck	-	1	-	3	-	-	4
Tibellus maritimus Menge	2	-	-	-	-	-	2
Tibellus oblongus Walckenaer	2	-	-	-	-	-	2
Salticidae	3	4	1		1	1	10

Marpissa nivoyi Lucas	1	-	-	-	-	-	1
Ballus depressus Walckenaer	-	-	-	-	-	1	1
Euophrys erratica Walck.	-	-	1	-	-	-	1
Euophrys frontalis Walck.	-	3	-	-	1	-	4
Euophrys petrensis C.L.Koch	1	-	-	-	-	-	1
Evarcha arcuata Clerck	-	1	-	-	-	-	1
Myrmarachne formicaria De Geer	1	-	-	-	-	-	1
Lycosidae	13		1		22		36
Pardosa lugubris Walckenaer	11	-	-	-	20	-	31
Trochosa ruricola De Geer	-	-	1	-	-	-	1
Pirata piraticus Clerck	1	-	-	-	-	-	1
Tricca lutetiana Simon	-	2	-	-	-	-	2
Aulona albimana Walckenaer	1	-	-	-	-	-	1
Pisauridae					1		1
Pisaura mirabilis Clerck	-	-	-	-	1	-	1
Agelenidae		1			3		4
Agelena glaciens C.L.Koch	-	1	-	-	3	-	4
Theridiidae	1	4	1		1	2	9
Episinus angulatus Blackwall	1	-	-	-	-	-	1
Euryopis flavomaculata C.L.Koch	-	-	1	-	1	-	2
Steatoda phalerata Panzer	-	4	-	-	-	-	4
Enophlognatha ovata Clerck	-	-	-	-	-	2	2
Tetragnathidae	2					1	3
Tetragnatha montana Simon	1	-	-	-	-	-	1
Tetragnatha pinicola L.Koch	1	-	-	-	-	-	1
Meta mengei Blackwall	-	-	-	-	-	1	1
Araneidae	8	1			4	7	20
Araneus marmoreus Clerck	1	-	-	-	-	-	1
Araniella cucurbitina Clerck	-	-	-	-	-	1	1
Hyposinga heri Hahn	1	-	-	-	-	-	1
Singa hamata Oliver	4	-	-	-	-	-	4
Singa nitidula C.L.Koch	2	-	-	-	-	-	2
Zilla diodia Walckenaer	-	-	-	-	-	4	4
Mangora acalypha Walck.	-	1	-	-	4	2	7
Linyphiidae	1		2		3		6
Walckenaeria melanocephala O.P.-Cambr.	-	-	1	-	-	-	1
Diplostyla concolor Wider	1	-	1	-	-	-	2
Linyphia triangularis Clerck	-	-	-	-	3	-	3

Table 6. The Coleoptera species and number of specimens in the different habitats

Species	Study area						
	I	II	III	IV	V	VI	Total
Carabidae	92	27	16	76	133	135	479
Carabus convexus Fabricius	-	-	1	21	8	36	66
Carabus coriaceus Linné	1	-	-	-	3	-	4
Carabus germani Sturm	5	-	-	-	-	-	5
Carabus granulatus Linné	2	-	1	-	-	-	3
Carabus nemoralis Müller	-	-	4	1	-	9	14
Carabus scheidleri Fabricius	1	-	-	1	2	-	4
Carabus ullrichi Germar	-	-	-	-	1	-	1
Leistus rufomarginatus Duftschmid	4	-	-	-	-	2	6
Notiophilus rufipes Curtis	-	-	-	-	-	1	1
Trechus quadristriatus Schrank	-	-	-	-	-	1	1
Ophonus nitidulus Stephens	-	-	1	-	-	1	2
Pseudoophonus rufipes De Geer	1	8	-	-	6	1	16
Harpalus anxius Duftschmid	-	5	-	12	-	-	17
Harpalus atratus Latroille	-	1	-	-	1	5	7
Harpalus distinguendus Duftschmid	-	1	-	-	-	-	1
Harpalus rubripes Duftschmid	-	-	-	3	-	-	3
Harpalus serripes Quensel	-	-	-	3	-	-	3
Harpalus tardus Panzer	-	-	1	1	8	7	17
Pterostrichus melas Creutzer	-	-	-	3	3	-	6
Pterostrichus oblongopunctatus Fabricius	-	-	-	-	-	21	21
Pterostrichus vulgaris Linné	5	-	-	1	-	-	6
Abax parallelepipedus Piller et Mit.	-	-	3	-	1	35	39
Abax parallelus Duftschmid	-	-	1	-	6	1-	17
Calathus ambiguus Paykull	-	-	-	1	-	-	1
Calathus fuscipes Goeze	36	11	-	27	93	-	167
Calathus melanocephalus Linné	36	-	-	1	-	-	37
Laemostenus terricola Herbst	-	-	-	-	1	1	2
Platyderes rufus Duftschmid	-	-	-	-	-	5	5
Amara aenea (De Geer)	-	1	-	1	-	-	2
Amara anthobia A. Villa et J.B. Villa	-	-	2	-	-	-	2
Amara familiaris (Duftschmid)	-	-	2	-	-	-	2
Oodes helopioides (Fabricius)	1	-	-	-	-	-	1
Silphidae	30	-	-	2	10	52	94
Necrophorus fossor Erichson	-	-	-	1	-	4	5
Necrophorus vespilloides (Herbst)	-	-	-	-	-	15	15
Necrophorus vespillo (Linné)	4	-	-	-	-	2	6
Oeceoptoma thoracicum Linné	-	-	-	-	-	6	6
Silpha carinata Herbst	24	-	-	1	9	23	57
Silpha obscura Linné	1	-	-	-	1	-	2
Silpha tristis Illiger	1	-	-	-	-	-	1
Phosphuga atrata (Linné)	-	-	-	-	-	2	2
Catopidae	27	3	-	-	-	21	51
Choleva oblonga Latreille	-	-	-	-	-	2	2
Sciodrepoides watsoni (Spence)	27	3	-	-	-	17	47
Nargus velox (Spence)	-	-	-	-	-	1	1
Ptomaphagus variicornis Rosenhauer	-	-	-	-	-	1	1
Staphylinidae	5	-	-	-	29	62	96
Ontholestes haroldi (Epph.)	-	-	-	-	-	6	6
Staphylinus caesareus Cederh.	1	-	-	-	6	2	9
Ocypus olens (Müll.)	-	-	-	-	22	-	22

Ocypus biharicus Müller	-	-	-	-	1	1	2
Ocypus pedator Gravenhorst	-	-	-	-	-	1	1
Philonthus decorus Gravenhorst	-	-	-	-	-	45	45
Philonthus intermedius (Lacordaire)	-	-	-	-	-	3	3
Abemus chloropterus (Panczer)	-	-	-	-	-	1	1
Platydracus fulvipes (Scopoli)	-	-	-	-	-	1	1
Tachinus rufipennis Gyllenhal	-	-	-	-	-	2	2
Drusilla canaliculata (Fabricius)	4	-	-	-	-	-	4
Elateridae	3	-	-	-	4	1	8
Lacon/Agrypnus murinus (Linné)	1	-	-	-	1	-	2
Athous niger (Linné)	1	-	-	-	-	-	1
Melanotus niger/ punctolineatus (Pellrin)	1	-	-	-	1	-	2
Pseudathous hirtus (Herbot)	-	-	-	-	1	-	1
Agriotes ustulatus (Schaller)	-	-	-	-	1	1	2
Dermestidae	30	3	-	35	-	-	68
Dermestes laniarius Illig	30	3	-	35	-	-	68
Temnochilidae	-	-	-	-	1	-	1
Thymalus limbatus Fabricius	-	-	-	-	1	-	1
Endomychidae	-	-	-	2	1	-	3
Dapsa denticollis Grm.	-	-	-	2	1	-	3
Coccinellidae	-	-	-	1	1	-	2
Anisosticta novemdecimpunctata (Linné)	-	-	-	-	1	-	1
Coccinella septempunctata (Linné)	-	-	-	1	-	-	1
Ptinidae	-	-	-	-	-	3	3
Ptinus calcaratus	-	-	-	-	-	3	3
Tenebrionidae	8	3-	-	28	-	-	66
Opatrum sabulosum (Linné)	-	27	-	27	-	-	54
Crypticus quisquilius (Linné)	7	3	-	1	-	-	11
Alphitophagus bifasciatus Schwarc	1	-	-	-	-	-	1
Anthicidae	4	-	-	-	-	-	4
Formicomus pedestris Rossi	4	-	-	-	-	-	4
Scarabaeidae	2	2	2	91	69	131	297
Geotrupes stercorosus (Scriba)	-	-	1	2	1	126	130
Geotrupes vernalis Linné	-	-	-	79	64	5	148
Aphodius lividus Ol.	-	1	-	-	-	-	1
Onthophagus coenobita Herbst	1	-	-	1	-	-	2
Onthophagus ovatus (Linné)	1	1	1	7	1	-	11
Onthophagus vacca (Linné)	-	-	-	1	-	-	1
Onthophagus verticicornis Laich	-	-	-	1	3	-	4
Melolonthidae	4	-	-	-	-	-	4
Valgus hemipterus (Linné)	4	-	-	-	-	-	4
Chrysomelidae	2	-	2	3	1	11	19
Lema melanopa Linné	1	-	-	-	1	-	2
Crysochus asclepiadeus Pall.	-	-	-	-	-	4	4
Hydrotassa marginella Linné	-	-	-	-	-	7	7
Crepidodera ferruginea (Scopoli)	1	-	1	2	-	-	4
Crysomela cuprina (Duftschman)	-	-	-	1	-	-	1
Aphthona euphorbiae Schrank	-	-	1	-	-	-	1
Curculionidae	15	4	1	2	5	9	36
Otiorhynchus raucus Fabricius	1	2	1	2	4	3	13
Otiorrhynchus rugosostriatus Goeze	2	-	-	-	-	-	2
Brachysomus setiger Boh.	12	-	-	-	-	-	12
Polydrusus coruscus Germ.	-	-	-	-	-	1	1
Trachyphloeus parallelus Seidl.	-	-	-	-	1	4	5
Trachyphloeus spinimanus Germ.	-	2	-	-	-	-	2

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The nutritional value of the biomass of butterflies and moths in temperate and tropical climates, II

By

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Abstract. Previously, we have determined the raw protein content, as derived from the total lipid and total nitrogen contents, of some Rhopalocera moths both from temperate (Hungary) and tropical (Vietnam) regions. This was used to determine the amount of biomass produced by them (Gere, 1993). In order to further clarify the questions arising in the study, we conducted more collections in both the northern and southern parts of Vietnam in October and November, 1996. We performed the same analyses as previously (Table 1). After calculating the necessary averages (Table 2), we were able to make the following conclusions: *1.* The relative amounts of the studied components vary greatly among individual animals. Within the group of Rhopalocera, no differences can be shown among the various species. It seems that their lipid content is primarily dependent upon the nutrition available to the animals. *2.* Generally, both their fat content and their protein content are lower at hot temperatures than in cooler weather. We, therefore, have to assume that their source of energy in hot weather is primarily glycogen instead of lipids. *3.* Female Rhopalocera usually contain somewhat more lipids than males, which is contrary to the case of non-feeding imagoes.

Biological communities are made possible by the constant circulation of matter and energy. This flow originates - with few exceptions - in green plants, and is kept in motion by the various organisms' nutrition systems that are structured on one another through metabolism. The quantity and quality of the total mass of living bodies (biomass) developing by means of this flow substantially influence the entire community's functioning, productivity, usefulness, and level of tolerance. Because of these reasons, we consider it very important to study the biomass of the populations that make up the community and collect data on its importance.

In developing our project, we were lead by the assumption that butterflies and moths play a very important role in most land communities because of their great numbers and many various species. Valuable information about the nutritional value of their bodies can be gained by studying their lipid reserves and the quantity of their organic matter rich in protein and nitrogen.

We already know that the composition of imagoes' bodies show great differences depending on whether they feed or not (Gere, 1964, 1978). According to our observations, the imagoes that do feed tend to maintain the composition of their bodies as long as sufficient nutrition is available. The same observation is made by

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Cross and Owen (1970) and Soltava and Lovlajainan (quoted in Hanegan and Heath, 1970). The former studied *Deilephila nerii* and *Herse convulvuli,* sphinx moths, while the latter studied *Phytometra gamma,* a noctuid moth. As opposed to this, imagoes that do not feed during their lifetimes tend to „live up" almost all „mobilizable" parts of their bodies during their short lifetimes.

The composition of the bodies of moths and butterflies depends on many other circumstances besides this one. Especially important in this respect are the effects of weather, especially temperature. *Danaus plexippus* butterflies store fat when the weather is hot or cold, but not at moderate temperatures (James, 1986). According to Pullin (1987), the lipid-content of butterflies belonging to the family Nymphalidae differ very much before and after overwintering.

In light of these observations and other similar data, we considered it important to become acquainted with the effects of climate and climatic seasons on the composition of butterflies' and moths' bodies. To this end, we embarked on a series of examinations in a suitable temperate region (Hungary) and a tropical area (Vietnam). Based on our examinations published earlier (Gere, 1993), the following points seemed very probable:

1) In temperate regions, the butterflies belonging to the genus *Pieris,* producing several broods yearly, have a higher fat content in spring and in the relatively warm part of autumn than in the middle of summer. Late in the autumn, however, probably because of the decrease of available nutrition, their fat content decreases again.

2) In the tropics, the feeding imagoes have a higher fat content in the cooler season and in cooler areas than under hotter circumstances.

3) It is particularly striking that there can be great variations in fat content among various individuals, probably because of the differences in access to nutrition. This phenomenon was also pointed out by Mason & al. (1989). This means that general observations can only be made if sufficiently large number of specimen are examined.

This last point indicated to us that we needed to continue our work. Therefore, we made more collections in Vietnam in October and November, 1996.

Methods and materials

Collections were made both in the northern and southern parts of Vietnam. During the time of the year when collections were made, the temperature is hot throughout the entire country, with daily maximums above 30 degrees Centigrade. There was only very little rainfall, and the sun was shining every day almost uninterruptedly.

The collected imagoes were stored in 96 % ethanol. In the laboratory, the air-dry mass of the animals' bodies was measured after evaporating the ethanol. The per cent results of our analyses are expressed in terms of these measurements. The amount of fatty and lipoid substances was determined by the Soxhlet's extraction method. Petrolether was used as extracting medium. The total nitrogen content was determined at the end, after performing destruction by sulphuric acid using Kjeldahl's method. Based on the data obtained, we were able to calculate the raw protein content. The calculations made in this way include nitrogen reserves that are not bound in protein.

Results and conclusions

The primary results are shown in Table 2. All except the last two genera belong to the group of Rhopalocera (which includes the family of Hesperidae). It should be noted that the composition of the animals' bodies, particularly their fat content, varies greatly. The males and females of *Junonia almana* had particularly high fat contents. This species occurred mostly in the parks of Hanoi, in areas with plenty of blooming flowers, supporting the assumption that the Rhopalocera accumulate great amounts of nutriment (energy) when plentiful food is available. The specimens of *Danaus genutia* lived in areas that were similarly abundant in blooming flowers. Interestingly however, among this species only females exhibited large amounts of fat. The males of *Appias paulina* in Cat Tien were apparently in the middle of migration, as suggested by the long rows they formed during their flight. Since they did not touch ground at all in the areas under examination, they were obviously not taking any food. Consequently, their fat content was very low.

Besides these differences that can be explained by environmental factors, there was no significant variation among the species. We can therefore assume that in this respect all Rhopalocera are similar, they all belong to the same type. And this fact made it possible to use their data together and thus reduce the effects of individual variations. In this way, we studied the general characteristics of the group as a whole instead of concentrating on the characteristics of any particular species.

Table 1 presents the data of Rhopalocera in two distinct groups, according to whether the imagoes were found in the northern or southern sections of Vietnam. In the same table, our previous results from Vietnam (Gere, 1993) can also be seen grouped in the same manner. Data of Rhopalocera found in Hungary (Gere, 1978, 1993) are also found in the table, which are divided according to whether they were collected in cool weather (spring, early autumn) or in hot weather (summer).

These data confirm our assumptions described above in points 1 and 2, with respect to Rhopalocera in both tropical and temperate regions. For a completely satisfying evaluation of the available data, it is important to note that in January, there is a marked difference in temperature between the northern and southern parts of Vietnam, whereas in October and November, the entire country is equally hot. In January, the total lipid content of imagoes collected in the northern parts of the country was almost double that of the ones collected in the southern areas. In October and November, the males had only slightly higher lipid contents in the north, whereas the females had actually somewhat less lipid in the north than in the south.

The raw protein or total nitrogen contents also show significant variations, but not nearly as much as the lipid reserves. It seems that the amounts of both lipids and nitrogen-containing materials found in the bodies of Rhopalocera are smaller at very hot temperatures than under cooler circumstances. This naturally raises the question of what constitutes the bulk of the dry matter content in the animals' bodies during the hot seasons. More research is needed to give a satisfying answer to this question, but it can be assumed that the relative proportion of hydrocarbons, especially glycogen, increases. It is well known that glycogen (next to or in place of fats), plays an important role in the metabolism of many insects, primarily as a means of storing energy. According to Hill and Goldsworthy (1970), glycogen is the main source of energy for *Locusta migratoria*, and fat is used only after the entire reserve of hydrocarbons is consumed. A similar observation was made previously by Weis-Fogh (1952), with respect to the flight of Orthoptera. According to Walker & al. (1970), the flying muscles of *Schistocera* locusts use a mixture of hydrocarbons and lipids. The high glycogen content in the various developmental stages of bees is well known (Pflugfelder, 1952; Roeder, 1953). It is certain that the ability to make use of nutrients depends largely on temperature. Uschatinskaja (1957) mentions that glycogen gains special significance during overwintering, probably because invertebrates are able to make use of it at low temperatures. This observation seems to be contradicted by the fact that it is usually the fat content of animals that increases significantly prior to overwintering. This is mentioned, among others, by Jasič (1970), with respect to *Perillus bioculatus* (Rhynchota). Keeping in mind this last observation, it seems probable that cooler temperatures shift the metabolism of Rhopalocera in the direction of synthesizing and using more fats and less glycogen. An advantage of this might be the high energy content of fats and lipids, causing more heat to be released when they are burned, thus raising the body temperature of the animal. And this is very important for the animal which strives to increase its „life-intensity."

We can further conclude, based on the available data, that female Rhopalocera usually have somewhat higher fat contents than males. This is opposite to the case of butterflies and moths whose imagoes do not feed, especially those whose females' movements are greatly reduced (Gere, 1964). This difference can be explained the following way. In the case of non-feeding imagoes, the male animals use the stored fat as their source of energy for flying. The females in this case need less fat, but more protein for producing eggs. In the case of imagoes that do feed, both sexes continuously gain enough energy for their movements from the food they consume, and so there is no need for sexes to develop wide differences in this area. The little extra fat in females finds its way to the eggs.

Table 2 contains data on some imagoes that do not belong among the Rhopalocera. These are *Tirathaba leucotephras, Creatonotus* sp., and *Creatonotus transiens.* They are listed in this article only for information. We will consider them, together with their relatives, in a future study.

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Table 1. Total lipid and raw protein contents of butterflies averaged for different seasons and temperatures in Hungary and Vietnam

Species	Locality	Season	Number of specimens	Male	Both genders	Female	Male	Both genders	Female
				Total lipid			Raw protein		
				expressed as % airdry body mass					
Lysandra coridon Poda	Hungary	summer	83+59	6,95		11,76			
Melanargia galathea (L.)	Hungary	summer	10+5	3,80		4,48			
Artogeia rapae (L.) and *napi* (L.)	Hungary	spring and autumn	49+18	12,16		16,00	64,9		61,0
Artogeia rapae (L.) and *napi* (L.)	Hungary	summer	42+30	11,93		10,92	58,1		58,3
Artogeia canidia (Sparrman) and *Zemeros flegyas* (Cramer)	Northern Vietnam	January	35		13,32			64,5	
Delias hyparete (L.) and *Junonia atlites* (L.)	Southern Vietnam	January	50		7,02			61,0	
Rhopalocera /4 species/	Northern Vietnam	October-November	34+24	9,67		11,18	60,5		62,5
Rhopalocera /7 species/	Southern Vietnam	October-November	102+50	6,80		11,88	62,3		63,0

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Table 2. Total lipid and raw protein contents of butterflies and moths collected in Vietnam during October and November

Species and family	Locality	Number of specimens	Gender	Total lipid	Raw protein
				expressed as % airdry body mass	
Artogeia canidia Sparrman (Pieridae)	Dalat	15	male	11,41	67,5
Artogeia canidia Sparrman (Pieridae)	Dalat	15	female	7,85	57,8
Appias albina Boisduval (Pieridae)	Dalat	3	male	6,87	70,7
Appias lyncida Cramer (Pieridae)	Ba Vi	3	male	6,99	69,6
Appias paulina Cramer (Pieridae)	Cat Tien	15	male	3,81	54,8
Appias paulina Cramer (Pieridae)	Cat Tien	14	male	3,42	57,7
Delias hyparete L. (Pieridae)	Saigon	12	male	6,53	68,6
Delias hyparete L (Pieridae)	Saigon	10	female	6,30	62,9
Eurema hecabe L (Pieridae)	Buon ma huot	18	male	5,26	76,6
Eurema hecabe L (Pieridae)	Buon ma huot	10	female	9,64	74,6
Neptis clinia leuconata Butler (Nymphalidae)	Ba Be	12	male	5,48	65,4
Neptis clinia leuconata Butler (Nymphalidae)	Ba Be	10	female	6,89	69,9
Junonia almana L (Nymphalidae)	Hanoi	4	male	20,50	45,5
Junonia almana L (Nymphalidae)	Hanoi	4	female	19,00	57,2
Danaus genutia Cramer (Danaidae)	Yokdon	15	male	6,89	46,7
Danaus genutia Cramer (Danaidae)	Yokdon	5	female	20,10	45,9
Mycalesis visala visala Moore (Satyridae)	Ma da gui	10	male	10,22	55,5
Mycalesis visala visala Moore (Satyridae)	Ma da gui	10	female	15,50	73,7
Caltoris brunnea (de Nicéville) (Hesperidae)	Hanoi	15	male	5,73	61,4
Caltoris brunnea (de Nicéville) (Hesperidae)	Hanoi	10	female	7,65	60,4
Tirathaba leucotephras Meyrick (Pyralidae)	Dalat	15	both genders	4,97	73,1
Tirathaba leucotephras Meyrick (Pyralidae)	Dalat	25	both genders	6,54	69,1
Creatonotus sp. (Arctiidae)	Ba Be	15	male	3,06	47,4
Creatonotus sp. (Arctiidae)	Ba Be	5	female	13,67	47,2
Creatonotus transiens Walker (Arctiidae)	Ma da gui	20	both genders	10,44	65,7

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Zoocoenological pattern of bug assemblies (Heteroptera: Gerromorpha, Nepomorpha, Leptodomorpha) in the Szilas- and Gyáli Streams, Hungary

By

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Abstract. Quantitative data on the species composition of bug communities are presented. Field sampling was carried out at six locations along two streams in Hungary, between 1993 and 1995. Diversity, water quality, and vegetation composition were compared. A relationship was found between the density of algae and the composition of bug communities.

The investigation of the composition of bug assemblies in wet habitats dates back to the turn of the century in Hungary. These early reports, though, usually contain only species lists based on the imagos. A lot of information can be obtained from these lists on the biogeography and ecology of species, moreover, they can be used for synbiological indication as well (Hufnagel & al., 1997, 1998). To monitor small changes or to explore finer patterns, however, it is necessary to take habitat characteristics as well as species abundances and larvae into account. Very few studies of this kind have been conducted up to now (Moldoványi, 1977, 1984).

Materials and methods

Field sampling was carried out in 3-3 sections (100 m each) of two streams, the Szilas Stream in the north-east of Budapest, and the Gyáli Stream in the south-east of Budapest. Each section was selected to be homogeneous. One of them was located close to the source, another one was close to the mouth, and the third one in between for both streams. The selection of the study areas was based on preliminary surveys. The location and marking of the sampled sections are shown in Figure 1. All of the sections were sampled monthly from March to November, and cumulative data were used for the characterization of a particular site. In each section, smaller areas

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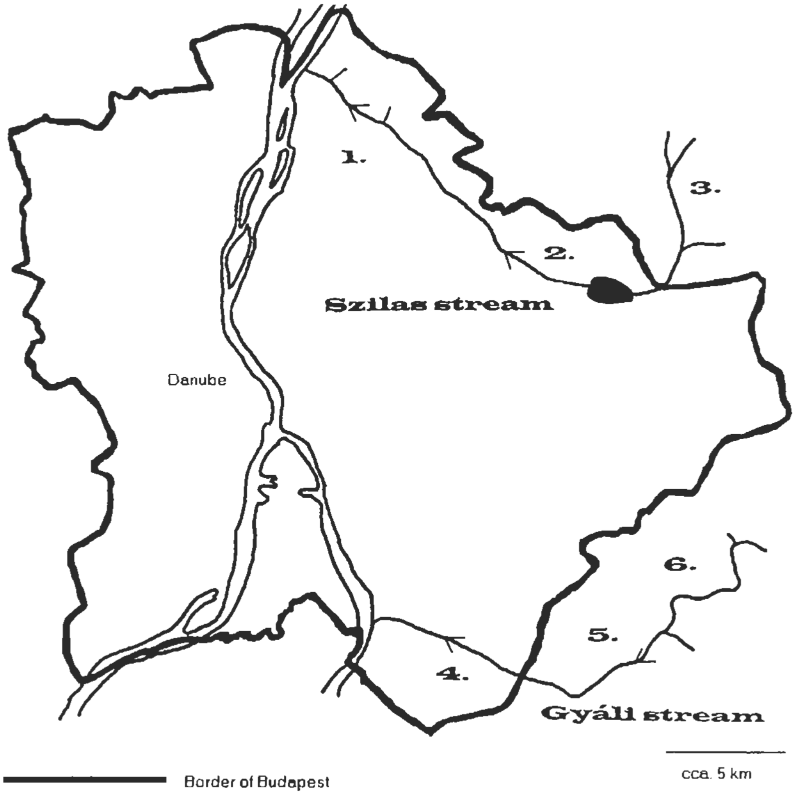

Fig. 1. Location of the sampling sites (sections)

were closed impermeably for bugs, and all the bugs found within these sub-areas were collected. At the same place and time, habitat and water quality characteristics were measured. In addition, cumulative plant species list was made including the species found in, along, and above the water. For the identification of bugs, the works of Benedek (1969), Jansson (1969, 1986), Péricart (1990), Savage (1989), Soós (1963), Stusak (1980), Väpseläinen and Krajewski (1986) and Vásárhelyi (1990) were used, species names are given according to Aukema and Rieger (1995). The nomenclature of plant species follows Simon (1992). Water quality characteristics were measured according to Felföldy (1987), except for Na^+ and Cl– concentration, which were measured using Radelkis ion-selective electrodes. The percentage cover of the herb layer was estimated for the open water and the shore, and tree canopy cover was estimated above the water each time.

In the analysis of the quantitative data of the bug communities, relative frequencies of the species were used to account for the differences among habitats. To explore similarity relations, metrical multidimensional scaling was applied based on Euclidean distance. The program package used was SYNTAX (Podani, 1993, 1997). To compare diversity relations, Rényi's diversity ordering was applied using NuCoSa program package (Tóthmérész, 1996, 1997).

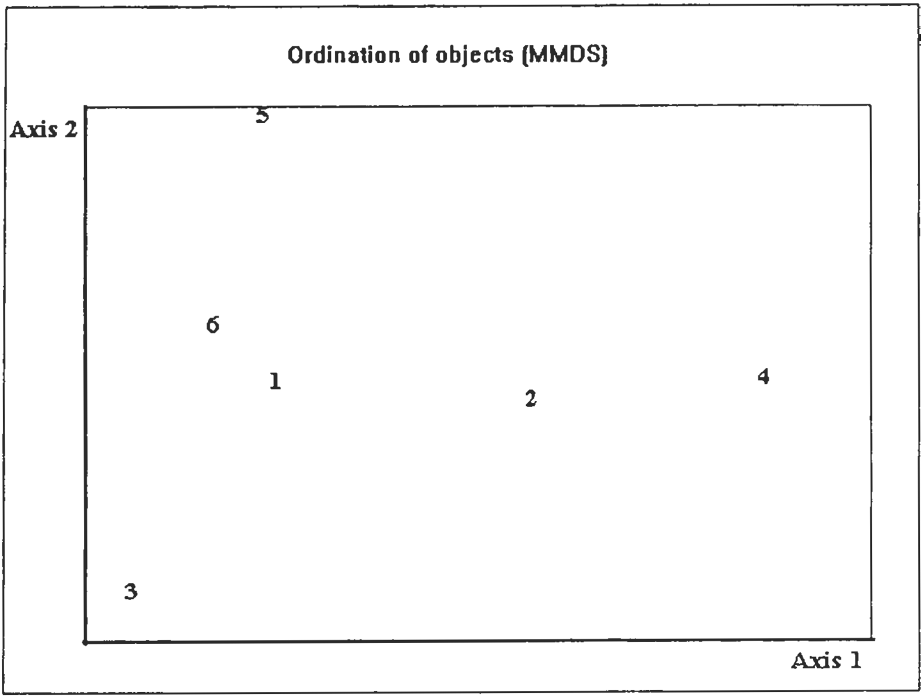

Fig. 2. Similarity pattern of sampling sites (sections)

Results

The faunistic, florist, water quality data and additional characteristics are presented in tables. In the columns of all the three tables, serial numbers refer to the sampling areas, and these numbers are the same as in Figure 1.

Table 1 contains habitat parameters. These parameters varied greatly during the study period, therefore, only their minima and maxima are shown in the table. It can be seen that the sections of the Gyáli Stream are significantly different from one another in terms of hydrological characteristics, whereas those of the Szilas stream are more similar. The Gyáli Stream seems to be more polluted even based on the saprobity and tropihty. The low number of algae in Section 4 can be misleading because of the intense eutrophication caused by *Lemna minor* in this study area.

Table 3 contains florist data. As expected, there is a high degree of similarity among the species lists: all the study areas are dominated by species of wet habitats (W value of 7–11) that favour calcareous soil (R value of 4) and deciduous forest climate, and have an Eurasian–Mediterranean distribution or are cosmopolitan. In Sections 2, 4, and 5, species characteristic of natural communities, while in Sections 1, 3, and 6 species characteristic of degraded communities are more abundant. Concerning species richness, Section 5 is the richest and Sections 3 and 6 are the poorest.

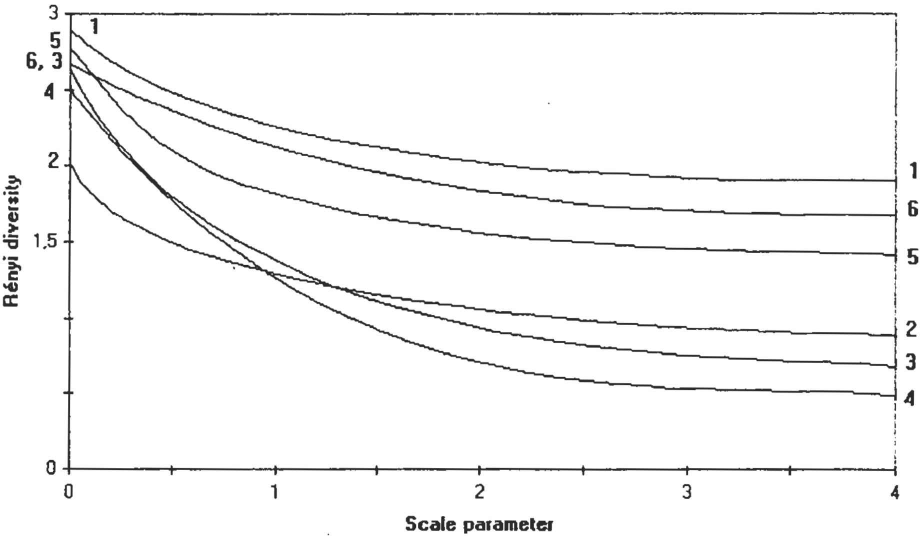

Fig. 3. Diversity ordering of sampling sites (sections)

Data on bugs are summarized in Table 2. The first numbers apply to the imagoes and the second ones to the larvae. It can be seen, that the imagoes and larvae of the same species have different meanings. Moreover, in some cases, only one of the two occurs. This latter fact emphasizes the importance of larva identification, which also has to be considered when interpreting data found in the literature.

Figure 2 shows the similarity pattern of the study areas (ordination based on dominance values). No segregation or grouping can be found based on the twostreams or in any other manner, thus the study areas should be characterized one by one.

Rényi's diversity ordering was applied for the comparison of diversities. Figure 3 shows that Section 1 is the most diverse, Sections 5 and 6 cannot be ordered relative to each other, but both of them are more diverse than Sections 2, 3, and 4. Section 3 is more diverse than Section 4, but neither of the two can be ordered relative to Section 2. Altogether, concerning the rare species, the increasing order of diversity is: 2, 4, 3, 6, 5, 1, while concerning the frequent species it is: 4, 3, 2, 5, 6, 1. This difference draws the attention to the fact, that applying simple diversity indices may lead to misinterpretation. The three most diverse sections are also close to one another in the ordination diagram.

During earlier studies at Lake Balaton, a possible relationship was hypothesized between TCV values (Total Coenological Value) used for the characterization of bug communities and the trophity (Hufnagel & al., 1998). For the first time, present data sets make it possible to calculate weighted averages (weighted by the dominance) from the species specific indicator values (CV), and to compare these to alga densities. Table 2 shows the weighted CV averages obtained. Both the CV average and the alga density values reach their maxima at Sections 5 and 6 and reach their minima at Section 3. This finding seems to support the above hypothesis.

Additional investigations are necessary for the ecological interpretation of he zoocoenological patterns (present and earlier relationships) described in the present paper. By publishing the above data we would like to promote these.

