Opusc. Zool. Budapest, 2002, 34: 3-4

In memoriam Dr. János Balogh

Hungarian science, university education and the whole environmentally conscious society has suffered a great loss. On 15th August 2002, at the age of 89, h.c. prof. emer. dr. János Balogh, member of the Hungarian Academy of Sciences, honorary member of the Austrian Academy of Sciences, leading professor of the Department of Systematic Zoology and Ecology at the Eötvös Loránd University, Budapest, an internationally renowned scientist, a distinguished specialist of Arachnida and Oribatida, an outstanding expert of soil zoology, community ecology of animals and terrestrial ecology and also working in the tropics and on global environmental protection, died in Budapest after a short illness.

János Balogh was born on 19th February, 1913 in Nagybocskó, north-east Hungary (belonging today to Ukraine). His father was a schoolmaster and cantor, but he died in action during the First World War. His wife soon followed him and János Balogh was raised by his caring grandparents before he was taken into a protestant orphanage. His extraordinary mental abilities, intelligence and dutifulness was already recognised at the age of 10 and he was accepted by the Lutheranian secondary school in Budapest, which was famous for its extremely high standard in education. He always remembered his old school as a determining factor of his career and mentality. He studied biology at the Pázmány Péter University, Budapest and defended his PhD in 1935. In 1944, at the age of 31, he qualified as a private lecturer of the university under the directorate of Professor Endre Dudich, Head of the Department of Systematic Zoology and Zoogeography, who had raised generations of Hungarian zoologists for more than three decades. János Balogh had already become an assistant lecturer of the department in 1937 and throughout his career as a teacher, professor and researcher most of his activities were centred there. Within the department, the Hungarian Academy of Sciences founded a Soil Zoology Research Team in 1960, which he led until 1980.

Following the retirement of Professor Dudich, János Balogh in turn became the head of the Department of Systematic Zoology and Ecology of the Eötvös Loránd University (1966-1984), from where he retired as an Emeritus University Professor. In 1985 he was conferred with an Honorary Doctorate of the university.

In 1965, he was elected a corresponding member, in 1973 an ordinary member of the Hungarian Academy of Sciences. In 1986, he became an honorary member of the Austrian Academy of Sciences. He chaired the Section of Biological Sciences in the Hungarian Academy of Sciences for two periods.

His scientific activities had three main directions: the taxonomy and historical chorology of spiders (Arachnida) and oribatid mites (Oribatida), the community ecology of terrestrial animals, and finally, global ecological problems and environmental protection. His first faunistic and community ecological work on spiders (1935) and his „Oribatei of Hungary" (1943) already showed his excellent taxonomical knowledge. His interest in ecology and community ecology led him to critically evaluate and synthesize the current international literature and to write his fundamental book on the community ecology of animals: „A zoocönológia alapjai" (Budapest, 1953, pp. 248), which was the first textbook in this topic in Hungary including an extended German summary. In 1958, he wrote an outstanding book in German, „Lebensgemeinschaften der Landtiere, ihre Erforschung unter besonderer Berücksichtigung der zoocönologischen Arbeitsmethoden" (Budapest–Berlin, 1958, pp. 560); which was highly recognised even outside German-speaking countries.

The taxonomical, faunistical, ecological and community ecological research of the Soil Zoology Research Team of the Hungarian Academy of Sciences, which was led by János Balogh, was internationally renowned. They were one of the first research groups dealing with the zoological components of organic matter decomposition in forest soils in Europe. The multidisciplinary approach of global ecological problems and other basic environmental questions (e. g. the relationship between the oxygen concentration of the air and abiotic and biotic evolution), János Balogh mainly built into his university lectures and into innumerable radio and television programmes, which he made in order to increase public awareness of the environment. He was a charismatic lecturer, presenting his thoughts clearly and in a fine voice.

An outstanding part of his scientific career was the result of more than thirty soil zoological expeditions he led from at the age of fifty (!) in 1963 up to 1995 to Africa, Asia, South-America, Australia, New Guinea, the South Sea Islands and New Caledonia with the support of UNESCO and the Hungarian Academy of Sciences and a lot of local help. From joint work with many co-authors, several hundred articles have been published on the scientific results of the soil zoological collection of his expeditions, some of them in our present journal, Opuscula Zoologica. Excellent television documentary series shown for decades in Hungary were also shot during the expeditions, which introduced many exotic parts of the world with the accurate and interesting text written by J. Balogh full of concern, care, and a sense of responsibility for the protection of natural values and the future of mankind.

His scientific publications bridged over nearly seven decades, finishing with the book: „Identification keys to the Oribatid mites of the extra-Holarctic Regions, I-II" (Well-Press, Budapest, 2002, pp. 450 + 504). This last *magnum opus* of his, written with his son, Péter Balogh, came out several months after his death making the total number of his publications: 10 books and over 200 scientific publications.

Professor Balogh was a helpful and understanding person, loving his family as well as his country. He did not like calling his colleagues to account, but expected everyone to work at the highest possible level and to be fair in every situation and towards everyone. He carried out his science-political duties with responsibility and with an appropriate approach to compromises, but only along obvious principles.

János Balogh was presented with many awards and prizes. He especially appreciated the Kossuth Prize, which is given to the most distinguished scientists in Hungary, the recognitions (e.g. h.c. prof. emer.) of his university, the Gold Medal of the Hungarian Academy of Sciences, the Hungarian Spiritual Heritage Price and the Corvin Chain given by the Prime Minister of the Republic of Hungary; which only a maximum of twelve internationally recognised scientists can hold at the same time. All who knows his scientific excellence and deep humanity will always remember him with true respect.

*Á. Berczik**

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New genera and species of nematodes from southern Chile

I. ANDRÁSSY*

Abstract. Two new nematode genera and five new species are described from southern Chile: *Plectus araucanorum* sp. n., *Paramphidelus par* sp. n., *Labronema diversum* sp. n., *Aporcella gibberocaudata* gen. n., sp. n. and *Acunemella torta* gen. n., sp. n. *Aporcella* gen. n. (Aporcelaimidae) resembles the genera *Aporcelaimellus* and *Tubixaba*, but differs from the former mainly by the homogeneous layers of cuticle and not sclerotized vulva, from the latter by the large aperture of stylet and the arrangement of oesophageal nuclei. *Acunemella* gen. n. (Nordiidae) is differentiated from all known genera of the family in having a heavily twisted body shape, small head and unusually long, needle-like stylet. In addition, a list of nematode species described as new from South Chile is given.

During the study of soil samples from South Chile, five nematode species were found that proved to be new to science. Two of them do not fit comfortably into any of the known genera, therefore a new genus is suggested for each. The five nematodes described herein are *Plectus araucanorum* sp. n. of the class Torquentia, *Paramphidelus par* sp. n., *Labronema diversum* sp. n., *Aporcella gibberocaudata* gen. n., sp. n. and *Acunemella torta* gen. n., sp. n. of the class Penetrantia.

The soil samples were collected in southern territories of Chile by Cs. Csuzdi and L. Hufnagel (Eötvös Loránd University, Budapest) in the course of a collecting trip in 2001. The samples were fixed on the site in FAA. After bringing them home, the nematodes were extracted by floating-decanting method, then fixed again and processed to anhydrous glycerine using a slow method. The nematode specimens were studied on permanent glass slides.

Chile, covering an area of 742,000 square kilometres, is one of the most peculiar, interesting and fascinating countries in the world; a true synthesis of all kinds of sceneries as well as of widest geographical and natural conditions. Chile is unique in its extremely elongate and narrow shape – 4300 km long and 175 km wide on the average, *i.e.* nearly 25 times as long as wide – extending on the western (pacific) coasts of the South American continent. It has in its territory the highest lake in America (Lago Chungara) located 5000 metres above sea-level, the longest coastline of the South American countries, 8300 kilometres, the giant mountain range of Cordilleras or Andes extending in a length of 4600 km, the most arid desert of the world, Atacama, an area, Antofagasta region, having the most concentrated solar intensity of the Globe (during 360 days of the year), great wild forests, an island zone where one island succeeds another, and the territory, Tierra del Fuego, at the southernmost end of the American continent, in the vicinity of Antarctica.

Owing to the very long extent of the country – from 18 to 56 degrees of the southern latitude, or, in other words, from the tropics to Subantarctic – the climates and other natural conditions are very different in certain regions of Chile. The northern territories belong to the arid (desert) zone, the middle regions have Mediterranean climate, southern Chile is of oceanic influence, and Tierra del Fuego has a Subantarctic character. While in the Atacama Desert no drop of rain has been falling for long decades, in Mid-, and especially in South Chile the precipitation averages are over 2500 mm per year.

In thinking of the natural conditions of Chile, anybody can easily conceive, how multifarious must be the flora and fauna in this country. The

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nematode fauna itself is also composed of a large scale of various forms or taxonomic units. Although our knowledge of the nematode world in Chile is still far from sufficient, we have still some data on it. The first reports on Chilean nematodes had been summarized by Steiner (1943). Subsequently, numerous species, new forms to science as well, have been described or recorded by several authors, mainly North American and European taxonomists. One, Raski should be mentioned by name; he has gained distinction with his 17 publications in the topic. The good fortune gave possibility to the present author as well to study once personally the soil and fresh-water nematodes of this fascinating country.

In summarizing what we know on the Chilean nematode fauna, it appears immediately that the picture in the southern regions strongly differs from that of the northern territories. As might be expected, the nematode fauna of South Chile excels in its richness of rarities. Prior to this paper, not less than 55 new species and 6 new genera have been described in 24 articles from this region. But how far we are still from more intensive investigations! Not going too far, we may suppose so much that every third/fourth nematode species from South Chile will prove to be undescribed. A genus, *Cristamphidelus* Siddiqi & Vinciguerra, 1991, may serve as an example. It is represented by eight species (probably by much more in effect), that have exclusively been disovered in this part of the world. The first and type species of all criconematids, these so fascinating forms of nematodes, was also discovered in southernmost Chile... And we could go on in enumerating the curiosities. This corner of the Globe, with its so unique environmental conditions, will certainly provide still much surprise to science.

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At the end of the present article I give a list of nematode species that have been discovered so far as new to science from South Chile. They represent 20 families. The richest families are Tylenchidae (with 11 species), Criconematidae (with 11 species) and Alaimidae (with 9 species). The richest genera are *Criconema* (with 9 species) and *Cristamphidelus* (with 8 species). Out of the 60 species (55 species described prior to this paper + 5 presently described ones), 8 (13 %) belong to the class Torquentia, 37 (62 %) to Secernentia and 15 (25 %) to Penetrantia.