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Table 1. Habitat charachteristics in the sampling sites

	Sampling sites					
	1	**2**	**3**	**4**	**5**	**6**
Width (cm)	100-215	180-250	200-250	400-500	280-400	50-200
Depth (cm)	8-30	15-35	15-40	40-100	20-80	10-40
Water current (m/s)	0,01-0,33	0,02-0,30	0,01-0,19	0,00-0,20	0,00-0,33	0,05-0,40
Vegetation cover (shore) (%)	0-100	40-100	30-100	100	100	0-90
Vegetation cover (bed) (%)	0-100	40-100	0-50	5-100	100	3-30
Cover of overhanging canopy (%)	0	0-1	0-100	0-100	0	0
pH	7,99-9,00	7,79-8,30	7,80-8,35	7,35-8,20	7,70-7,99	7,50-9,10
Conductivity (mS/cm)	0,595-1,200	0,785-1,850	0,690-1,050	1,02-1,41	0,89-1,30	0,620-1,280
KOI$_{Mn}$ (mgO/dm^3)*	1,0-8,7	3,2-15,0	4,0-9,0	1,5-16,0	5,0-16,8	6,0-20,0
Cl$^-$ (mol/dm^3)	0,001-0,006	0,001-0,006	0,000-0,005	0,001-0,006	0,001-0,007	0,000-0,007
Na$^+$ (mol/dm^3)	0,001-0,003	0,000-0,002	0,000-0,003	0,000-0,003	0,000-0,005	0,000-0,005
m-alcality	4,91-8,03	5,64-6,21	7,00-7,73	7,45-8,18	8,03-8,86	4,09-7,91
p-alcality	0	0	0	0	0	0,15-0,45
Number of algae(10^{6}i/dm^3)	0,1-2,2	0,3-3,5	0,2-1,4	0,1-2,0	0,8-24,0	1,0-6,34

* Chemical oxygen demand

Table 2. Occurrence of bug species in the sampling sites

Taxa	Sampling sites					
	1	2	3	4	5	6
GERROMORPHA						
Gerridae						
Gerris thoracicus Schummel, 1832	14/20	3/0	16/17	8/0	41/238	21/3
Gerris lacustris (Linnaeus, 1758)	26/52	130/120	224/324	0/2	1/3	16/0
Gerris asper (Fieber, 1860)	3/27		20/38	27/1	27/166	3/1
Gerris argentatus Schummel, 1832				9/0	33/132	1/0
Gerris odontogaster (Zetterstedt, 1828)	1/0		3/0	16/0	28/7	1/0
Aquarius paludum (Fabricius, 1794)	2/0				1/0	
Limnopolus rufoscutellatus (Latreille, 1807)					1/0	
Hydrometridae						
Hydrometra stagnorum (Linnaeus, 1758)	74/20	80/7	127/76	4/0		14/1
Hydrometra gracilenta Horváth, 1899					1/1	
Veliidae						
Microvelia pygmea (Dufour,1833)	0/6	7/0	0/44			
Velia saulii Tamanini, 1947	13/9		4/0			1/0
NEPOMORPHA						
Nepidae						
Nepa cinerea Linnaeus, 1758	25/40	149/382	3/26	83/94	1/7	2/2
Notonectidae						
Notonecta glauca Linnaeus, 1758	45/3	241/1	10/21	5/0	6/401	7/1
Notonecta viridis Delcourt, 1909	1/0	5/0	1/0			1/0
Corixidae						
Sigara striata (Linnaeus, 1758)	3/1		1/0	3/3	4/106	
Sigara nigrolineata (Fieber, 1848)	2/1					
Sigara lateralis (Leach, 1810)	15/12					11/1
Sigara falleni (Fieber, 1848)				2/0		
Corixa punctata (Illiger, 1807)	1/0			1/1	2/2	0/4
Corixa affinis Leach, 1817	1/0					
Hesperocorixa linnaei (Fieber, 1848)	11/0	2/0		4/1	21/65	1/0
Hesperocorixa shalbergi (Fieber, 1848)					1/0	
Micronecta scholtzi (Fieber, 1860)	5/3					
Naucoridae						
Ilyocoris cimicoides (Linnaeus, 1758)				1/0		1/0
Pleidae						
Plea minutissima Leach, 1817					1/0	
LEPTOPODOMORPHA						
Saldidae						
Chartoscirta cincta (Herrich-Schaeffer, 1841)	10/0	1/0	7/0		12/0	
Chartoscincta elegantula (Fallén, 1807)			1/0			
Saldula arenicola (Scholtz, 1847)			2/0			
Saldula saltatoria (Linnaeus, 1758)			1/0		1/0	
Number of species	19	9	15	13	17	14
Number of individuals	453	1128	966	264	1310	95
Average of CV	-0,64	-0,77	-0,78	-0,64	-0,42	-0,56

Table 3. Plant species in the sampling sites

Taxa	Sampling sites					
	1	2	3	4	5	6
Clematis vitalba L.	x					
Ranunculus repens L.			x	x	x	x
Ranunculus acris L.						
Ceratophyllum demersum L.				x		
Trifolium pratense L.		x				
Robinia pseudo-acacia L.						x
Vicia cracca L.	x					
Vicia sativa L.					x	
Lathyrus tuberosus L.	x					
Epilobium hirsutum L.		x	x	x		
Anthriscus sylvestris (L.) Hoffm.			x			
Pimpinella major (L.) Huds.	x					
Sium erectum Huds.			x	x		
Sium latifolium L.		x				
Angelica sylvestris L.		x				
Daucus carota L.	x					
Galium aparine L.			x		x	x
Galium elongatum Presl.				x	x	
Galium rivale Sibth. et Sm..	x					
Galium mollugo L.		x			x	
Sambucus nigra L.				x		x
Euphorbia cyparissias L.					x	
Convolvulus arvensis L.	x					
Calystegia sepium (L.) R. Br.					x	
Symphytum officinale L.	x		x	x		
Anchusa offcinalis L.		x			x	
Myosotis palustris (L) Nath. em. Rchb.		x				
Mentha longifolia (L) Nath.	x	x				
Mentha aquatica L.		x			x	
Solanum dulcamara L.		x	x			
Scrophularia umbrosa Dum.		x				
Chelidonium majus L.			x			
Papaver rhoeas L.		x				x
Sinapis arvensis L.	x					
Armoracia lapathifolia Usteri	x				x	
Rorippa amphibia (L.) Bess.					x	
Erysimum diffusum Ehrh.					x	
Echinocystis lobata (Michx.) Torr. et Gray			x			
Eupatorium cannabinum L.		x				
Bidens tripartita L.	x					
Athemis austriaca Jacq.					x	
Tussilago farfara L.				x		
Tragopogon orientalis L.		x				

Cirsium arvense (L.) Scop.			x			
Taraxacum officinale Weber & Wiggers		x				
Sonchus arvensis L.	x	x				
Silene vulgaris (Mönch) Garcke	x					
Melandrium album (Mill.) Garcke	x				x	x
Stellaria media (L.) Vill.						x
Polygonum hydropiper L.	x					x
Cannabis sativa L.				x		
Urtica dioica L.	x		x		x	x
Alnus glutinosa (L.) Gartn.				x		
Salix purpurea L.				x		
Alisma lanceolatum Wth.				x	x	
Butomus umbellatus L.	x			x	x	x
Potamogeton pectinatus L.					x	
Potamogeton berchtoldii Fieber		x				
Potamogeton crispus L.	x			x		
Muscari neglectum Guss. ex Ten.						x
Iris pseudacorus L.					x	x
Juncus inflexus L.		x				
Scirpus sylvaticus L.		x				
Carex acutiformis Ehrh.		x				
Glyceria maxima (Hartm.) Holmbg.	x				x	
Glyceria fluitans (L) R. Br.				x		
Poa trivialis L.				x		x
Catabrosa aquatica (L.) P. B.				x		
Phragmites australis (Cav.) Trin.	x	x	x	x	x	
Arrhenatherum elatius (L) Presl					x	
Lemna minor L.			x	x	x	
Sparganium erectum L.					x	
Typha angustifolia L.			x	x	x	x
Number of species	21	21	15	20	25	14

Opusc. Zool. Budapest, XXXI, 1998

Phenological data on a parasitic relationship between *Electrogena lateralis* (Curtis, 1834) (Ephemeroptera) and *Symbiocladius rhithrogenae* (Zavrel, 1924) (Chironomidae)

By

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Abstract. As a result of six-year (1993-98) research in the field and under laboratory conditions, we have completed our knowledge about the chironomid species *Symbiocladius rhithrogenae*. by examining its life cycle as well as formation and facts of its parasitic relationship. According to our unambiguous conclusion its co-existence with *Electrogena lateralis* is a true parasitism; wich, thus, differs from the relationships formed between a Plumed Gnat larva, *Epoicocladius flavens* (Malloch, 1915) and mayfly larva, *Ephemera danica and Ephemera vulgata.*

Between 1993 and 1998, we studied the life-cycle of a non-biting midge, *Symbiocladius rhithrogenae* from egg-laying to swarm in the field and in the laboratory as well. Larvae of this species, similarly to another non-biting midge breeding in our country, *Epoicocladius flavens,* form relationship with mayfly larvae at a particular stage of their life cycle. *E. flavens* was found in Morgó Creek, Börzsöny Mountains, Hungary (Berczik, 1968) while *S. rhithrogenae* examined by us, is in the determination book of chironomid larvae (Bíró, 1981) without comments on breeding-place.

Similarly to *Epoicocladius flavens* (Cobo, 1987; Coffman & al., 1986; Soldan, 1988; Tokeshi, 1986, 1988), we possess several European data about the spread of *Symbiocladius rhithrogenae* (Coffman & al., 1986; Moubayed, 1991). We carried out field experiments and observations by a creek in Pilis Hills, along Holdvilág Ditch between 1993 and 1998 (Fig. 1 a). The largest width of the creek was 1–1.5 metres, the depth changes during the year between 10–20 cms. The creek had little water in, and it flowed on volcanic stones, mainly andezit and its debris. Alder trees grow along the creek which produce high amounts of plant detritus during the year.

The conductivity expressing the overall salt contents of the creek is about 487 mS/cm; this value is common in small waters flowing into the River Danube. The

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examined stage of the creek needs a considerable quantity of chemical oxygen demand (19 mg/l O_2) as well as iron (0.54 mg/l) and manganese (0.48 mg/l). This high amount of organic material in the autumn samples (23. 09. 1995) probably come from a lot of fallen alder leaves. The aim of our work was to get new information on the life-cycle of *Symbiocladius rhithrogenae* by exploring its living and nonliving environment at a particular-breeding-place as well as to investigate the formation and development of the parasite relationship of this species with *Electrogena lateralis* mayfly larva.

Materials and methods

We carried out field examinations at the Holdvilág Ditch in the Pilis Mountains every two weeks, however, we collected twice a week after the parasited mayfly larvae appeared (from April to June and from August to September). We took hydrochemical samples from the creek on one occasion, 23. September, 1995, and their measurements were performed in the hydrobiological laboratory of Zoological Department EKTF.

We collected *Electrogena lateralis* larvae and eggs of *Symbiocladius rhithrogenae* with tweezers from the surfaces of the stones in the creek. We determined the collected mayfly larvae by examining in the field that parasitism was only formed with larvae larger than 7.5 mm; therefore we merely took samples of larvae larger than about 6 mm. These larvae bred on the lower and lateral surfaces of the stones with diametres of about 20–40 cm.

We found the 1–2 mm sized whitish, jellywise eggs of *Symbiocladius rhithrogenae* (Fig. 1 c), similarly to mayfly larvae on the lower and lateral surfaces of the stones with diametres of about 20-40 cm. Mostly, we only came across one bunch of eggs on one stone, however, occasionally two bunches were to be found as well. The eggs were identified by microscope by one hundred magnification. While testing them, the primary marking feature appeared to be the typical spiral form of the eggs in the egg-mass. As a result of the subsequent laboratory experiments lasting for several months, we also succeeded in raising imagoes of *S. rhithrogenae* (Fig. 1 b) from the eggs collected in the field.

We collected *Electrogena lateralis* larvae from a part of the creek on 100–150 metres investigating branches and stones in the bed simultaneously.

Larvae were taken to the laboratory and the assumed degree of their being parasited was identified by microscope by hundred magnification. The microscope test turned out to be indispensable since in the case of often tiny *Symbiocladius rhithrogenae* larvae flattening to the lower surface of wingbuds completely, it was extremely difficult to determine parasitism unambiguously even by applying a larger magnification.

Results

Electrogena lateralis mayfly species was identified by the book of Studemann & al. (1992). The taxonomic status of the species has been clarified as a result of enzyme-electroforetic examinations (Zurwerra & Tomka, 1985). Formerly the „*lateralis*" group (13 species) was considered to be among *Ecdyonurus* Eaton, 1868 by their features in larval and adult stages, or *Heptagenia* Walsh, 1862. However morphological traits of larvae and imagos attached to genus often did not coincide, thus following gelelectroforetic test results the independent status of „*lateralis*" group was justified.

Symbiocladius rhithrogenae was determined by the keys of Bíró (1981) and Coffman & al. (1986).

Periods of the parasite's and host's life-cycle

We have obtained new informations on the life-cycle of a parasite chironomid species *Symbiocladius rhithrogenae*. This species is bivoltin in Hungarian climate, i.e. it produces two generations annually. Its swarm starts along the Holdvilág Ditch early June, subsequently the first eggs appear in the creek approximately a week later. The larvae appear from the eggs 8–11 days later, in the second half of June, then they abandon the jellylike eggs 1–2 days later. It might be assumed that *S. rhithrogenae* takes 8–11 days for embryonic development. The first mayfly larvae parasited by *S. rhithrogenae* larvae are to be found at the breeding place six weeks later, early August (Fig. 1 d). At first, the low degree of being parasited of *Electrogena lateralis* larvae sized 7.5 mm or more reaches 37% by mid-August, and by the end of the month it might even exceed 59%.

The univoltin *Electrogena lateralis* swarming process lasting from July till September culminates early September also affecting the speed of the swarm of *Symbiocladius rhithrogenae*. The primary reason for this is that *E. lateralis* larvae develop sizeable black wingbud after the last larval moult, which, according to our observation, makes it impossible for *S. rhithrogenae* larvae to penetrate under the mayfly's wingbuds. We were unable to identify parasitism in the case of any mayfly larva that had sizeable black wingbuds before swarm. Considerably many of *E. lateralis* populations larger than 7.5 mm participate in the swarm, therefore the number of parasitable mayfly larvae decreases after the last moult, which hinders increasing percentages of parasitism (Fig. 2). On forming parasite relationship, most *S. rhithrogenae* larvae are 1 mm long, afterwards, as a result of swift growth, they reach 3 mm 1 or 1.5 weeks later before pupation. The fast growth of *S. rhithrogenae* larva under the wingbud of mayfly larva is the most relevant evidence of parasite relationship: namely that chironomid larva feeds from mayfly larva.

The first *Symbiocladius rhithrogenae* adults appear mid-August, subsequently their number increases until mid-September. Imagos having emerged by late September, when the swarm begins. The first eggs appear in the creek late September. The first larvae emerged 9–12 days later. Subsequently, the first mayfly larvae parasited by *S. rhithrogenae* larvae appeared in the second half of April in next year. We found the first imago early May and all imagos came out a month later by early June. The above data show it clearly that the summer cycle merely lasts for 3 months (from mid-June to the second half of September), while the autumn one lasts three times as long, i.e. about nine months (from late September to mid-June). Although there is a marked difference between the cycle-lengths starting from early summer and early autumn, the parasite relationship arises in both cycles 1-1.5 months before the end of the life cycle. Therefore, the approximately five-month-long difference between the two cycles is restricted upon the development of the free living larva. Whereas the *S. rhithrogenae* larvae appearing in June form parasite

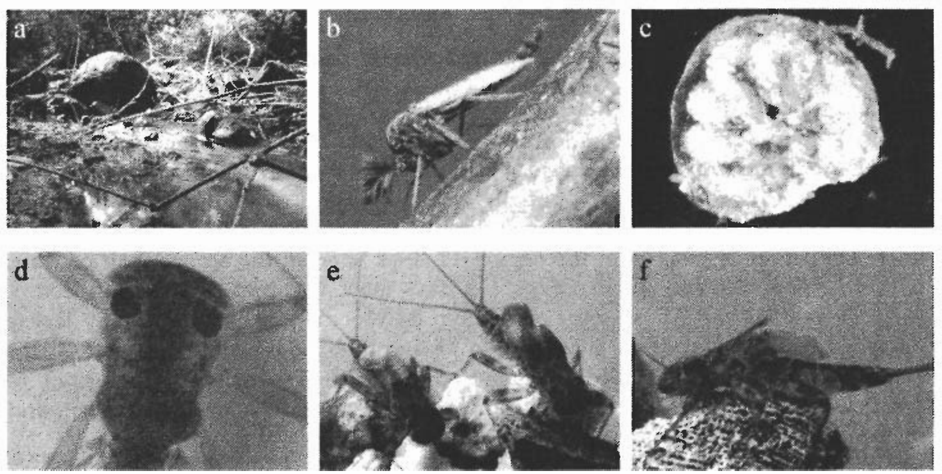

Fig. 1. a: Venue of terrain examinations; b: male *Symbiocladius rhithrogenae* imago; c: eggs of *S. rhithrogenae;* d: *S. rhithrogenae* larva under the mayfly larva's wingbuds; e: *Electrogena lateralis* parasited with *S. rhithrogenae* pupas; f: *E. lateralis* larva after the chironomid imago's release

relationship with mayfly larvae two months later, the larvae appearing in October do this almost seven months later. We assume, the difference is due to the accelerated development of the free *S. rhithrogenae*. Favourable environmental conditions, primarily higher water temperature (about 20–21° C), contribute to the rapid growth of the species

Formation and development of parasitism

The forming parasite relationship between *Symbiocladius rhithrogenae* and *Electrogena lateralis* is a remarkable process: the tiny, about 1–2 mm long slow-moving chironomid larva has to penetrate into the relatively fast-moving mayfly larva, where it will live until the imago comes up to the surface. While collecting, we came across *E. lateralis* larvae several times that already had *S. rhithrogenae* on them, however, they had not got under the mayfly larva's wingbuds yet. The chironomid larva hung on the mayfly larva so firmly that it was hardly possible to remove it with tweezers, either. On forming parasite relationship the chironomid larva crept towards the wingbuds and from one side, either right or left, it drilled itself under the wingbuds (Fig. 1 d). This process lasted 108 minutes on average.

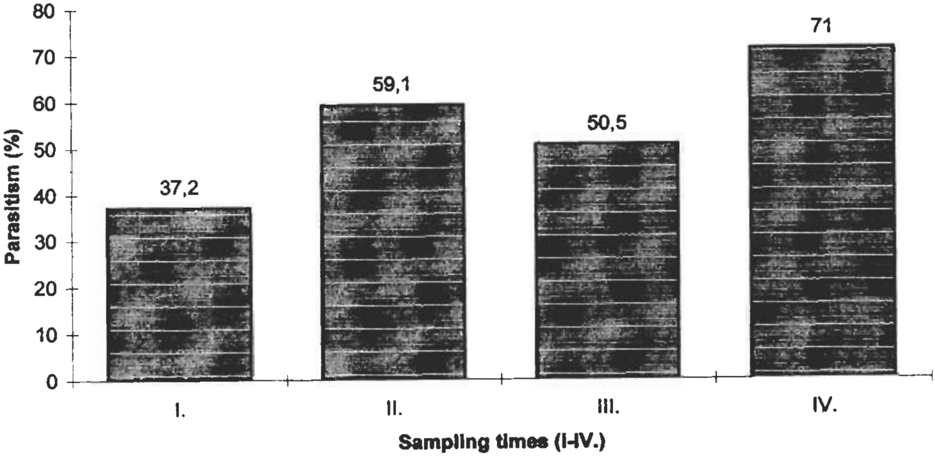

Fig. 2. I-IV sampling times: 19. August, 1998 (I); 25. August, 1998 (II); 31. August, 1998 (III); 10. September, 1998 (IV)

We found different size (1–2 mm) *Symbiocladius rhithrogenae* larvae among those that had got under the mayfly larva's wingbuds, so we drew a conclusions: parasite relationship may form at different larval stages of *S. rhithrogenae*. So, the time necessary for chironomid larva to form a parasite relationship with mayfly larva might extend.

From among the parasited mayfly larvae collected in the field, some (7) lost their larval skin during the microscope test, which resulted in chironomid larva's coming off the mayfly larva together with the lost larval skin of the latter. This chironomid larva had been hiding under the mayfly larva's wingbuds. However, this process did not last long, since the chironomid larva left the lost larval skin withinsome seconds and it crept back to the wingbuds of the mayfly larva just losing its cuticle. The chironomid larva got under the wingbuds again within 45 minutes which is a much shorter time as compared with the first penetration time (108 minutes). We do not have data on the fact to what degree the mayfly larva's losing its larval skin might influence the chironomid imago come out after the pupation of *Symbiocladius rhithrogenae* in the case of the pupas at the bottom. After pupation, the firstly light pupas gradually become darker and darker (Fig. 1 e). The actively moving pupa breaks the cuticle of the wingbuds before appearance, subsequently the chironomid imago emerges.

When comparing parasited and unparasited mayfly larvae, we did not experience any deviation in behaviours; according to our observations, mayfly larvae always survived when *Symbiocladius rhithrogenae* pupas became free (Fig. 1 g).

This proves that this must be a slight degree of parasitism, however, *S. rhithrogenae* larva feeding from mayfly larva, therefore the relationship forming between them has to be considered parasitism.

Summary

As a result of our regular field experiments between 1993–1998, we collected new data on the life-cycle of *Symbiocladius rhithrogenae* by examining its animate and unanimate surroundings. We also examined the formation of parasite relationship of the above species with *Electrogena lateralis* mayfly species: regarding the timespan of the relationship, too. As a result of the parasite relationship between *S. rhithrogenae* and *E. lateralis*, the chironomid species population doubtlessly becomes stronger at the expense of another species of insects; even though, according to our research, in this particular situation, a slight form of parasitism exists that parasited mayfly larvae survive.

Having examined the two species life-cycle overlaps, we assume that research into populations' intereffects, which is sometimes very hard, not only helps us get they more informations on the life-cycles of particular species, but might also contribute to the recognition of significant ecological phenomena.

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Einige Angaben zur Hirudineen-Fauna der Pyreneen

Von

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Abstract. Leeches belonging to three families and five species have been found in seven localities of the French Pyrenees. One species, *Dina apathyi* Gedroyc, 1916 proved to be new to the fauna of France.

Die Hirudineenfauna wurde sowohl in Frankreich (Blanchard, 1893 a; Bouvet, 1968 a, b, 1977; Gadeau de Kerville, 1935; Jarry, 1959 a, b; Kiener & Ollier, 1970; Oliver, 1950) als auch in Spanien (Blanchard, 1893 b; Garcia-Más & Jimenez, 1984; Gomez Tersol & al., 1976; Jarry, 1959; Jimenez & Garcia-Más, 1980/81) des öfters untersucht. Sawyer (1986) führt für Frankreich 18, für Spanien 11 Arten in seiner zusammenfassenden Arbeit an (Tab. 1).

Aus den Pyreneen liegen über Hirudineen nur wenig Angaben vor (Gadeau de Kerville, 1935). Während einer Sammelreise ungarischer Zoologen in den französischen Pyreneen, wo vorwieglich terrestrische Oligochaeten gesammelt wurden, sind auch Hirudineen erbeutet, die mir freundlicherweise zur Bestimmung überlassen wurden.

Ergebnisse

An den sieben Fundorten sind die unten aufgezählten Arten angetroffen worden. Die Zahlen vor den Fundorten beziehen sich auf die Hirudineensammlung des Lehrstuhls für Tiersystematik und Ökologie der Eötvös Loránd Universität, Budapest. Sämtliches material wurde von Dr. Cs. Csuzdi, Dr. K. Dózsa-Farkas und Dr. A. Zicsi gesammelt.

Fam. Glossiphoniidae Vaillant, 1890

Glossiphonia complanata (Linné, 1758)

Fundorte: *H. 100.* Vor Visker, Bachrand, unter Steinen (43°8'43"N, 0°12'42"E),

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400 m, 06. 1997, 1 Ex.; *H. 102.* Augierein, Bach (42°55'49"N, 0°54'54"E), 600 m, 27. 06. 1997, 1 Ex.

Fam. Haemopidae Richardson, 1969

Haemopis sanguisuga (Linné, 1758)

Kennzeichend ist das schöne Muster der Dorsalseite der beiden Tiere, sie ähneln den von Neseman (1990, p. 241, Abb. 17) aus Deutschland bekanntgewordenen Exemplaren.

Fundorte: *H. 94.* Arette, Bachrand (43°5'50"N, 0°43'10"W), 25. 06. 1997, 1 juv. Ex.; *H. 97.* Hinter Assasi (43°7'8"N, 0°32'54"W), 380 m, 25. 06. 1997, 1 Ex.

Fam. Erpobdellidae Blanchard, 1894

Erpobdella octoculata (Linné, 1758)

Nur ein Exemplar konnte bestimmt werden, wo die männlichen und weiblichen Poren nur durch zwei Ringe voneinander getrennt sind, anstatt durch 2 1/2 - 3, wie dies bei dieser Art im allgemeinen der Fall ist.

Fundorte: *H. 101.* Moulis-Remilassé, Bachrand (42°56'52"N, 1°5'35"E), 230 m, 27. 06. 1997, 1 Ex.

Dina apathyi Gedroyc, 1916

Diese Art war bisher nur aus Ost-Europa und aus den nördlichen Gegenden Italiens bekannt. Ihr Vorkommen für Frankreich ist neu.

Fundorte: *H. 96.* Le Lourdios, Bach (43°6'26"N, 0°38'23"W), 450 m, 25. 06. 1997, 1 Ex.

Trocheta subviridis Dutrochet, 1817

Von dieser in der West-Paläarktik verbreiteten Art sind nur wenige adulte bzw. juvenile Exemplare erbeutet worden.

Fundorte: *H. 95.* Zwischen Arette und Issar, Waldrand (43°5'28"N, 0°42'10"W), 500 m, 25. 06. 1997, 1 juv. Ex.; *H. 98.* Hinter Assasi, Wald (43°7'8"N, 0°32'54"W), 380 m, 25. 06. 1997, 2 juv. Ex.; *H. 99.* Vor Visker, Bachrand (43°8'43"N, 0°12'42"E), 400 m, 26. 06. 1997, 1 juv. Ex.; *H. 103.* Augierein, Bach (42°55'54"N, 0°54'54"E), 600 m, 27. 06. 1997, 1 Ex.

Zusammenfassend sei erwähnt, dass in dem untersuchten Material insgesamt fünf Arten aus drei Hirudineen-Familien nachgewiesen werden konnten, wovon sich eine Art neu für die Fauna Frankreichs erwies. Die Zusammensetzung der Arten weist darauf hin, dass es sich nicht um limnische Arten, sondern hauptsächlich aus feuchtem Boden stammende, bzw. unter Steinen lebende Tiere handelt.

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Tab. 1. Die bisher in Frankreich und Spanien nachgewiesenen Hirudineen-Arten (nach Sawyer, 1986)

Arten	Nachweis aus	
	Frankreich	Spanien
GLOSSIPHONIIDAE		
Theromyzon tessulatum (O.F. Müller, 1774)	+	+
Glossiphonia complanata (L., 1758)	+	+
Glossiphonia verrucata (Fr. Müller, 1844)	+	
Glossiphonia paludosa (Carena, 1824)	+	
Alboglossiphonia heteroclita (L., 1761)	+	
Helobdella stagnalis (L., 1758)	+	+
Batracobdella algira (Moquin-Tandon, 1846)		+
Hemiclepsis marginata (O.F. Müller, 1774)	+	+
Placobdella costata (Fr. Müller, 1846)	+	+
PISCICOLIDAE		
Piscicola geometra (L., 1761)	+	
Cystobranchus respirans (Troschel, 1850)	+	
HIRUDINIDAE		
Hirudo medicinalis L., 1758	+	+
Limnatis nilotica (Savigny, 1820)	+	+
HAEMOPIDAE		
Haemopis sanguisuga (L., 1758)	+	+
ERPOBDELLIDAE		
Erpobdella octoculata (L., 1758)	+	
Erpobdella testacea (Savigny, 1820)	+	+
Trocheta subviridis Dutrochet, 1817	+	
Trochaeta bykowskii Gedroyc, 1913	+	
Dina lineata (O.F. Müller, 1774)	+	+

Opusc. Zool. Budapest, XXXI, 1998

Small mammal (Insectivora, Rodentia) and amphibian communities in the drainage area of Lake Balaton

By

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Abstract. The aim of the present study was to observe the structure of small mammal and amphibian communities in different habitats of the drainage area of Lake Balaton, to compile a species list and to describe the demographic parameters of Insectivora and Rodentia. Large areas were divided into smaller study areas, which differed from each other in vegetation and microclimatic conditions. In total, 336 small mammal specimens of 12 species were sampled. In the large investigated areas, the rate of the populations, the degree of diversity and the spatial dispersion of the different populations depend mainly on the vegetation and the humidity. Altogether eight amphibian species were listed. *Rana arvalis* was not recorded earlier in the 1996 survey. In spite of repeated efforts, *Triturus dobrogicus* could not be found. No considerable changes were recorded in the breeding pattern of *Rana dalmatina* along the Endrédi Stream.

Lake Balaton is one of the most popular turistic center of Hungary, there are still some natural and semi-natural places there. Natural value of these localities are very high, because a lot of rare, protected animals and plants confined to these habitats. Realize this fact, the goverment leads to organize at Balaton the youngest natural park in Hungary. The ecological conditions of these places can be protected or improved only by the investigation of them, by studying the animal and plant communities.

Though the fauna of the lake is extensively studied, our knowledge of the fauna, mainly the vertebrate one of the drainage area is very poor. Some protected and endangered species live here, like *Microtus oeconomus.*

The amphibian fauna of Lake Balaton and its surroundings has been studied by several authors (e.g. Fejérváryné, 1943; Ilosvay, 1985; Marián, 1988). A gradual decline, including the disappearance of populations were recorded, but no quantitative data were produced on its intensity in the individual populations. This would especially be important in the case of *T. dobrogicus,* which has a distribution greatly restricted to Hungarian lowlands (Griffiths, 1996).

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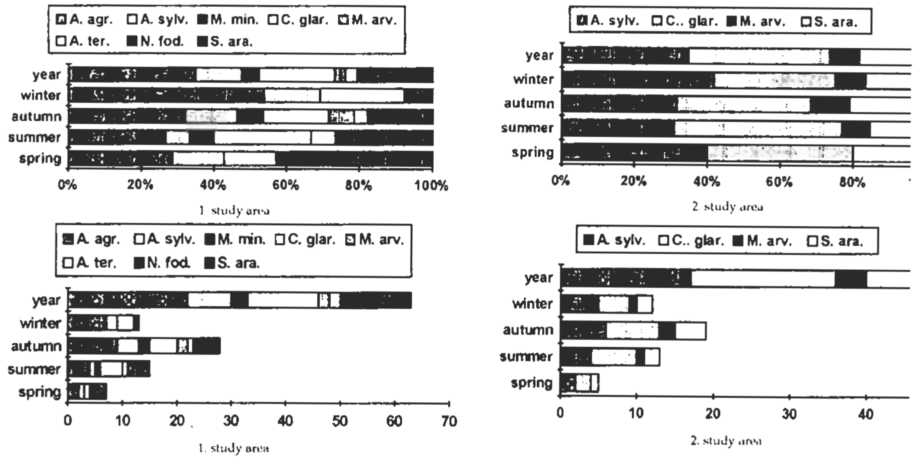
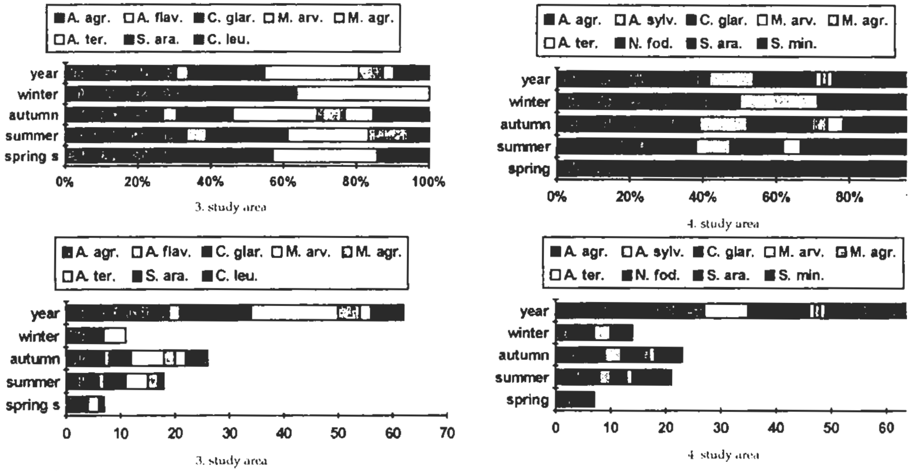


Explanation:
A. agr.: Apodemus agrarius Pallas
A. flav.: Apodemus flavicollis Melchior
A. sylv.: Apodemus sylvaticus Linné
M. min.: Micromys minutus Pallas
C. glar.: Clethrionomys glareolus Schreber
M. arv.: Microtus arvalis Pallas
M. agr.: Microtus agrestis Linné
A. ter.: Arvicola terrestris Linné
N. fod.: Neomys fodiens Pennant
S. ara.: Sorex araneus Linné
S. min.: Sorex minutus Linné
C. leu.: Crocidura leucodon Hermann

Fig. 1 a. Number of small mammal individuals and rate of the species in study areas 1-2



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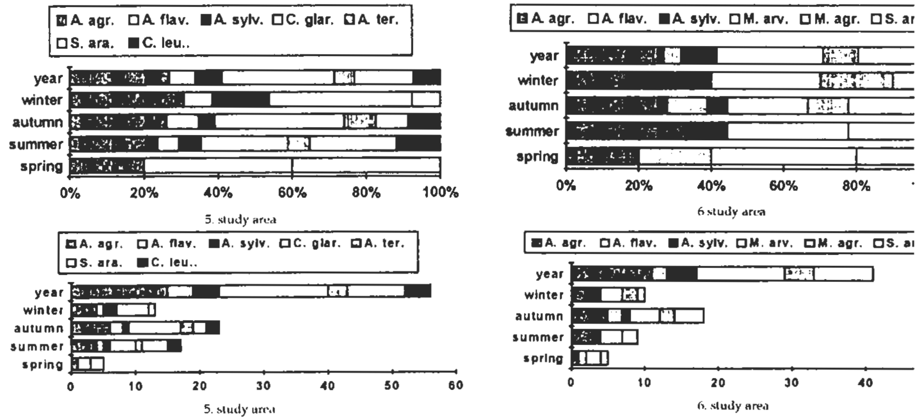
S. ara.: Sorex araneus Linné
S. min.: Sorex minutus Linné
C. leu.: Crocidura leucodon Hermann

Fig. 1 b. Number of small mammal individuals and rate of the species in study areas 3-4



5. study area

6 study area

5. study area

6. study area

Explanation:
A. agr.: Apodemus agrarius Pallas
A. flav.: Apodemus flavicollis Melchior
A. sylv.: Apodemus sylvaticus Linné
M. min.: Micromys minutus Pallas
C. glar.: Clethrionomys glareolus Schreber
M. arv.: Microtus arvalis Pallas
M. agr.: Microtus agrestis Linné
A. ter.: Arvicola terrestris Linné
N. fod.: Neomys fodiens Pennant
S. ara.: Sorex araneus Linné
S. min.: Sorex minutus Linné
C. leu.: Crocidura leucodon Hermann

Fig. 1 c. Number of small mammal individuals and rate of the species in study areas 5-6

Investigation of small mammals and amphibians was carried out in mosaic-type places, where we hoped to found the most species. Large investigation areas were divided into smaller study areas; they differed from each other in vegetation and the degree of wetness.