DESCRIPTIONS

Plectus araucanorum sp. n.

(Fig. 1 A-F)

Holotype female: L = 0.65 mm; a = 22; b = 4.0; c = 7.6; c' = 5.8; V =48 %.

Paratype females (n = 10): L = 0.55–0.66 mm; a = 20–23; b = 4.0–4.6; c = 6.8–7.6; c' = 5.8–7.6; V = 45–48 %.

Body small and rather stout, at anterior end hardly, at posterior end more strongly tapering, 26–29 µm wide at middle. Cuticle very thin. Annulation hardly discernible in most parts of body. Lateral fields narrow and plain. Somatic setae thin and long. Labial region continuous with adjacent body, rounded, 8–10 µm wide at the base; lips small, hardly separated. Body at posterior end of oesophagus 2.6–2.9 times as wide as head. Cephalic setae rather back in position, at level of proximal end of cheilostom, thin, 3.0–3.5 µm long, about as long as maximal width of buccal cavity. Amphids somewhat hook-like or transverse oval, at level of mid-stoma or a little posterior to that.

Buccal tube 17–20 µm long, twice as long as labial width. Anterior part (cheilostom) in its entire length sclerotized, thereupon seemingly longer than in most species of the genus. Oesophageal lumen anteriorly wider than posteriorly. Oesophagus (measured from head end) 140–164 µm long, 22–25 % of entire length of body. Isthmus only slightly narrower than corpus. Terminal bulb moderately strong, together with cardial process 26–35 µm long. Rectum nearly equal in length to anal body diameter, with large proximal cells. Distance between posterior end of oesophagus and vulva 0.9–1.1 times as long as oesophagus.

Female. Reproductive system typical, amphidelphic. Vulval lips slightly elevated, with small lateral liplets. Genital tract 4–5 body widths long, or occupying 20–23 % of body length. In females possessing no eggs, the reflexed ovaries reach to or over the vulva. Ovaries consisting of few cells. One or two uterine eggs measuring 36–48 × 19–21

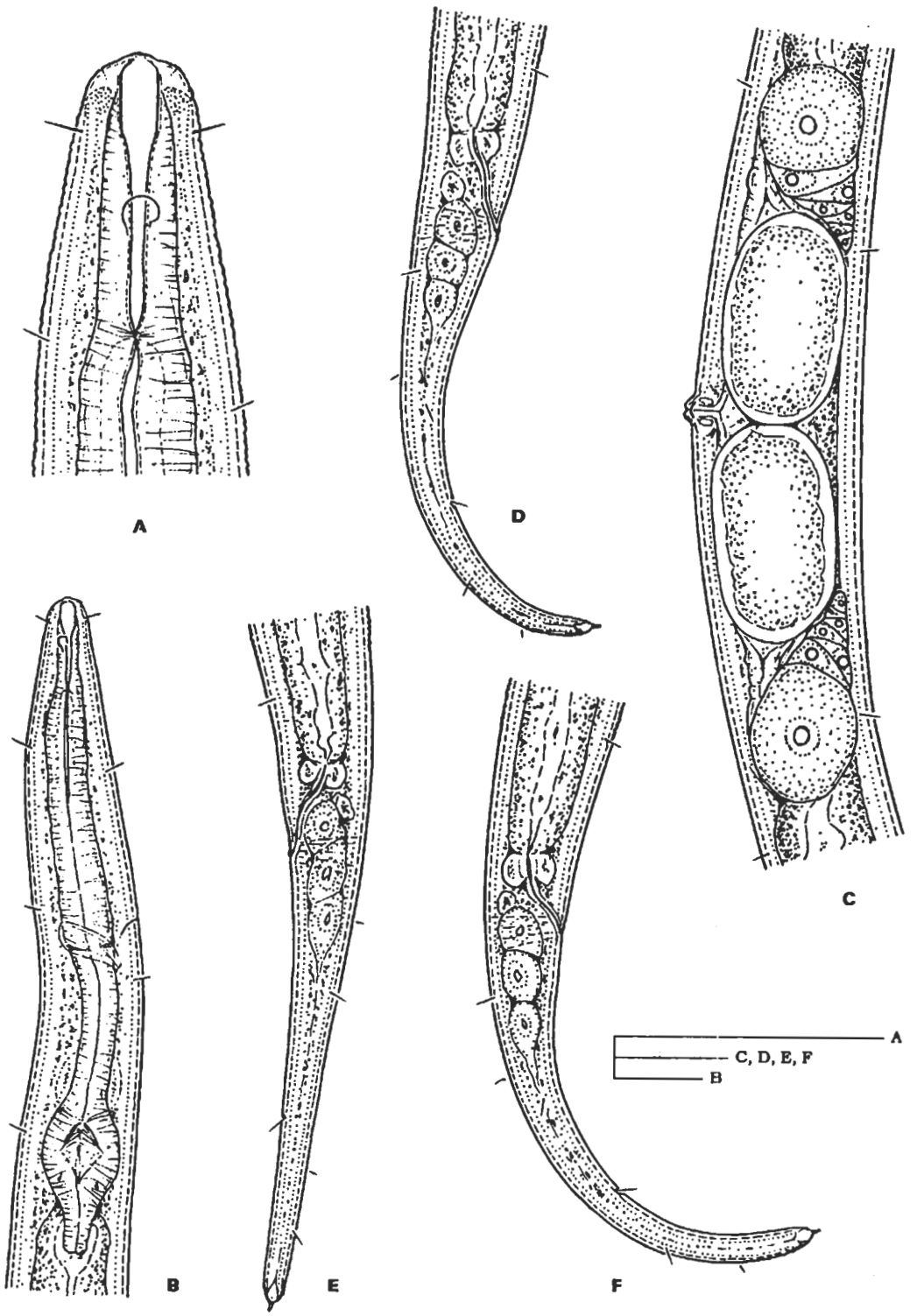


Figure 1. *Plectus araucanorum* sp. n. A: anterior end (cheilostom sclerotized in its entire length); B: oesophageal region; C: female genital apparatus with two eggs; D–F: female tails. (Scale bars 20 µm each)

µm or 1.3–1.7 corresponding body diameters. Eggshell smooth. Since no spermatozoa were detected in the uteri of gravid females, the reproduction most probably occurs by automixis.

Vulva–anus distance equal to 2.6–3.0 tail lengths. Tail 80–90 µm, 13–15 % of body length, slender, nearly cylindrical in most part, straight or ventrally arcuate. Caudal glands and terminal spinneret present. Caudal setae thin and long; subterminal seta (spur) relatively far (14–17 µm) from tail tip. Arrangement of caudal setae to be seen in the small table below.

Arrangement of caudal setae in Plectus araucanorum

S1	Right-dorsal	10–16 %
S2	Left-dorsal	28–32 %
S3	Right-lateral	36–46 %
S4	Ventral/Left-ventral	58–64 %
S5	Right-dorsal	68–72 %
S6	Left-dorsal	80–84 %

Male. Not known.

Diagnosis: A small species of the genus, with very finely annulated cuticle, not offset head, thin and posteriorly located cephalic setae, thin and long somatic and caudal setae, amphids levelling with mid-stoma, well sclerotized cheilostom, short rectum, lateral vulval liplets, smooth-shelled eggs, and with slender, nearly cylindrical tail.

Relationships. The most significant characters of this new species are the structure of buccal cavity (cheilostom in its entire length sclerotized), the slenderness and posterior location of cephalic setae, the vulva provided with small lateral lips, and the shape and length of tail. Such a combination of morphological structures does not occur in any other representatives of the genus *Plectus*.

The anterior section of stoma within the lip region (cheilostom) is in *Plectus* species either unsclerotized or only shortly sclerotized (appearing as small dots or commas). A full-length sclerotization of cheilostom appears very rare. I observed an entirely sclerotized cheilostom in *Plectus insolens* Andrássy, 1998. Apart from its occurrence – a probably endemic member in the Antarctic fauna – *P. insolens* is larger (0.84–0.96 mm) and slenderer than *P. araucanorum* sp. n., besides, its amphids lie quite posteriorly and its tail is „S"-shaped and so twisted axially that the spur shows a ventral position.

Plectus araucanorum sp. n. can be compared with two further species having more or less similar appearance (short and rather stout body, continuous labial region, long and thin cephalic and caudal setae, amphids lying at mid-stoma or posterior to that, elongate tail). They are *Plectus parvus* Bastian, 1865 and *P. opisthocirculus* Andrássy, 1952. Apart from the structure of stoma, the new species differs *a)* from *P. parvus:* labial region wider (8–10 *vs.* 6–7 µm), vulva of other shape, tail longer (5.8–7.6 *vs.* 4–5 anal body widths), vulva–anus distance shorter (2.6–3.0 *vs.* 3.5–4.0 tail lengths); *b)* from *P. opisthocirculus:* head wider (8–10 *vs.* 6–7 µm), cephalic setae obliquely directed (*vs.* at right angles to body axis), amphids not so far back, buccal tube shorter (2 *vs.* 2.5–3.0 head diameters) and vulva other shaped.

Holotype: Female on the slide No. 14533. Paratypes: 18 females. Holotype and paratypes in the collection of the author.

Type locality and habitat: Quellón (between 42° and 43° S), Isla de Chiloé, Prov. Chiloé, South Chile, moss from trunk, February 2001 (16 females). Other locality: Chonchi, Isla de Chiloé, Prov. Chiloé, South Chile, soil from around *Juncus* roots, February (3 females).

Etymology. The species is named after the largest tribe of aborigines in Chile, the Araucan Indians.

Paramphidelus par sp. n.

(Fig. 2 A–H)

Holotype female: L = 1.86 mm; a = 82; b = 4.8; c = 24; c' = 6.5; V = 39 %.

Paratype male: L = 1.82 mm; a = 102; b = 5.0; c = 30; c' = 4.7.