It is well known, that the food preferences of small mammals depend on the species themselves and the food supply (Hjalten, 1996; Bellocq, 1994). Thus, the vegetation of the areas determine the communities of the animals.

The aim of the present study was to monitor the amphibian community along the upper reach of the Endrédi Stream and to compile a species list for the investigated localities with special emphasis on *T. dobrogicus*.

Sampling sites and methods

We investigated small mammals in two large, mosaic-type areas in the north part of the lake. Each of them were divided into 3 smaller areas. We trapped the small mammals in the following quadrats:

I. Palóznak. - Area of large reeds, a patch of willow trees and a place with sedges and grasses, close to the coast of Lake Balaton. Every study area was in contact with the others. The size of the quadrats were 1.1 ha.

1. Area with reeds, bulrushes and sedges (Caricetum acutiformis-ripariae). - This area is moderately wet and never dry during summer. Dominant plant species are *Phragmites communis, Typha latifolia, Carex.*

2. Patch of willow trees (Salicetum albae-fragilis). - Some parts of this area are covered with water in spring, but it is only moderately wet in other seasons. There are some poplar (*Populus nigra*) and alder trees (*Alnus glutinosa*) among the willow trees and bushes. The grass level is very poor.

3. Area with sedges and grasses (Caricetum alatae). - This open area is usually moderately dry, it is covered with water in spring. Dominant members of the flora are *Carex, Agrostis alba, Calamagrostis neglecta, Poa.*

II. Area close to Szigliget. - Similar to the large investigation area I. It is a mosaic-type area also, but larger than the other one and it shows the certain degree of the degradation in some parts. It was divided into three smaller study areas, which were contact with each other.

4. Large reedy area, with sedges and bulrush (Caricetum acutiformis-ripariae). - This place is moderately wet and dry during a short time of summer. Dominant plant species are *Carex, Typha latifolia, Phragmites communis.*

5. A small forest of willow trees (Salicetum albae-fragilis). - This are is moderately dry, with the exception of spring, when it is wet. Besides of the willow trees (*Salix*), there are poplars (*Populus nigra*), birch trees (*Betula pendula*) and elders (*Sambucus*) in large number in this area. Different sedge species and blackberries are frequent, too.

6. Area with sedges and grasses (Caricetum alatae). - This area is moderately dry during most of the year, covered with water in spring and partly dry in summer. The vegetation were dominated by sedges (*Carex*), *Agrostis alba, Calamagrostis neglecta,* grasses (*Poa*). This open habitat is influenced by human activities, the most frequent weed is *Erygeron canadensis.*

The Endrédi Stream is dammed above Balatonendréd near the source creating a siltated pond. The water flows through a meadow before reaching the village. Upstream from the village two artificial ponds are in the floodplain near the stream. The stream bed has been deepened downstream from the village resulting in a canal-like appearance of the stream. Reservoirs were created in the mid-section of the stream surrounded by arable fields.

In addition, presence of amphibians was checked at the Kétöles- and Tetves Streams, too. The former is a northern inflow with a highly canalised lower section, the latter flows into Lake Balaton from the south, and is in connection with a sophisticated fish pond system. The Köcsi tó at Balatonalmádi, a previous *T. dobrogicus* locality was also sampled.

Data were collected from March, 1998 to November, 1998.

Studying the small mammal fauna we applied the Capture-Mark-Recapture method. We used live-traps to catch the animals. 49 traps were arranged into 7 rows. Every trapping covered a homogeneous habitat. The traps were baited with a piece of toast spiced with onion. Seeds of sunflower and corn were put into the trap to reduce the mortality. Trapped animals were narcotized by diethyl-ether during the treatment. Several parameters of animals, for example length of body, legs and tail, weight, state of sex etc. were recorded. Animals were marked by cut fingers method.

The amphibians of the sampling sites were investigated in different developmental stages. Visual encounter surveys, torching and netting were applied. During the breeding period, both egg clutches and adults were counted. Amphibians were identified according to Dely (1967), Arnold & Burton (1980) and Nöllert & Nöllert (1992). Green frogs (*Rana esculenta, Rana ridibunda, Rana lessonae*) were regarded and described as a „species group".

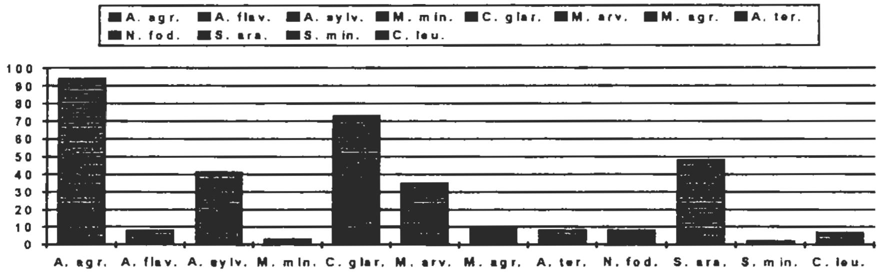


Fig. 2. Number of individuals in total study areas

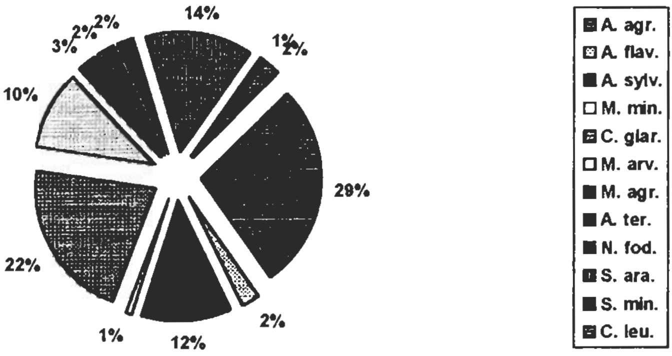


Fig. 3. Rate of individuals in total study areas

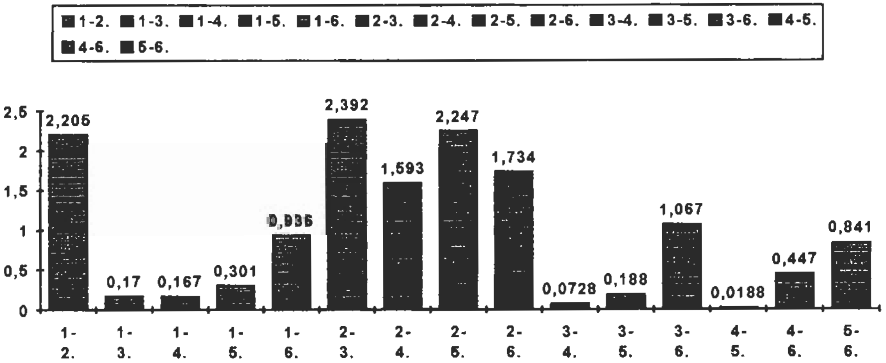


Fig. 4. Differences beetwen the study areas (t-value)

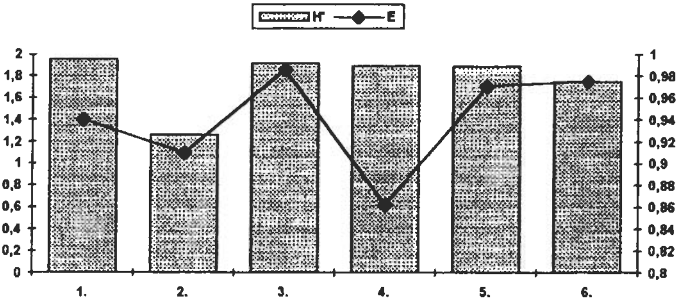


Fig. 5. Shannon-Wiener index and eveness

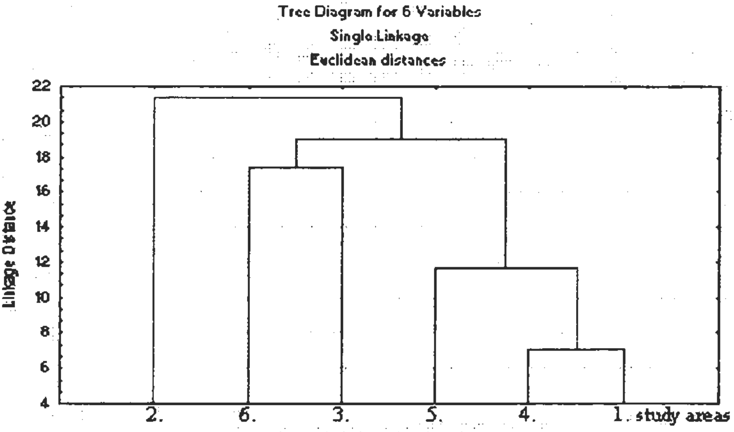


Fig. 6. Result of cluster analysis

Results and discussion

Altogether, 336 specimens of 12 small mammal species were collected (Table 1). The dominant mouse, vole and srew species were *A. agrarius, C. glareolus* and *S. araneus,* respectively. Most of the specimens were found in autumn (Table 2). The greatest number of species and specimens was detected in the study area 4. The less number of species and the lowest rate of density were found in the areas (study area 2 and 6) most influenced by human. The similarity of the two large investigation areas correlates with the similarity of the small mammal communities of the areas.

The effect is similar of the lack of the grass and bush level (study area 2).

Small mammals prefer the boundaries of the differant habitats. We trapped the largest number of specimens in this type of localities, but we could not detect a high rate of migration. The rate of males and females of the abundant species proved to be roughly equal.

Data were used for cluster analysis (Fig. 6). Large reedy areas (study areas 1, 4) form a common group, and the open, grassy areas (study areas 3, 6) form an other group. The study areas 2 and 5 differ from the other ones. Finally, we conclude that the communities of the large, mosaic-type natural or semi-natural habitats are very similar in the drainage area of Lake Balaton. The human activities result changes in the structure of the small mammal communities.

Table 1 contains the list of amphibian species found at the sampling sites in 1996 and 1998. A new element is the presence of *Rana arvalis.* During the 1996 investigations and also in the previous decades, this frog has not been recorded from the Tetves Stream (pers. obs.), though it was thought to be present along the southern shore of Lake Balaton (Ilosvay, 1985). Three young adults were collected, which might indicate a possible colonisation.

The position of *R. dalmatina* egg clutches at Endrédi Stream can be seen in Fig. 8. The distribution pattern remained relatively constant during the years (Farkas & Puky, 1997) indicating only minor changes in the aquatic environment. The individual number of breeding females of *R. dalmatina* also remained relatively stable.

The search for *T. dobrogicus* proved to be unsuccessful even in areas, where it used to be abundant or breed (pers. obs., Marián, 1988). Its absence is probably due to various human activities (habitat loss, pollution, developed road system, illegal dumping). From a conservation viewpoint, as this species has been ranked internationally as vulnerable (Arntzen et al., 1997), it gives reason for growing concern.

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Table 1. Presence of amphibian species at the sampling sites around Lake Balaton

Species	1996	1998
Triturus vulgaris Linné	+	+
Bombina bombina Linné	+	+
Bufo bufo Linné	+	+
Hyla arborea Linné	+	+
Pelobates fuscus Laurenti	+	+
Rana dalmatina Bonaparte	+	+
Rana arvalis Fejérváry	-	+
Rana esculenta complex Linné	+	+

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On soil-inhabiting spiders of Nagy-Szénás Hill in Hungary

By

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Abstract. More than one thousand species of the group Araneidea are known in Hungary. From three studied plant associations (Festuco pallenti-Brometum pannonici, Fago-Ornetum, Querco-Carpinetum) 87 spider species in 1317 individuals were collected, of which only a few species were observed as frequent in all three associations. Since the soil-inhabiting macrofauna was investigated, the species living in litter, below rocks and beneath shrubs were trapped. The several-year collection made possible a comparison of the spider faunas characteristic for the diverse plant associations. Species of low individual number can not be used for characterization, nevertheless, they are included in the list.

In the Nagy-Szénás Hill three plant associations were studied: *a)* Closed dolomite rocky grassland, Festuco pallenti-Brometum pannonici. The steep northern slopes of the dolomite hill have a cool, fairly constant microclimate. *b)* Mixed karstic woodland, Fago-Ornetum. This is the characteristic forest association of the steep northern slopes. The two characteristic species of mixed karstic woodland, the coincidence of the cool-loving beech and the warm-loving *Fraxinus ornus* indicate a postglacial relic character of the association. *c)* Hornbeam-oak wood, Querco-Carpinetum. A closed canopy woodland. The stands are often mixed with single individuals of beech or hornbeam, or other tree species (Sallai, 1992).

So-called Barber traps were used. The first traps were set in October 1982, then checked in November and left out during winter. Subsequently, traps were checked in March, summer and October 1983, as well as in January 1984. As seen in the analysis, a part of the deposited traps were destroyed, so the material of several areas had to be pooled (Sallai, 1992).

Spider species observed in large individual number

The species *Harpactes rubicundus* (Dysderidae) represented by the largest number of specimens (266) has been found in all three plant associations. *H. rubicundus* is the most common *Harpactes* species in Hungary. It occurs from North-Africa to Poland, prefers forests. The second most abundant species (129) is

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the throughout common *Leptyphantes flavipes* (Linyphiidae), it was characteristic to the Fago-Ornetum association.

Alopecosa trabalis (96) and *Trochosa terricola* (93) were nearly equal in abundance. The first was characteristic for the Festuco pallenti-Brometum pannonici association, while the second occurred in considerable number in the Fago-Ornetum association. *A. trabalis* prefers open habitats, in Hungary it is not rare in hilly regions. This spider is distributed in Europe, Central Asia, Asia Minor. *T. terricola* is an euryoec species.

The fourth most abundant species was *Cicurina cicur* (83, Agelenidae) with high dominance in Fago-Ornetum association. It prefers damp places, and is widespread in Europe, but it lives in Japan, too. In Hungary it occurs in the hilly regions.

According to the number of trapped individuals, the next one was *Microneta viaria* (51, Linyphiidae). It was observed in large number (48) in Fago-Ornetum association.

Centromerus similis (50, Linyphiidae) was found in all three plant associations. A considerable number of specimens was registered in *Festuco pallenti-Brometum pannonici* (23) and *Fago-Ornetum* (20) associations.

Short characterization of the families

Atypidae: Because of its rare incidence, *Atypus affinis* collected in *Querco-Carpinetum* is worth mentioning. The species lives in oak forests in mountains of medium height in Hungary. Distribution: Europe (north to Denmark), North-Africa, Caucasus, on chalk hillsides.

Pholcidae: *Pholcus opilionides* came from the Querco-Carpinetum. It is common in Hungary, distributed in Europe, Central Asia, China, in warm regions.

Dysderidae: From the three species on the spot, some individuals of *Dysdera erythrina* have been trapped in Querco-Carpinetum and Fago-Ornetum. Beside the formerly mentioned *Harpactes rubicundus* of general incidence, some individuals of *H. hombergi* came from Fago-Ornetum. *D. erythrina* and *H. hombergi* inhabit the hilly regions in Hungary.

Agelenidae: From the seven collected species, *Cicurina cicur* occurred in all the three plant associations. *Coelotes longispina* was characteristic for the Festuco pallenti-Brometum pannonici and Fago-Ornetum associations. This species comes from warm southern, south-western slopes. *Tegeneria agrestis* is a migratory species, it turn up in 1937 in Hungary. Some individuals could be found in every plant association. *Agelena gracilens, T. torpida* and *T. silvestris* have been trapped in low individual number in Fago-Ornetum. *Cybaeus angustiorum* is a rare species, one single specimen was collected in the *Festuco-pallenti-rometum pannonici* association. *A. gracilens* likes warm places, and is common in hilly regions, it is widespread in Europe. *T. torpida* occurs in forests, *T. silvestris* in forests and bushy places. *C. angustiorum* prefers beech woods and other cool forests, it is sporadic in Querco-Carpinetum association.

Pisauridae: The family was represented by *Pisaura mirabilis*. Each individual was collected in the Festuco pallenti-Brometum pannonici association. This species lives in woods; it is widespread in Europe.

Lycosidae: *Alopecosa trabalis* and *Trochosa terricola* have already been mentioned among the abundant species. Individuals of *A. sulzeri* were found in the Festuco pallenti-Brometum pannonici association. The species is known from scrub, on grassy rocks of hilly regions, and also in dry oak forests. *Pardosa lugubris* was found in some individuals in all three plant associations. The species comes from sunny places in woods; it is common and widespread throughout. *Aulonia albimana* was trapped in Festuco pallenti-Brometum pannonici and Fago-Ornetum. It occurs on grassy or stony places with warm and sunny exposition. Widespread in Europe, but uncommon in north. *Alopecosa aculeata* occurs in Festuco pallenti-Brometum pannonici. It is a mountainous species.

Mimetidae: Some individuals of one species, *Ero furcata*, were found. This species is fairly common throughout.

Metidae: One species, *Meta segmentata*, with low number of individuals. This spider lives in woods, gardens, wasteland. Abundant throughout.

Linyphiidae: This was the most significant family of the studied plant associations, being the richest in both number of species (27) and of individuals (536). 40% of all trapped animals belonged to this family. Among species observed in large number of individuals, *Leptyphantes flavipes* (129), *Microneta viaria* (51) and *Centromerus similis* (50) have already been mentioned. Because of their high dominance within the family, *Linyphia hortensis* (48), *Lepthyphantes collinus* (29), *L. minutus* (28), *L. mansuetus* (28), *L. mengei* (26), *L. angulipalpis* (26), *Macrargus rufus* (21) shall be mentioned. Their distribution is shown in Table 1.

Micryphantidae: It is represented by 13 species in the associations, three of which deserve attention. One of them is *Wideria simplex*, all individuals (14), with one exception, were found in Fago-Ornetum. *Minirioloides* sp. and *Araeoncus* sp. are members of northern group of species, but it is improbable that they are glacial relics.

Theridiidae: Each of its five species were represented by one individual in the associations (Table 1).

Gnaphosidae: Nine species were found. They were collected in the Festuco pallenti-Brometum pannonici association, except for *Drassodes pubescens* which was found in all three plant associations, under stones in woods and more exposed places. It is rather uncommon, but widespread throughout. Two individuals of *Zelotes erebeus* were collected in Querco-Carpinetum.

Clubionidae: Five species were found (Table 1).

Thomisidae: Five species were found, as can bee seen in the Table 1.

Salticidae: The only species observed was *Evarcha laetabunda*. It lives in dry places and is widespread in Europe.

Tab. 1. List of species and their individual number in the plant associations studied (a: Festuco pallenti–Brometum pannonici; b: Fago–Ornetum; c: Querco-Carpinetum, S: total number of individuals)

Species	a	b	c	S
ATYPIDAE				
Atypus affinis (Eichw.)			1	1
PHOLCIDAE				
Pholcus opilionides (Schrank)		1	1	
DYSDERIDAE				
Dysdera erythrina (Walck.)		2	1	3
Harpactes rubicundus (C.L. Koch)	8	142	56	266
Harpactes hombergi (Scop.)		4		4
AGELENIDAE				
Tegeneria agrestis (Walck.)	2	2	1	5
Tegeneria torpida (C.L. Koch)		2		2
Tegeneria silvestris (C.L. Koch)		1		1
Agelena gracilens (C.L. Koch)		1		1
Coelotes longispina (Kulcz.)		10	14	24
Cybaeus angustiorum (C.L. Koch)	1		1	
Cicurina cicur (Fabr)	16	57	10	83
PISAURIDAE				
Pisaura mirabilis (Cl.)	7			7
LYCOSIDAE				
Aulonia albimana (Walck.)	4	1		5
Pardosa lugubris (Walck.)	5	3	2	10
Trochosa terricola (Thor.)	49	39	5	93
Alopecosa aculeata (Pav)	1			1
Alopecosa cuneata (Cl.)		1		1
Alopecosa sulzeri (Cl.)	13	1		14
Alopecosa trabalis (Cl.)	88	6	2	96
MIMETIDAE				
Ero furcata (Villers)	2	1		3
METIDAE				
Meta segmentata (Cl.)	1	9	5	15
LINYPHIIDAE				
Macrargus rufus (Wid)	1	18	2	21
Microneta viaria (Blackw.)	43	8		51
Tapinopa longidens (Wid)	1	1		2
Stemoniphantes lineatus (Linné)	7			7
Sydera gracilis (Menge)			1	1
Centromerus sylvaticus (Blackw.)	9	2	3	14
Centromerus similis (Kulcz.)	23	20	7	50
Centromerus serratus (Kulcz.)		3		3
Centromerus jacksoni (Denis)	3	2		5
Bolyphantes crucifer (Menge)	2			2
Leptyphantes collinus (Westr.)	23	6		29
Leptyphantes minutus (Blackw.)	2	24	2	28
Leptyphantes cristatus (Menge)	2		1	3
Leptyphantes flavipes (Blackw.)	3	102	24	129
Leptyphantes tenebricola (Wid)	5	6	5	16
Leptyphantes mengei (Kulcz.)	22	4		26
Leptyphantes mansuetus (Thor.)	16	9	3	28
Leptyphantes nanus (Kulcz.)			1	1
Leptyphantes leprosus (Ohl.)			10	10
Leptyphantes pallidus (O.P. Cambr.)	1	4		5
Leptyphantes angulipalpis (Westr.)		21	5	26
Stylophora concolor (Wid)	13	1		14

Drapetisca socialis (Sund.)	2	1	3	
Linyphia hortensis (Sund.)	4	29	15	48
Linyphia clathrata (Sund.)	5		4	9
Porrhoma convexa (Westr.)		4		4
Mikrolyniphia pusilla (Sund.)		1		
MICRYPHANTIDAE				
Wideria simplex (Kulcz.)	1	14		15
Wideria cucullata (C.L. Koch)		2		2
Wideria antica (C.L. Koch)	1			1
Wideria capito (Westr.)		1		1
Wideria melanocephala (O.P. Cambr.)		3		3
Nematogmus sanguinolentus (Walck.)		1		1
Tigellinus furcillatus (Menge)	3			3
Gonatium corallipes (O.P. Cambr.)		2	1	6
Ceratinella scabrosa (O.P. Cambr.)	2		2	
Tapinocyba insecta (C.L. Koch)		1		1
Minirioloides sp.	24	2		26
Trichoncus scrofa (Sim.)	1	1		2
Araeoncus sp.	1			1
THERIDIIDAE				
Robertus arundineti (O.P. Cambr.)			1	2
Pholcomma gibbum (Westr.)		3		3
Theridium ovatum (Cl.)	1			1
Episinus lugubris (Sim.)	1	1		2
Dipoena melanogaster (C.L. Koch)	1		1	
GNAPHOSIDAE				
Drassodes pubescens (Thor.)	7	1	5	13
Drassodes lapidosus (Walck.)	1			1
Haplodrassus silvestris (Blackw.)	2		1	3
Zelotes electus (C.L. Koch)	1		1	2
Zelotes villicus (Thor.)	2			2
Zelotes erebeus (Thor.)			2	2
Zelotes serotinus (C.L. Koch)	3			3
Phaeocedus braccatus (C.L. Koch)				1
Gnaphosa sp.	1			1
CLUBIONIDAE				
Clubiona terrestris (Westr.)	14		2	16
Clubiona compta (C.L. Koch)	1			1
Clubiona marmorata (Webstr.)		1		1
Agroeca pullata (Thor.)	10	1		11
Scotina celans (Blackw.)			3	3
THOMISIDAE:				
Xysticus cambridgei (Blackw.)		1		1
Oxyptila atomaria (Panz.)	2			2
Xysticus sp.	3	1		4
Thanatus vulgaris (Sim.)	1			1
Philodromus aureolus (Cl.)		1		1
SALTICIDAE				
Evarcha laetabunda (C.L. Koch)	2			2

Spider species characteristic for the plant associations

Festuco pallenti-Brometum pannonici: The species collected in the largest number of individuals was *Alopecosa trabalis,* and also significant were the following ones: *Harpactes rubicundus, Trochosa terricola, Centromerus similis* and *Leptyphantes mengei.*

Fago-Ornetum: *Harpactes rubicundus, Leptyphantes flavipes, Cicurina cicur, Microneta viaria, Trochosa terricola, Linyphia hortensis* were common in this association.

Querco-Carpinetum: *Harpactes rubicundus, Leptyphantes flavipes, Linyphia hortensis* were characteristic.

Summary

87 spider species in 1317 individuals have been registered on the territory. Only a few species could be found with significant frequency in all the three plant associations. According to the original conditions - the seeking of phytocenological parallelisms - the results certify that in the spider fauna there had not been found species of glacial relic character. The explication can be found primarily in the movement - active migrations - of the spiders. Relic species of last glaciation had only been found in swamps (Bátorliget, Csaroda, Ócsa) in Hungary (Tóth, 1985).

Acknowledgment. The authors thank Mrs. Kinga Szathmáry for her assistance in revising an earlier version of the table.

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Opusc. Zool. Budapest, XXXI, 1998

Spiders (Araneae) collected with Berlese-sampler by the Hungarian Soil Zoological Expedition in Ecuador, 1988

By

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Abstract. The Hungarian Academy of Sciences as well as the Department of Systematic Zoology and Ecology of Eötvös University (Budapest) had organized a number of Soil Zoological Expeditions to Ecuador. One of them was directed to Ecuadorian mountain rain forests in 1988. In the course of this expedition several samples were collected. The spiders were obtained by Berlese-sampler and determined by the author. Among 110 specimens of spiders – belonging to 13 families – a lot of juvenile and indeterminable individuals were found. Adult specimens were in 18% present. Depth of determination was kept on family level. Compositions of spider families found in different habitat types (moss, litter, soil and others) are compared. Some interesting Chelicerata are also included in summarizing table.

Sampling sites were located throughout the Ecuadorian mountain forests. Sampling was carried out at 46 sites from different habitats; altogether 100 samples were taken (Table 1) by Dr. A. Zicsi, Dr. Cs. Csuzdi and the Székely family. The material obtained by Berlese-samplers was preserved in metil-alcohol, it was sorted in Hungary and determined by the author in Budapest and Karlsruhe. The spiders are preserved in the collection of Department of Systematic Zoology and Ecology of Eötvös University (Budapest, Hungary) and, in part, in the Staatliches Museum für Naturkunde (Karlsruhe, Germany).

Collecting by Berlese-sampler is generally a good method for the small soil-inhabiting invertebrates. The spiders, however, especially the larger ones which move rapidly, often don't remain in the samples, consequently only the small spiders can be caught with Berlese-sampler. This method seems to be useful for the families Dipluridae, Ochyroceratidae, Caponiidae, Oonopidae, Symphytognathidae, Anapidae and Mysmenidae.

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Results

Altogether 110 spider specimens were found in the studied sites with the Berlese-sampler: 20 adults and subadults (together 18%) and 90 juveniles (82%).

Most of the juvenile spiders were unidentifiable; in these cases only the names „Mygalomorphae" or „Araneomorphae" are used in the table (Table 2). Determination depth of adult and the other older spiders has been kept on family levels. The spiders observed belong to 13 families which are as follows: Scytodidae (4 juv.), Ochyroceratidae (5 juv. + 2 ad.), Segestriidae (1 juv.), Oonopidae (6 juv. + 3 ad.), Theridiidae (5 juv. + 10 ad.), Theridiosomathidae (1 ad.), Linyphiidae (1 ad.), Anyphaenidae (1 juv. + 1 ad.), Zodariidae (1 juv.), Ctenidae (2 juv.), Heteropodidae (1 juv.), Thomisidae (1 ad.), Salticidae (4 juv. + 1 ad.). In addition, 60 juvenile, unidentifiable spiders were detected: 12 mygalomorph and 48 araneomorph spiders.

There were a number of habitats where no spider could be observed; most of the spiders (9 specimens) were found in sample 12, which was moss from branches lying on the ground, above the lagoon San Marcos.

The results of the comparison of different habitat types from the collecting sites are seen in Table 3.

Fig. 1 shows the spider family distribution in the individual habitat types. Most of the spiders came from moss, although the litter was also a relatively rich habitat type for them. Other types of habitats were poorer in spiders. In the soil no adult spiders have been detected, only three juvenile and unidentifiable individuals.

The specimens of the families may occur in different habitat types. Some families (Theridiosomatidae, Linyphiidae, Anyphaenidae, Zodariidae, Ctenidae, Heteropodidae, Thomisidae) were represented only in one habitat type, the others in more than one (Fig. 2). The most interesting species belonged to the families Ochyroceratidae and Oonopidae. These small, tropical spiders were present in moss, litter and in wood debris (see the "other" category), but the majority of both families could be found in litter.

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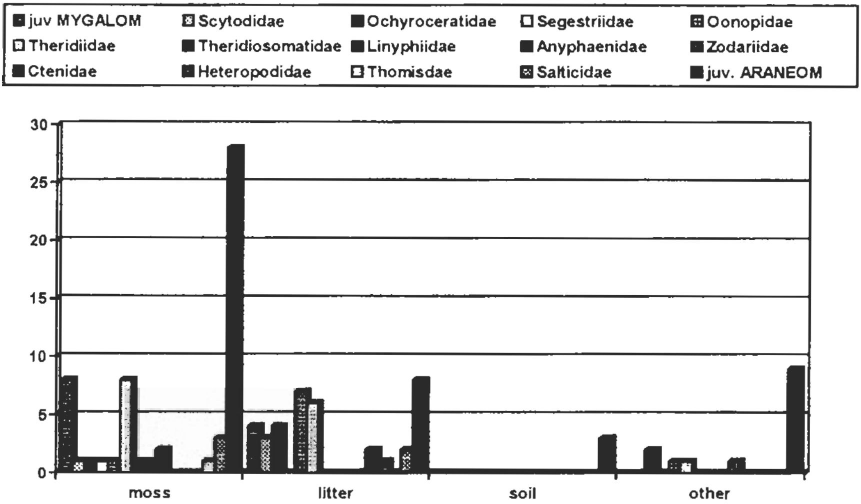

Fig. 1. Distribution of spider families in the habitat types.
(On the vertical axis the number of individuals is indicated)

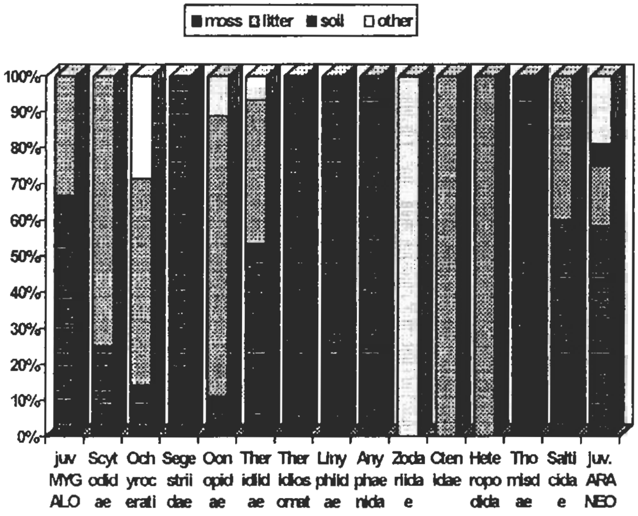

Fig. 2. Percentage distribution of the spider families according to the different habitat types

Table 1. List of the collecting sites in Ecuador

Samples	Date: 1988	Sample type	Habitat and locality
			Providence Pichincha
1.	21.04.	moss	above Quinto, 3200-3400 m a.s.l., 46 km leaving Quinto to Santo Domingo
2.		litter	same place
3.		soil	same place
4.	21.04.	moss	close to a rapid, between Quinto and Santo Domingo
5.		litter	same place
6.		soil	same place
7.	23.04.	grassy level	meadow with couch-grass, below Olmedo
8.		soil	same place
9.	23.04.	moss	grassy, shrubby vegetation, slope of the volcano Cayambe, 4200 m a.s.l.
10.		grassy level	same place
11.		soil	same place
12.	23.04.	moss	from branches lying on the ground, above the lagoon San Marcos
13.		moss	walls of a road cut, same place
14.		moss-cushion	slope of the bank, same place
15.	24.04.	moss	lakeshore (leaving the waterfall), 71 km from Quito to Santo Domingo
16.		litter	same place
17.		soil	same place
			Providence Chimborazo
18.	25.04.	moss	Chrunchi, 7 km approaching town
19.		litter	same place
			Providence Canar
20.	25.04.	litter	below shrubs, 12 km to El Tambo
			Providence Azuay
21.	26.04.	litter	an access road, below shrubs, 26 km leaving Cuenca
22.		grass	same place
23.		soil	same place
24.	26.04.	*Sphagnum*	plateau, 4000 m a.s.l., 52 km from Cuenca, on the road to Loja
25.		litter	same place
26.		soil	same place
			Providence Loja
27.	26.04.	moss	leaving Saraguro, 175 km from Cuenca
28.		litter	same place
29.		soil	same place
30.	27.04.	mixed litter, soil and grass	5 km leaving Loja, towards Vilcabama
31.	27.04.	moss	12 km leaving Loja, on the way to Vilcabama
32.		litter	same place
33.		soil	same place
34.	28.04.	litter	valley of a creek, 6 km leaving Yangana to Zumba
35.	01.05	litter	dry, shrubby area, 35 km leaving Loja, on the way to Machala
36.		tussocks	same place
37.	01.05.	moss	at the bridge, 85 km from Loja, leaving Zambi
38.		litter	same place
39.		soil	same place
			Providence El Oro
40.	02.05.	litter	patch of primary forest, 11 km from Santa Rosa, to Loja
41.		bromelias	same place
42.	02.05.	tussocks, tuff	leaving Pasaje, 54 km from Santa Rosa
43.		succulent	same place
44.	02.05.	tussocks	dry area, leaving Pasaje, 64 km from Santa Rosa
45.		soil	same place
46.	02.05.	moss	mountain slope, 15 km leaving Santa Isabel
47.		litter	same place
48.		soil	same place
			Providence Azuay
49.	02.05.	litter	between Giron and Victoria de el Portete
50.		grass	same place
51.		soil	same place

Table 1. (Continued)

Samples	Date 1988	Sample type	Habitat and locality
52.	03.05.	moss	leaving Chordeleg, 39 km from Cuenca
53.		litter	same place
54.	03.05.	moss	slope of bank, 2 km leaving Sigsig
55.		litter	same place
			Providence Canar
56.	04.05.	moss	between El Tambo and Zhud, 84 km from Cuenca
57.		litter	same place
58.		soil	same place
			Providence Loja
59.	30.04.	soil	52 km from Loja, on the way to Cuenca
			Providence Tungurahus
60.	04.05.	soil, lower lay.	leaving Riobamba, near Mocha Pata
61.		soil, upper lay	same place
			Providence Pichincha
62.	06.05.	moss	from trees, on the slopes of the volcano Cayabe, above the lagoon San Marcos
63.	07.05.	bromelias	79 km from Quinto, leaving the church, at an Indian dwelling
			Providence Napo
64.	09.05.	moss	from trees, cut primary forest patch, leaving Borja, to Lago Agrio
65.		litter	same place
66.		tussocks	same place
67.		wood debris	same place
68.		bromelias	same place
69.		soil	same place
70.	09.05.	moss-cushion	hillside, on the way to Lago Agrio, 3 km leaving Las Palmas
71.		litter	same place
72.	09.05.	moss	near the bridge of Rio Marker, on the way to Lago Agrio
73.	10.05.	moss	primary forest patch, leaving San Vicente
74.		litter	same place
75.		soil	same place
76.	10.05.	litter	patch of primary forest, leaving Lago Agrio, 8 km towards Dureno
77.		wood debris	cut forest patch on the same place
78.	10.05.	litter	of coffee plantation, 25 km leaving Lago Agrio
79.		litter	nearby primary forest patch, same place
80.		moss	same place
81.	10.05.	litter	primary forest patch on the riverside of Rio Aguarico, leaving Dureno
82.	10.05.	litter	primary forest patch at the second bridge, leaving Dureno
83.	10.05.	litter	primary forest patch, 2.5 km on accede road, to Ago Agrio
84.	11.05.	moss	primary forest cut, 48 km leaving Lago Agrio, towards Quinto
85.		litter	same place
86.		wood debris	same place
87.	11.05.		primary forest patch, between Lago Agrio and Quinto, 70 km from Lago Agrio
88.	11.05.	moss	primary forest between Lago Agrio and Quinto, 80 km from Lago Agrio
89.		litter	same place
90.	11.05.	bromelias	cut primary forest, 1 km leaving Reventador
91.	11.05.	moss	meadow, above Papallacta, in about a distance of 7 km
92.		litter	same place
93.		soil	same place
94.	11.05.	litter	of a pachonal, about 9 km above Papallacta
95.	11.05.	moss	near the summit, between Papallacta and Pifo
			Providence Pichincha
96.	13.05.	moss	leaving El Chaupi, on the way to El Refugio finca
97.		litter	same place
98.	13.05.	soil	paramo vegetation, above El Chaupi on the slope of Iliniza
99.		chusion-pl.	same place
100.		moss	from the ground, higher on the slope of Iliniza, on 4400 m a.s.l., 2 km further

Table 2. Spiders and other Chelicerata from Ecuadorian mountain forests, from Berlese-samples, 21. 04. - 13. 05. 1988.