Body extremely slender, 23 µm (female) or 18 µm (male) wide at mid-region, in male more strongly curved in posterior part than in female. Cuticle very thin and smooth. Labial region tall, rounded, 6–7 µm wide at base (a' = 303–310). Lips fused, papillae minute. Body at posterior end of

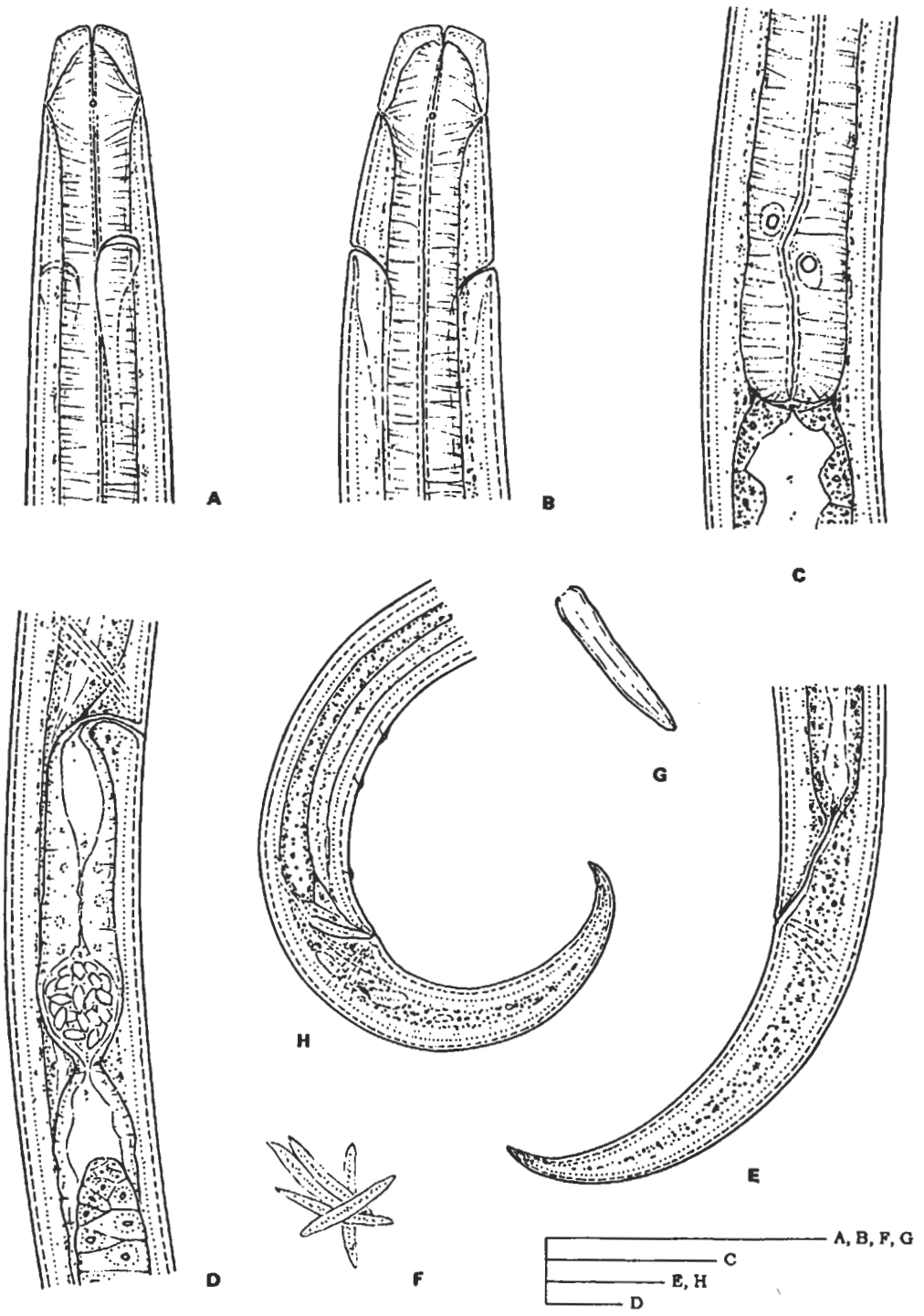


Figure 2. *Paramphidelus par* sp. n. A: anterior end of female; B: anterior end of male; C: posterior end of oesophagus with two nuclei; D: vulval region (spermatheca with „shortened" spermatozoa); E: female tail; F: spermatozoa from the testis; G: spiculum (with weak central line); H: posterior end of male with three precloacal papillae. (Scale bars 20 µm each)

oesophagus 2.7–3.2 times as wide as head. Postlabial sensillae (pits) distinct. Amphidial openings transverse-oval, about as wide as one-third of corresponding body diameter, 16–18 µm or 2.7–3.0 head diameters from anterior end. Mouth cavity minute. Oesophagus 363–386 µm long, 20–21 % of body length, gradually widening posteriorly. Of the oesophageal gland nuclei, the two AS nuclei are distinct, at 15 and 20 µm from posterior margin of oesophagus, respectively. Rectum 1.3 anal body widths long. Distance between proximal end of oesophagus and vulva about as long as oesophagus.

Female. Vulva a transverse slit, vagina thin, arcuate. Genital organ opisthodelphic, gonad 20 times as long as body width or 26 % of body length. Prevulval uterine sac absent. Ovar reflexed to three-fourth of the distance to vulva. Uterus with spermatheca. No uterine egg. Distance vulva–anus 13 times as long as tail. Tail 78 µm, 4 % of entire length of body, slightly ventrally curved, gradually tapering to the acute terminus.

Male. Testis one. Genital tract (from anterior tip of testis to cloaca) 43 times as long as body diameter, occupying 42 % of body length. Spermatozoa fusiform, 7–9 µm long, very densely concentrated in testis.[1] Spicula small, 12 µm, much shorter than one anal body diameter, straight, proximally slightly expanded, distally finely rounded. Three ventromedial papillae, 11, 27 and 36 µm from cloaca, respectively, all before the spicula. Male tail 60 µm, 3.3 % of body length, gradually tapering, ventrally bent, with acute terminus.

Diagnosis. A comparatively long and very slender species, with amphids lying three head diameters from anterior end, transverse vulva, opisthodelphic female gonad, short and straight spicula, three supplementary papillae and with comparatively short tail.

Relationships. As for length of body, *Paramphidelus par* sp. n. is the third among the representatives of the genus. Under the 19 known (to species (Andrássy, 2002), two are 2 mm or longer 3.3 mm), the remaining shorter than 1.5 mm. The new species can be distinguished from the two long-sized species as follows. From *P. exilis* (Andrássy, 1962) Andrássy, 1977: body shorter (1.8–1.9 *vs.* 2.1–2.4 mm), female less slender (a = 82 *vs.* 104–124), tail shorter (6–7 *vs.* 10–12 anal body widths) and simply curved (*vs.* S-shaped); from *P. paludicola* Gagarin, 1991: body smaller (1.8–1.9 *vs.* 2.3–3.3 mm), distance between head and amphidial opening shorter (16–18 *vs.* 22–30 µm), tail shorter (78 *vs.* 107–111 µm) and not so sharply pointed. The males are rare in *Paramphidelus* species, not known in *P. exilis* and *P. paludicola*.

Holotype: Female on the slide No. 14531. Paratype: one male.

Type locality and habitat: Quellón (between 42–43° S), Isla de Chiloé, Prov. Chiloé, South Chile, soil with roots from a needle wood, February 2001 (one female and one male).

Etymology. The species epithet „*par*" (Latin) means: two, or a pair; it refers to the presence of a couple, *i.e.* two specimens of different sexes.

Labronema diversum sp. n.

(Figs. 3 A–H and 4)

Holotype female: L = 2.17 mm; a = 24; b = 3.4; c = 60; c' = 0.7; V = 50 %.

Paratype female: L = 2.44 mm; a = 25; b = 3.7, c = 72; c' = 0.8; V = 53 %.

Paratype males (n = 4): L = 2.56–2.85 mm; a = 24–26; b = 3.1–4.5; c = 68–72; c' = 0.7.

A rather robust species, males a little longer than females. Diameter 90–105 µm at mid-body. Cuticle thick, 4–6 µm, smooth. Labial region 28–30 µm wide, set off from body by a shallow depression. Lips hardly separate with small papillae. Mouth opening surrounded by six small inner liplets. Body at posterior end of oesophagus 3.0–3.4 times as wide as head (a' = 75–94). Amphidial openings half as wide as corresponding body.

Odontostyle strong, 38–40 µm long, longer than labial diameter, 6.0–6.6 % of oesophagus length, narly as thick as cuticle. Aperture occupy-

[1] In the spermatheca of the one (fertilized) female the spermatozoa became shorter and much more ovoid. It seems that this phenomenon may occur in other alaimids as well; e.g. Coomans and Raski (1988) have observed a similar case in *Cristamphidelus* species.

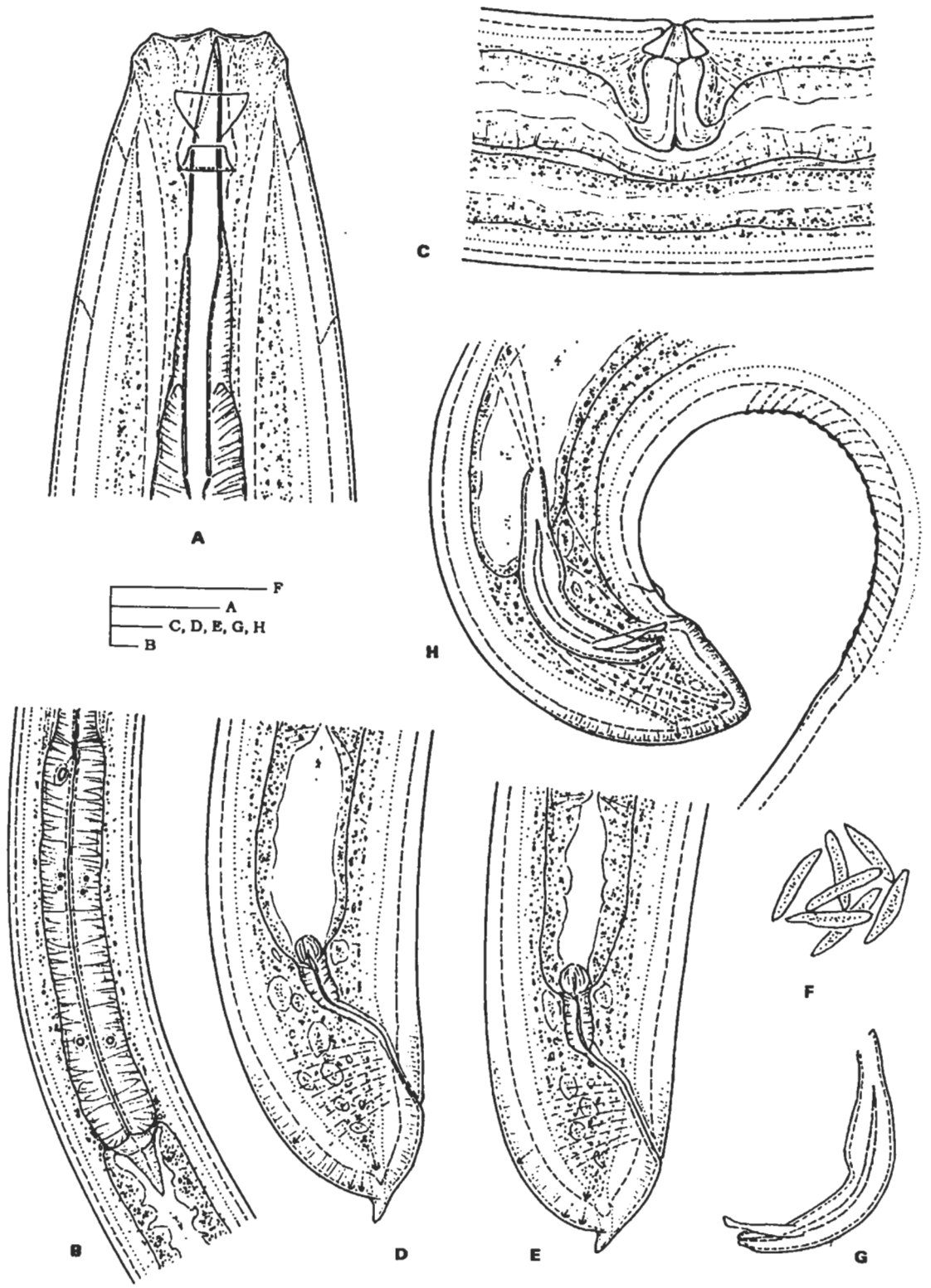


Figure 3. *Labronema diversum* sp. n. A: anterior end; B: cylindrus and cardia (oesophageal nuclei seven in number: AS nuclei divided into a small pair each); C: vulval region (vulva longitudinal); D–E: posterior end of two females (tail with peg); F: spermatozoa; G: spiculum and comes (accessory piece); H: posterior end of male (with 25 contiguous ventromedial supplements). (Scale bars 20 µm each)

ing one-third of stylet length. Guiding ring double, at middle of the restricted stylet.

Oesophagus 610–650 µm long, 22–30 % of body length, relatively broad in its anterior part, gradually expanded at 44–48 % of its length. Cylindrus moderately thick. Cardia consisting of a thin disc plus a muscular cone. Rectum equal to 1.3–1.4, prerectum to 1.4–2.2 anal body widths. Distance between posterior end of oesophagus and vulva shorter (0.7–0.9 times) than oesophagus.

Glandularium 294–312 µm long, occupying nearly the half length of oesophagus. Oesophageal gland nuclei very characteristic. Dorsal nucleus (D) large, oval, located at or somewhat posterior to the middle of oesophagus, at 14–16 % of entire length of body. Posterior subventral nuclei (PS) comparatively large, conspicuous, round, at 85–105 µm from posterior end of cylindrus. Anterior subventral nuclei (AS) uncommonly small but discernible; they are „double": each consisting of two small nuclei lying close, 4–6 µm to each other. This divided appearance of AS nuclei is unusual in dorylaimid nematodes[2].

Oesophageal gland nuclei in Labronema diversum

D = 49–54 %	AS_1 = 25–27 % (a) = 28–29 % (b) AS_2 = 26–27 % (a) = 28–30 % (b) PS_1 = 66–70 % PS_2 = 68–72 %

Female. Vulva longitudinal, with conoid sclerotized inner lips. Vagina 48–56 µm, reaching to middle of body diameter. Genital organ amphidelphic, both gonads lying on the right side of body. Anterior gonad 3.3–4.0 times as long as body width or 14–16 % of body length, posterior gonad 4.6–4.8 times as long as body width or 19–20 % of body length. Uterus long, equal to 3–4 body diameters, ovaries short. One mature egg observed, 113 x 50 µm, longer than corresponding width of body. Distance vulva–anus 29–32 times as long as tail. The latter 34–36 µm, 1.4–1.7 % of body length, digitate: rounded in most part and ending in a rather long, dorsally curved peg. Anal musculature strongly developed, wide.

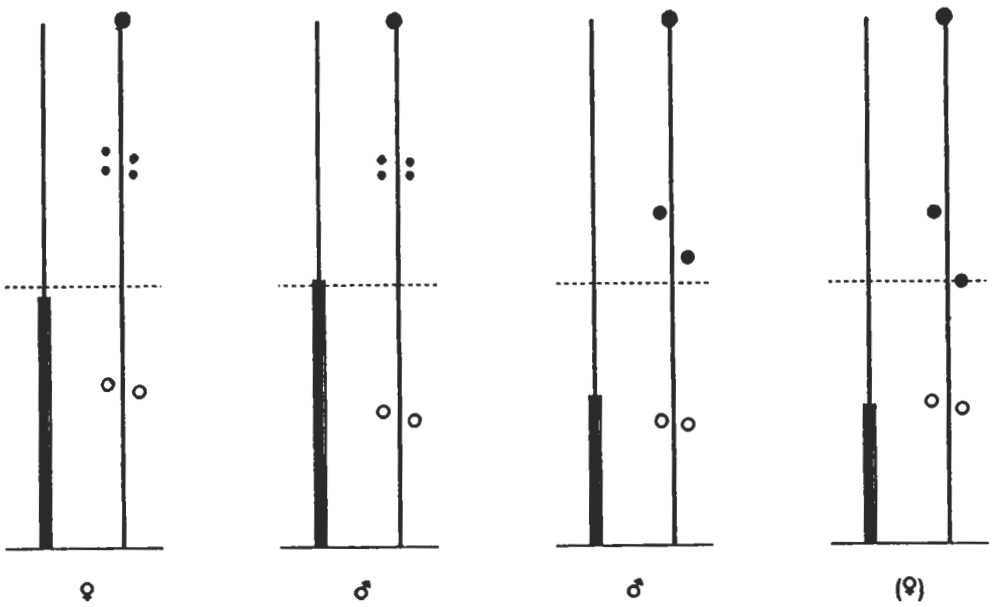
Male. Testes two. Spermatozoa fusiform, 13–15 µm long. Spicula 96–105 µm in curvature, slender, ante- and postcorpus nearly equally long. Comes relatively large, 25–28 µm, more or less bottle-shaped. Prerectum reaching midway of the supplements. Medioventral supplements varying from 23 to 28 in number, small, contiguous, posterior ones well before the spicula. A weak copulatory hump present. Tail short, 34–40 µm, conoid-rounded without digitate tip. Caudal papillae small, five or six pairs.

Diagnosis. A medium-sized nematode with stout body. Head hardly separated, odontostyle strong, longer than labial width and as thick as cuticle, guiding ring double, anterior subventral oesophageal nuclei small and double, vulva longitudinal, male supplements numerous and contiguous, tail sexually dimorphic: in female digitate, in male rounded.

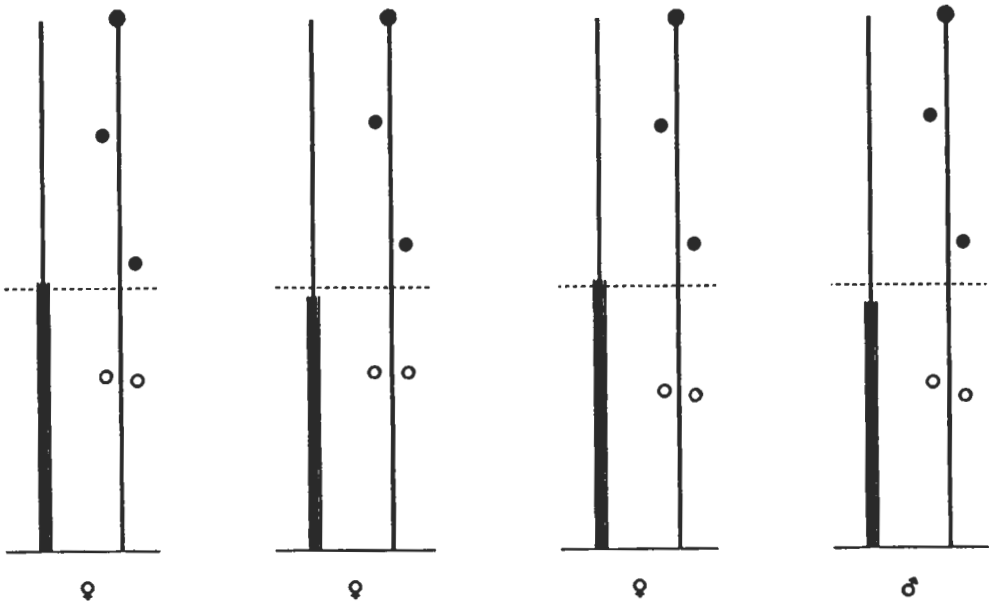
Relationships. Labronema diversum sp. n. corresponds well to the general criteria of the genus *Labronema* Thorne, 1939 (shape of labial region and stylet, double guiding ring, longitudinal vulva, short tail, densely arranged supplements) on the one hand, but it shows some characters that are unusual in the genus (structure of oesophageal nuclei, dimorphism in tail shape) on the other hand. Whether the divied appearance of the AS nuclei is a unique phenomenon of the present species, a decision is not possible, because little is known on the glandular map in *Labronema* species. Loof and Coomans (1970) described the position of these nuclei in *L. czernowitziense* (Micoletzky, 1922) Thorne, 1939, and found the AS nuclei undivided as it is general in dorylaimid nematodes.

In the revision of the family Qudsianematidae (Andrássy, 1992), I listed 29 valid species within the genus *Labronema* Thorne, 1939. Since then, nine further species have been described. Apart from the special glandular picture (AS nuclei), *Labronema diversum* sp. n. shares similarities in tail forms with *L. varicaudatum* (Thorne, 1929) Thorne, 1939. There are, however, essential differ-

[2] In a soil sample from Alaska I found quite recently a (new) *Dorylaimus* species that similarly had a small additional nucleus before each anterior sublateral nucleus.



Labronema diversum *Acunemella torta*



Aporcella gibberocaudata

Figure 4. Map of oesophageal gland nuclei in *Labronema diversum* sp. n., *Acunemella torta* gen. n., sp. n. and *Aporcella gibberocaudata* gen. n., sp. n. The left column in each pair of figures represents the entire oesophagus with the glandularium (thickened section), the right column represents the glandularium proper with the location of the gland nuclei (D nucleus on the top, AS nuclei black, PS nuclei simple)

ences between them. Thus, the new species differs from the other in the following characteristics: body shorter (2.2–2.8 *vs.* 3.5–3.6 mm), stylet longer than labial diameter (*vs.* equal to that), advulval papillae absent, tip of the female tail dorsally bent *vs.* straight). There are some further *Labronema* species having digitate–subdigitate tail, this shape however occurs in both females and males (no sexual dimorphism), e.g. *L. rapax* Thorne, 1974.