The sample is: ☐ moss, ▨ litter, ▤ soil, ☐ something else

Samples	Ordo or subordo	Spider family	Male	Female	Total			Total	Other Chelic.
					Juv.	Adult	Spiders /habit.	Spiders/ coll.site	
1.	OPILIONIDEA						-		1
▨ 2.		Ctenidae			1				-
	MYGALOMORPHAE				2				-
	SCHIZOMIDA								1
	OPILIONIDEA								3
		Ochyroceratidae			2				-
		Oonopidae			1		6		-
▤ 3.							-	6	-
4.		Anyphaenidae		1		1			-
		Segestriidae			1		2		-
▨ 5.	MYGALOMORPHAE				1		1		-
▤ 6.							-	3	-
7.							-		-
▤ 8.							-		-
9.	OPILIONIDEA								1
	ARANEOMORPHAE				5		5		-
10.	OPILIONIDEA								2
	ARANEOMORPHAE				6		6		-
▤ 11.	ARANEOMORPHAE				1		1	12	-
12.	ARANEOMORPHAE				9		9		-
13.	ARANEOMORPHAE				4		4		-
14.	ARANEOMORPHAE				1		1	14	-
15.		Oonopidae			1		1		-
▨ 16.		Oonopidae			2		2		-
▤ 17.							-	3	-
18.							-		-
▨ 19.							-	-	-
▨ 20.							-	-	-
▨ 21.							-		-
22.							-		-
▤ 23.							-	-	-
24.		Theridiidae			1		1		-
▨ 25.							-		-
▤ 26.							-	1	-
27.		Theridiidae			3		3		-
▨ 28.							-		-
▤ 29.	ARANEOMORPHAE				1		1	4	-
30.							-	-	-
31.		Scytodidae			1		1		-
▨ 32.	OPILIONIDEA								2
		Ochyroceratidae	1		1	1			-
	ARANEOMORPHAE				1		3		-
▤ 33.							-	4	-
34.							-	-	-
▨ 35.							-		-
36.							-	-	-
37.							-		-
▨ 38.		Oonopidae	s1			s1			-
		Theridiidae	1			1			-
	ARANEOMORPHAE				1		3		-
▤ 39.								3	-

Table. 2. (Continued)

Sam-ples	Ordo or subordo	Spider family	Male	Fe-male	Total			Total	Other Chelic.
					Juv.	Adult	Spiders /Shabit.	Spiders/ coll.site	
40.		Theridiidae		1		1	1		-
41.	ARANEOMORPHAE				1		1	2	-
42.							-		-
43.							-	-	-
44.	ARANEOMORPHAE				2		2		-
45.							-	2	-
46.							-		-
47.		Scytodidae			2		2		-
48.							-	2	-
49.	OPILIONIDEA								1
	ARANEOMORPHAE				1				-
		Scytodidae			1		2		-
50.		Ochyroceratidae			1		1		-
51.							-	3	-
52.							-		-
53.	MYGALOMORPHAE				1				-
		Heteropodidae			1				-
		Salticidae			1		3	3	-
54.	MYGALOMORPHAE				6		6		-
55.		Ctenidae			1		1	7	-
56.		Salticidae			1		1		-
57.							-		-
58.							-	1	-
59.							-	-	-
60.							-		-
61.							-	-	-
62.		Theridiidae		1		1	1	1	-
63.							-	-	-
64.							-		-
65.							-		-
66.							-		-
67.		Ochyroceratidae	1			1	1		-
68.		Theridiidae		1		1	1		-
69.							-	2	-
70.	ARANEOMORPHAE				5				-
	MYGALOMORPHAE				1				-
		Salticidae			1				-
	OPILIONIDEA								1
		Theridiidae	1			1	8		-
71.	ARANEOMORPHAE				1		1	9	-
72.		Anyphaenidae			1				-
		Thomisidae		1		1			-
		Linyphiidae	1			1	3	3	-
73.		Ochyroceratidae			1		1		-
74.							-		-
75.							-	1	-
76.		Theridiidae			1				-
		Oonopidae			2		3		-
77.							-	3	-
78.	OPILIONIDEA								1
	SCHIZOMIDA						-		2
79.		Oonopidae		1		1	1		-
80.	ARANEOMORPHAE				1		1	2	-
81.	ARANEOMORPHAE				2		2	2	-
82.							-	-	-
83.		Theridiidae	s1			s1	1	1	-

Table 2. (Continued)

Sam-ples	Ordo or subordo	Spider family	Male	Fe-male	Total			Total	
					Juv.	Adult	Spiders /habit.	Spiders/ coll.site	Other Chelic.
84.		Theridiidae		1		1	1		-
▨ 85.							-		-
86.		Oonopidae	s1			s1	1	2	-
87.		Zodariidae			1		1	1	-
88.	OPILIONIDEA								7
	MYGALOMORPHAE				1				-
		Salticidae	s1			s1	2		-
▨ 89.							-	2	-
90.							-	-	-
91.		Theridiidae		1		1			-
		Theridiosoma-tidae	s1			s1			-
							2		
▨ 92.	ARANEOMORPHAE				1				-
		Salticidae			1				-
		Theridiidae	s1			s1	3		-
▤ 93.	ARANEOMORPHAE				1		1	6	-
▨ 94.	ARANEOMORPHAE				1		1	1	-
95.							-	-	-
96.	ARANEOMORPHAE				2		2		-
▨ 97.	OPILIONIDEA								1
	ARANEOMORPHAE				1				-
		Theridiidae		1		1	2	4	-
▤ 98.							-		-
99.							-	-	-
100.							-		-
								110	23

Table 3. Summ-up of spider individuals in similar habitats from different collecting sites

Spider families	Moss	Litter	Soil	Other	Total
juv. MYGALOM.	8	4			12
Scytodidae	1	3			4
Ochyroceratidae	1	4		2	7
Segestriidae	1				1
Oonopidae	1	7		1	9
Theridiidae	8	6		1	15
Theridiosomatidae	1				1
Linyphiidae	1				1
Anyphaenidae	2				2
Zodariidae				1	1
Ctenidae		2			2
Heteropodidae		1			1
Thomisidae	1				1
Salticidae	3	2			5
juv. ARANEOM.	28	8	3	9	48
Σ spider individ/ habitat type	56	37	3	14	Σ110
Σ spider families/ habitat type	10	7	-	4	Σ13

Average number of spiders/ habitat type	(56/28) 2,00	(37/32) 1,15	(3/21) 0,14	(15/11) 1,36

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Data to the diet of the urban Stone marten (*Martes foina* Erxleben) in Budapest

By

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Abstract. Stone marten (*Martes foina* Erxleben) seems to be one of the most successful, adaptable mammal. All the studies, dealing with the feeding ecology of this marten, emphasize and verify the fact that it is an omnivorous, euriphagous, opportunistic predator species of the family Mustelidae. Within its huge biogeographical area it found its rule in the food chain of urban environment, too. The frequency and biomass of different items are miscellaneous, according to sources of environment, but the quantity of the urban garbage is insignificant, against its high abundance and easy availability.

The present study took into consideration numerous previous studies (e.g. Delibes, 1978; Lucherini & Crema, 1993; Lanszki, 1994; Pandolfi, De Marinis & Petrov, 1996; Doncaster, Dickman & MacDonald, 1990). Abundance, availability and dispersion of food resources determine the food habits of carnivores (e.g. MacDonald, 1981; Doncaster et al. 1990; Cavallini & Lovari, 1991). But we have only a few data about the diet of the urban Stone marten, just like the exploitable resources of urban environment. Important factors are: presence of men, lock or low number of competitors, predators and richness of food and hiding-places. The „parameters" of urban populations are unknown, but it is sure that a meeting with this acrobatic animals are frequent all over the town. Their presence becomes evident causing different economic damage, or by stealing eggs, eating bunnies, chickens, plucking the nests of song-birds and causing terrible noise, nasty odor in the often used dens, so they viewed as pests.

The aim of this study was to analyze the 87 collected faeces samples to get data on the diversity of the food and feeding behavior of Stone marten inhabiting Budapest. Conclusions are on the basis of identified food items and using the registrations of citizenry I have been collecting through two years (08. 1996 - 08. 1998). As far as I know there were no similar studies in Hungary.

Sampling area and methods

The 87 faeces samples were collected at the same time, from a garret of a family house, in a socalled „green district" of Budapest, in April 1998. The family houses and gardens are

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in good conditions there. There are a lot of old fruit-trees, pines, thugs, ornamental shrubbery's. Little outbuildings, undisturbed attics important hiding places. The den hadused continuously through two years by 1–4 Stone martens, probably a female and her cubs. The garret was surely only one of the nocturnal resting sites inside of the territories of this family. Some studies described that *Martes* species use a lot of resting sites within their territory in natural environment (e.g. Zalewski, 1997). The territory of Stone martens in their natural environment is about 350-400 ha, that mean an approximate density of 0.7 individuals/100 ha (Serafini & Lovari, 1993). The territories of males are twice as big as those of females (Seknack, 1990). My sampling place probably is on the edge of the territory of martens using this garret, because to the East extend are densely populated areas and a very busy thoroughfare, and runs the Danube as North-South barrier. Human surroundings offer high density of food and dens, so the territory of urban martens shrink and their density may grow. Calculating about 100 ha territory, these martens prowl often hills of Buda.

Summarizing the data about the sampling place, the diversity of vegetation, the high number of possible hiding places, the closeness of forestry hills and parks mean an ideal habitat for the Stone martens.

The different aged faeces well represented the yearly diet, but didn't allow to analyze the season dependent changes. Samples must had been soaked in 60% alcohol to loosen its content so preparing them for washing. Each samples was washed under tap water through a bolting work, using sieves taking under each other with 2.8, 2.5, 2.0, 1.0, 0.7 mm mesh. Then all the selected samples were oven dried. The scat analysis followed mainly the methodology described by Goszczynski (1974), Delibes (1978), Kruuk & Parish (1981), Holisova & Obrtel (1982), Serafini & Lovari (1993). 25 random samples were counted to express the number of occurrence (N. occ.), the percent frequency of occurrence (% freq. occ.: as number of occurrence of each food/number of faeces × 100), percentage of occurrence (number of occurrence of each food/total number of occurrences × 100). Dry weight of main items was given, too.

The indigestible remnants were examined under microscope. The hairs were identified by my own reference collection. The other items were identified using taxonomic key-books.

Results and discussion

Previous studies show the high and locally changing diversity of the diet composition, the low level of urbanization, important rule as top-predator of vertebrates of urban Stone martens (Holisova & Obrtel, 1981; Lucherini & Crema, 1993). My results prove a generalist predator, as in other studies. Supposing that martens had used this garret all over the two years and that the contents of faeces are from surrounding urban environment, the results reflect the diversity of sampling area, too.

After washing the 87 samples through the sieves, percentage of dry weight of items were plant: 50.48%, feather: 6.18%, bone: 5.51%, hair: 3.33%, insect: 2.82%, mixture: 31.68%, on the basis of first selection. The so called „Mixture" category contain all the other remnants, including unidentified materials. The large biomass of easy selectable and definable items (62.7 % dry weight) were on the sieve with 2.8 mm mesh, while the so called „Mixture" category proved to be very informative, were on the sieve with 1.0 mm mesh (18.6%). Selected and identified items of mixture category contributed to the results, so the „Other" category as food item means only the garbage and stones (Fig. 1).

According to standard methods the results were expressed in the number of occurrences, percent frequency of occurrence as well as percentage of occurrence (Table 1).

Plants

The most important items were the different vegetable parts. The pulpy fruits mean the dominant mass, reflected in the high number of occurrence of their seeds (22), and percentage of occurrence (37.3). The most frequent were plums (*Prunus*), mulberries (*Morus*), grapes (*Vitis*), hips (*Rosa*) which probably were consumed in summer and autumn. Seeds and leaves of *Thuja* species, and little percent of needles of pines, grasses, seeds of sunflower (*Helianthus annuus*), pieces of barks and a seed of clematis (*Clematis vitalba*) take the dry parts of plants and were probably consumed in winter or mixture with other times. The small quantity but relative frequent occurrence of other seeds of monocotyledonous plants perhaps derive from consumed pouches, e.g. the seeds of wheat (*Tritium*), millet *(Panicum*) and unidentified grasses. Stone martens should be spread some seeds.

Vertebrates

Birds become the most dominant item among vertebrates, the percentage of tgheir occurrence (16.6) is twice as big as mammal items (8.8). The unidentified samples consisted of broken fragments of bones, floccuses and underhairs, claws, parts of feet.

There were three faeces samples containing only hairs with skin and some bones of mammals and five samples only feathers and bones, feet of birds in it. All the other samples had vegetative parts, too. The hair analysis shows very interesting results. In the 87 samples the more frequent mammals were *Apodemus sylvaticus* (13), *Mus musculus* (4), *Sciurus vulgaris* (3), *Glis glis* (2), *Rattus norvegicus* (1), and an unidentified bat species (1). One faeces contained human hairs, derive of course from a garbage. These results show that Stone martens hunt at least three level, on the ground, on the stem and in the leafage, and prefer the den-living preys. The samples contain their own hairs, too, derive from making toilet, playing each other, etc. There were guard hairs of cats in two faeces. I have information that stone martens kill the house cats or their cubs, and the stray cats disappear from martens' territory. Probably these hairs derive from a fight of them. Cats and martens would become competitors for the same vertebrate food-supply and dens in urban environment.

Birds were mostly Passeriformes species and *Turdus*. There were little parts of white and blue egg-shells, intact feet. In case of easy accessibility, Stone martens often stole chickens and eggs. Eggs often stored in their dens (Morimando, 1996), as I found in some cases, too. Perhaps the white egg-shells were of domesticated birds. While the biomass of vertebrate food mainly consists of birds, the diversity of it is lower than mammal items.

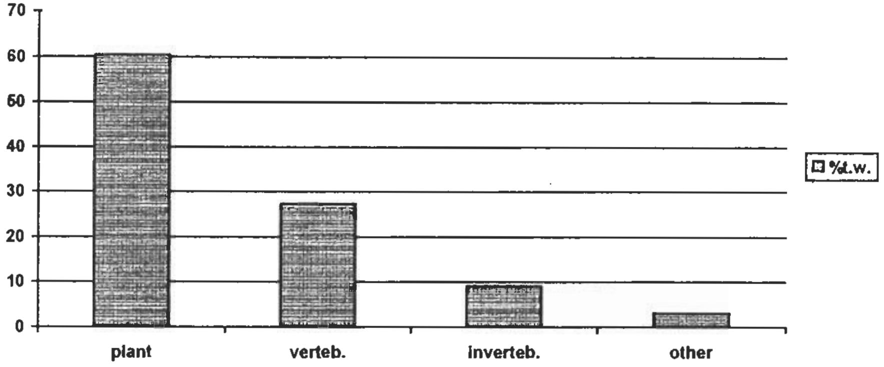

Fig. 1. Dry weight of selected 87 samples

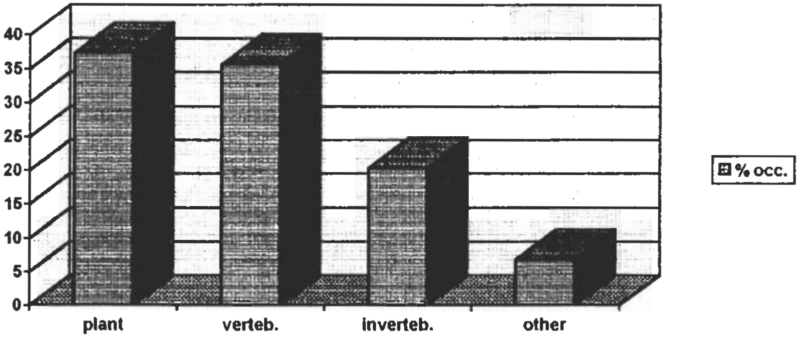

Fig. 2. Percentage of occurrence (in the 25 analyzed samples)

Invertebrates

The invertebrates mean the third fundamental food item. This study did not analyzed the presence of earthworms, but comparing with previous studies, Stone marten consume only low mass of invertebrates, including earthworms (Holisova & Obrtel, 1981). There were wings, legs, chitin fragments, total inhurt insects and a lot of unidentifiable, little parts of arthropods. The samples form three categories. The first category and largest biomass were those ones living probably in the faeces. Its number of occurrence were 2–20 : *Ptirus* spp. and ants (*Formica*) were the most frequent, then *Stegobium* sp., *Ptirus* larvae and unidentified larvae of Coleoptera in totally uninjured state. Important to mention that there were none living insects in the samples, perhaps they were eaten by chance but undigestibled? Other studies are needed to solve this question. The second category consisted of those probably eaten by chance with other food, the number of its occurrence only 1–3: *Otiorhynchus rugosostriatus* (frequent in grapes and berries), *Melanotus* sp., *Harpa-*

Table 1. 25 faeces were analized individually to get standard data
(% t.w. : percentage of dry weight of the 87 samples)

Food items	N.occ.	%freq.occ.	%occ.	% t.w.
Plants	22	88	37.3	60.5
1. seeds of fruits	16	64	16.6	
2. seeds of others	13	52	13.5	
3. dry parts of plants	11	44	11.4	
4. unindentified	5	20	5.2	
Vertebrates	21	84	35.6	27.4
1. mammals	9	36	9.4	
2. birds	17	68	17.7	
3. unindentified	2	8	2.1	
Invertebrates	12	48	20.3	9.1
1. insects	7	28	7.3	
2. chelicerata	2	8	2.1	
3. larvae	5	20	5.2	
4. unindentified	4	16	4.2	
Other	4	16	6.8	3
1. garbage	3	12	3.1	
2. stones	2	8	2.1	

lus sp., *Palomena prasina,* a fragment of Hymenoptera (Vespidae) and anunidentified Arachnida. The ticks (Chelicerata) would had been the parasitic of Stone marten or even of consumed pride. To the third category belonged the probably really preys, like *Rhizotrogus aequinoctialis,* unidentified butterfly (Lepidoptera) and beetles (Coleoptera). Its number of occurrence: 2–12.

Other

The scats contained some items derive from urban garbage. There were little pieces of paper, alufolia, plastic folia of salami. Stones were of the different size. The number of occurrences in the 87 faeces were only 7. It is sure that Stone martens consume the kitchen offal. Probably they eat more than it should be calculated from results of this study, because the proportion of undigested remains is less.

Summary

Stone martens eat piggishly, quickly. While they chew extensively the bones of vertebrates, they swallow most of the plant almost at one mouthful, together with its indigestible seeds. Vegetables are important sources of carbohydrates and minerals even in the winter period (Pandolfi, De Marinis & Petrov, 1996) but probably the digestive system of Stone martens require large quantity of plants' fibres. There were different items, but the staple of diet was the vegetable food (Fig. 2). The proportion of fruits and birds are high while mammals and insects are slow on yearly average. These data diverge from the diet in natural environment, for example, the number of occurrences was the highest of insects, then plants, mammals and birds (Lanszki, 1994). The percentage of occurrence and dry weight of garbage is low but surely the estimated volume would be higher because these items contain negligible quantity of indigestible remnants.

The damage by consuming even song-birds, some chickens is negligible comparing with causing economical damage or by storing somekinds of foods, taking faeces and urine in our close environment, etc., and spreading some diseases, parasitic. From this point of view they are pests.

But Stone martens have important trophic rule and strategy as top-predators, mainly eating and so controlling the populations of small urban vertebrates. Their versality is reflected in their euryphagy, e.g. insectivory, frugivory, folivory, necrophagy, too.

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Brief survey of testate amoeba research in Hungary, and a synopsis of species

By

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Abstract. This report summarizes the results hitherto achieved in the study of testate amoebae in Hungary since the beginnings (1876). Part one presents the list of identified taxa: altogether 201 species, 71 subspecies and infraspecific categories have been recorded, 3 species appeared only out of the present borders of Hungary. A list of all mentioned synonyms is given together with the relevant references. As far, 10 new testacean taxa have been described in the district of Hungary. Part two deals with the historical aspect: scientists and sampling areas of special interest are introduced. Geographic distribution of sampling sites and biotope types are described.

Taxonomy, faunistics and ecological research all need reliable grounds, therefore one must emphasize the correctness of species data. For testate amoebae, yet a conspicuous group of protists, the last faunistic synopsis displaying their contribution to the Hungarian fauna was written more than one hundred years ago (28). The large amount of research and literature produced during the present century makes a new synopsis of the Hungarian testaceans now timely, so this report attempts to fulfil this need on the basis of the widely scattered literature. Quite a few papers of the early workers are difficult to achieve, since only few libraries have the relevant volumes. Latter fact is another argument which makes this task most acute.

This paper yields a complete list of testaceans ever recorded in Hungary. The list serves as a reference for protozoologists and provides a useful ground work for the non-specialists.

Part 1

Altogether 272 taxa have been reported from Hungary since 1876 (Table 1). Among them 201 valid species appear to be included. Rest of the list contains 37 subspecies and infraspecific categories, as well as 34 synonyms. Three *Euglypha* species, *Pleurophrys helix* Entz and the two varieties of *Difflugia* described by Daday were recorded exclusively from areas that belong to the neighbouring countries since 1920 (note * in Table*s* 1, 2).

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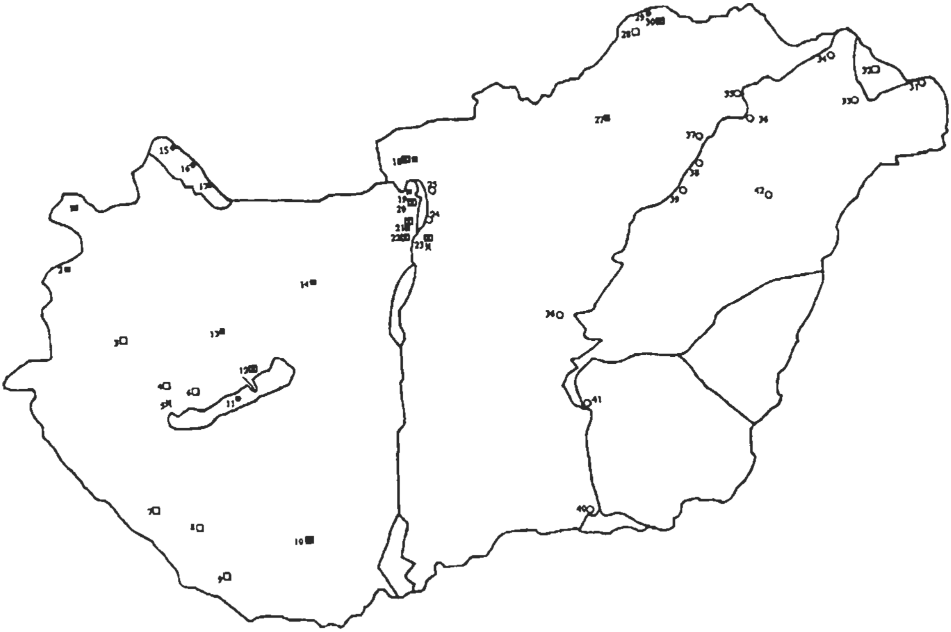

Fig. 1. Geographic distribution of testaceans' sampling areas in Hungary from 1876. Sites situated in the historical Hungary - today parts of neighbouring countries - are also depicted.

Genera *Difflugia*, *Centropyxis*, *Arcella* and *Nebela* proved to be the richest with 50, 17, 15 and 15 species, respectively. 19 genera comprised only one species, each.

Many authors used somewhat outdated, or not widely accepted taxonomic names during identification. This resulted in a large number of synonyms. This phenomenon seemed most remarkable in the genus *Difflugia* (especially in the „*oblonga* group").

Hungarian researchers described 10 species and varieties from Hungary (Table 2). However, these taxonomic names have apparently not been used, or just exceptionally mentioned by other authors since their description (15).

Presumably, subsequent faunal surveys will reveal further testacean species. According to the European literature, over species even some genera will very probably be recorded from Hungary.

Part II

Considering the geographic distribution of the sampling sites, one can recognize certain favoured areas of collection (Fig. 1). In the last, and the beginning of this century, these included the edge of the Carpathic Basin, mainly Transsylvania. Troughout the latter area collections and the subsequent surveys were carried out mainly by Géza Entz sen. and Jenő Daday. Entz can be respected as the initiator of the Hungarian testacean research (26). Prior to his carrier, there were no written data on these protists in Hungary. However, only some years later, Margó published his comprehensive book about the fauna of Budapest and its vicinity (48), including six testacean species. Budapest was the other place which attracted much attention of the early scientists. In addition to Margó's volume, 3 more papers participated in the recognition of testaceans in the same area within the next 50 years (46, 47, 50).

The most intensive faunistic surveys on testate amoebae were completed by Daday at that time, although he showed much more interest in the larger representants of the „microfauna" as termed in those days (16-23). Actually, he carried out the identification of testaceans in the comprehensive volume about the fauna of Nagyvárad (45). He described two varieties from Hungary, however, he made his most important contribution to the group of testaceans processing many samples originating from other continents (24, 25).

After the Second World War, researchers' attention was directed toward certain biotope types. Varga and Biczók focused on the soil biotopes (1-3, 11, 55-61, 63) and they were the first to start experimental researches involving testaceans in Hungary (10-14, 62, 64).

Sphagnum bogs, scanty and declining in Hungary, have been subject of faunistic analyses from time to time (43, 44, 55) displaying the decrease and disappearance of rare species (e.g. *Amphitrema* spp).

Among natural waters, Lake Balaton, River Tisza and River Danube were especially regarded almost from the beginnings (31, 19, 46, 32-41, 4, 6-9, 53). Over faunistic work, various ecological surveys have been carried out on testaceans inhabiting the aquatic biotopes.

Two foreign scientists, Ertl (30) from Czechoslovakia and Grospietsch (42) from Germany completed a nice paper each, collecting samples during their holiday in Abaliget and Hévíz, respectively.

References include all the relevant bibliography on the subject outlined above.

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Table 1. Testacean taxa described in Hungary from 1876
(: species collected from sampling area that ceased to be Hungarian territory in 1920)*

	Taxa	References
*	*Difflugia acuminata* var. *duplicata* Daday, 1892	21;
*	*Difflugia acuminata* var. *furcata* Daday, 1892	21; 15;
	Difflugia balatonica Bereczky, 1973	7;
	Difflugia baradlana Varga, 1963	63; 5;
	Difflugia oblonga var. *curvicollis* Varga, 1963	63; 5; 6;
*	*Euglypha pusilla* Entz, 1877	27; 15;
	Euglypha tiscia Gál, 1969	37; 38; 39;
*	*Pleurophrys helix* Entz, 1877	27;
	Pontigulasia bigibbosa var. *minor* Varga, 1963	63; 5;
	Trinema verrucosa Francé, 1897	31;

Table 1. Testate amoebae recorded in Hungary during the period 1876-1997
(: species identified from sampling area that ceased to be Hungarian territory in 1920)*

	Taxa	References
1	*Amphitrema flavum* Archer, 1877	55;
2	*Amphitrema stenostoma* Nüsslin, 1884	11; 55;
3	*Amphitrema wrightianum* Archer, 1869	55;
4	*Amphizonella violacea* Greeff, 1886	50; 55; 56; 60; 44;
5	*Arcella arenaria* Greeff, 1886	57; 59; 60; 30; 8; 9; 51; 52;
6	*Arcella artocrea* Leidy, 1879	10; 11; 13; 55;
	Arcella artocrea var. *pseudocatinus* Deflandre, 1928	30;
7	*Arcella catinus* Penard, 1890	43; 55; 30; 32; 8; 40;
8	*Arcella costata* Ehrbg., 1847	55; 3; 59; 38; 39; 40; 41;
9	*Arcella conica* Deflandre, 1928	4;
10	*Arcella dentata* Ehrbg., 1830	17; 22; 45; 50; 31; 55; 41; 4; 42;
11	*Arcella discoides* Ehrbg., 1872	43; 49; 11; 2; 55; 3; 60; 32; 33; 34; 35; 36; 37; 38; 39; 40; 41; 4; 6; 8; 9; 42; 51; 53;
	Arcella discoides pseudovulgaris Deflandre, 1928	42;
12	*Arcella excavata* Cunningham, 1919	53;
13	*Arcella gibbosa* Penard, 1890	49; 32; 33; 34; 36; 38; 39; 40; 41; 8; 42;
	Arcella gibbosa laevis Deflandre, 1928	36; 42;
14	*Arcella hemisphaerica* Perty, 1852	49; 55; 3; 37; 32; 33; 34; 36; 38; 39; 40; 41; 42; 53;
	Arcella hemisphaerica intermedia Deflandre, 1928	42;
	Arcella hemisphaerica undulata Deflandre, 1928	42;
15	*Arcella megastoma* Penard, 1902	8; 9; 42;
16	*Arcella mitrata* Leidy, 1879	46; 50;
17	*Arcella polypora* Penard, 1890	49; 42;
= 18	*Arcella rotunda*	3;
	Arcella rotunda var. *aplanata* Deflandre, 1928	40;
18	*Arcella rotundata* Playfair, 1918	60; 42;
	Arcella rotundata stenostoma Deflandre, 1928	42;
	Arcella rotundata aplanata Deflandre, 1928	32; 33; 34; 36; 36; 37; 38; 39; 42;
19	*Arcella vulgaris* Ehrbg., 1832	48; 16; 17; 19; 21; 22; 23; 45; 50; 31; 46; 49; 1; 2; 55; 3; 37; 32; 34; 36; 38; 39; 40; 41; 44; 8; 9; 42; 53;
	Arcella vulgaris var. *angulosa* Leidy, 18	49;
	Arcella vulgaris polymorpha Deflandre, 1928	4;
	Arcella vulgaris f. *undulata* Deflandre, 1928	4; 44; 8; 9;
20	*Assulina muscorum* Greeff, 1888	43; 11; 12; 55; 57; 59; 60; 61; 44; 51; 52;
21	*Assulina scandinavica* Penard, 1890	55;
22	*Assulina seminulum* Ehrbg., 1848	16; 50; 43; 55; 57; 44;
23	*Awerinczevia cyclostoma* Penard, 1902	30; 52;
24	*Bullinula indica* Penard, 1907	55; 44; 8;
25	*Campascus minutus* Penard, 1899	42;
26	*Campascus triqueter* Penard, 1899	42;
27	*Centropyxis aculeata* (Ehrbg.) Stein, 1857	48; 16; 17; 18; 19; 21; 22; 23; 50; 31; 46; 43; 49; 11; 1; 2; 3; 55; 63; 32; 33; 34; 35; 36; 37; 38; 39; 40; 41; 4; 5; 6; 7; 44; 8; 9; 42; 53;
	Centropyxis aculeata var. *discoides* Penard, 1890	11; 1; 2; 3;
	Centropyxis aculeata grandis Deflandre, 1929	42;
	Centropyxis aculeata var. *oblonga* Deflandre, 1929	1; 2; 3; 30; 63; 5; 42; 53;
28	*Centropyxis aerophila* Deflandre, 1929	57; 59; 60; 61; 30; 5; 51; 52; 53;
	Centropyxis aerophila var. *sphagnicola* Defl., 1929	55; 30; 44; 44; 8; 51; 52; 53;
	Centropyxis aerophila var. *sylvatica* Defl., 1929	57; 63; 30; 5;
	Centropyxis aerophila f. *kryptostoma* Schönborn, 1964	51;
syn 55	*Centropyxis arcelloides* Penard, 1902	1; 2; 57; 59; 32; 33; 38; 39; 44;
29	*Centropyxis cassis* Deflandre, 1929	42; 51;
	Centropyxis cassis spinifera Playfair, 1918	63; 5;
30	*Centropyxis constricta* Deflandre, 1929	11; 12; 13; 1; 2; 55; 56; 57; 58; 3; 59; 61; 30; 32; 33; 34; 35; 36; 37; 38; 39; 40; 4; 5; 6; 7; 44; 8; 9; 42; 52; 53;
31	*Centropyxis discoides* Penard, 1902	63; 4; 5; 6; 7; 8; 9; 40; 42; 53;
32	*Centropyxis ecornis* Ehrbg., 1838	17; 55; 57; 59; 42; 53;
33	*Centropyxis elongata* (Penard) Thomas, 1959	51; 53;
syn 56	*Centropyxis eurystoma* Deflandre, 1929	59;
34	*Centropyxis gibba* Deflandre, 1929	63; 5; 6; 7; 42; 53;

Table 1. (cont.)