So far, one *Labronema* species, *L. chilense* Andrássy, 1967 has been reported from Chile. This is shorter than the present new species (1.8–1.9 mm), it has a more posterior vulva (in 60 %), the spermatozoa are oval or ovoid, and the female tail is broadly rounded, not digitate. I discovered *L. chilense* in Prov. Valparaiso, Central Chile.

Remarks. Similar short dimorphic tails like in *Labronema diversum* sp. n. (mammillate or digitate in female, rounded in male) can be found in some groups of dorylaimid nematodes, namely in the families Dorylaimidae, Aporcelaimidae and Qudsianematidae. Under the so numerous species of the genus *Mesodorylaimus* Andrássy, 1959 (Dorylaimidae), the following ones may be mentioned in this respect: *M. aduncus* Andrássy, 1986, *M. cognatus* Andrássy, 1986, *M. procerus* Andrássy, 1986, *M. recurvus* Andrássy, 1964 and M. *vulneratus* Andrássy, 1986. In the family Dorylaimidae, *Laimydorus centrocercus* (de Man, 1880) Siddiqi, 1969 also shows a similar sexual dimorphism in tail. In the family Aporcelaimidae, some species of *Aporcelaimellus* Heyns, 1965 are characterized by such tail shapes, *viz. A. gerlachi* (Meyl, 1956) Heyns, 1965, *A. kikereensis* Baqri & Coomans, 1973, *A. malagasi* Heyns, 1996, *A. paracentrocercus* (De Coninck, 1935) Baqri & Coomans, 1963 and *A. stilus* Kirjanova, 1951. Of the family Qudsianematidae, a species of *Labronema* Thorne, 1939 has a digitate-subdigitate tail in female and a rounded tail in male: *L. varicaudatum* (Thorne, 1929) Thorne, 1939.

In addition to them, two monotypic genera of rather uncertain taxonomic position have been described as showing a similar sexual dimorphism in tails: *Coomansinema* Ahmad & Jairajpuri, 1989 and *Namaquanema* Heyns & Swart, 1993. *Coomansinema dimorphicauda* Ahmad & Jairajpuri, 1989 was placed to the family Dorylaimidae and the subfamily Thornenematinae. The authors differentiated their genus from *Mesodorylaimus* in the shape of stylet (slightly bent) and the anterior position of the second pair of subventral oesophagus nuclei (at about 55 % of glandularium). *Namaquanema hanki* Heyns & Swart, 1993 was provisionally regarded as belonging to the family Dorylaimidae, subfamily Laimydorinae. This species seems to be close to the representatives of *Laimydorus* and *Mesodorylaimus*, but it differs from them by the non-sclerotized odontophore and the anterior location of the dorsal nucleus (at 47–50 % of oesophagus length).

Holotype: Female on the slide No. 14556. Paratypes: one female and five males. All are preserved in the collection of the author.

Type locality and habitat: Aguas Calientes in Puyehue National Park (between 40° and 41° S), Prov. Osorno, southern Chile, litter from a deciduous forest with bamboo, February 2001.

Etymology. The Latin word „*diversum*" (neutral in gender) means: different; here: the tails of sexes are dissimilar.

Aporcella gen. n.

Aporcelaimidae. Body moderately long, about 2 mm. Cuticle simple, without inner refractive layer. Labial region narrow, strongly offset, lips fused. Odontostyle robust, somewhat longer than head diameter, with large aperture. Guiding sheath fairly thick. Oesophagus heavily muscular, widened anterior to its middle. Nuclei well discernible; AS_1 lying closer to D than to AS_2. Female genital system amphidelphic, ovaries short, vulva transverse, not sclerotized. Spermatozoa minute, oval. Spicula slenderer than the general dorylaimoid type. Supplements separated, well before the spicula. Tails of both sexes similar, shorter than anal body width, with deep dorsal depression and a large mammillate „peg"

Type and sole species: *Aporcella gibberocaudata* sp. n.

Aporcella gibberocaudata sp. n.

(Figs. 4 and 5 A–G)

Holotype female: L = 2.20 mm; a = 22; b = 3.8; c = 55; c' = 0.5; V = 56 %.

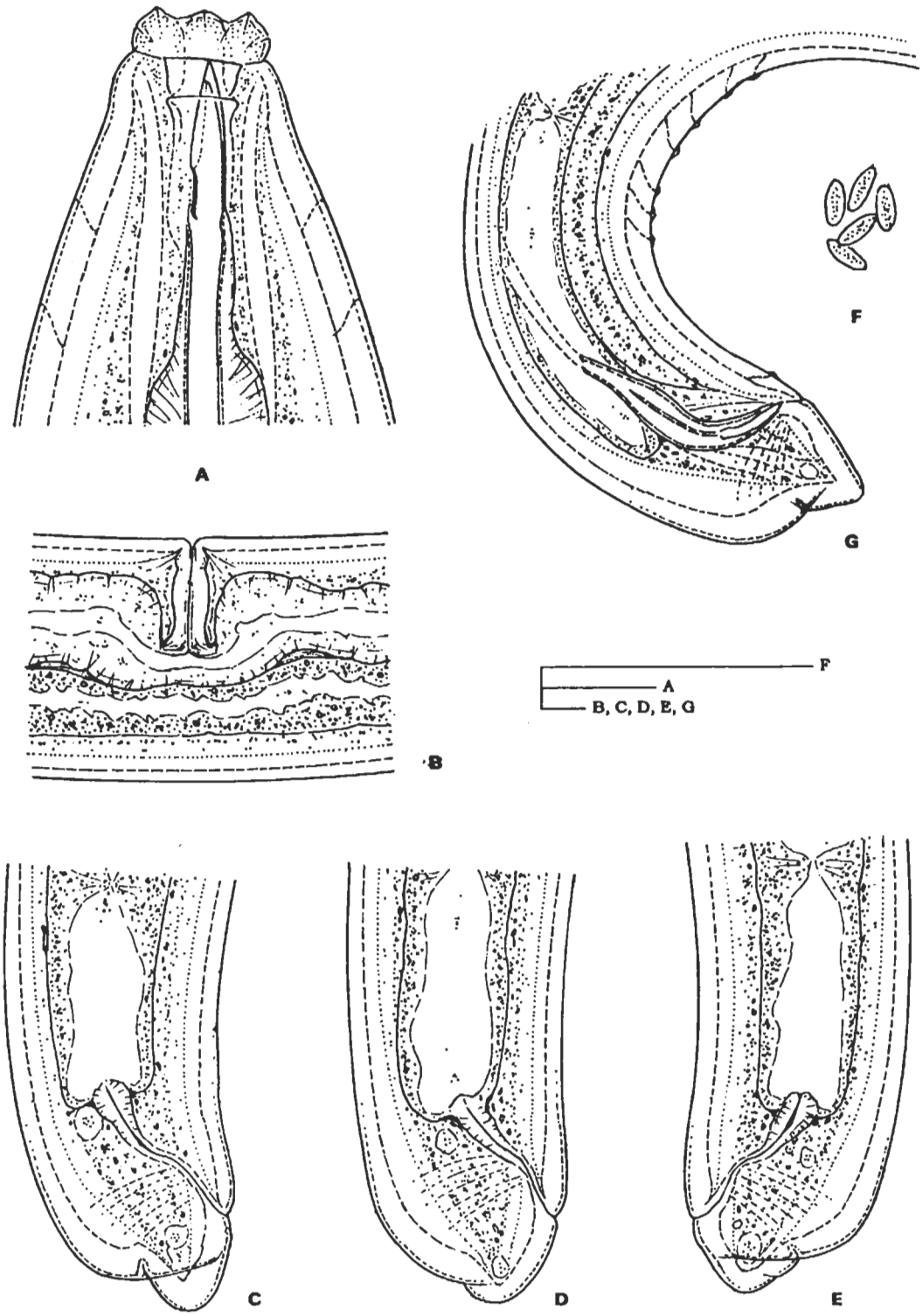


Figure 5. *Aporcella gibberocaudata* gen. n., sp. n. A: anterior end; B: vulval region (vulva transverse, not sclerotized); C–E: posterior end of three females (each tail with dorsal depression and a large peg); F: spermatozoa; G: posterior end of male (with seven ventromedial supplements). (Scale bars 20 µm each)

Paratype females (n = 4): L = 2.13–2.21 mm; a = 20–23; b = 3.9–4.1; c = 50–74; c' = 0.4–0.5; V = 54–58 %.

Paratype male: L = 2.16 mm; a = 22; b = 4.0; c = 43; c' = 0.7.

Body robust, 94–110 µm wide at middle. Cuticle smooth, in most part of body 4–6 µm on tail thicker. Although it consists of more layers, but none differ in refraction from the other. Lip region 23–25 µm wide, clearly separated from adjacent body by a deep constriction, Body at posterior end of oesophagus 3.7–4.2 times as wide as head. Amphid aperture half the corresponding body wide.

Odontostyle short and stout with rather thick walls, 26–29 µm, a little longer than labial diameter, only 5 % of oesophagus length. Aperture occupying almost 2/3 of stylet length. Guiding sheath aporcelaimid, fairly strong, at the first third of the stylet when retracted. Oesophagus 540–575 µm, 24–26 % of body length, heavily muscular in its entire length, gradually widening before its middle (at 43 to 48 %). Cylindrus thick. Cardia short, conoid. Intestine thin-walled, with several small lacunae. Rectum as long as anal body diameter, prerectum 1.4–1.5 times longer.

Oesophageal gland nuclei in Aporcella gibberocaudata

D = 49–54 %	AS_1 = 19–22 %
	AS_2 = 43–45 %
	PS_1 = 67–71 %
K = 42–49 %	PS_2 = 68–72 %

Glandularium 260–290 µm, nearly half of the oesophagus length. Ooesophageal gland nuclei well visible. Dorsal nucleus relatively small, at 12–13 % of total body length. Anterior subventral nuclei far from each other, AS_1 closer to D than to AS_2 (an aporcelaimid character). Distance D–AS_1 48–60 µm, distance D–AS_2 113–132 µm. AS nuclei hardly smaller than D. Posterior subventral nuclei (PS) round, somewhat smaller than the anterior ones, located at 72–82 µm from posterior margin of cylindrus.

Female. Vulva transverse, not sclerotized. Vagina 48–54 µm, half as deep as body diameter. Genital tract amphidelphic, extending in 32–37 % of body length. Anterior gonad on the left side, 3.3–4.0 times as long as body width or 156–127 % of body length, posterior gonad on the right side, 3.4–4.4 times as long as body width or 16–20 % of body length. Uterus long and narrow, ovaries shorter than half-lengths of gonads. Mature eggs not observed. Distance vulva–anus 22–28 times as long as tail. Female tail 30–45 µm, 1.3–2.0 % of body length, much shorter than anal body diameter, broadly rounded, strongly depressed on dorsal side with a large hemispheroid extension/peg.

Male. Testes paired. Spermatozoa oval, small, 4–5 µm. Prerectum beginning at middle of supplemental row. Spicula 105 µm along curved axis, slender with long collum and week venter. Comes 27 µm long. Ventromedial supplements 7 in number, the posteriormost larger than the other; posterior three supplements close to each other, other four well spaced. All supplements lying outside the range of the spicula. Male tail 50 µm or 2.3 % of body length, similar to female tail, caudal papillae minute, inconspicuous.

Diagnosis. Body about 2 mm long, fairly robust, head strongly set-off, lips moderately separated, odontostyle strong with large aperture, oesophagus widened before its middle, gland nuclei as described above, rectum and prerectum short, vulva transverse, not sclerotized, ovaries short, spermatozoa oval, spicula slim, supplements few, mostly separate, before spicula, tail short, dorsally depressed with large mammillate tip.

Relationships. Aporcella gibberocaudata gen. n., sp. n. undoubtedly belongs to the family Aporcelaimidae. It resembles in many respects the representatives of *Tubixaba* Monteiro & Lordello, 1980, thus, in shape of head, simple cuticle, unsclerotized vulva, short ovaries, slender spicula and separate supplements. It is however smaller (2.1–2.2 *vs.* 4 to 12 mm), the stylet aperture larger (2/3 *vs.* 1/3), the nuclear map of oesophagus dissimilar (AS_1 close to D *vs.* far from D; PS in 2/3 of glandularium *vs.* unusually anterior, at middle of glandularium) and tail other-shaped.

Aporcella gibberocaudata sp. n. also resembles the species of *Aporcelaimellus* Heyns, 1965, but it differs from them in having simple cuticular layers and unsclerotized vulva. (The cuticle consisting of

layers showing dissimilar refraction is a character of first rank in *Aporcelaimellus;* see Andrássy, 2002.)

It is not impossible that some species of the genus *Aporcelaimellus* should be later transferred to *Aporcella.* For instance, *A. parapapillatus* Botha & Heyns, 1990 and *A. pseudospiralis* Botha & Heyns, 1990 seem to be close to the type species of *Aporcella* in more respects: cuticle without refractive layer, aperture longer than 1/2 of stylet, AS_1 relatively close to D, vulva not sclerotized. Of them, the male is known in *A. parapapillatus* only: the spicula are slender, the supplements are, in contrast with *Aporcella gibberocaudata,* contiguous.

Oesophageal gland nuclei in Aporcelaimellus parapapillatus (after Botha & Heyns, 1990)

D = 54 %	AS_1 = 26 %
	AS_2 = 50 %
	PS_1 = 70 %
K = 52%	PS_2 = 72 %

Holotype: Female on the slide No. 14556. Paratypes: four females and one male. Deposited at the collection of the author.

Type locality and habitat: Aguas Calientes in Puyehue National Park (between 40–41° S), Prov. Osorno, southern Chile, litter from a deciduous forest with bamboo, February 2001.

Etymology: The species name comes from the Latin: *gibber* = humped, *cauda* = a tail.

Acunemella gen. n.

Nordiidae. Body strongly tapering in its anterior region towards the head and spring-likely twisted in its posterior two-thirds. Cuticle smooth. Head practically not separated, lips amalgamated, labial papillae minute. Odontostyle exceptionally long and thin, equal to 8–9 labial diameters. Oesophagus suddenly widening in last third of its length, its anterior section weakly muscular. Dorsal oesophageal nucleus very posterior in position: at 70 % of oesophagus length. Female genital structure uncertain. Testes two, spermatozoa fusiform. Spicula robust. Adcloacal supplements farther from cloaca than usual, ventromedial supplements few, spaced. Tail short, conoid, ventrally arcuate.

Type and only species: *Acunemella torta* sp. n.

Acunemella torta sp. n.

(Figs. 4 and 6 A–F)

Holotype male: L = 1.57 mm; a = 38; b = 4.0; c = 49; c' = 1.1.

Paratype male: L = 1.48 mm; a = 41; b = 3.7; c = 45; c' = 1.1.

Paratype (young) female: L = 1.02 mm; a = 35; b = 3.2; c = 30; c' = 1.6.

Body posture upon fixation very characteristic: in anterior third almost straight, strongly tapering towards head, in posterior two-thirds or three-fourth however heavily twisted resembling a spiral-spring. Mid-body 36–40 µm wide. Cuticle smooth, on neck occasionally very finely annulated, 1.5–2.0 µm thick. Head small, practically confluent with body, 5.5–6.0 µm wide, only one-sixth of body diameter at posterior end of oesophagus; a' = 260–270 (!). Lips fused, labial papillae minute. Amphidial opening larger than half a corresponding body width.

Oesophageal gland nuclei in Acunemella torta

D = 70–72 %	AS_1 = 37–40 %
	AS_2 = 47–51 %
	PS_1 = 74–80 %
K = 74–78 %	PS_2 = 75–80 %

Odontostyle very long and thin, needle-like, with very narrow but conspicuous lumen; in the holotype male 44 µm, in the other male 53 µm long, 11–13 % of oesophagus length, 7.5 and 9 times as long as labial diameter, respectively. Weekly gradually widened backwards, aperture indistinct, probably quite small. Odontophore simple, not flanged. Guiding ring simple, thin, at the first-fourth of the retracted spear. Oesophagus 390–404 µm long, 25–27 % of body length, hardly muscular in its anterior section, suddenly widening at 62–65 % of its length. Cardia short, conoid. Intestine thin-walled, full with small ball-

like corpuscles. Rectum in the young female 1.3, prerectum 2.2 anal body diameters long. Prerectum in males beginning at level of the second or third supplement.

Glandularium 102–116 µm long, only 26–28 % of entire length of oesophagus. Dorsal oesophageal nucleus situated far back, at 70–72 % of entire length of oesophagus, or at 17–18 % of total length of body. AS nuclei nearly equal in size, AS_1 however less conspicuous than its couple. PS nuclei smaller, but well discernible.

Male. Testes paired, opposed. Spermatozoa fusiform, 6–8 µm, as long as 1/5–1/6 of body width. Spicula unusually robust, 50–52 µm in curvature, 12–14 µm wide posterior to venter, bluntly rounded on its both tips, with narrow but strongly expressed central line. Comes 12–13 µm long. Adcloacal pair of supplements at a greater distance from cloaca than general in dorylaimid nematodes. Ventromedial supplements four or five, very small, all lying anterior to spicula; supplements 12–14 µm from one another. Male tail conoid, strongly bent ventrally, 33–38 µm long with sharply pointed or finely rounded tip. Three pairs of small caudal papillae discernible.

Female. Only an immature specimen of female character (an L4?) was observed. Functional stylet 30 µm, „reserve" stylet 45 µm long. Oesophagus as long as 31 % of body length. Arrangement of gland nuclei in oesophagus quite similar to that of adults. Of the structure of genital primordium, it cannot be settled with certainty if the mature female will become amphi- or monodelphic. Tail 35 µm, ventrally curved. Posterior half of body similarly twisted as in males.

Diagnosis. Body rapidly tapering anteriorly and strongly twisted posteriorly. Head not offset, in comparison with mid-body width very small. Odontostyle needle-like, extremely long, posessing a narrow lumen and small aperture. Oesophagus enlarging posteriorly. Dorsal nucleus far posterior. Spicula massive. Supplements few, spaced, anterior to spicula. Tail short, conoid.

Relationships. Although adult females are not at disposal, the two male specimens and the preadult, female-like specimen unambiguously verify that *1)* this species belongs to the family Nordiidae, *2)* it fits into none of the known genera within the family. The long and thin stylet, the far back expanded oesophagus and the general arrangement of the five oesophageal nuclei all show nordiid characters. (Longidorids have a similar stylet and posteriorly widened oesophagus, the gland nuclei in the oesophagus are however reduced to three.) On the other hand, in virtue of the extremely thin, needle-like stylet, strongly narrowed anterior body, small head, twisted posture of posterior body, robust spicula, position of adcloacal supplements and of the strongly curved short-conoid tail this species cannot be placed in any of the genera described so far.

Under the representatives of the genus *Longidorella* Thorne, 1939 there are a few species possessing very long stylet (up to 5 head diameters), their body is however always robust, much less tapering anteriad, and never twisted.

Holotype: Male on the slide 14544. Paratypes: one male and one juvenile. All in the collection of the author.

Type locality and habitat: Chonchi in Isla de Chiloé (between 42–43° S), Prov. Chiloé, South Chile, soil around fern roots, February 2001.

Etymology: The species epithet *„torta"* (feminine in gender) is from the Latin, and means: twisted.

NEW NEMATODE SPECIES DISCOVERED IN SOUTHERN CHILE

Those nematode species, 60 in number, are listed here that were discovered in South Chile and described as new to science. New genera are marked with dotted underlining.

Class TORQUENTIA

Fam. Halaphanolaimidae

Aphanolaimus chilensis Raski & Coomans, 1990
Aphanolaimus elegans Raski & Coomans, 1990
Aphanolaimus fuegoensis Raski & Coomans, 1990
Aphanolaimus yamani Raski & Coomans, 1990
Paraphanolaimus terrestris Raski & Coomans, 1991

Fam. Plectidae

Plectus araucanorum sp. n.