	Taxa	References
35	*Centropyxis hirsuta* Deflandre, 1920	4; 5; 6; 7; 8; 9; 42;
36	*Centropyxis laevigata* Penard, 1890	43; 3; 55; 57; 59; 60; 61; 63; 30; 5;
37	*Centropyxis lata* Jung, 1942	2; 3;
38	*Centropyxis marsupiformis* Deflandre, 1929	30; 53;
39	*Centropyxis minuta* Deflandre, 1929	61; 4; 5; 44; 42; 51;
40	*Centropyxis orbicularis* Deflandre, 1929	51; 52; 53;
41	*Centropyxis patula* Stepánek, 1967	5;
42	*Centropyxis plagiostoma* Bonnet & Thomas, 1955	52;
43	*Centropyxis platystoma* (Penard) Deflandre, 1929	5; 6; 7; 42; 51; 53;
	Cingodifflugia laevis = *Difflugia tuberculata* var. *laevis* Penard, 1912	3;
44	*Clypeolina marginata* Penard, 1902	57;
45	*Cochliopodium ambiguum* Penard, 1904	14; 57;
46	*Cochliopodium bilimbosum* Auerbach, 1856	50;
47	*Cochliopodium echinatum* Korotnef, 1880	57; 59; 62;
48	*Cochliopodium granulatum* Penard, 1890	56; 57; 59; 60; 61; 62; 7;
49	*Cochliopodium obscurum* Penard, 1890	32; 33; 36;
syn 145	*Corycia flava* Greeff, 1866	60;
50	*Corythion dubium* Taranek, 1882	43; 55; 57; 59; 60; 61; 44; 42; 51; 52;
51	*Corythion pulchellum* Penard, 1890	43; 11; 55; 3; 42; 51;
52	*Cryptodifflugia compressa* Penard, 1902	55;
syn 111	*Cryptodifflugia oviformis* Penard, 1890	10; 11; 12; 13; 1; 2; 14; 55; 57; 60; 61; 62; 36; 38; 39; 40; 44;
53	*Cryptodifflugia vulgaris* Francé, 1913	55; 56; 57; 61;
54	*Cucurbitella mespilliformis* Penard, 1901	3;
55	*Cyclopyxis arcelloides* Penard, 1902	3; 63; 5; 6; 7; 42; 52; 53;
56	*Cyclopyxis eurystoma* Deflandre, 1929	57; 60; 63; 30; 5; 42; 51; 52;
57	*Cyclopyxis kahli* Deflandre, 1929	30; 8; 42; 51; 52;
58	*Cyphoderia ampulla* Ehrbg., 1840	17; 18; 55; 30; 4; 5; 6; 7; 44; 8; 9; 42; 53;
59	*Cyphoderia laevis* Penard, 1902	32; 36; 39; 40; 41; 4; 5; 6; 7; 42; 53;
syn 58	*Cyphoderia margaritacea* (Ehrbg.) Schlumberger, 1845	21; 23; 45; 43; 1; 2; 3; 32; 33; 34; 35; 36; 37; 38; 39; 40; 41;
	Cyphoderia margaritacea var. *major* Penard, 1891	32; 33; 38; 39; 40;
60	*Cyphoderia trochus* Penard, 1899	37; 32; 33; 35; 38; 39; 40; 6; 7; 9; 42;
61	*Difflugia achlora* (Penard) Ogden, 1980	53;
62	*Difflugia acuminata* Ehrbg., 1838	16; 17; 19; 20; 21; 22; 23; 45; 50; 31; 49; 3; 32; 33; 34; 35; 38; 39; 40; 41; 4; 8; 9; 42; 53;
*	*Difflugia acuminata* var. *duplicata* Daday, 1892	21;
*	*Difflugia acuminata* var. *furcata* Daday, 1892	21;
syn 78	*Difflugia acuminata inflata* Penard, 1899	42;
63	*Difflugia amphora* Leidy, 1867	32; 35; 37; 38; 39; 40; 41; 4; 6; 7; 8; 9; 42; 53;
64	*Difflugia avellana* Penard, 1890	49; 58; 3; 33; 38; 39; 40; 5; 42; 53;
65	*Difflugia bacillariarum* Perty, 1849	42;
66	*Difflugia bacillifera* Penard, 1902	55; 42;
	Difflugia bacillifera var. *inflata* Penard, 1890	49;
67	*Difflugia balatonica* Bereczky, 1973	7;
68	*Difflugia baradlana* Varga, 1963	63; 5;
69	*Difflugia bicornis* Penard, 1890	53;
70	*Difflugia bicruris* G.L. & Thomas, 1958	53;
71	*Difflugia bidens* Penard, 1902	6; 7; 8; 42;
72	*Difflugia brevicolla* Cash, 1909	55;
73	*Difflugia bryophila* (Penard) Jung, 1942	51; 52; 53;
74	*Difflugia clavata* Penard	49;
syn 30	*Difflugia constricta* Ehrbg., 1841	18; 19; 22; 50; 31; 2;
75	*Difflugia corona* Wallich, 1864	19; 20; 21; 22; 23; 45; 50; 38; 39; 40; 41; 6; 7; 8; 42; 53;
76	*Difflugia craterella* Francé, 1913	59; 61;
77	*Difflugia curvicaulis* Penard, 1899	49; 32; 38; 40; 53;
	Difflugia curvicaulis inflata Decloitre	53;
78	*Difflugia distenda* (Penard) Ogden, 1983	53;
79	*Difflugia elegans* Penard, 1890	37; 32; 35; 38; 39; 40; 5; 6; 7; 8; 9; 42; 53;
	Difflugia elegans var. *teres* Penard,1899	5; 7; 53;
80	*Difflugia elongata* Penard, 1905	42;
81	*Difflugia fallax* Penard, 1890	11; 13; 1; 2; 3; 55; 5; 6; 7; 53;
82	*Difflugia gassowskii* (Gassowsky) Ogden, 1983	53;

Table 1. (cont.)

	Taxa	References
83	*Difflugia glans* Penard, 1902	55; 30;
84	*Difflugia globulosa* Dujardin, 1837	48; 16; 17; 18; 20; 21; 22; 45; 50; 31; 46; 47; 49; 1; 2; 14; 55; 60; 63; 32; 38; 39; 40; 41; 4; 42;
syn 84 i.p.	*Difflugia globulus* (Ehrbg., 1848)	11; 12; 13; 3; 56; 59; 61;
85	*Difflugia gramen* Penard, 1902	32; 33; 34; 35; 36; 37; 38; 39; 41; 4; 5; 8; 9; 40; 42; 53;
86	*Difflugia lacustris* (Penard) Ogden, 1983	3; 53;
87	*Difflugia lanceolata* Penard, 1890	49; 11; 32; 33; 34; 35; 37; 38; 39; 40; 41; 42;
88	*Difflugia lebes* Penard, 1902	42; 53;
89	*Difflugia lemani* Blanc, 1892	30; 5; 53;
90	*Difflugia limnetica* (Levander) Penard, 1902	6; 7; 8; 53;
91	*Difflugia linearis* (Penard) G.L. & Thomas, 1958	53;
92	*Difflugia lithoplites* Penard, 1902	55;
93	*Difflugia lobostoma* Leidy, 1879	22; 46; 47; 49; 11; 13; 3; 33; 38; 39; 41; 4; 8; 9; 42; 53;
94	*Difflugia lucida* Penard, 1890	43; 55; 60; 63; 30; 5; 6; 7; 44; 42; 51; 52; 53;
95	*Difflugia mammillaris* Penard, 1893	32; 33; 35; 36; 38; 39; 41; 5; 6; 7; 53;
96	*Difflugia manicata* Penard, 1902	1; 3; 53;
97	*Difflugia mica* Frenzel, 1892	42;
98	*Difflugia microclaviformis* (Kourov) Ogden, 1983	6; 53;
99	*Difflugia minuta* Rampi, 1950	53;
syn 62	*Difflugia oblonga acuminata* Ehrbg., 1838	5; 6; 7;
	Difflugia oblonga angusticollis Stepánek, 1952	5;
syn 72	*Difflugia oblonga brevicolla* Cash, 1909	5; 6; 7;
syn 73	*Difflugia oblonga bryophila* Penard, 1902	30; 5;
	Difflugia oblonga caudata Stepánek, 1952	6; 7;
syn	*Difflugia oblonga claviformis* (Penard) Stepánek, 1967	7; 42;
	Difflugia oblonga curvicollis Varga, 1963	5; 6;
100	*Difflugia oblonga* Ehrbg., 1838	55; 57; 58; 3; 60; 63; 30; 4; 5; 6; 44; 8; 9; 42; 51; 52; 53;
syn 86	*Difflugia oblonga lacustris*, Penard, 1902	42;
syn 96	*Difflugia oblonga manicata* Penard, 1902	5;
	Difflugia oblonga nodosa Leidy, 1879	42;
syn 73	*Difflugia oblonga* var. *bryophila* Penard, 1902	30;
syn 77	*Difflugia oblonga* var. *curvicaulis* Penard, 1899	7; 44;
	Difflugia oblonga var. *curvicollis* Varga, 1963	63;
syn 162	*Difflugia oviformis* Cash, 1909	55; 3; 63; 30; 32; 34; 38; 39; 40; 4; 5; 44;
101	*Difflugia penardi* Hopkinson, 1909	11; 1; 2; 3;
102	*Difflugia pristis* Penard, 1902	1; 2; 3; 56; 63; 5; 6; 7; 53;
syn 93i.p.	*Difflugia proteiformis* Ehrbg. 1838	48;
103	*Difflugia pulex* Penard, 1902	53;
syn 100	*Difflugia pyriformis* Perty, 1848	16; 17; 18; 21; 23; 45; 50; 31; 46; 47; 43; 49; 1; 2; 3; 57; 32; 34; 38; 39; 40; 41;
syn	*Difflugia pyriformis* var. *claviformis* Penard, 1899	49;
	Difflugia pyriformis var. *grandis* Penard	49;
syn 73	*Difflugia pyriformis* var. *bryophila* Penard, 1902	43; 11;
syn 86	*Difflugia pyriformis* var. *lacustris* Penard, 1899	43;
104	*Difflugia rubescens* Penard, 1902	1; 55; 42; 53;
105	*Difflugia scalpellum* Penard, 1899	6; 7; 53;
106	*Difflugia stouti* Ogden, 1983	51;
107	*Difflugia tuberculata* (Wallich, 1864)	1; 42;
108	*Difflugia urceolata* Carter, 1864	16; 18; 20; 21; 22; 45; 50; 31; 6; 7; 8; 42; 53;
	Difflugia urceolata var. *olla* Leidy, 1879	21; 53;
109	*Difflugia varians* Penard,1902	42;
syn 179	*Difflugia vas* Leidy, 1879	17;
110	*Difflugia viscidula* Penard, 1902	3; 6; 7;
111	*Difflugiella oviformis* (Penard) Bonnet & Thomas, 1955	51; 52;
112	*Euglypha acanthophora* Ehrbg., 1843	55; 3; 60; 5; 6; 9; 7; 42; 51; 53;
113	*Euglypha alveolata* Dujardin, 1841	26; 16; 19; 22; 45; 50; 31; 46; 47; 43; 10; 49; 11; 12; 13; 1; 2; 3; 14; 55; 56; 57; 59; 62; 37; 32; 33; 35; 36; 38; 39; 41; 44; 9;
syn 116	*Euglypha ampullacea* Hertwig & Lesser	31;

Table 1. (cont.)

	Taxa	References
114	*Euglypha brachiata* Leidy, 1879	1; 3; 32; 33; 35; 36; 38; 39; 40; 41;
115	*Euglypha ciliata* Ehrbg., 1848	16; 22; 50; 46; 43; 11; 55; 57; 58; 3; 59; 32; 33; 36; 38; 39; 41; 4; 44; 52;
	Euglypha ciliata var. *glabra* Leidy, 18	11;
116	*Euglypha compressa* Carter, 1864	26; 55; 30; 42; 51;
117	*Euglypha cristata* Leidy, 1879	43; 11; 55; 57; 3; 59; 5; 44; 42; 51; 52;
118	*Euglypha filifera* Penard, 1890	55; 44; 51;
119	*Euglypha globosa* Carter, 1865	26; 50;
120	*Euglypha laevis* Perty, 1849	11; 12; 13; 1; 3; 55; 56; 57; 58; 59; 60; 61; 30; 32; 33; 36; 38; 39; 40; 4; 6; 7; 44; 8; 42; 51; 52; 53;
121 *	*Euglypha macrolepis* Leidy	45;
122 *	*Euglypha mucronata* Leidy, 1878	45;
123 *	*Euglypha pusilla* Entz, 1877	27;
124	*Euglypha rotunda* Wailes, 1911	11; 13; 14; 42; 51; 52; 53;
125	*Euglypha strigosa* Ehrbg., 1872	43; 11; 1; 3; 55; 59; 42; 51;
126	*Euglypha tiscia* Gál, 1969	37; 38; 39; 40;
127	*Euglypha tuberculata* Dujardin, 1841	30; 5; 51; 52;
128	*Geopyxella sylvicola* Bonnet, 1955	52;
129	*Gromia fluviatilis* Dujardin, 1835	48;
syn 129	*Gromia terricola* Leidy, 1879	46;
130	*Heleopera petricola* Leidy, 1879	55; 57; 3; 60; 63; 30; 5; 51;
	Heleopera petricola var. *amethysta* Penard, 1902	30;
131	*Heleopera picta* Leidy, 1879	16; 55; 3; 61;
132	*Heleopera rosea* Penard, 1890	43; 55; 57; 59; 60; 61; 51; 52;
133	*Heleopera sphagni* Leidy, 1879	44;
134	*Heleopera sylvatica* Penard,1902	59; 51; 52;
135	*Hyalosphaenia cuneata* Stein, 1857	1; 6; 7;
136	*Hyalosphaenia elegans* Leidy, 1879	16; 43; 55; 44;
137	*Hyalosphaenia gigantea* de Graaf, 1952	6; 7;
syn 135	*Hyalosphaenia lata* Schulze, 1875	45;
138	*Hyalosphaenia papilio* Leidy, 1879	16; 55; 37; 33; 38; 39;
139	*Hyalosphaenia subflava* Cash & Hopkinson, 1909	51;
syn 159	*Hyalosphaenia tincta* Leidy, 1879	22;
140	*Lesquereusia epistomium* Penard, 1893	42;
141	*Lesquereusia modesta* Rhumbler, 1855	43; 42; 53;
142	*Lesquereusia spiralis* Ehrbg., 1840.	23; 45; 43; 32; 39; 40; 42;
143	*Lieberkuehnia wagneri* Clap. & Lachm., 1859	45; 46;
144	*Microcorycia aculeata* Greeff, 1896	55;
145	*Microcorycia flava* Cockerell, 1866	55; 61; 51;
146	*Microcorycia radiata* Penard, 1912	51;
147	*Nebela americana* Taranek, 1890	43;
148	*Nebela bigibbosa* Penard, 1890	52;
149	*Nebela bohemica* Taranek, 1882	43;
150	*Nebela carinata* Archer, 1867	22; 55; 57;
151	*Nebela collaris* Leidy, 1879	16; 45; 50; 31; 46; 43; 11; 2; 55; 56; 57; 59; 60; 32; 38; 39; 40; 41; 44; 8; 52;
152	*Nebela crenulata* Penard, 1893	59;
153	*Nebela dentistoma* Penard, 1890	42; 53;
154	*Nebela galeata* Penard, 1902	55;
155	*Nebela lageniformis* Penard, 1902	43; 55; 57; 51; 52;
156	*Nebela militaris* Penard, 1902	55;
157	*Nebela retorta* (Wailes) Stepánek, 1953	52; 53;
158	*Nebela tenella* Penard, 1902	43; 62;
159	*Nebela tincta* Leidy, 1879	55; 44;
160	*Nebela tubulosa* Brown, 1911	55; 44;
161	*Nebela vitraea* Penard, 1899	49; 55; 57; 59;
162	*Netzelia oviformis* (Cash)	53;
163	*Paraquadrula discoides* (Pen.) Deflandre, 1932	42;
164	*Paraquadrula globulosa* (Pen.) Deflandre, 1932	42;
165	*Pareuglypha reticulata* Penard, 1902	32; 33; 36; 38; 39;
166	*Paulinella chromatophora* Lauterborn,1895	G. Entz, Jr., 1916, cit: 46; 47; 42; 53;
167	*Phryganella acropodia* Hopkinson, 1909	51; 52;
168	*Phryganella hemisphaerica* Penard, 1902	55; 3; 59; 42;
169	*Phryganella nidulus* Penard, 1902	11; 13; 55; 56; 42;

Table 1. (cont.)

	Taxa	References
170	*Phryganella paradoxa* Penard, 1902	32; 38; 39; 40; 42; 51;
171	*Placocysta spinosa* Leidy, 1874	11; 42;
172	*Plagiopyxis declivis* Thomas, 1955	30; 51; 52; 53;
173	*Plagiopyxis intermedia* Bonnet, 1959	52; 53;
174	*Plagiopyxis labiata* Penard, 1910	51;
175	*Plagiopyxis oblonga* Bonnet & Thomas, 1960	52;
syn 94	*Planodifflugia opulenta* Jung, 1942	11;
176 *	*Pleurophrys helix* Entz, 1877	27;
177	*Pontigulasia bigibbosa* Penard, 1902	44; 42; 53;
	Pontigulasia bigibbosa var. *minor* Varga, 1963	63; 5;
178	*Pontigulasia bryophila* Penard, 1902	30; 3; 52;
179	*Pontigulasia spectabilis* Penard, 1902	43; 11; 1; 32; 38; 39; 40; 42; 53;
180	*Pontigulasia spiralis* Rhumbler, 1896	22; 38; 6; 7;
181	*Pseudochlamys patella* Claparede & Lachmann, 1859	50; 31; 47; 14; 60;
182	*Pseudodifflugia fascicularis* Penard, 1902	3; 36; 38; 40;
183	*Pseudodifflugia gracilis* Schlumberger, 1845	21; 6; 7;
	Pseudodifflugia gracilis var. *terricola* Bonnet & Thomas, 1960	51;
syn 83	*Pycnochila glans* Jung, 1942	11;
184	*Pyxidicula operculata* Agardh, 1827	55; 36; 38; 39;
syn 163	*Quadrula discoides* Penard, 1893	11;
185	*Quadrula irregularis* Archer, 1877	11;
syn 187	*Quadrula symmetrica* (Wallich) Cockerell, 1911	11; 3;
	Quadrula symmetrica var. *longicollis* Taranek, 1882	3;
syn 164	*Quadrulella globulosa* Penard, 1897	1; 55;
syn 185	*Quadrulella irregularis* Archer, 1877	2; 30;
186	*Quadrulella scutellata* Wailes, 1912	42
187	*Quadrulella symmetrica* (Wallich) Cockerell, 1911	21; 45; 46; 43; 40; 55; 57; 4; 51; 52;
188	*Schoenbornia viscicula* Schönborn, 1964	53;
189	*Schwabia regularis* Jung, 1942	11; 2;
190	*Sexangularia minutissima* (Penard) Bartos, 1934	62;
syn 193	*Sphenoderia dentata* Penard, 1890	11; 12; 13; 1; 2; 3; 55;
191	*Sphenoderia fissirostris* Penard, 1890	55; 57;
192	*Sphenoderia lenta* Schlumberger, 1845	43; 11; 12; 55; 44;
193	*Tracheleuglypha dentata* Moniez,1888	30; 42; 51; 52;
194	*Trigonopyxis arcula* Penard, 1879	55; 5; 44; 52;
195	*Trigonopyxis microstoma* Hoogenraad, 1948	55;
syn 197, 50 i.p.	*Trinema acinus* Leidy, 1879	26; 31;
196	*Trinema complanatum* Penard, 1890	43; 12; 55; 56; 57; 58; 60; 61; 62; 30; 44; 42; 51; 52;
197	*Trinema enchelys* Ehrbg., 1838	48; 16; 43; 10; 11; 12; 13; 1; 2; 3; 14; 55; 57; 59; 60; 61; 62; 30; 32; 33; 36; 38; 39; 40; 41; 4; 5; 44; 9; 51; 52; 53;
198	*Trinema lineare* Penard, 1890	43; 10; 11; 12; 13; 1; 2; 3; 14; 55; 56; 57; 59; 61; 62; 30; 32; 33; 36; 38; 39; 40; 41; 5; 44; 42; 51; 52; 53;
199	*Trinema penardi* Thomas & Chardez, 1958	51; 52;
200	*Trinema verrucosa* Francé, 1897	31; 11;
201	*Wailesella eboracensis* (Wailes) Deflandre, 1928	57; 60;

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Comparison of phytal- and förna-bound macroinvertebrate communities at Lake Fertő, Hungary

By

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Abstract. During 1995-96 the macroinvertebrate fauna of dead reed remains at Lake Fertő was investigated. Our water chemistry and faunistic data were compared to the results of Andrikovics (1973, 1979 a, b), who carried out similar investigations on submersed macrophyton vegetation and the reed stands. From among the water chemistry parameters, the dissolved oxygen conditions showed a significant difference among the study sites. More favourable parameters were measured in submersed macrophyton stands. The oxygen concentration of dead reed remains that are normally pushed to the reed belt, are similar to the level measured in living reed stands. The least diverse macrofauna was found in reed stands. The fauna of submersed macrophyton stands and dead reed remains were found to be richer. Differences were found in the presence and absence of species, animal groups and the dominance relationships of the communities.

Lake Fertő is a typical representative of large European shallow lakes. Due to its shallowness, this is a characteristically unstable, astatic lake as far as physico-chemical and biocoenological data are concerned (Varga, 1962). As a result of shallowness, environmental factors such as wind, temperature and light have relatively great effect on the lake. The temperature of the water and the sediment follows relatively rapidly the air temperature. The water mass of the lake shows a high seasonal variation. As a result of intensive wind disturbance, the water of the lake is mixed with the fine sediment from the lake bottom. This has a significant effect on the planctonic biota and a direct effect on the nutrient material cycles and energy flow of the open water. The predominant northern, north-western wind blows the water towards the southern, reed-covered part of the lake increasing the water level and mixing the water of the reed belt and open water area (Szabó, 1962).

Macrophytes has a special importance in the nutrient cycles of Lake Fertő, similarly to other large, shallow lakes. 80% of Hungarian part of the lake is covered by reed. The extensive, several kilometres wide reed stands cut the open water into several parts, forming bays and limnologically special, so called „inner lakes" (Dinka & Berczik, 1992). A characteristic feature of the reed stands (Scirpeto-Phragmitetum Koch, 1926) is the presence of a canal network throughout the lake having been created for reed management reasons. Water cover of the reed stands greatly fluctuates, and from a botanical point of view, the stands are species-poor areas (Tóth & Szabó, 1962). Nowadays, the reed is thinning out in more and more, mainly due to human disturbance. Reed covered area increases with the filling up of the

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lake. With the increase of harvested often degraded reed stands, *Typha angustifolia* becomes more common (Ráth, 1990). Only 20 % of the reed is not harvested, as a consequence, reed degradation processes are going on their natural way. A considerable amount of reed remains and turn rhizome can also be found there even in harvested areas. This grain detritus forms a suitable habitat for several macroinvertebrate species.

The distribution of submersed macrophyton stands is also characteristic. With a certain periodicity, their expansion, and in some years their decline or disappearance can be observed (Schiemer, 1978; Ráth, 1990). A good example to show this process is that at the beginning of the 70's, there were large submersed macrophyton stands. After their disappearance, they have only been expanded again in recent years. The ecological and zoological conditions and seasonal changes of macrophyton stands (submersed macrophytes and reed belts) are hardly known, despite of their importance. The reason for completing this study was that only a little information was available on the macrofauna of these stands, despite of their high indicator value. Another advantage is, that taxa abundant in these habitats are relatively easy to identify.

Materials and methods

During the 1970's complex investigations were carried out (Andrikovics, 1973, 1979 a) to elucidate the hydroecological and zoological conditions of Lake Fertő, to describe the characteristic animal associations of the different habitats, to indicate ecological differences between submersed macrophyton stands of different size, position and species composition, and their effect on the macrofauna. Therefore, samples were taken from submersed macrophyton stands of over 15 m² surface, from October to April every month, both from isolated inner lake sites (No. 7–11) and from open water sites (No. 1–6) (Fig. 1). A semi-quantitative sampling was applied, a near equal quantity of submersed macrophyton was pulled out over a net with a mesh size of 25. In addition, approximately 10 net samples were also taken. At the beginning of the investigations (in 1971–72) there were still large submersed macrophyton stands in the lake. In the open water *Potamogeton pectinatus* and *Myriophyllum spicatum*, in the inner lakes *Utricularia vulgaris* and *Najas marina* were the dominant species of the submersed macrophyte stands. These stands are disappeared by the middle of the 1970's (Andrikovics, 1988). During the quantitative investigations in 1975–76, sampling was not possible from the same sites. Besides from submersed macrophyton stands, samples were also taken from water-covered reed stands (Andrikovics, 1980) to collect the reed-bound animals, too. A 50x50 cm framed net sampler was used for this purpose (Andrikovics, 1977).

More than 20 years later, in 1995–1996, the macroinvertebrate fauna of floating dead reed remains was studied to investigate the macroinvertebrate species composition, the hydroecological conditions, seasonal dynamics and dominance structure of the species composition of a previously neglected habitat (Varga, 1997). Dead reed remain piles are formed from reed remains that naturally get into the water year by year. As a result of the constant wind effect, they are pushed to the edge of the reed belt. These remains are floating on the water surface and water-covered during the whole year (unlike reed remains in shore deposits). Seasonal samples were taken for 2 years from 5 regular (4 inner lake and 1 open water) and 6 occasional sampling sites (Fig. 1). Samples were taken by surface netting (mesh size: 0.5 mm) and washing out. This sampling method only gives a semi-quantitative estimation.

Water chemistry parameters with the highest effect on the fauna and an ease for regular monitoring such as temperature, pH, conductivity, dissolved oxygen concentration were measured parallel with zoological sampling in both investigation periods (Andrikovics, 1978; Varga, 1997). In both study results were analysed with statistical tests (Andrikovics, 1988; Varga, 1997).

The present paper contains only a part of my results. Even on this basis it is reasonable to compare these results with other similar macrofauna studies. My aim was to make general comparison of the fauna in the above described characteristic habitats of the Lake Fertő. As a pilot study, a metric-multidimensional scale analysis was also completed using the species lists of three sites with several distance functions making similar results. In this article the results of the ordination with Euclidian distance are given.

Results

The macroinvertebrate fauna of dead reed remains are compared separately to those of submersed macrophyton stands and the water-covered reed belts.

Comparison of submersed macrophyton stands and floating dead reed remains

From among the water chemistry parameters dissolved oxygen concentration showed the most striking differences. In submersed macrophyton stands, the concentration of dissolved oxygen is always higher (8.53–13.17 mg/l) than in dead reed remains (1.5–5.9 mg/l). Conductivity values measured in 1971 were considerably higher in submersed macrophyton stands (2040–2568 μS/cm) than in dead reed remains (1415–1882 μS/cm). In 1972, however, these values did not differ from each other (1378–2008 μS/cm). Taxa found in submersed macrophyton stands and dead reed remains are shown in Table 1. The faunistical differences between the two habitats are as follows.

Hirudinoidea: Andrikovics found this group to be a characteristic group for isolated submersed macrophyton stands. In my study, however, its abundance was always low.

Gastropoda: Andrikovics found *Lymnaea peregra* and *Gyraulus crista* in the open water macrophyton stands, and he also recorded *Lymnaea peregra* in the inner lakes with an increased, but not mass occurrence. In dead reed remains *Gyraulus crista* and *Planorbis planorbis* species proved to be most common.

Isopoda: The only representative species of this taxa was *Asellus aquaticus* (a detritus inhabitant), it was found in dead reed remains far more often than in the submersed vegetation.

Ephemeroptera: Andrikovics found *Cloeon dipterum* and *Caenis horaria* to be mass species in reed-encircled submersed macrophyton stands, while in dead reed remains Ephemeroptera species were rare. *Caenis horaria* that lives in the sediment, was not found in dead reed remains at all.

Odonata: While species found by Andrikovics are characteristic, permanent inhabitants of submersed macrophyton stands, they were infrequent and rare in dead reed remains. *Ischnura pumilio* was the predominant species both in open water- and reed-encircled macrophyton stands.

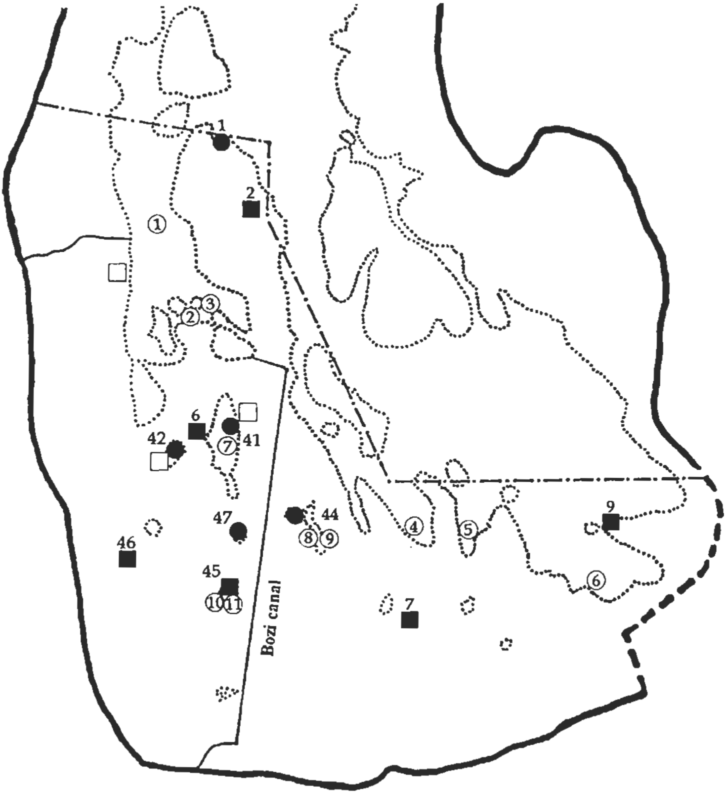

Fig. 1. Sampling sites. ● - Regular- 1:B0, 41: Herlakni-, 42: Kis-Herlakni-, 44: Hidegségi-, 47: Átjáró pond. ■ - Occasional sampling sites of dead reed remains: 45: Nagyhatártisztás, 46: Pitner Beach, 2: Fertőrákosi bay, Keresztárok canal, 6: Herlakni canal, 7: Homoki-ferde canal, 9: Madárvárta bay. 1-11- Submersed macrophyton stands: 1: Fertőrákosi bay, 2-3: Püspök pond, 4: Rucás-, 5: Hegykői-, 6: Madárvárta bay, 7: Herlakni-, 8-9: Hidegségi-pond, 10-11: Nagyhatártisztás; 1,4,6,7,8,10: *Potamogeton pectinatus*-, 2 ,3, 5: *Myriophyllum spicatum*-, 9: *M. verticillatum*-, 11: *Utricularia vulgaris* stand. □ - Living reed stands: Eastern basin of Fertőrákosi bay, 41: Herlakni pond, 42: Kis-Herlakni pond

Trichoptera: In submersed macrophyton stands the members of the genera *Cyrnus, Agrypnia* and *Ecnomus* were the most common. In isolated inner lake submersed macrophyton stands *Cyrnus* was the predominant genus. Trichoptera species were only found in dead reed remains in low number. *Ecnomus tenellus* and *Oecetis furva* were the dominant species. A new species for the Hungarian fauna, *Tricholciochiton fagesi* was found in dead reed remains.

Lepidoptera: Both *Nymphula nymphaeta* and *Parapoynx stratiota* present in submersed macrophyton stands are aquatic species, their caterpillars feed on weed.

Coleoptera: Only a few individuals were found in both investigations. More taxa was collected from dead reed remains than from macrophyton stands.

Heteroptera: *Notonecta* species were missing from dead reed remains. In reed encircled submersed macrophyton stands the *Ilycoris cimicoides, Sigara striata,*

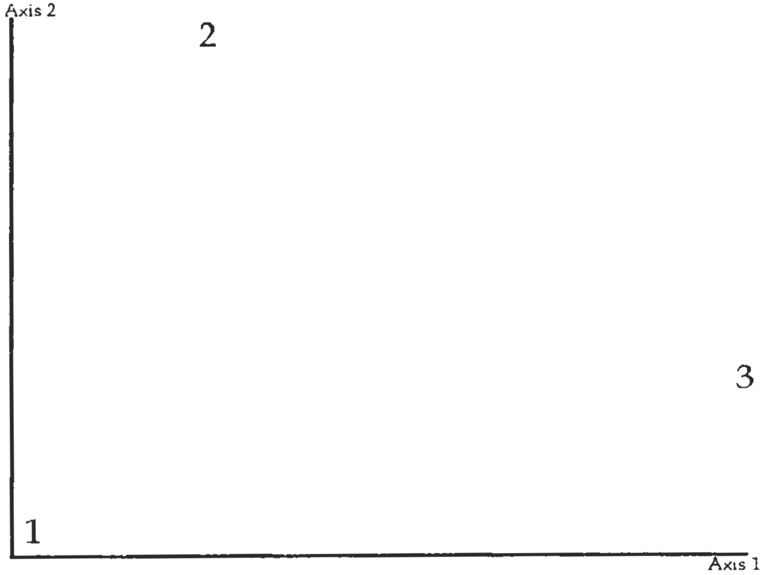

Fig. 2. Ordination (Metric Multidimensional Scale) for the macroinvertebrate communities of three habitats. 1: submersed macrophyton stands, 2: living reed stands, 3: dead reed remains

Cymatia coleoptrata species composition was predominant, while in the open water samples *Micronecta pusilla* predominated. From dead reed remains *Cymatia coleoptrata, Plea minutissima* and the larvae of Corixidae were found in larger number.