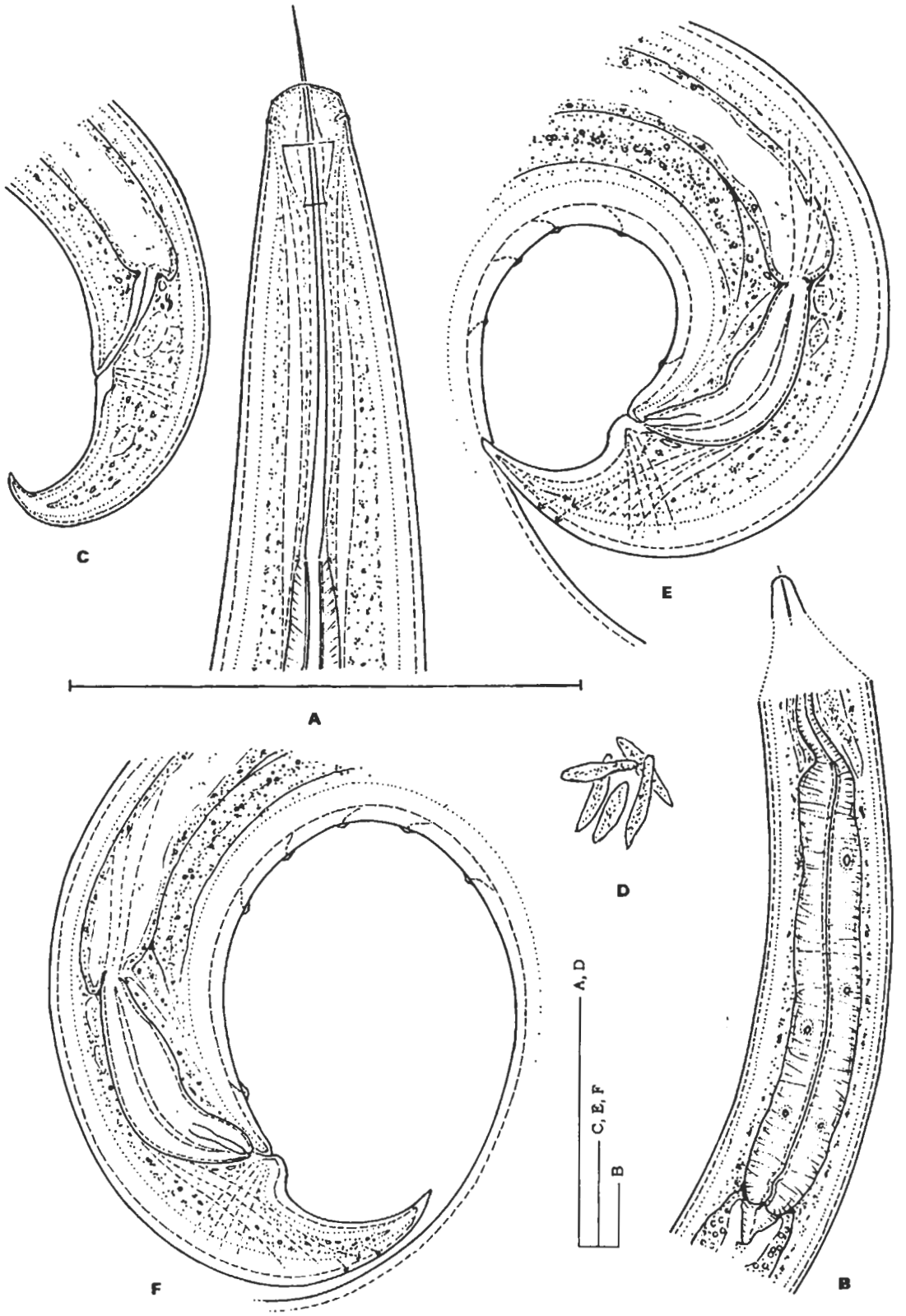


Figure 6. *Acunemella torta* gen. n., sp. n. A: anterior end, and body diameter at posterior end of oesophagus; B: oesophageal cylindrus with the five gland nuclei, and, in comparison, the anterior end of body; C: tail of a juvenile; D: spermatozoa; E–F: posterior end of two males with four and five ventromedial supplements, respectively (note the heavily twisted posterior body). (Scale bars 20 µm each)

Fam. Leptolaimidae

Chronogaster chilensis Raski & Maggenti, 1985
Leptoplectonema fuegoense Coomans & Raski, 1991

Class SECERNENTIA

Fam. Cephalobidae

Cervidellus vinciguerrae Clausi, 1998
Metacrolobus festonatus Vinciguerra, 1994

Fam. Aphelenchoididae

Tylaphelenchus yamani Raski & Valenzuela, 1988

Fam. Tylenchidae

Filenchus normanjonesi Raski & Geraert, 1987
Filenchus terrestris Raski & Geraert, 1987
Polenchus curvicauda Raski & Geraert, 1988
Basiria uncinata (Geraert & Raski, 1986) Siddiqi, 2000 *[Basirienchus u.]*
Neothada costata (Geraert & Raski, 1986) Siddiqi, 2000 *[Basirienchus c.]*
Malenchus adelinae (Raski & Geraert, 1987) Siddiqi, 2000 *[Filenchus a.]*
Malenchus leiodorus Geraert & Raski, 1986
Malenchus parthenogeneticus Geraert & Raski, 1986
Malenchus williamsi Geraert & Raski, 1986
Ridgellus elenae (Geraert & Raski, 1986) Siddiqi, 2000 *[Basirienchus e.]*
Zanenchus chilensis (Raski & Geraert, 1987) Siddiqi, 2000 *[Filenchus ch.]*

Fam. Ecphyadophoridae

Ecphyadophora caelata Raski & Geraert, 1986
Lelenchus filicaudatus Raski & Geraert, 1986
Chilenchus elegans (Raski & Geraert, 1986) Siddiqi, 2000 *[Lelenchus e.]*

Fam. Atylenchidae

Eutylenchus fueguensis Valenzuela & Raski, 1985

Fam. Tylodoridae

Cephalenchus chilensis Raski & Geraert, 1986

Fam. Anguinidae

Subanguina chilensis Vovlas, Troccoli & Moreno, 2000
Ditylenchus filicauda Geraert & Raski, 1990
Ditylenchus flagellicauda Geraert & Raski, 1990

Fam. Pratylenchidae

Pratylenchus australis Valenzuela & Raski, 1985

Fam. Criconematidae

Criconema certesi Raski & Valenzuela, 1986
Criconema giardi (Certes, 1889) Micoletzky, 1925 *[Dorylaimus g.]*
Criconema meridianum (Mehta, Raski & Valenzuela, 1983) Siddiqi, 1986 *[Criconemella m.]*
Criconema navarinoense Raski & Valenzuela, 1988
Criconema neopacificum (Mehta, Raski & Valenzuela, 1983) Raski & Luc, 1985 *[Nothocriconema n.]*
Criconema orellanai Raski & Valenzuela, 1988
Criconema osornoense Raski & Valenzuela, 1988
Criconema racemispinosum (Mehta, Raski & Valenzuela, 1983) Siddiqi, 1986 *[Seriespinula r.]*
Criconema velatum (Mehta, Raski & Valenzuela, 1983) Raski & Luc, 1985 *[Bakernema v.]*
Ogma sagi Raski & Valenzuela, 1988
Ogma terrestre Raski & Valenzuela, 1986

Fam. Hemicycliophoridae

Hemicycliophora monticola Mehta, Raski & Valenzuela, 1983
Hemicycliophora macrodorata Raski & Valenzuela, 1986

Fam. Paratylenchidae

Paratylenchus fueguensis Raski & Valenzuela, 1986

Class PENETRANTIA

Fam. Alaimidae

Paramphidelus par sp. n.
Cristamphidelus acucephalus (Coomans & Raski, 1988) Siddiqi & Vinciguerra, 1991 *[Etamphidelus a.]*

Cristamphidelus andrassyi (Vinciguerra & Clausi, 1990) Siddiqi & Vinciguerra, 1991 *[Etamphidelus a.]*
Cristamphidelus chilenus Andrássy, 2002
Cristamphidelus fueguensis (Coomans & Raski, 1988) Siddiqi & Vinciguerra, 1991 *[Etamphidelus f.]*
Cristamphidelus magnus Andrássy, 2002
Cristamphidelus subantarcticus (Vinciguerra & Clausi, 1990) Siddiqi & Vinciguerra, 1991 *[Etamphidelus s.]*
Cristamphidelus vinciguerrae Andrássy, 2002
Cristamphidelus yamani (Coomans & Raski, 1988) Siddiqi & Vinciguerra, 1991 *[Etamphidelus y.]*

Fam. Prismatolaimidae

Prismatolaimus chilensis Coomans & Raski, 1988
Prismatolaimus novoporus Coomans & Raski, 1988

Fam. Mononchidae

Coomansus intestinus (Vinciguerra & La Rosa, 1990) Andrássy, 1993 *[Clarkus i.]*

Fam. Qudsianematidae

Labronema diversum sp. n.

Fam. Aporcelaimidae

Aporcella gibberocaudata gen. n., sp. n.

Fam. Nordiidae

Acunemella torta gen. n., sp. n.

REFERENCES „A"

Papers containing descriptions of new nematode species from southern Chile (including also the Argentine part of Tierra del Fuego) are listed below.

ANDRÁSSY, I. (2002): The genus *Cristamphidelus* Siddiqi & Vinciguerra, 1991 and a general survey of the family Alaimidae (Nematoda). *Journal of Nematode Morphology and Systematics*, 4: 51–82.

CERTES, A. (1889): Protozoaires. Appendice: organismes divers appartenant à la faune microscopique de la Terre de Feu. *In: Mission scientifique du Cap Horn (1882–1883), Zoologie, Paris*, 6: 45–50.

CLAUSI, M. (1998): *Cervidellus vinciguerrae* sp. n. (Nematoda: Cephalobidae) from Tierra del Fuego and notes on the genus *Cervidellus* Thorne, 1937. *Fundamental and Applied Nematology*, 21: 273–279.

COOMANS, A. V. & RASKI, D. J. (1988): Three new species of *Etamphidelus* Andrássy, 1977 (Nemata: Alaimidae) in Southern Chile. *Journal of Nematology*, 20: 9–22.

COOMANS, A. & RASKI, D. J. (1988): Two new species of *Prismatolaimus* de Man, 1880 (Nemata: Prismatolaimidae) in Southern Chile. *Journal of Nematology*, 20: 288–303.

COOMANS, A. & RASKI, D. J. (1991): Observations on *Paraplectonema* Strand, 1934 and description of *Leptoplectonema fuegoense* n. g., n. sp. (Nematoda: Leptolaimidae). *Revue de Nématologie*, 14: 197–205.

GERAERT, E. & RASKI, D. J. (1986): Three new species of *Basirienchus* g. n. from southern Chile compared with *Campbellenchus*, *Neothada* and *Basiria* (Nematoda: Tylenchida). *Nematologica*, 31: 266–288.

GERAERT, E. & RASKI, D. J. (1987): Unusual *Malenchus* species (Nematoda: Tylenchidae). *Nematologica*, 32: 27–55.

GERAERT, E. & RASKI, D. J. (1990): Description of two new *Ditylenchus* species with long, filiform tails (Nemata: Tylenchida) from Tierra del Fuego. *Revue de Nématologie*, 13: 297–301.