Diptera: Due to the well-known taxonomic difficulties and identification problems, no detailed investigation of this group was completed. Andrikovics found Chironomidae to be a frequent and dominant group. In both studies at nearly all sampling sites a high proportion (27-90 %) of the individuals belong to Chironomidae. Within this family the dominant species were from the Orthocladiinae subfamily. From dead reed remains, apart from these groups, Culicidae, Stratiomyidae, Ceratopogonidae, Limoniidae taxa were also frequently found. With the exception of Limoniidae, all these groups were found in the quantitative investigations of Andrikovics as well.

Araneidea: No Araneidea species occurred in the submersed macrophyton samples. Several species were found in dead reed remains, but only *Argyroneta aquatica* was typically aquatic.

The fauna of submersed macrophyton stands and dead reed remains of the open water was found to be much less diverse than that of the inner lakes.

Comparing submersed macrophyton and dead reed remain samples collected from the same part of the lake, obvious differences were found. As an example: dead reed samples from Hidegségi pond (44), besides Chironomidae species, often also contained species of Hirudinoidea, Gastropoda, Isopoda in relatively large number, while in submersed macrophyton samples species of Ephemeroptera and Odonata were dominant. Andrikovics also found a great difference between the two submersed macrophyton sampling sites (*Potamogeton pectinatus, Myriophyllum verticillatum)* of the Hidegségi pond (44). Similarly, Herlakni pond (41) samples were distinctly different originating from *Potamogeton pectinatus* and dead reed remains, just as in Kis-Herlakni pond (42), where samples were collected from *Utricularia vulgaris* and from the dead reed floating among *Utricularia*.

Sokal-Mitchener index and the similarity index of Baroni-Urbani-Buser II was used to analyse the macroinvertebrate fauna of submersed macrophyton stands and dead reed remains respectively. No sampling site or seasonal grouping was possible to show on the dendrograms. What is more, no grouping could be made according to the plant species of the macrophyton stands.

Comparison of water-covered reed stands and dead reed remains

The dissolved oxygen concentration varied between 0.2–2.0 mg/l during a day (1976. 07–08.). 47 taxa were found in the quantitative reed belt samples (Andrikovics, 1979) (Fig. 1). The faunistical differences between the two habitats are as follows.

Hirudinoidea: Typical mass species were found to be similar in the two investigations: *Glossiphonia heteroclita, Helobdella stagnalis, Erpobdella octoculata.* Two species were found only in the reed stand samples, both of them with a small individual number (*Theromyzon tessulatum* and *Piscicola geometra*).

Gastropoda: They were characteristic in both investigations. The species composition was nearly identical, except for *Gyraulus albus* found only in the reed stands and *Lymnaea palustris* found only in dead reed remain samples.

Isopoda: The only recorded species, *Asellus aquaticus* was found to be abundant in all samples in both investigations.

Ephemeroptera*:* *Cloeon dipterum* and *Caenis robusta* were found in both studies, though the first species was more common on live reed, the latter on the dead reed remains.

Odonata: This group is represented by a small individual number in both studies. No common species was detected.

Heteroptera: A much more diverse heteropteran community was collected from dead reed remains.

Coleoptera: A more diverse community was found in dead reed remains again. With the exception of *Bidessus geminus,* all reed stand beetles were also found in dead reed remains.

Trichoptera: Andrikovics described *Orthotrichia costalis, Oxyethira* and *Limnephilus* species to be characteristic for the emerge vegetation. Dominant species on dead reed remains - *Ecnomus tenellus* and *Oecetis furva* - were also present, unlike the representatives of the genus *Cyrnus,* which existed in dead reed remains.

Lepidoptera: The two species detected in the submersed macrophyton stands were also found in the reed belt samples.

Diptera: Chironomid species were the most common in both studies. Family Tabanidae was found only in the reed stand and not in the dead reed samples.

Using Hummon's index for analysing the macroinvertebrate samples, we can conclude that the similarity between samples taken in different time periods is very low.

Discussion

On the basis of our general evaluation of all sampling sites, the following conclusion can be drawn. The dissolved O_2 conditions are always more favourable (more balanced and higher oxygen concentration) in submersed macrophyton stands than in dead reed remains or in reed stands, since submersed macrophytes produce a large amount of oxygen *via* their photosynthetic activity. With the exception of the open water edge, where in oxygen rich water is mixed with the water of the reed stand, reed belts are always characterised by a low level of dissolved oxygen concentration during the day, while at night they can become anaerobic. Dead reed remains are usually situated at the edge of the reed belt. Therefore, their oxygen concentration is similar to that habitat type, especially as degradation processes already start in those areas. The oxygen conditions of submersed macrophyton stands were between those of the open water and the reed stands. The most important phenomenon of the transitional status was that its climatic conditions were different from those of the open water and the dead reed remains. The microclimate of open water macrophyton stands is basically determined by the open water, while the microclimate of inner pond and reed belt-edge macrophyton stands is also influenced by their species composition. Differences of conductivity data can be explained by a higher water level due to a more rainy year, but apart from this, a high salt concentration of the lake is well shown, too.

The list of determined species can generally be characterized by the lack of halophil species. Due to the astatic nature of Lake Fertő, mostly euriok species were found in the samples. The fauna of open water submersed macrophyton stands and dead reed remains differ. The open water macrophyton stand samples did not contain as many species as the samples from the inner lakes. This can be explained by the unfavourable colonisation conditions caused by the strong and constant wind. From a certain viewpoint, both sites can be considered transitional, colonisation can be expected from the reed stands or by species that put their eggs on plants. Reed stands serve as an appropriate habitat for only few species due to unfavourable water chemistry conditions. Especially the inner, oxygen-poor part of the reed stand is uniform with a low species diversity. The species composition in reed stands is relatively diverse, but the small individual number indicate the unfavourable conditions (Andrikovics, 1979).

Differences between samples from the same sites, but from different vegetation stands proved that not only the similar ecological macro-environment, but also the relative position (open water and isolated inner pond) and morphology of the substrate vegetation has an effect on the zoocenosis. The quality and morphology of the substrate and the developing periphyton as a food supply, also affect on the macroinvertebrate community. In this particular case it is especially true, since most of the species identified feed on detritus (most Chironomida, Ephemeroptera, Isopoda and Trichoptera species). Few herbivore species were found. Only snails, *Asellus* sp. and several Trichoptera and Chironomidae larvae could be put into that category.

Reed stand samples were the least diverse. Nearly the same species number was recorded in submersed macrophyton and dead reed remain samples, but the dominance pattern differed. In submersed macrophyton stands Hirudinoidea, Odonata and Trichoptera, while on the dead reed remains Coleoptera, Heteroptera and Araneidea species were more common. The relatively low number of Coleoptera species in submersed macrophyton stands could also be caused by a sampling error, since this group is extremely species-rich and mobile. Spiders were found only in dead reed remains. The only aquatic spider was *Argyroneta aquatica.* The other non-aquatic species live near the water bodies, probably they either overwinter in reed stems and on dead reed remains or they were already dead at the time of the collection.

Habitats investigated during this study due to their location, morphology and hydroecological characteristics provide different conditions favourable for species with different ecological needs. *Notonecta* species are missing from dead read remains and reed stands, since they are bound to macrophyton stands. No Lepidoptera larvae were found on dead reed, since they feed on living vegetation. The *Cloeon simile* preferring open water habitats and the mud dweller *Caenis horaria* could only be collected from submersed macrophyton stands. *Ecnomus tenellus,* though it was present in all three habitats, could only be recorded in large number in near-reed submersed macrophyton stands. *Agrypnia* (Phryganeidae) and *Limnephilus* species mostly develop in reed stands. *Oecetis* species live in a wide range of habitats, *Oecetis furva* and *O. ochracea* were detected in all three examined habitats.

Our working hypothesis, that the invertebrate community of dead- and live reed samples are more similar to each other than to those of the submersed macrophyton stands, has not been proved. This hypothesis was based on the fact that the locality and oxygen conditions of dead reed remains are more similar to those of the reed stands than to the submersed macrophyton stands. To a certain extent, dead reed remains can be considered as a phase of reed stands. The quality of the substrate and the developing periphyton are also similar in reed stands and dead reed remains. Despite in the ordination, samples representing each site was situated nearly at the same distance from the samples of the two other habitats. None of the investigated habitats showed higher similarity to any other habitats (Fig. 2).

Summary

The macroinvertebrate fauna of submersed macrophyton stands, reed belts and dead reed remains considerably differed according to studies carried out in the 1970's and 1990's. Besides water chemistry, position of vegetation stands within the lake, the quality and morphology of the plant as a substrate also have a decisive role. Habitat differences were also proved by metric multidimensional scaling carried out for preliminary testing.

The lowest macrofauna diversity was found in the reed belt. Unfavourable water chemistry conditions led to smaller individual numbers. Submersed macrophyton stand and dead reed remain samples were more diverse. The species

composition and dominance relationships were found to be different between these habitat types.

Further investigations are needed to clarify the ecological conditions causing these differences in species composition and abundance, and to elucidate the role of dead reed remains in the ecosystem as a whole. These investigations can also be useful by applying new statistical methods to reveal tendencies and correlation in macro-invertebrate fauna changes.

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Table 1. List of species and other taxa

Species	Submersed macrophyton stands (Andrikovics)	Reed stands (Andrikovics)	Dead reed remains (Varga)
Hirudinoidea			
Theromyzon tessulatum O.F.Müll.	+	+	
Piscicola geometra L.	+	+	
Hemiclepsis marginalis O.F.Müll.	+		
Glossiphonia heteroclita L.	+	+	+
G. heteroclita f. papillosa Braun	+		
Hirudo medicinalis L.	+		
Helobdella stagnalis L.	+	+	+
Erpobdella octoculata L.	+	+	+
Gastropoda			
Lymnaea stagnalis L.	+		
Lymnaea peregra Müll.	+	+	+
Lymnaea auricularia L.	+		
Lymnaea truncula Müll.	+		
Lymnaea palustris O.F.Müll.			+
Planorbis planorbis L.	+	+	+
Physa fontinalis L.	+	+	+
Bithynia tentaculata L.	+	+	+
Gyraulus albus O.F.Müll.		+	
Gyraulus crista L.	+	+	+
Gyraulus laevis Ald.	+		
Gyraulus sp.	+		
Isopoda			
Asellus aquaticus L.	+	+	+
Ephemeroptera			
Cloeon dipterum L.	+	+	+
Cloeon simile Etn.	+		
Caenis horaria L.	+		
Caenis robusta Etn.	+	+	+
Odonata			
Sympecta fusca Vanderl.	+		
Ischnura elegans Vanderl.	+	+	
Ischnura pumilio Charp.	+		+
Enallagma cyathigerum Charp.	+	+	
Coenagrion puella L.	+		
Coenagrion pulchellum Vanderl.	+		
Coenagrion sp.		+	
Erythromma najas Hansem.	+		
Crocothemis erythraea Brullé	+		
Heteroptera			
Notonecta glauca L.	+		
Notonecta sp. larva	+		
Plea minutissima McGreg & Kirk	+		+
Micronecta pusilla Horv.	+		
Micronecta Scholtzii Fieb.			+
Cymatia coleoptrata Fabr.	+	+	+
Paracorixa concinna Fieb.	+		
Sigara striata L.	+	+	
Corixidae sp. larva	+		+
Corixidae sp. juv.		+	
Hesperocorixa linnei [Fieb.]			+
Gerridae larva			+
Microvelia reticulata Scholz			+
Ranatra linearis L.	+		+
Ilycoris cimicoides L.	+		+
Coleoptera			
Haliplus ruficollis Deg.	+		
Haliplus variegatus Sturm.			+
Haliplidae sp. larva	+		+
Haliplus sp.			+

Laccophilus variegatus Germ.	+	+	+
Bidessus unistriatus Schrank			+
Bidessus geminus F.		+	
Noterus crassicornis Müll.	+	+	+
Noterus clavicornis De Geer			+
Hygrotus inequalis Fabr.			+
Dytiscidae sp. larva	+	+	+
Ochtebius sp.			+
Limnebius aluta Bedel			+
Cercyon obsoletus Gyll.			+
Enochrus maritimus Thoms.		+	+
Hydroptilidae sp. larva		+	+
Palpicornia larva	+		
Stenus sp.			+
Ptenidium sp.			+
Scirtes sp. larva			+
Trichoptera			
Ecnomus tenellus Ramb.	+	+	+
Cyrnus crenaticornis Kol.			+
Cyrnus sp.	+		
Holocentropus picicornis Steph.	+	+	+
Holocentropus sp.			+
Athripsodes senilis Burs.	+		
Agraylea multipunctata Curt.		+	
Oxyethira sp.		+	
Tricholeiochiton fagesii Guinard			+
Orthotrichia costalis Curt.		+	
Phryganeidae sp. juv.	+	+	
Limnephilidae sp. juv.		+	
Oecetis ochracea Curt.	+	+	+
Oecetis furva Ramb.	+	+	+
Oecetis sp.	+		
Lepidoptera			
Nymphula nymphaeta L.	+	+	
Parapoynx stratiota L.	+	+	
Diptera			
Chironomidae	+	+	+
Culicidae			+
Chaoboridae	+	+	+
Tabanidae		+	
Stratiomyidae	+	+	+
Ceratopogonidae	+	+	+
Limoniidae			+
Araneidea			
Donacochara speciosa Thorell			+
Linyphiidae			+
Tetragnatha sp.			+
Clubiona sp.			+
Argyroneta aquatica Clerk			+
Pirata sp.			+
Hydracarina	+	+	+

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New data on the macrofauna of Lake Fertő, Hungary

By

I. VARGA*, S. ANDRIKOVICS** and L. HUFNAGEL***

Abstract. In the course of zoological investigations on Lake Fertő, some new species for its Hungarian area were discovered. Species from the following taxa were found for the first time in this lake: Hirudinoidea 1, Heteroptera 4, Coleoptera 8 and Trichoptera 1 species. Two of these species, *Salda muelleri* (Gmelin, 1790) and *Tricholeiochiton fagesii* (Guinard, 1879) are new elements for the fauna of Hungary, too.

Lake Fertő (Austrian part named Neusiedler See) is a typical example of shallow lakes with a relatively large surface. This lake is of special interest from limnological point of view due to its extreme shallowness and high salinity, which make an unbalanced system to the lake. The first zoological records on this area are from the beginning of the 20's (Horváth, 1923). Scientific results on the lake were published by disciplines in the papers of the Fertő Basin Committee (Andrikovics & Berczik, 1975; Lászlóffy, 1972). Work carried out in Austrian part of the lake was summarised by Löffler (Löffler, 1979). During the 1970's a detailed long-term macrofauna study was carried out on the submerse macrophyte stands of Lake Fertő by Andrikovics (1973, 1979). After a longer break, new macrofauna investigations have started in recent years. Results of these studies are published in the present article.

Materials and methods

(1) Under the guidance of the late Dr. Imre Loksa, a large number of pitfall traps were put out by the Department of Systematic Zoology and Ecology of the Eötvös Loránd University to investigate the fauna elements of the lake from 1982 to 1986. The aquatic-, semiaquatic- and shore bugs were completely identified from the collected material.

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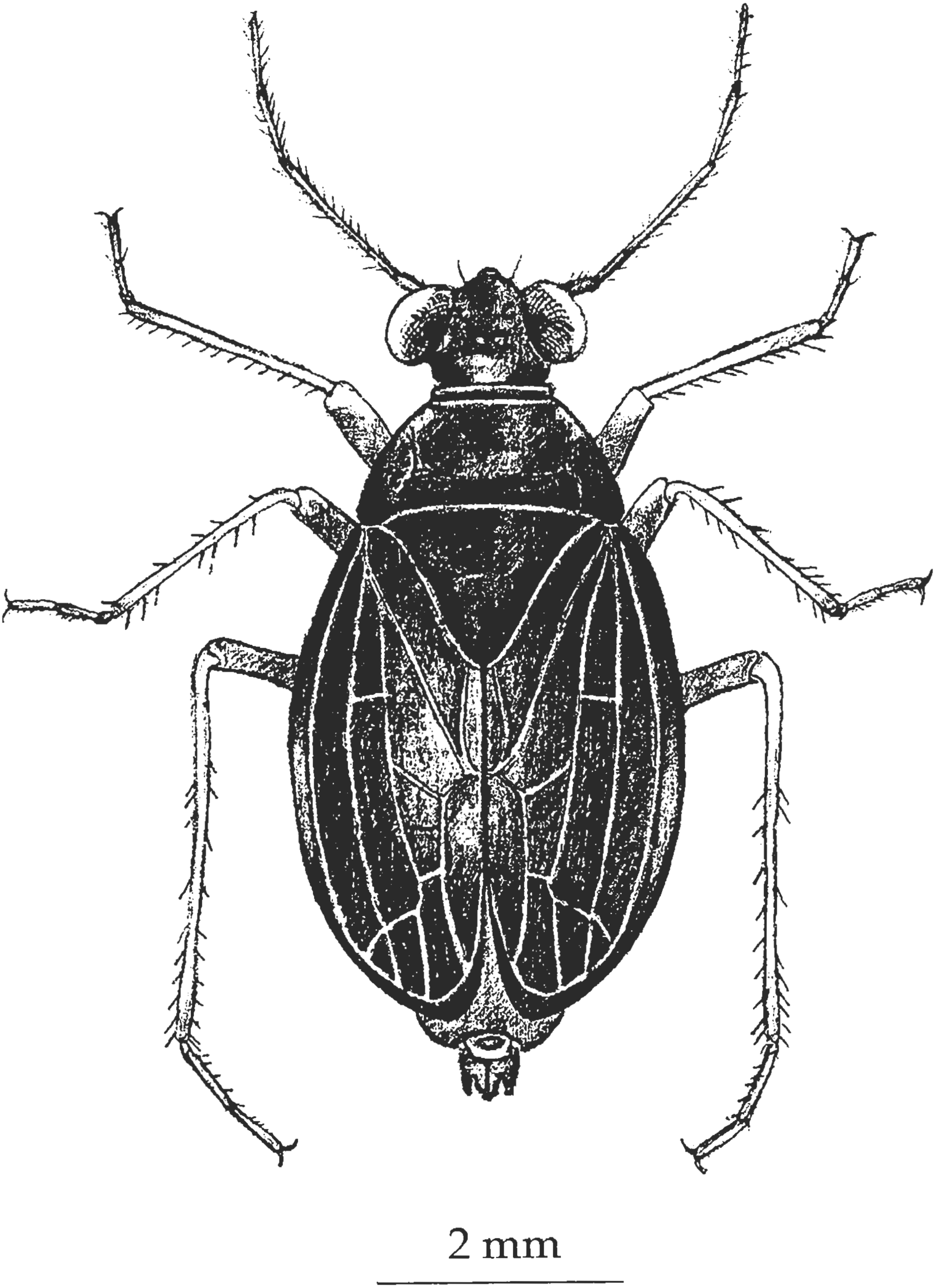

Fig. 1. *Salda muelleri* (Gmelin, 1790), a heteropteran species new to the fauna of Hungary

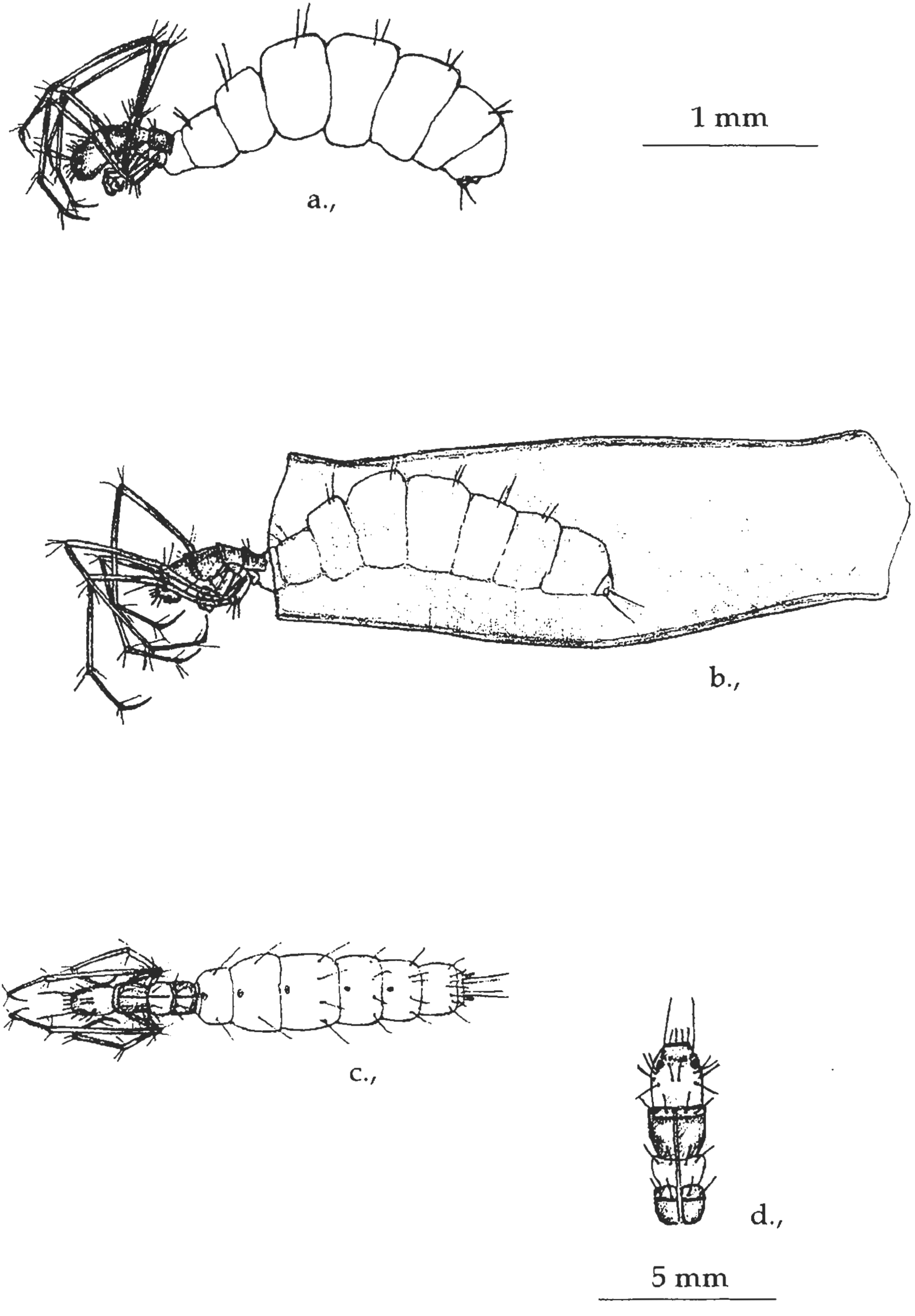

Fig. 2. *Tricholeiochiton fagesii* (Guinard, 1879), a trichopteran species new to the fauna of Hungary.

(2) We investigated the macroinvertebrate communities of floating dead reed remains (*Phragmites australis*) at Lake Fertő in 1995-96. Animals were collected seasonally by surface netting and washing out from five sampling sites of different characteristics (open water edge of reed, smaller and larger inner ponds etc.) (Varga, 1997).

(3) *In situ* studies following the speed of reed degradation have been done since 1995 at Lake Fertő in the framework of EUREED, the complex reed research programme of the European Union. A determined quantity of reed stem and leaves were put into separate litter bags (made out of 1 mm mesh size nets) and fixed in the water at approximately 30 cm above the lake bottom, at two sites (Herlakni pond; 300 meter south-east from the Hidrometeorological Station at Fertőrákos - called Reed 3 area). Litter bags were put out in November, 1995. Two reed stem and two leaf samples were collected monthly from each site from April, 1996. Macroinvertebrates were washed out from the samples directly after the sampling procedure. Zoological analysis was made in every second months. Till now, a preliminary analysis of the material from April, June, August, October and December of 1996 and March of 1997 was carried out (Varga & Berczik, 1998).

For species identification, the following keys were used: Benedek, 1968, 1969; Freude et al., 1971; Jansson, 1986; Péricart, 1990; Richoux, 1982; Savage, 1989; Soós, 1968; Vásárhelyi, 1990; Wallace et al., 1990; Waringer & Graf, 1997.

New species for the fauna of Lake Fertő (Hungarian part)

Hirudinoidea		
Erpobdella monostriata Gedroyc		(3)
Heteroptera		
Micronecta scholtzi Fieber [Corixidae]		(2)
Microvelia reticulata Burmeister [Veliidae]		(2)
Salda muelleri (Gmelin) [Saldidae]	(1)	
Chartoscirta elegantula Fallén [Saldidae]		(1)
Coleoptera		(2)
Haliplus variegatus Sturm. [Haliplidae]		
**Noterus clavicornis* De Geer [Dytiscidae]		
**Bidessus unistriatus* Schrank [Dytiscidae]		
Limnebius aluta Bedel [Hydrophilidae]		
Cercyon obsoletus Gyll. [Hydrophilidae]		
Ptenidium sp. [Hydrophilidae]		
**Scirtes* sp. larva [Helodidae]		
Trichoptera		
Tricholeiochiton fagesii (Guinard) [Hydroptilidae]		(2,3)

*Known earlier from the Austrian part of Lake Fertő (Löffler, 1979).

Salda muelleri (Gmelin, 1790)

Salda is a Holoarctic genus consisting of 17 species. Nine species have Palearctic distribution, six species live in Europe. No representative of this genus has been found in Hungary so far. *S. muelleri* is a 4.6–7 mm long, dark coloured animal with light legs. Hemielytra black, slightly dotted. Medialis cell of the membrane distally not reaching to the neighbouring cells (Fig. 1). Distributed throughout the western Palearctic, though it was also found in Kazakhstan and moreover, even from the Kamchatka Peninsula. In Europe it is widely distributed, but not common. The occurrence of this species was expected in the north-west part of Hungary, since it had already been found in both Slovakia and Austria (Aukema & Rieger, 1995). It is generally believed to be a mountain species. This species usually appears in wet detritus in littoral zone of running waters. Its feeding habits are not known, probably it mostly predates. – Locality: 3 specimens, Hegykő, 1985.

Tricholeiochiton fagesii (Guinard, 1879)

Fully grown larvae 3.5–4 mm long. Thoracic segments long, abdomen characteristically curved. The 1st and 2nd abdominal segments are much smaller (narrower and lower) than the following ones. The largest segment is the 4th. The 2nd and 3rd pair of legs four to five times longer than the 1st one. They are more or less equal to the entire body lengths (Fig. 2).

This species is the only representative of the genus. It has a Western-Palearctical distribution. Since the species had already been found in the neighbouring countries, it was also expected to occur in Hungary (Botosaneanu–Malicky, 1978). Habitats favoured by this species are lakes or slowly flowing rivers with a dense macrophyton vegetation. Case is made out of saliva secretion by the final (V.) installs only. Case is sac-shaped with thin transparent walls, laterally strongly flattened, anterior and posterior ends of case similar shape. The larvae feed on periphyton and fine organic particles (Lepneva, 1966; Wallace et al., 1990). – Localities: Kisherlakni pond, V. 1995, Hidegségi pond, V., VII., X. 1996, washed, reed 3, IV. 1996, stem VI.,VIII., X., stem, leaf, III. 1997, leaf.

These data also emphasize that the faunistical investigations on the fauna of Lake Fertő are not completed yet. There is need for further investigations, which can produce a lot of new results.

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Revision weiterer *Martiodrilus*-Arten (Oligochaeta: Glossoscolecidae)

Regenwürmer aus Südamerika, 30

Von

A. ZICSI*

Abstract. „Revision of further *Martiodrilus* species. (Earthworms from South America, 30.)" On the basis of type materials, the morphological and anatomical characters of the species *Martiodrilus gravis, M. tutus, M. benhami, M. andiorrhinoides, M. bicolor, M. helleri, M. onorei*, and *M. poncei* are revised. A new subgenus, *Botaria* subgen. n. is suggested. Four new species, *M. (B.) minor, M. (B.) minoriformis, M. (B.) parvus, M. (B.) feijooi* and a new subspecies, *M. (B.) euzonus filiformis* spp. n. are described.

In vorausgehenden Arbeiten (Zicsi und Csuzdi, 1997; Zicsi, im Druck) ist ein Teil der zur Gattung *Martiodrilus* gehörenden Arten revidiert, die Gattung in zwei Untergattungen geteilt worden. Vorwiegend wurden anhand der neuen Aufsammlungen in Ekuador (1986-1993) und der Revision zahlreicher Typen die Untergattungen *Cordilleroscolex* und *Martiodrilus*, beide aufgrund der verdickten Dissepimente hinter dem Muskelmagen, begrenzt. Die erstere Untergattung wurde wegen eines rosettenförmigen Nephrostoms von der letzteren getrennt. Die jetzt zur Revision herangezogenen Spezies dieser artenreichen Gattung haben keine verdickten Dissepimente hinter dem Muskelmagen, besitzen 3 Paar Samentaschen, sind rot pigmentiert und verfügen über verschiedenförmige Chylustaschen.

In einer späteren Arbeit beabsichtige ich, eine weitere Gruppe der Arten dieser Gattung zu revidieren, u. zw. diejenige, die ebenfalls keine verdickten Dissepimente hinter dem Muskelmagen besitzt, aber über vier Paar Samentaschen verfügt und 7 oder 8 Paar Chylustaschen aufweist.

An dieser Stelle sei erwähnt, dass Righi (1995) für Arten der Gattung *Martiodrilus*, die ebenfalls keine verdickten Dissepimente hinter dem Muskelmagen aufweisen, allein die verminderte Zahl der Chylustaschen berücksichtigend, verschiedene neue Gattungen begrenzt. So werden für Arten mit 7 Paar Chylustaschen die Gattung *Maipure*, mit 5 Paar Chylustaschen die Gattung *Tupinaki* und für die, wo 8 Paar Chylustaschen im 8.–15. Segment liegen,

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die Gattung *Zongodrilus* aufgestellt. Bei dieser Trennung werden Arten wie *M. ecuadoriensis, savanicola, inertus* mit 7 Paar Chylustaschen z. B. von *M. agricola* mit 8 Paar Chylustaschen getrennt, obwohl sie in allen übrigen Merkmalen vollkommen übereinstimmen.

Da ich mich in einer nachfolgenden Arbeit mit der Revision derjenigen *Martiodrilus*-Arten befassen werde, die über 7 bzw. 8 Paar Chylustaschen verfügen und keine verdickten Dissepimente hinter dem Muskelmagen besitzen, könnten bis dahin *a priori* sämtliche Arten dieser Gruppe provisorisch zu *Maipure* Righi, 1995 als 4. Untergattung der Gattung *Martiodrilus* gestellt werden.

Da die monophyletische Gattung *Zongodrilus* zu *Inkadrilus* eingezogen wurde (Zicsi und Csuzdi, 1999), würde allein *Tupinaki* mit 5 Paar Chylustaschen als selbständige Gattung bestehen bleiben.

Martiodrilus (Botaria) subgen. n.

Diagnose: Kleine bis mittelgrosse, rotpigmentierte Arten. Borsten am ganzen Körper in 8 Längsreihen angeordnet. Chylustaschen 8 Paar im 7.–14. Segment. Die 3 vorderen unterscheiden sich in Form und Struktur von den 5 hinteren, es sind Kompositenschlauch- bis Wabentaschen. Geschlechtsapparat holoandrisch und metagyn 3 Paar Samentaschen im 7.–9. Segment. Dissepimente hinter dem Muskelmagen nicht verdickt. Meganephridien ohne rosettenförmiges Nephrostom.

Die neue Untergattung unterscheidet sich von den übrigen Untergattungen durch das Fehlen von verdickten Dissepimenten hinter dem Muskelmagen, durch die 3 Paar Samentaschen im 7.–9. Segment und durch die verschiedene Form der Chylustaschen.

Die neue Untergattung wird zu Ehren der verstorbenen Frau I. Botár (Quito), die uns bei der Verwirklichung unserer Expeditionen weitgehend behilflich war, benannt.

Typusart: *Thamnodrilus (Botaria) euzonus* Cognetti, 1904.

Die weiteren Arten lassen sich zur Untergattung einreihen: *M. (B.) gravis* (Cognetti, 1904), *M. (B.) euzonus* (Cognetti, 1904), *M. (B.) tutus* (Cognetti, 1904), *M. (B.) benhami* (Cognetti, 1904), *M. (B.) andiorrhinoides* (Michaelsen, 1910), *M. (B.) bicolor* (Michaelsen, 1913), *M. (B.) helleri* (Michaelsen, 1918), *M. (B.) onorei* Zicsi, 1988, *M. (B.) poncei* Zicsi, 1988, *M. (B.) colomai* Zicsi, 1988, *M. (B.) pano* Righi, 1992, *M. (B.) gara* Righi, 1995, *M. (B.) murindo* Righi, 1995, *M. (B.) vassae* Zicsi & Csuzdi, 1999; sowie vier neue Arten wie *M. (B.) feijooi, M. (B.) minor, M. (B.) minoriformis, M. (B.) parvus* spp. n.

Bemerkung: Die rote Pigmentation der der Untergattung angehörenden Arten weist darauf hin, dass die Tiere hauptsächlich in der Laubstreu oder in den obersten Schichten des Bodens anzutreffen sind. Sie wurden auch in Höhen von 4500 m über dem Meeresspiegel erbeutet.

Martiodrilus (Botaria) euzonus (Cognetti, 1904)

Thamnodrilus euzonus Cognetti, 1904: 474.
Rhinodrilus (Thamnodrilus) euzonus, Cognetti, 1906: 194.
Rhinodrilus (Thamnodrilus) euzonus, Michaelsen, 1910a: 131, 1910b: 149, 1913: 234.
Thamnodrilus (Thamnodrilus) euzonus, Michaelsen, 1918: 117.
Martiodrilus euzonus, Righi, 1981: 244, 1984: 456.
Martiodrilus euzonus, Zicsi, 1988: 436.
Martiodrilus euzonus, Zicsi & Feijoo, 1994: 61.
Martiodrilus gara part., Righi, 1995: 525.

Von dieser anhand zahlreicher Exemplare beschriebenen Art (OL 426, El Troje Haca, 3100 m, 9+7 juv. Ex., OL 427, Tulcan, 2977 m, 6+5 juv. Ex., OL 428, Vallevicosa, 3500 m; 1+1 juv. Ex., OL 429, Papallacta, 3100 m, 4+1. Ex.) liegen ebenfalls viele Stücke aus Ekuador und Kolumbien vor. Es ist interessant, dass die Fundorte, wie auch bei anderen *Martiodrilus*-Arten, südlich nur bis in die Provinz Cotopaxi reichen (Zicsi, 1988; Zicsi und Csuzdi, 1999), im Norden aber auch bis nach Kolumbien verbreitet sind. Schon bei der Erstbeschreibung von Cognetti wird darauf hingewiesen, dass sie grosse Ähnlichkeit mit *M. gravis* und *M. tutus* zeigt, zu der im späteren auch *M. bicolor* gezählt wird (Michaelsen, 1913). Ein Teil der von Righi (1995) als *M. gara* beschriebenen Tiere ist *M. euzonus* so ähnlich, dass diese *a priori* zu dieser Art gestellt werden müssten.

Da ich die Gelegenheit hatte, das Typenmaterial von *M. euzonus, M. bicolor, M. gravis* und *M. tutus* einzusehen, zahlreiche Exemplare aus Kolumbien zu überprüfen, führe ich keine grundsätzliche Synonymisierung durch, sondern versuche während der Revision der einzelnen Arten auf die Unterschiede bzw. Übereinstimmungen hinzuweisen.

Fundorte: Kolumbien: Depto del Valle. AF/3660, 3 Ex., AF/3662, 2 Ex., 3663, 1 Ex., 3665, 1 Ex., Muncipio de Florida, Paramo de Tinajas, 3200 m, 16.-17. 5. 1992, leg. Feijoo.-Depto de Narino. AF/3684 1 Ex., Chiles Vulkan, 29. 3. 1997. leg. Feijoo. - **Ekuador**: Prov. Carchi. AF/998-999, 3+3 juv. Ex., 28 km von Tulkan in Richtung Chiles Vulkan, oberhalb Tufino, 15. 5. 1988, leg. Zicsi+Csuzdi. - AF/1015, 7 Ex., Chiles Vulkan, 4300-4500 m, 15. 5. 1988, leg. Zicsi+Csuzdi. - AF/1009, 15+3 juv. Ex., Rumichaca, 2800 m, 16. 5. 1988, leg. Zicsi+Csuzdi. -AF/3865, 1 Ex., 15 km von Tulkan bei der Abzweigung El Camilo, 15. 5. 1988, leg. Zicsi+Csuzdi. - AF/3924, 1 Ex., oberhalb Tufino, 4200 m, 8. 5. 1990, leg. Zicsi+Csuzdi. - AF/1949, 3 Ex., hinter Libertad, 3400 m, Paramo Schwarerde, 25. 4. 1989, leg. Zicsi+Loksa+Lopez. - AF/3870, 8 Ex., am Weg von Santa Barbara bei der Abzweigung nach Tulcan, 3200 m, schwarzer Sandboden, 26. 4. 1989, leg. Zicsi+Loksa+Lopez. - AF/3915, 3 Ex., AF/3922, 1 Ex., zwischen El Angel u. Las Juntas, 3300-3400 m, 8. 5. 1990 leg. Zicsi+Csuzdi+Florenzio. - AF/3911, 11+3 juv. Ex., zwischen Mira und El Angel, 2900 m, 12. 5. 1990, leg Zicsi +Csuzdi+Florenzio. - Prov. Imbabura. AF/3906, 5+2 juv. Ex., zwischen Otavalo und Cayambe, 28. km von Otavalo, 2500 m, Wiese, 13. 5. 1993, leg. Zicsi+Csuzdi+Florenzio. - AF/1976, 1 Ex., Mirador de Pijal, 2950 m, 27. 4. 1989, leg. Zicsi+Loksa+Lopez. - Prov. Napo. AF/ 1023, 1 Ex., AF 1590, 2+1 juv. Ex., Cayambe Vulkan, 4000-4200 m oberhalb der Lagune San Marcos, 6. 5. 1988, leg. Zicsi+Csuzdi. - AF/3932, 2 Ex., AF/3934, 1+4 juv. Ex., Cayambe Vulkan, 4100 m, 28. 4. 1990 m,. leg. Zicsi+Csuzdi+Nonn. - AF/3860, 6+2 juv. Ex., zwischen Pifo und Papallacta, 3900 m, 11. 5. 1988, leg. Zicsi+Csuzdi. - AF/3928, 10 Ex., vor Papallacta beim Denkmal der Madonne, 4200 m, 4. 5. 1988, leg. Zicsi+Csuzdi. - Prov. Pichincha. AF/1996, 2 praead. Ex., AF/3768, 1 Ex., Olmedo, 3000 m, 23. 5. 1988, leg. Zicsi+Csuzdi. - AF/1614, 1 Ex., Antisana Vulkan, 3500 m, 17. 5. 1988, leg. Zicsi+Csuzdi. - AF/3749, 1 Ex., San José de Minas, 21. 4. 1987, leg. Zicsi+Loksa. - AF/3879, 4 Ex., El Chaupi, Iliniza Vulkan, 4000 m, 13. 5. 1988, leg. Zicsi+Csuzdi.

Die Überprüfung des reichen Typenmaterials von *euzonus* zeigte, dass in der Lage des Gürtels und der Pubertätsstreifen gewisse Variationen auch innerhalb einer Population bestehen. So konnten Tiere mit einer Gürtellage vom 15.-24., 1/4 25. Segment nachbestimmt werden, wo der Gürtel nur auf der Dorsalseite einen dünnen

Streifen bildend auf das 25. Segment übergeht. Die Pubertätsstreifen erstrecken sich vom 1/2 19., 19. - 1/2 24., 24. Segment. Bei einer anderen Lage dieser Organe ist es sicher, dass wir einer anderen Art dieser Gattung gegenüberstehen (vergl. Righi, 1981; Zicsi, 1988, p. 436). Die von Righi (1955, p. 526) angeführte Ventralansicht der Abbildung 172/A stimmt mit der Lage der Pubertätsstreifen von *euzonus* überein (Abb. 1), und da auch in anderen Merkmalen, wie Form der Chylustaschen (Abb. 2 a, b) und Samentaschen (Abb. 3 a, b) Übereinstimmungen bestehen, wird ein Teil der als *M. gara* beschriebenen Tiere zu *euzonus* gestellt.

Über die sehr kennzeichnende Form der Chylustaschen des 7.–9. Segments hatte sich Michaelsen (1910 a, b) sehr ausführlich ausgesprochen. Besonders hervorzuheben ist die aufgeblähte Kalkdrüsenform mit bohnenförmigem Körper, dem am konkaven Innenrand ein keulenförmiger Zapfen entspringt. Die interessanten phyletischen Folgerungen, die Michaelsen (1910 a, b) aus der verschiedenen Form der Kalkdrüsen im 7.–9. Segment und deren zapfenförmigen Anhang zieht (die Differenzierung der Gattungen *Rhinodrilus* und *Aptodrilus* soll aus der Gattung *Thamnodrilus*, jetzt *Martiodrilus* hervorgegangen sein), sind, was die Gestaltung der Chylustaschen betrifft, zurückgezogen worden (Michaelsen, 1918, p. 118.). Eines bleibt jedoch bestehen: die vorderen Chylustaschen des 7.–9. Segments unterscheiden sich von den übrigen hinteren 5 Paar. Meines Erachtens werden durch den nach hinten verschobenen Muskelmagen (Lage im 15. anstatt im 6. Segment) und die geschwundenen Dissepimente hinter diesem die vorderen Kalkdrüsen durch die vorhandenen hinteren Dissepimente fest an den Muskelmagen gepresst und verlieren dadurch ihre kennzeichnende Form, es bleibt nur ein Netz von leeren Wabenzellen zurück (Abb. 2 a).

Was die Samentaschen anbelangt, wodurch sich *euzonus* von *M. bicolor* deutlich unterscheiden soll, wie von Michaelsen (1913 p. 234) betont, ist schon schwerer Stellung zu beziehen, da bei zahlreichen Exemplaren das Ende des Ausführungsganges stark angeschwollen und mit Samenmassen gefüllt ist. Bei *M. bicolor* verursachen die Samenkämmerchen divertikelartige Vorwölbungen, die aus der Aussenhaut hervorstehen (Abb. 5). Dies konnte beim Typus von *bicolor* erkannt werden und auch bei einigen Exemplaren aus Kolumbien. Auf die Vielfältigkeit der Samentaschenformen wird auch in der Beschreibung von *M. gara* von Righi (1955) hingewiesen.

Erwähnt sei noch, dass die Testikelblasen eines Paares ventral miteinader verbunden, die einer Seite vollkommen getrennt sind. Die Form der Nephridien wird in Abb. 4 veranschaulicht. Ein weiteres Kennzeichen, das Fehlen der schlingenförmigen Herzen im 12. Segment, unterscheidet *euzonus* auch von den weiter unten angeführten, ihr nahestehenden Arten.

Im weiteren sind die Beschreibungen von Cognetti (1904, 1906) und Michaelsen (1910 a,b, 1913) zur Bestimmung der Art vollkommen ausreichend.

Martiodrilus (Botaria) euzonus filiformis ssp. n.

Fundorte: Prov. Carchi. Holotypus. AF/3955, Rio Chingual in Richtung Tulcan bei der Verzweigung Santa Barbara, 2480 m, in der Nähe des Ufers, 26. 4. 1989, leg. Zicsi+Loksa+Lopez. - AF/2203, 8+1 juv. Ex., Fundort wie beim Holotypus.

Länge des Holotypus 51 mm, Breite 2 mm, Segmentzahl 102. Paratypen: Länge 36–52 mm, Breite 1,5-2,1 mm, Segmentzahl 89–112.

Farbe rot. Kopf rüsselförmig eingezogen, am Ende daumenförmig verdickt. 1.–2. Segment verwachsen. Vom 3. Segment an ungeringelt. Borsten am ganzen Körper gepaart. Borstenverhältnis hinter dem Gürtel aa:ab:bc:cd:dd wie 4:1:3,2:1:15,5. Borsten des 16. und 18. Segments von kleinen Papillen umgeben, in Geschlechtsborsten verwandelt.

Länge der Borsten 0,65–0,95 mm, Breite 0,04 mm. Zahl der Kerben 12. Borsten *a* des 21.–23. Segments in kleinen runden Vertiefungen (nicht bei allen Exemplaren vorhanden). Nephridialporen in der Borstenlinie *cd*. Samentaschenporen auf Intersegmentalfurche 6/7–8/9, von aussen nicht erkennbar.

Gürtel sattelförmig vom 15.-24. Segment, Pubertätsstreifen vom 1/2 19.– 1/2 24. Segment, bei einigen Exemplaren auch nur auf die Hälfte des 19. bzw. 24. Segments übergehend. Es sind dünne Streifen, die von einem Wall umgeben sind (Abb. 6). Weibliche Poren auf dem hinteren Rand des 14. Segments in der Borstenlinie *b*. Männliche Poren auf Intersegmentalfurche 19/20.

Innere Organisation. Verdickte Dissepimente fehlen, von 9/10–14/15 hautförmig dünn vorhanden. Schlund gross, Oesophagus vor dem Muskelmagen von Peptonephridien umgeben. Muskelmagen im 6. Segment, zwiebelförmig verzogen ohne Kragen. Oesophagus tritt auf der Dorsalseite hervor (Abb. 7). Die 3 Paar vorderen Chylustaschen dicht an den Muskelmagen gepresst, dorsal an das Blutgefäss gebunden. 4. Paar ebenfalls stark zusammengedrückt mit abgeschnürtem länglichen Kopf, aber nach oben stehend, die übrigen 4 Paar Chylustaschen ebenfalls mit abgeschnürtem Kopf, eingerollte, gebogene Wabentaschen. Die 8 Paar Chylustaschen liegen im 7.–14. Segment. Lateralherzen im 7.–9., Intestinalherzen im 10. und 11. Segment. Keine schlingenförmigen Herzen im 12. Segment. Hoden und Samentrichter in oesophageale Testikelblasen eingeschlossen, die eines Paares ventral verbunden, die Paare der beiden Segmente ventral nicht verbunden. Aus den Testikelblasen gehen die Samensäcke des 11. und 12. Segments hervor. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., strichförmige dünne Typhlosolis im 27. Segment beginnend. Nephridien mit dünner Nphridialblase (Abb. 8).

Samentaschen im 7.–9. Segment, kleine kolbenförmige Ampulle mit kurzem Ausführungsgang, der an der Basis etwas angeschwollen ist, ohne Samenmassen zu enthalten (Abb. 9).

Die neue Unterart steht *M. (B.) euzonus* am nächsten, unterscheidet sich von dieser in der Grösse, in der Form der Geschlechtsborsten und der Zahl ihrer Kerben, in der Form der Nephridien und des Muskelmagens. Während die Pubertätsstreifen bei *euzonus* breite Bänder bilden, sind diese bei der neuen Unterart zwirndünne Streifen, die von einem Wall umgeben werden.

Martiodrilus (Botaria) bicolor (Michaelsen, 1913)

Thamnodrilus (Thamnodrilus) bicolor Michaelsen, 1913: 230.
Thamnodrilus (Thamnodrilus) bicolor, Michaelsen, 1918: 119.
Martiodrilus bicolor, Zicsi, 1988: 438.

Fundorte: Kolumbien: AF/3524, 1 Ex., Paramo del Huila, 3700 m, 28. 7. 1978, leg. Sturm. – Ekuador: Prov. Carchi. AF/1004, 1+3 juv. Ex., 15 km von Tulcan vor der Abzweigung Carmelo, 15. 5.

1988, leg. Zicsi+Csuzdi. - AF/1005, 4+4 juv Ex., Rumichaca, 15. 5. 1988, leg. Zicsi+Csuzdi. - Prov. Napo. AF/1594, 9+4 juv. Ex., 12 km von Borja in Richtung Lago Agrio, 9. 5 1988, Zicsi+Csuzdi.

Die Art wurde aufgrund eines adulten und eines vollständigen, aber juvenilen Exemplars beschrieben. In der Sammlung von Hamburg lag nur ein adultes Tier vor (V 7748, *Thamnodrilus bicolor*, Columbia, südlich von Medellin, leg. Fuhrmann). Die inneren Organe des Tieres liegen gesondert in einem kleinen Fläschchen. Die kennzeichnenden Samentaschen der linken Seite waren unversehrt zu erkennen (Abb. 5). Die männlichen Poren, die in der Originalbeschreibung nicht angegeben wurden, liegen auf Intersegmentalfurche 19/20 zwischen den Pubertätsstreifen, die weiblichen Poren auf dem hinteren Rand des 14. Segments in der Borstenlinie *b*. Der Gürtel erstreckt sich vom 15.-24. Segment, ein etwas weniger drüsiger Streifen geht dorsal auch auf das 1/2 25. Segment über. Pubertätsstreifen von einem schmalen Wall eingefasst, verlaufen von der Mitte des 19. bis auf 1/3 des 24. Segments. Im neueren Material, wo auch mehrere Tiere als *bicolor* identifiziert wurden, verlaufen die Pubertätsstreifen bis in die Mitte des 24. Segments. Im weiteren ist die Originalbeschreibung massgebend, so dass aufgrund der scharf abgestzten Rückenfärbung, der Länge der Geschlechtsborsten, der grösseren Kerbenzahl und der Form der Samentaschen *bicolor* auch im weiteren als gute Art betrachtet wird.

Martiodrilus (Botaria) gara Righi, 1995

Martiodrilus gara part. Righi, 1995: 525.

Fundorte: Kolumbien. Depto del Valle. AF/3486, 1 Ex., Muncipio de Buenaventura, 680 m, 16. 3. 1997, leg. Feijoo. AF/ 3511, 1 Ex., Muncipio de Yotoco, 1600 m, 3. 2. 1995, leg. Feijoo.

Wie bei der vorausgehenden Art, *M. (B) euzonus* erwähnt, werden nur die Tiere als *gara* bestimmt, bei denen die Pubertätsstreifen innerhalb des 19.-23. Segments liegen.

Martiodrilus (Botaria) helleri (Michaelsen, 1918)

Thamnodrilus (Thamnodrilus) helleri Michaelsen, 1918: 113.

Unter Inv. Nr. V. 3126 (Suriname, Oberlauf des Flusses Suriname, leg. C. Heller, 1909) liegen in der Sammlung von Hamburg 8 Exemplare in verschiedener Geschlechtsreife vor. Michaelsen betrachtete bei der Erstbeschreibung nur ein Tier als vollständig adult, die anderen als halbreife Stücke.

Bei einem Teil der halbreifen Exemplare konnte jedoch die Lage des Gürtels und die der Pubertätsstreifen deutlich erkannt und eine Übereinstimmung mit dem adulten Tier bestätigt werden. Bei zwei gürtellosen Tieren lagen die Pubertätsstreifen um ein Segment nach hinten verlagert. Da keine weiteren Unterschiede erkannt werden konnten, der Gürtel nicht ausgebildet, und die Zahl der Kerben an den Geschlechtsborsten ebenfalls die gleiche war, kann diesen Exemplaren gegenüber nicht Stellung bezogen werden. Sie werden ebenfalls bei *helleri* belassen. Die

Verschiedenheit der 3 Paar vorderen Chylustaschen von den 5 hinteren wird auch in der Originalbeschreibung erwähnt. Die unbeschriebenen männlichen Poren liegen auf Intersegmentalfurche 20/21, die weiblichen Poren auf dem hinteren Rand des 14. Segments. Das von Michaelsen geöffnete, vollkommen geschlechtsreife Exemplar wird unter Inv. Nr.V. 3126 a als Lectotypus designiert.

Martiodrilus (Botaria) feijooi sp. n.

Fundort. Kolumbien. Holotypus. AF/3957, Dpto. de Cauca, Muncipio Páez Vereda Escalereta, 3300 m , 17.1. 1995, leg. Feijoo. Paratypen. AF/3677, 2 Ex., Fundort wie beim Holotypus.

Länge des Holotypus 172 mm, Breite 7 mm, Segmentzahl 182. Paratypen: Länge 132-183 mm, Breite 6-7 mm, Segmentzahl 132-182.

Farbe rot, auf der Dorsalseite ausgelöschte Streifen noch zu erkennen. Kopf rüsselförmig eingezogen, am Ende ewas verdickt. 1.-2. Segment verwachsen, 2. Segment längsgefurcht, die übrigen ungeringelt. Ventrale Borsten vom 5., dorsale vom 6. Segment vorhanden. Borsten am ganzen Körper eng gepaart. Borstendistanz hinter dem Gürtel aa:ab:bc:cd:dd wie 15:1,5:7,7:1:45. Borsten *ab* des 10., 17.-26. Segments von Papillen umgeben, z.T. in Geschlechtsborsten verwandelt. Länge der Geschlechtsborsten 1,40 mm, Breite 0,06 mm, Zahl der Kerben 8-10. Nephridialporen in der Borstelinie *d,* im vorderen Teil des Segments, kleine Öffnungen von einem schwarzen Fleck umgeben. Samentaschenporen auf Intersegmentalfurche 6/7-8/9 oberhalb der Borstenlinie *cd.*

Gürtel sattelförmig vom 1/2 15.-26. Segment. Pubertätsstreifen vom 1/2 19.-1/2 26., die dünnen, streifenförmigen Pubertätsorgane sind von den Intersegmentalfurchen unterbrochen und von einem kleinen Wall umgeben (Abb. 10). Weibliche Poren auf dem 14. Segment in der Borstenilie *b,* am hinteren Rand des Segments. Männliche Poren auf Intersegmentalfurche 19/20.

Innere Organisation. Vordere Dissepimente fehlen, von 12/13-16/17 vorhanden und etwas verdickt. Schlund und vorderer Teil des Oesophagus bis ins 9. Segment nach hinten verschoben. Muskelmagen mit deutlichem Kragen im 6. Segment bis ins 13. Segment verzogen. Lateralherzen im 7.-9., Intestinalherzen im 10. u. 11. Segment. Schlingenförmige Herzen im 12. Segment fehlen. 8 Paar Chylustaschen im 7.-14. Segment. Wabentaschen, die 3 vorderen zusammengedrückt, mit abgeschnürtem Kopf, der nach unten gerichtet ist, die hinteren 5 Paar kleine weisse, kipfelförmig gebogen Gebilde mit abgeschnürtem braunen Kopfteil. Oesophageale Testikelblasen im 10. u. 11. Segment, aus ihnen gehen die mächtigen Samensäcke durch Durchbrechung der entsprechenden Dissepimente hervor und bilden im 11. u. 12. Segment grosse lappenförmige Gebilde, die sich dorsal berühren ohne zu verschmelzen. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend. Nephridien mit Nephridialblase (Abb. 11).

Samentaschen 3 Paar im 7.-9. Segment, es sind birnenförmig bis runde Gebilde mit einem langen, muskulösen Ausführungsgang (Abb. 12).

Die neue Art steht *M. (B) helleri* am nächsten, unterscheidet sich von ihr in der Länge des Gürtels und der Pubertätsstreifen, durch die Form der Samentaschen und durch die Lage der männlichen Poren.

Die neue Art wird zu Ehren von Herrn A. Feijoo (Palmira) benannt, der mir das Material zur Bestimmung überlassen hat.

Martiodrilus (Botaria) gravis (Cognetti, 1904)

Thamnodrilus gravis Cognetti, 1904: 12.
Rhinodrilus (Thamnodrilus) gravis, Cognetti, 1906: 190.
Thamnodrilus gravis, Michaelsen, 1918: 119.
Martiodrilus euzonus, Righi, 1981: 235.

In der Sammlung von Torino (OL 430, Valle del Rio Santiago, Ecuador orientale, II./III. 1896, leg. Festa) liegen drei erweichte Exemplare vor. Die inneren Organe sind z.T. noch zu erkennen. Besonders kennzeichnend ist der gebogene Ausführungsgang der Samentaschenampulle, der an der Basis keine Verdickung zeigt, so auch keine Samenkämmerchen besitzt. Von den drei Exemplaren reicht nur bei einem Tier der Gürtel auch bis ins 26. Segment, bei den übrigen nur bis ins 25. Die drei Paar vorderen Chylustaschen sind ebenfalls zusammengedrückt und aufgebläht, doch besitzen sie keinen inneren Zapfen, sondern einen abgeschnürten Kopf. Unter Inv. OL 430/a wird ein von Cognetti geöffnetes Tier als Lectotypus designiert.

Martiodrilus (Botaria) tutus (Cognetti, 1904)

Thamnodrilus tutus Cognetti, 1904: 13.
Rhinodrilus (Thamnodrilus) tutus, Cognetti, 1906: 192.
Thamnodrilus (Thamnodrilus) tutus, Michaelsen, 1918: 124.

Es liegen 3 Exemplare in der Sammlung von Torino vor (OL 443, Valle del Rio Santiago, II./III. 1986, leg Festa). Nur ein Tier scheint ganz geschlechtsreif zu sein, die anderen beiden haben nur die Pubertätsstreifen entwickelt. Aufgrund der Samentaschen steht diese Art *euzonus* am nächsten, unterscheidet sich jedoch von ihr in der Lage des Gürtels und der Pubertätsstreifen sowie durch die schlingenförmigen Herzen im 12. Segment und durch das Fehlen des Zapfens der vorderen Chylustaschen. Unter Inv. Nr. OL 443/a wird das adulte Exemplar als Lectotypus designiert. Es ist interessant, dass in unseren Aufsammlungen keine Exemplare dieser Art erbeutet werden konnten.

Martiodrilus (Botaria) minor sp. n.

Fundorte: Prov. Napo. Holotypus. AF/3954, 58 km von Tena in Richtung Baeza, 4 km vor Cosanga, 2150 m, 4. 5. 1990, leg. Zicsi+Csuzdi+Paredes. - Paratypen. AF/2214, 5+5juv. Ex., AF/2215, 10 +2 juv. Ex.. Fundort wie beim Holotypus. AF/2206, 2+2 juv. Ex., 42 km von Tena in Richtung Baeza, in morschem Holz, 4. 5. 1990, leg Zicsi+Csuzdi+Paredes.

Länge des Holotypus 30 mm, Breite 1,5 mm, Segmentzahl 103. Paratypen: Länge 25–32 mm, Breite 1,2–1,6 mm, Segmentzahl 99–123.

Farbe rot. Kopf rüsselförmig eingezogen am Ende daumenförmig verdickt. 1.-2. Segment verwachsen, ab 3. Segment ungeringelt. Borsten gepaart, Borstenverhältnis hinter dem Gürtel aa:ab:bc:cd:dd wie 9:1,5:5:1:27. Borste *a* des 18. Segments von einer kleinen, runden Papille umgeben, in Geschlechtsborsten verwandelt. Länge der Geschlechtsborsten 0,4 mm, Breite 0,02 mm, Zahl der Kerben 5-6. Nephridialporen in der Borstenlinie *cd*. Samentaschenporen auf Intersegmentalfurche 6/7-8/9, von aussen nicht zu erkennen.

Gürtel sattelförmig vom 15.–24. Segment, bei einigen Exemplaren dorsal strichförmig auch auf das 25. Segment übergehend. Pubertätsstreifen vom 1/2 19.-1/2 22. Segment. Es sind entweder strichförmige dünne Erhebungen (Abb. 13) oder zugespitzte, etwas dickere Streifen (Abb. 14). Männliche Poren auf Intersegmentalfurche 19/20, weibliche Poren auf dem hinteren Rand des 14. Segments.

Innere Organisation. Verdickte Dissepimente fehlen. Mächtiger Schlund bis ins 6. Segment verzogen. Oesophagus von Peptonephridien umgeben. Muskelmagen mit deutlichem Kragen im 6. Segment, weit nach hinten bis ins 13. Segment verschoben. Lateralherzen im 7.–9., Intestinalherzen im 10. u. 11. Segment. Schlingenförmige Herzen im 12. Segment nicht erkannt. 8 Paar Chylustaschen im 7.–14. Segment, die vorderen 3 ganz plattgedrückte Gebilde mit abgeschnürtem Kopf, die hinteren 5 Paar Chylustaschen sind stark gebogene Wabentaschen mit abgeschnürtem Kopf. Oesophageale Testikelblasen im 10. u. 11. Segment. Kleine Samensäcke im 11. und 12. Segment. Winzig kleine Ovarien im 13. Segment, Ovarientrichter auf dem Dissepiment 13/14. Mitteldarm im 18., kräftige S-förmige Typhlosolis vom 27. Segment vorhanden, Nephridien mit einer einfachen Nephridialblase (Abb. 15).

Samentaschen 3 Paar im 7., 8., 9. Segment, schlauchförmige Ampulle mit sehr kurzem Ausführungsgang, ohne Samenkämmerchen. Die schlauchförmige Ampulle (Abb. 16) kann auf kleine tropfenförmige Gebilde reduziert sein, manchmal gänzlich fehlen.

Martiodrilus (Botaria) minoriformis sp. n.

Fundort. Prov. Napo. Holotypus. AF/3956, zwischen Puerto Napo und Ahuano, 24 km von Tena entfernt, 400 m, Regenwald, 3. 5. 1990, leg. Zicsi+Csuzdi+Paredes. M - Paratypen. AF/2216, 3 Ex., Fundort wie beim Holotypus. Prov. Pastaza. AF/3958, 1 Ex., AF/3960, 1 Ex., hinter Madre Tierra Regenwald, 800-850 m, 2. 5. 1989, leg. Zicsi+Loksa+Ponce. - AF/3959, 4 Ex., 16 km von Puyo in Richtung Macas, 1100 m, 1. 5. 1989, leg. Zicsi+Loksa+Ponce.

Länge des Holotypus 55 mm, Breite 3 mm, Segmentzahl 133. Paratypen: Länge 35–55 mm, Breite 2,2–3,1 mm, Segmentzahl 98–35.

Farbe dorsal rot. Kopf rüsselförmig eingezogen, am Ende kolbenförmig verdickt. 1.–2. Segment verwachsen, ab 3. Segment ungeringelt. Borsten am ganzen Körper gepaart, am Schwanz hervorstehend, etwas gekrümmt. Borstenverhältnis hinter dem Gürtel aa:ab:bc:cd:dd wie 15:1,5:5:1:35. Borsten *ab* des 9.,15., 18. Segments auf kleinen runden Papillen angeordnet, in Geschlechtsborsten verwandelt. Länge der Geschlechtsborsten vom 18. Segment 0,65 mm, Breite 0,04 mm, Zahl der Kerben 11. Nephridialporen in der Borstenlinie *d*. Samentaschenporen auf Intersegmentalfurche 6/7-8/9 in der Borstenlinie *cd*.

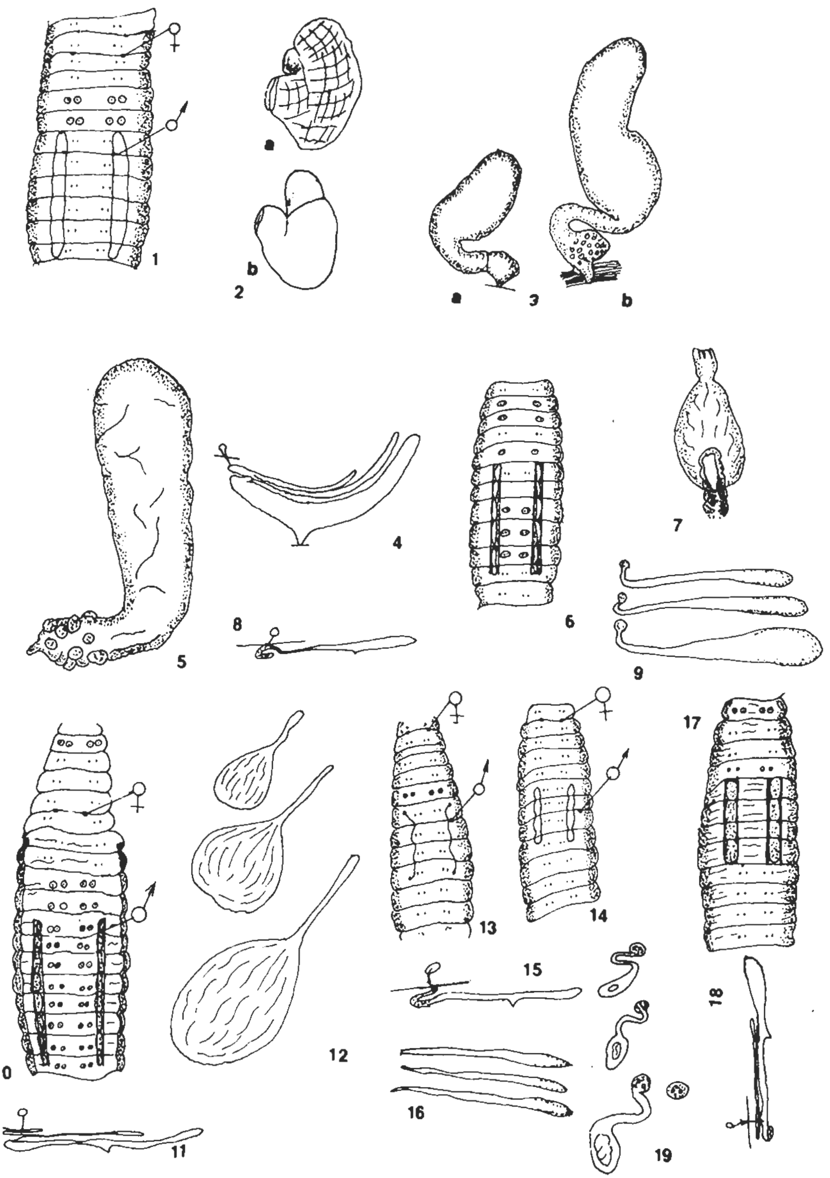

Abb. 1–4. *Martiodrilus (Botaria) cuzonus* (Cognetti, 1904). 1: Ventralansicht. 2a: Vordere Chylustasche mit aufgeblähter leerer Wabentaschenstrucktur und abgeschnürtem seitlichem Zapfen. 2b: Hintere Chylustasche mit abgeschnürtem Kopf. 3a: Samentasche ohne Samenkämmerchen. 3b: Samentasche mit Samenkämmerchen. 4. Nephridialblase. – **Abb. 5.** *Martiodrilus (Botaria) bicolor* (Michaelsen, 1913). Samentasche mit Samenkämmerchen. – **Abb. 6–9.** *Martiodrilus (Botaria) cuzonus filiformis* ssp. n. 5: Ventralansicht. 7: Muskelmagen mit dorsaler Fortsätzung des Ösophagus. 8: Nephridialblase. 9: Kolbenförmige Samentaschen. – **Abb. 10–12.** *Martidrilus (B.) feijooi* sp. n. 10: Ventralansicht. 11: Nephridialblase. 12: Samentaschen. – **Abb. 13–16.** *Martiodrilus (B.) minor* sp. n. 13–14: Ventralansicht mit verschiedenen Pubertätsstreifenformen. 15: Nephridialblase. 16: Samentaschen. – **Abb. 17– 19.** *Martiodrilus (B.) minoriformis* sp. n. 17: Ventralansicht. 18: Nephridialblasen. 19: Samentaschen.

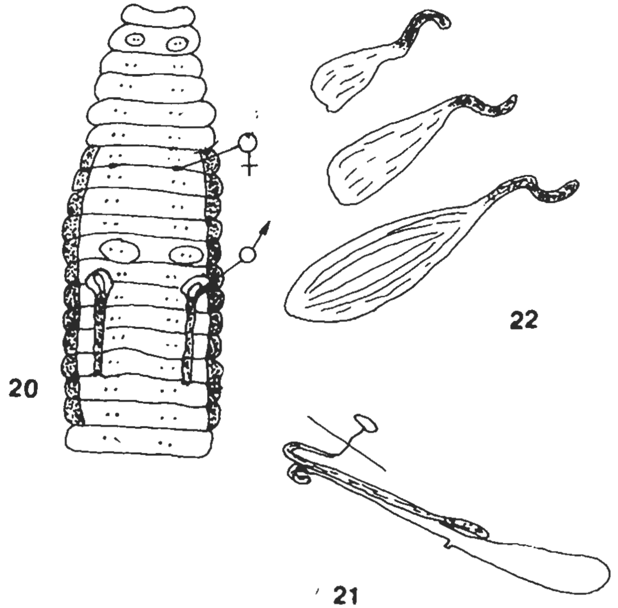

Abb. 20–22. *Martodrilus (B.) parvus* sp. n. 20: Ventralansicht. 21: Nephridialblase. 22: Samentaschen.

Gürtel sattelförmig auf dem 15.–5. Segment. Pubertätsstreifen auf dem 19.–23. Segment, breite Streifen, die beiderseits von einem dünnen Wall umgeben sind (Abb 17). Weibliche Poren am hinteren Rand des 14. Segments. Männliche Poren auf Intersegmentalfurche 19/20.

Innere Organisation. Dissepimente nicht verdickt, vorne fehlend, von 9/10 bis zu 14/15 hautförmig dick zu erkennen. Schlund gross, Osophagus vor dem Muskelmagen von Peptonephridien umgeben. Muskelmagen im 6. Segment, zwiebelförmig verzogen, ohne Kragen. Lateralherzen im 7.–9, Intestinalherzen im 10. und 11. Segment. Schlingenförmige Herzen im 12. Segment fehlen. Chylustaschen im 7. Segment, die drei Paar vorderen plattgedrückt mit einem Zapfen auf der inneren Seite, die hinteren 5 mit abgeschnürtem Kopf. Wabentaschen. Hoden und Samentrichter in oesophageale Testikelblasen eingeschlossen, die sich seitlich am Oesophagus heraufziehen, ohne die Herzen und Chylustaschen der entsprechenden Segmente einzuschliessen. Aus ihnen gehen die lappenförmigengrossen Samensäcke des 11. u. 12. Segments durch Durchbrechung der Dissepimente hervor. Samenrinnen kommen etwas gewunden hervor und verlaufen unvereint an der Muskelwand entlang, münden in die drüsig hervortretenden Pubertätswälle ein. Ovarien im 13. Segment, winzig kleine Gebilde, Ovarietrichter auf Dissepiment 13/14. Mitteldarm im 18., breite S-förmige Typhlosolis im 27. Segment beginnend. Nephridien mit einfacher Nephridialblase (Abb. 18).

Samentaschen 3 Paar im 7.–9. Segment, grosse keulenförmige Ampulle mit stark gewundenem Ausführungsgang der an der Basis angeschwollen und mit

Samenmassen gefüllt ist. Auch in den keulenförmigen Ampullen schimmern granulierte, silberne Samenmassen durch. Neben den Samentaschen im 9. Segment liegen zwei grosse, runde Drüsen, dicht unterhalb der inneren Borstendrüsen (Abb. 9).

Die neue Art steht der vorausgehend beschriebenen *M. (B.) minor* am nächsten, unterscheidet sich von ihr durch die Lage des Gürtels und der Pubertätsstreifen sowie durch die gewundenen, keulenförmigen Ampullen der Samentaschen.

Martiodrilus (Botaria) parvus sp. n.

Fundort. Prov. Pastaza. Holotypus. AF/3961,. 31 km von Puyo in Richtung Banos, 1100 m, 3. 5. 1989, leg. Zicsi+Loksa+Ponce. – Paratypen. AF/3962, 2 Ex., Fundort wie beim Holotypus.

Länge des Holotypus 40 mm, Breite 2 mm, Segmentzahl 121. Paratypen: Länge 25–45 mm, Breite 1,8-2,2 mm, Segmentzahl 98–121.

Farbe rot, dorsal gestreift. Kopf kolbenförmig eingezogen. 1.-2. Segment verwachsen, letzteres längsgefurcht. Vom 3 Segment ungeringelt. Borsten am ganzen Körper gepaart, am Hinterende stark hervortretend und hakenförmig gebogen. Borstenverhältnis hinter dem Gürtel aa:ab:bc:cd:dd wie 15:2,5:12,5:1:42. Borsten *ab* des 9. und 18. Segments auf grossen Papillen, in Geschlechtsborsten verwandelt. Länge 0,8 mm, Breite 0,03 mm, Zahl der Kerben 9. Nephridialporen in der Borstenlinie *cd.* Samentaschenporen auf Intersegmentalfurche 6/7-8/9.

Gürtel sattelförmig auf dem 15.-24. Segment. Pubertätsstreifen auf dem 1/2 19.-23. Segment, dünne Streifen in einer Vertiefung liegend, die beiderseits von einem Wall umgeben sind. Am Anfang der Streifen, auf Intersegmentalfurche 19/20, liegen die männlichen Poren auf hervorstehenden, penisartigen Gebilden (Abb. 20), in die von innen, die getrennten Samenleiter einmünden. Weibliche Poren auf dem hinteren Rand des 14. Segments, in der Borstenlinie *b.*

Innere Organisation. Verdickte Dissepimente fehlen, von 9/10-15/16 hautförmig dünne Disspepimente vorhanden. Schlund gross, Oesophagus vor dem Muskelmagen von Peptonephridien umgeben. Muskelmagen ohne Kragen im 6. Segment. Lateralherzen im 7.-9., Intestinalherzen im 10. u. 11. Segment. Schlingenförmige Herzen im 12. Segment fehlen. 8 Paar Chylustaschen im 7.–14. Segment, die vorderen 3 fest an den Muskelmagen gepresst, die 5 hinteren mit abgeschnürtem Kopf. Wabentaschen. Oesphageale Testikelblasen im 10. und 11. Segment, ziehen sich am Oesophagus hoch, ohne die Herzen und Chylustaschen der entsprechenden Segmente einzuschliessen. Aus ihnen gehen die grossen, lappenförmigen Samensäcke des 11. u. 12. Segments, durch Durchbrechung der Dissepimente, hervor. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend. Nephridien mit einfacher Nephridialblase (Abb. 21).

Samentaschen 3 Paar im 7.–9. Segment, gewundener, muskulöser Ausführungsgang mit keulenförmiger Ampulle, die mit Samenmassen voll gefüllt sind. Auch an der Basis des Ausführungganges sind Samenmassen zu erkennen (Abb. 22).

Die neue Art steht *M. (B.) moniliformis* sp. n. am nächsten, unterscheidet sich von dieser in der Lage der Pubertätsstreifen und durch die penisförmigen männlichen Poren, die bei keiner Art dieser Untergattung beobachtet werden konnten.

Martiodrilus (Botaria) andiorrhinoides (Michaelsen, 1918)

Thamnodrilus (Thamnodrilus) andiorrhinoides Michaelsen, 1918: 20.

Fundort. Prov. Napo. AF/1593, 3 Ex., 10 km von Borja in Richtung Lago Agrio, Regenwald, in Bromelien, 1300 m, 9. 5. 1988, leg. Zicsi+Csuzdi.

In der Sammlung von Hamburg (V. 6977, Ecuador, Loja, leg. Ohaus) liegen ein geschlechtsreifes und 5 gürtellose Tiere vor, von denen 3 geöffnet sind. Die inneren Organe liegen gesondert in kleinen Gläschen vor. Die von mir als *andiorrhinoides* identifizierten 3 Exemplare, die lebend schwarzgrün waren, stimmen mit dem geschlechtsreifen Exemplar vollkommen überein, insbesondere kennzeichnend sind die am Hinterende in der Borstenlinie *cd* liegenden hellen Flecke in der Pigmentierung. Die bei den nicht adulten Tieren angeführten 3 Papillen auf den Pubertätsstreifen sind nicht zu erkennen, doch sind diese auch am Originalstück nicht vorhanden. Die weiteren Übereinstimmungen in der Lage des Gürtels, der Pubertätsstreifen, der Kerbenzahl, der auf Papillen stehenden Borsten und der inneren Organe lassen trotz der weiten Entfernung der beiden Fundorte keinen Zweifel hinsichtlich der Identität der beiden aufkommen.

Das geschlechtsreife Exemplar aus der Sammlung von Hamburg wird unter Inv. Nr V. 6977/a als Lectotypus designiert.

Martiodrilus (Botaria) benhami (Cognetti, 1904)

Thamnodrilus benhami Cognetti, 1904: 6.
Rhinodrilus (Thamnodrilus) benhami, Cognetti, 1906: 206.
Thamnodrilus(Thamnodrilus) benhami, Michaelsen, 1918: 12.

Laut Originalbeschreibung soll zur Beschreibung ein Exemplar vorgelegen haben. In der Sammlung von Torino werden unter Inv. Nr. OL 424 (*Thamnodrilus benhami* Cognetti typi, Foreste della Rio Santiago, Ecuador, viaggio Festa, II. 1896) 5 Exemplare aufbewahrt, von denen 2 vollkommen geschlechtsreif sind, bei 2 Tieren ist der Gürtel angedeutet, einem Stück fehlt der Gürtelteil. Da der Gürtel bei keinem Tier bis zum 26. Segment reicht, die Pubertätsstreifen bis zum 25. Segment reichen, ist das Originalstück, von dem die Beschreibung gegeben wurde, schwer zu bestimmen. Bei allen Tieren sind die perioesophagealen Testikelblasen zu erkennen, wodurch sich *benhami* von *tutus* und *gravis*, die aus der gleichen Umgebung beschrieben wurden, unterscheidet. Da alle Tiere geöffnet waren und sich auch in ziemlich schlechtem Zustand befanden, verzichte ich auf die Designierung eines Lectotypus und halte die sehr ausführliche Originalbeschreibung für massgebend.

Martiodrilus (Botaria) onorei Zicsi, 1988

Martiodrilus onorei Zicsi,1988: 438.

Fundorte. Prov. Pichincha. AF/510, 5+1 juv. Ex.., Finca la Cypressis, Bachufer, 26. 2. 1986, leg. Zicsi+Loksa+Benavides. - AF/1612, 1 Ex., Iliniza, 4000m, 13. 5. 1988, leg. Zicsi+Csuzdi. - Prov. Napo. AF/3894, 1 Ex., oberhalb Papallacta, 3800 m, 1. 5. 1988, leg. Zicsi+Csuzdi. - AF/258, 5 Ex., AF/267, 1 Ex., AF/264, 1 Ex., AF/280, 1 Ex., San Francisco de las Pampas, Naranchito, 1800 m, 8.-10. 2. 1986, leg. Zicsi+Loksa. - Prov. Cotopaxi. AF/297, 1 Ex., Pueblo Quemado, 16. 2. 1986, leg. Zicsi+Loksa. - AF/290, 4 Ex., Cotopaxi Vulkan,3750 m, 26. 2. 1986, leg. Zicsi+Loksa+Benavides. - Prov. Imbabura. AF/504, 1+2 juv. Ex., 53 km von Otavalo in Richtung Selva Alegre, 24. 4. 1987, leg. Zicsi+Loksa.

Eine Nachuntersuchung des Typenmaterials zeigte, dass die männlichen Poren auf Intersegmentalfurche 20/21 liegen und nicht auf dem vorderen Teil des 21. Segments. Die drei vorderen Chylustaschen sind ebenfalls plattgedrückte Wabentaschen mit abgeschnürtem seitlichem Zapfen.

Martiodrilus (Botaria) poncei Zicsi, 1988

Martiodrilus poncei Zicsi, 1988: 441.

Fundort. Prov. Napo. AF/344, 1Ex., zwischen Puerto Misahuali und Tena, Regenwald, 14. 2. 1986, leg Zicsi+Loksa+Benavides. - Prov. El Oro. AF/1587, 2 praead. Ex., hinter Santa Rosa in Richtung Loja, 5 km vor Pinas, 500 m, 2. 5. 1988, leg. Zicsi+Csuzdi.

Die vorderen 3 Paar Chylustaschen sind auch bei dieser Art zusammengepresste Wabentaschen mit abgeschnürtem Kopf, der nach unten gerichtet ist.

Mit den Arten *M. colomai* Zicsi, 1988, *M. pano* Righi, 1992, *M. murindo* Righi, 1995 und *M. vassae* Zicsi & Csuzdi, 1999, die alle über einen Blindsack im 26. bzw. 27. Segment verfügen, werde ich mich im späteren befassen. Da ich Righis Arten nicht überprüfen konnte, aus der Beschreibung jedoch auf eine verschiedene Form der Chylustaschen folgern kann, wären auch diese in diese Unterart einzureihen. Meine beiden Arten hingegen zeigen diese Unterschiede in der Form der Chylustaschen nicht. Da in anderen Familien, wie Megascolecidae und Acanthodrilidae, dieses Merkmal auch supraspezifischen Wert besitzt, ist es in der Familie Glossoscolecidae auch in anderen Gattungen bekannt (*Rhinodrilus, Andiorhinus*), wird aber nur als artspezifisches Kennzeichen betrachtet. Da die Bedeutung dieses Merkmales noch nicht zur Genüge geklärt ist, gleicherweise auch bei Arten mit 4 Paar Samentaschen ohne verdickte Dissepimente hinter dem Muskelmagen (*M. friderici* Michaelsen, 1918) und bei solchen mit verdickten Dissepimenten hinter dem Muskelmagen (*M. (M) menai* Zicsi & Csuzdi, 1999) vorkommt, könnte an eine Absonderung dieser Spezies im Rahmen einer supraspezifischen Einheit im späteren gedacht werden. Dies auch desto mehr, da meine Revisionen die Gattung *Martiodrilus* betreffend gezeigt haben (Zicsi, im Druck), dass dieses Kennzeichen von den älteren Autoren nicht übersehen wurde, wie wir dies in einer vorausgehenden Arbeit (Zicsi und Csuzdi, 1999) angedeutet hatten. Vorerst soll aber auch die letzte Gruppe der *Martiodrilus*-Arten, die mit 4 Paar Samentaschen und fehlender verdickter Dissepimente hinter dem Muskelmagen revidiert werden, um endgültig Stellung beziehen zu können.

Zusammenfassung

Die bisher bechriebenen und jetzt zur neuaufgestellten Untergattung *Botaria* eingereihten Arten der Gattung *Martiodrilus* konnten bis auf *M. (B.) gara* Righi, 1995 anhand des Typenmaterials überprüft und revidiert werden, wobei auch je ein Lectotypus, soweit dies erforderlich war, designiert wurde.

Von den besprochenen spezifischen Taxa kommen *M. (B.) helleri, M. (B.) gara* und *M. (B.) feijooi* nur in Kolumbien, *M. (B.) euzonus* und *M. (B.) bicolor* in Kolumbien und Ekuador gleicherweise vor. Die übrigen Arten bzw. die Unterart wurden nur in Ekuador gesammelt und auch hier haben einige wie *M. (B) gravis, M. (B.) tutus, (B.) benhami* und *M. (B.) andiorrhinoides* sowie *M. (B.) poncei, M. (B.) minor, M. (B.) minoriformis, (B.) parvus* nur in den südlichen und südöstlichen Teilen des Landes vor. Das Vorkommen der am häufigsten verbreiteten Art *M. (B.) euzonus* und ihrer Unterart *filiformis* reicht nur bis in die Provinz Cotopaxi, wo auch diesen, wie vielen anderen *Martiodrilus*-Arten, der interandine Trockenstreifen eine weitere Verbreitung nicht ermöglicht (Zicsi und Csuzdi, 1999; Zicsi, im Druck).

Danksagung. Für die Überlassung von Typenmaterial spreche ich Frau Doz. Dr. H. Ruhberg und Herrn Prof. Dr. M. Dzwillo (Zoologisches Institut und Museum der Universität, Hamburg) und Herrn Dr. A. Rolando (Museo ed Istituto di Zoologica Sistematica della Universitŕ, Torino) auch an dieser Stelle meinen besten Dank aus.

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Communicationes Breves

Once more: the oesophageal gland nuclei in the dorylaimoid nematodes

By

I. ANDRÁSSY*

Abstract. The significance of the oesophageal gland nuclei in morphological characterization of dorylaimoid nematodes is underlined. Maintaining the principles of Loof and Coomans (1970), a modified method and graphic diagrams are proposed in order to express and illustrate the arrangement of the nuclei.

In a fundamental paper on the oesophageal gland nuclei in the Dorylaimina, Loof and Coomans (1970) called attention to the importance of these nuclei in morphology and systematization. As they demonstrated with numerous examples, the location of the nuclei - their arrangement in the cylindrus and percentile position as compared to each other - is fairly constant within each species and, therefore, it may be considered good morphological character for both species and genera, or occasionally even for families.

In one of my recent publications (1998), I also tried to emphasize the significance of the oesophageal gland nuclei in the Dorylaimina. On this occasion, the subject shall be surveyed once more.

As it is known, there are embedded salivary or digestive glands in the oesophageal tissues of the dorylaimoid nematodes which pour their secretion into the the lumen of the oesophagus. These glands are always located in the posterior widened section of the oesophagus, the so-called cylindrus. They are five in number, but one or the other of them may occasionally be reduced. These glands are unicellular and have large, in most cases well discernible nuclei; owing to their definite figure and refraction they differ from the surrounding tissues. Often they can be seen also under low magnifying, sometimes, particularly in small animals, a higher magnification (immersion) is necessary to recognize them. The nuclei are generally round (better: globular), occasionally oblong, the „court" or „halo" around them is mostly oval, rarely round.

The nuclei are located not accidentally but in certain formula in the cylindrus. One of the five nuclei is unpaired, the other ones are more or less arranged in two pairs. The anteriormost nucleus stands alone and lies dorsal; it is generally the largest, either globular or oblong. This dorsal nucleus is located near the anterior end of the cylindrus and it is practically always present and conspicuous. It can be marked with a D (dorsal nucleus). The other four nuclei lie posterior to this D; their position is subventral or ventrosublateral. They are in almost every case distinctly smaller than the dorsal nucleus. The members of the first/anterior subventral pair can seldom be found close to one another, usually they lie at

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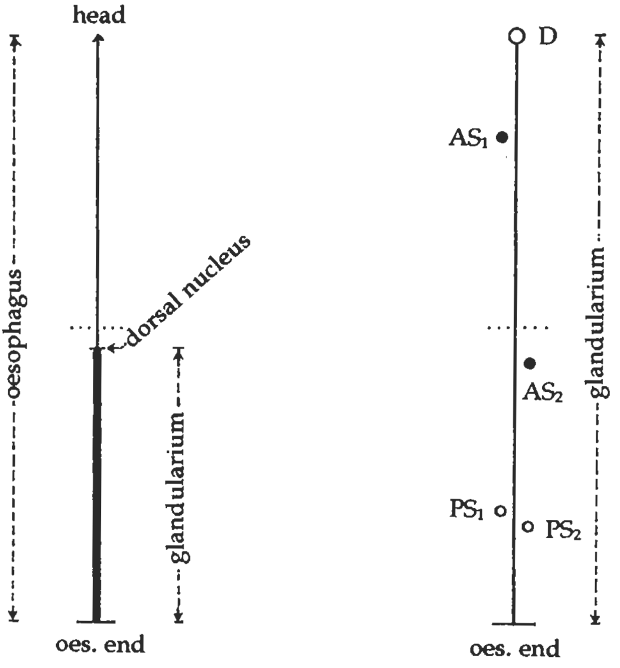

A B

Fig. 1. A–B: A graphic method to illustrate the position of the oesophageal gland nuclei. A: Length of the glandularium (the posterior thicker section) in percentage of the total oesophagus length measured from head to posterior end of cylindrus. Beginning of the glandularium = location of the dorsal nucleus. B: Position of the subventral nuclei within the glandularium, in percentage of the length from dorsal nucleus to posterior end of cylindrus (● AS nuclei, o PS nuclei). Dotted lines indicate the middle (50 %) of both lengths

different levels, not rarely rather far from one another. Thus, it may happen that one nucleus of the first pair lies closer to the dorsal nucleus than to its partner. In general, these nuclei are embedded in the middle region of the cylindrus, their concrete location varies however from species to species. They are symbolized as AS_1 (anterior subventral nucleus, *first*) and AS_2 (anterior subventral nucleus, *second*). It is common that AS_1 is smaller than AS_2, sometimes even invisible. AS_1 is generally globular, AS_2 either globular or ovoid. The second/posterior subventral pair lies in the posterior third or fourth of cylindrus. These nuclei are equal in size and shape, predominantly globular, distinct, and actually arranged in twos lying at the same level or nearly so. They may be symbolized as PS_1 (posterior subventral nucleus, *first*) and PS_2 (posterior subventral nucleus, *second*).

The juices of the glands flow through small canals into the oesophageal lumen. These canals are very fine and not or hardly discernible owing to the heavily striated-vesiculated structure of the oesophageal musculature. Their orifice is often conspicuous, but these minute apertures are mostly much less visible than the nuclei themselves. The orifice of the dorsal gland generally lies anterior to the nucleus, those of the other four glands can be found in the close vicinity of the corresponding nucleus.

Unfortunately, the authors dealing with dorylaims often do not pay attention properly to the oesophageal nuclei. True enough, the recognition of the nuclei and thus the definition of their exact position needs an accurate work, good eyes and, first of all, excellently fixed and well preserved animals. As for me, I have also taken these nuclei only for the late times into extra account. In the course of serious new observations, I have definitely been convinced of the importance of these nuclei in morphological characterization of dorylaimoid nematodes. I found that these small organella can frequently be recognized also in 20-30-40 years old nematode specimens.

Nowadays, the science of nematology, especially the taxonomic branch of it, is under heavy parturition. On the one hand, numerous new nematode species are being described and several new genera established. On the other hand, known species are being either synonymized or scattered in diverse genera, and old genera fused or, on the contrary, splitted. It happens that these taxonomic or nomenclatorial transactions or „non-appealable-verdicts" are merely based on subjective (maybe even not quite competent) opinions. Well, in order to reduce subjectivity in taxonomic operations as far as possible, the oesophageal gland nuclei, even if they can not solve every problem, but they may lend a true „helping hand" in morphological-taxonomical valuation of species and genera in Dorylaimina. The position, we may say „map" or pattern of the oesophagus nuclei, if precisely stated, is an absolutely concrete character, it is out of any subjectivity. However, one thing is very important: the location of the nuclei must not be given but as a result of quite precise measurements only! Should someone be not completely sure in the position of one or the other nucleus, then to say nothing is much better than to give some unprecise information.

Loof and Coomans (1970) gave diagrams or representation in order to express the position of the gland nuclei. Keeping the principles, I suggested most recently (1998) a somewhat modified method for representing the nuclei. While the two authors gave the position of all the five gland nuclei as percentage of the total oesophagus length (from head to posterior end of oesophagus), I proposed only the dorsal nucleus to be determined as a percentage of this length, the other four nuclei, however, should be localized as a percentage of the distance from the dorsal nucleus to the posterior end of cylindrus. The dorsal nucleus is big enough to be recognized even under low magnification and its position is easily specified in relation to the entire length of oesophagus. The position of the subventral nuclei is however very characteristic just within the cylindrus and much more advisable to be expressed in percentile relations to each other or to the dorsal nucleus than in relation of the total oesophagus length. (Percentage values of the subventral nuclei are unadvisable to be given in the length of cylindrus since in determining this distance certain subjectivity may occur: the anterior end of the cylindrus is namely difficult to determine accurately.)

Modified diagrams shall also be proposed to make the position of the nuclei graphic. They are easy to perceive as illustrated in Fig. 1. This diagram of each nematode specimen consists of two elements (columns): the one (the left hand column; Fig. 1 A) shows the length of the glandularium in percentage of the total oesophagus length, the other (the right hand column; Fig. 1 B) illustrates the location of the nuclei within this glandularium. As seen, a new technical term, *glandularium*, is suggested (from the Latin, *glandula* = gland, *glandularium* = a holder or receptacle for glands, or so). It expresses in a single word the distance between dorsal nucleus and posterior margin of cylindrus, or in other way, glandularium is that part of the oesophagus, more closely: of the cylindrus, that comprises the whole glandular apparatus. The anterior end of the glandularium coincides with the dorsal nucleus, thus, it indicates the exact position of that. The dotted lines in the diagram indicate the middle (50 %) of both the oesophagus length and glandularium, and they help in conceiving the arrangement of the nuclei.

Summing up, on the basis of older and newer observations the conclusion can be drawn that each species (and probably genus as well) of dorylaimoid nematodes has its own special

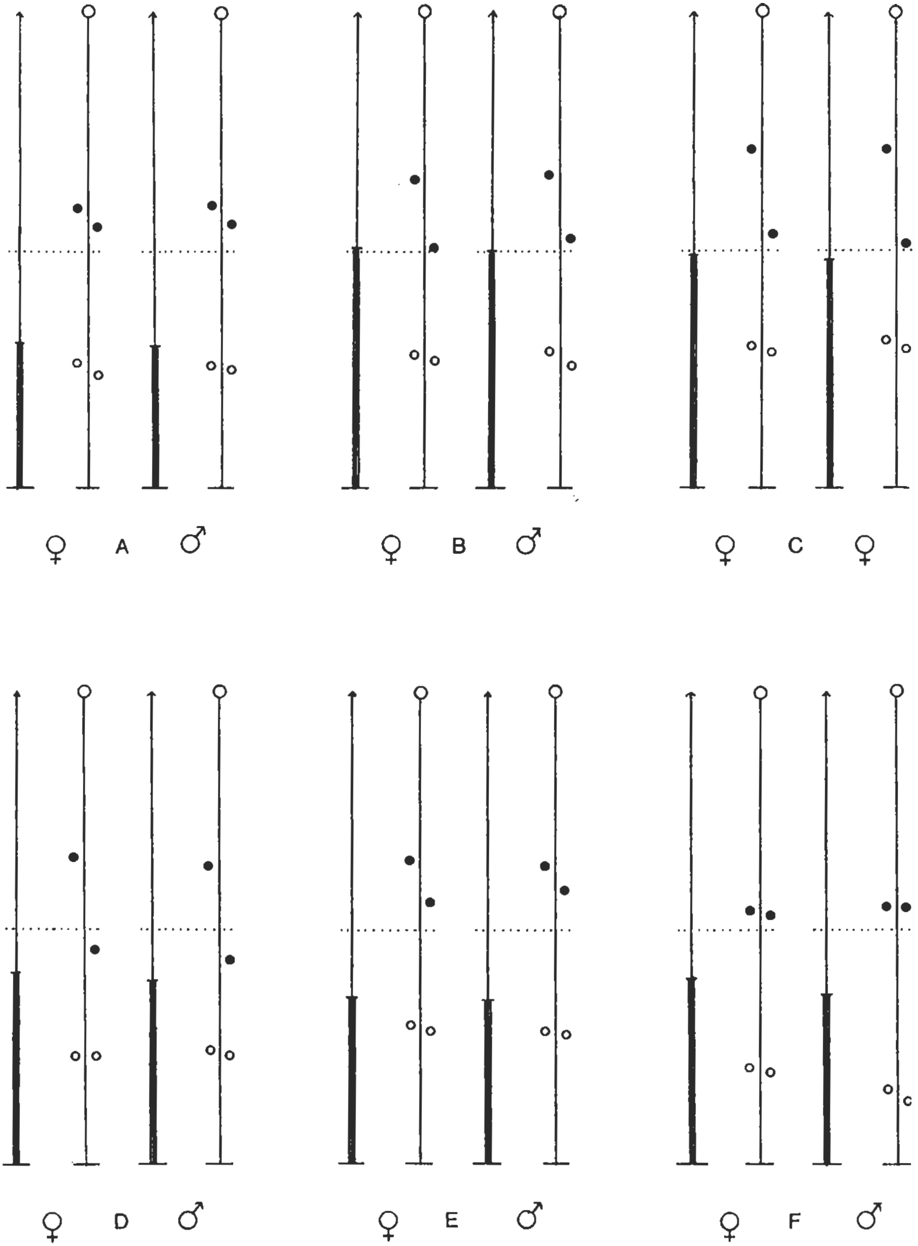

Fig. 2. A–F. Position of oesophageal gland nuclei in some species of Dorylaimina. A: Thorniidae: *Nygolaimoides borborophilus* (de Man, 1876), a female and a male from Hungary. B: Dorylaimidae: *Dorylaimus fodori* Andrássy, 1988, a female and a male from India. C: Dorylaimidae: *Laimydorus prolificus* (Thorne & Swanger, 1936), two females from Slovakia. D: Dorylaimidae: *Mesodorylaimus plicatus* Andrássy, 1986, a female and a male from Ecuador. E: Qudsianematidae: *Allodorylaimus septentrionalis* (Kreis, 1963), a female and a male from Hungary. F: Qudsianematidae: *Eudorylaimus acuticauda* (de Man, 1880), a female and a male from Poland

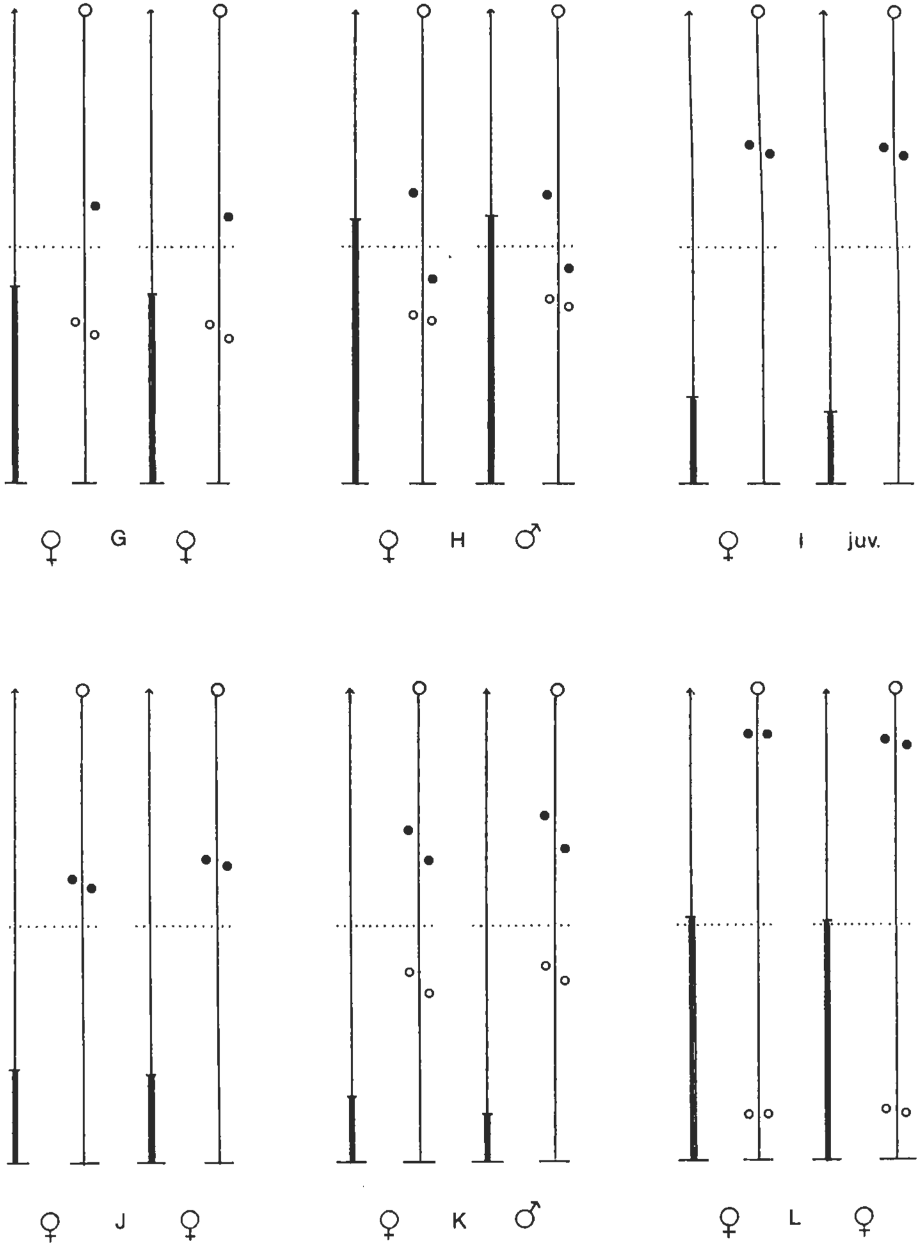

Fig. 2. G–L. Position of oesophageal gland nuclei in some species of Dorylaimina. G: Qudsianematidae: *Boreolaimus borealis* Andrássy, 1998, two females from Norway. H: Aporcelaimidae: *Aporcelaimus declinatoaculeatus* (Kreis, 1924), a female and a male from Hungary. I: Longidoridae: *Paralongidorus rex* Andrássy, 1986, a female and a juvenile from Hungary. J: Longidoridae *Xiphinema index* Thorne & Allen, 1950, two females from France. K: Tylencholaimellidae: *Tylencholaimellus neotropicus* Andrássy, 1997, a female and a male from Ecuador. L: Nygolaimidae: *Clavicaudoides trophurus* (Heyns, 1968), two females from South Africa

nuclear arrangement in the oesophageal cylindrus. In Figs. 2 A–F and 2 G–L, some examples are given in order to illustrate how multifarious the „map" of oesophageal nuclei can be in Dorylaimina, as well as to help in comprehending and using the method proposed. After a short practice, it is easy to characterize and compare dorylaimoid nematode species on the basis of their glandularium.

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Percentile values of oesophageal gland nuclei in some species of Dorylaimina illustrated in Figs. 2 A–F and 2 G–L

Nygolaimoides borborophilus

D = 69–70%	AS_1 = 40–42%
	AS_2 = 44–45%
	PS_1 = 73–74%
K = 91–93%	PS_2 = 75–76%

Dorylaimus fodori

D = 49–50%	AS_1= 34–35%
	AS_2= 47–49%
	PS_1 = 71–72%
K = 71–72%	PS_2 = 73%

Laimydorus prolificus

D = 51–52%	AS_1 = 28%
	AS_2 = 47–48%
	PS_1 = 68–70%
K = 58–60%	PS_2 = 71%

Mesodorylaimus plicatus

D = 59–61%	AS_1 = 35–37%
	AS_2 = 54–56%
	PS_1 = 75–77%
K = 65–66%	PS_2 = 76–77%

Allodorylaimus septentrionalis

D = 63–65%	AS_1 = 35–37%
	AS_2 = 42–44%
	PS_1 = 70–71%
K = 83–84%	PS_2 = 71–72%

Eudorylaimus acuticauda

D = 60–63%	AS_1 = 45–46%
	AS_2 = 45–47%
	PS_1 = 79–83%
K = 98–100%	PS_2 = 80–86%

Boreolaimus borealis

D = 58–60%	AS_1 = lacking
	AS_2 = 42–44%
	PS_1 = 66–67%
K = no value	PS_2 = 68–69%

Aporcelaimus declinatoaculeatus

D = 43–44%	AS_1 = 38–39%
	AS_2 = 54–57%
	PS_1 = 72–74%
K = 68–70%	PS_2 = 73–75%

Paralongidorus rex

D = 82–84%	AS_1 = 28–29%
	AS_2 = 30–31%
	PS_1 = lacking
K = 93 %	PS_2 = lacking

Xiphinema index

D = 80–81%	AS_1 = 36–40%
	AS_2 = 37–42%
	PS_1 = lacking
K = 95–97 %	PS_2 = lacking

Tylencholaimellus neotropicus

D = 86–89%	AS_1 = 27–30%
	AS_2 = 33–36%
	PS_1 = 58–60%
K = 82–83%	PS_2 = 62–64%

Clavicaudoides trophurus

D = 48–49%	AS_1 = 10–11%
	AS_2 = 10–12%
	PS_1 = 88–90%
K = 92–100%	PS_2 = 89–90%

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