MEHTA, U. K., RASKI, D. J. & VALENZUELA, A. (1983): Five new species of Criconematidae (Nemata) from southern Chile. *Nematologica*, 28: 398–411.

RASKI, D. J. & COOMANS, A. (1990): Five new species of *Aphanolaimus* (Nemata: Araeolaimida) with a key to species. *Nematologica*, 36: 22–54.

RASKI, D. J. & COOMANS, A. (1991): Three new species of *Paraphanolaimus* (Nemata: Araeolaimida) with key to species. *Nematologica*, 37: 44–62.

RASKI, D. J. & GERAERT, E. (1986): New species of *Lelenchus* Andrássy, 1954 and *Ecphyadophora* de Man, 1921 (Nemata: Tylenchida) from southern Chile. *Nematologica*, 31: 244–265.

RASKI, D. J. & GERAERT, E. (1986): Descriptions of two new species and other observations on the genus *Cephalenchus* Goodey, 1962 (Nemata: Tylenchidae). *Nematologica*, 32: 56–78.

RASKI, D. J. & GERAERT, E. (1987): Review of the genus *Filenchus* Andrássy, 1954 and descriptions of six new species (Nemata: Tylenchidae). *Nematologica*, 32: 265–311.

RASKI, D. J. & GERAERT, E. (1988): *Polenchus curvicauda* sp. n., second species of a rare genus. *Revue de Nématologie*, 11: 411–413.

RASKI, D. J. & MAGGENTI, A. R. (1985): Four new species of *Chronogaster* Cobb, 1913 (Nemata: Plectidae) with a key to species of the genus. *Nematologica*, 30: 117–130.

RASKI, D. J. & VALENZUELA-A., A. (1986): Descriptions of four new species of Criconematoidea (Tylenchina: Nemata) from Southern Chile. *Journal of Nematology*, 18: 252–266.

RASKI, D. J. & VALENZUELA-A., A. (1987): Descriptions of four new species of Criconematidae, male of *Ogma terrestris* (Tylenchida: Criconematoidea) and *Tylaphelenchus yamani* sp. n. (Aphelenchina: Aphelenchoididae). *Nematologica*, 33: 149–166.

VALENZUELA-A., A. & RASKI, D. J. (1985): *Pratylenchus australis* n. sp. and *Eutylenchus fueguensis* n. sp. (Nematoda: Tylenchina) from Southern Chile. *Journal of Nematology*, 17: 330–336.

VINCIGUERRA, M. T. (1994): *Metacrolobus festonatus* gen. n., sp. n. and *Scottnema lindsayae* Timm, 1971 (Nemata: Cephalobidae) from Subantarctic and Antarctic regions with proposal of the new subfamily Metacrolobinae. *Fundamental and Applied Nematology*, 17: 175–180.

VINCIGUERRA, M. T. & CLAUSI, M. (1990): Two new species of *Etamphidelus* Andrássy, 1977 (Nematoda: Alaimidae) from Tierra del Fuego (Argentina). *Animalia*, 17: 73–84.

VINCIGUERRA, M. T. & LA ROSA, G. (1990): A new species of *Clarkus* Jairajpuri, 1970 (Nematoda: Mononchida) from Subantarctic America. *Animalia*, 17: 99–104.

VOVLAS, N., TROCCOLI, A. & MORENO, I. (2000): *Subanguina chilensis* sp. n. (Nematoda: Anguinidae), a new leaf-gall nematode paraziting *Nothophagus obliqua*, in Chile. *International Journal of Nematology*, 10: 1–8.

REFERENCES „B"

In addition, the following publications have been considered.

AHMAD, W. & JAIRAJPURI, M. S. (1989): *Coomansinema* n. gen. (Nematoda: Dorylaimida) with the description of *C. dimorphicauda* n. sp. *Nematologica*, 35: 142–146.

ANDRÁSSY, I. (1967): Nematoden aus Chile, Argentinien and Brasilien gesammelt von Prof. Dr. H. Franz. *Opuscula Zoologica Universitatis Budapestinensis*, 7: 3–34.

ANDRÁSSY, I. (1985): The genus *Plectus* Bastian, 1865 and its nearest relatives (Nematoda: Plectidae). *Acta Zoologica Academiae Scientiarum Hungaricae*, 31: 1–52.

ANDRÁSSY, I. (1992): The superfamily Dorylaimoidea (Nematoda) – a review. Family Qudsianematidae, II. *Opuscula Zoologica Universitatis Budapestinensis*, 24: 3–55.

ANDRÁSSY, I. (1998): Nematodes in the Sixth Continent. *Journal of Nematode Morphology and Systematics*, 1: 107–186.

ANDRÁSSY, I. (2001): A taxonomic review of the genera *Aporcelaimus* Thorne & Swanger, 1936 and *Metaporcelaimus* Lordello, 1965 (Nematoda: Aporcelaimidae). *Opuscula Zoologica Universitatis Budapestinensis*, 33: 7–47.

ANDRÁSSY, I. (2002): Free-living nematodes from the Fertő–Hanság National Park, Hungary. *In: Mahunka, S. (ed.): The Fauna of the Fertő–Hanság National Park. Budapest*, 357–432.

BOTHA, A. & HEYNS, J. (1990): Aporcelaimidae (Nematoda: Dorylaimida) from the Kruger National Park. *Koedoe*, 33: 27–46.

HEYNS, J. & SWART, AS. (1993): *Namaquanema hanki* n. gen., n. sp. from South Africa (Nematoda: Dorylaimoidea). *Fundamental and Applied Nematology*, 16: 171–175.

JAIRAJPURI, M. S. & AHMAD, W. (1992): Dorylaimida. Free-living, predaceous and plant-parasitic nematodes. *New Delhi*, pp. 458.

MONTEIRO, A. R. & LORDELLO, L. G. E. (1980): *Tubixaba tuxaua* n. g., n. sp., a suspected parasitic nematode of soybean roots (Aporcelaimidae). *Revista Agricultura, Piracicaba*, 55: 301–304.

NELL, N. & HEYNS, J. (1987): A new species of *Tubixaba* Monteiro & Lordello, 1980 from Botswana (Nematoda: Dorylaimida). *Phytophylactica*, 19: 433–436.

NELL, N. & HEYNS, J. (1988): A diagnostic species compendium of the genus *Labronema* Thorne, 1939 (Nematoda: Dorylaimida). *Phytophylactica*, 230: 47–53.

STEINER, G. (1943): New nematodes associated with a disease of the papaya in Chile. *Boletin del Departamento de Sanidad Vegetal, Santiago*, 3: 95–116.

VINCIGUERRA, M. T. (1984): Description of two new species and remarks on some known species of Nematodes from Sardinia. *Animalia*, 11: 127–134.

ZELL, H. (1993): Die Gattung *Plectus* Bastian, 1865 sensu lato (Nematoda., Plectidae). Ein Beitrag zu Ökologie, Biogeographie, Phylogenie und Taxonomie der Plectidae. *Andrias*, 11: 171.

Opusc. Zool. Budapest, 2002, 34: 23–34

On the genus *Oriverutus* Siddiqi, 1971 (Nematoda: Dorylaimida)

I. ANDRÁSSY*

Abstract. A known and two new species of the genus *Oriverutus* Siddiqi, 1971 are described. *Oriverutus maturitatis* Andrássy, 1995 is reported from Bolivia, Ecuador and Peru, and the male described for the first time. *Oriverutus masculus* sp. n. from Ecuador is an amphidelphic species characterized by large size, number and arrangement of ventromedial supplements. *Oriverutus orientalis* sp. n. from New Guinea is a monodelphic species characterized by the length and shape of stylet and tail. A general view of the genus *Oriverutus* and a key to its species are added.

Although the genus *Oriverutus* Siddiqi, 1971 is distributed almost all over the world (in Europe, Asia, Africa, South America and Oceania), its species are rare elements of the terrestrial faunas. In most localities they can be found in low individual number.

Up to now, nineteen species had been regarded as belonging to this interesting genus. In the second part of this article I want to give a general survey of the genus *Oriverutus* and to enumerate its species. First, however, I provide the descriptions of three species. One species, *Oriverutus maturitatis* Andrássy, 1995, was already known, but this is the first report on the male. Two species are new to science: *Oriverutus masculus* sp. n. and *O. orientalis* sp. n. The two former originated from South America, the latter came from New Guinea.

Oriverutus maturitatis Andrássy, 1995

(Fig. 1 A–F)

Specimens from Bolivia:

Females (n = 2): L = 0.82–0.92 mm; a = 24–26; b = 3.2–3.8; c = 18–19; c' = 2.5–2.9; V = 46–49 %.

Specimens from Peru:

Female: L = 0.96 mm; a = 27; b = 3.4; c = 18; c' = 3.0; V = 50 %.

Male: L = 1.04 mm; a = 30; b = 3.5; c = 28; c' = 1.7.

Specimens from Ecuador:

Females (n = 2): L = 0.83–1.00 mm; a = 25–26; b = 3.5–3.6; c = 17–21; c' = 2.2–2.5; V = 44–47 %.

Body C-shaped after fixation, 32–38 µm wide at mid-region. Cuticle thin and smooth, 1.0–1.5 µm, on tail somewhat thicker. Labial region 9–10 µm wide (a' = 80–115), set off by constriction. Lips separated from one another, labial papillae prominent, especially the anterior ones. Body at posterior end of oesophagus 3.4–3.8 times as wide as head. Amphids large, wide and deep with apertures nearly equal to corresponding body diameter.

Odontostyle 13–15 µm, about 5 % of oesophagus length, 1.3–1.6 times the labial width long, slender, nearly as thick as cuticle, sharply pointed on its anterior tip. Length of stylet aperture inconspicuous. Guiding ring simple, thin. Oesophagus 245–296 µm long, occupying 27–31 % of body length, slender and weakly muscular in its anterior part, gradually widened at 57–61 % of its length. Cylindrus thick and strongly muscular. Glandularium 88–95 µm long. Oesophageal nuclei small, rather inconspicuous. Dorsal nucleus at 20 % of entire length of body. AS_1 closer to AS_2 than to D. PS nuclei at a distance of 10–14 µm (barely a cylindrus width) from posterior margin of

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oesophagus. Cardia conoid, short. Rectum as long as 1.7–1.9, prerectum as 2.2–2.9 anal body diameters.

Oesophageal nuclei in Oriverutus maturitatis

D = 67–69 %	AS_1 = 32–34 %
	AS_2 = 47–48 %
	PS_1 = 84–85 %
K = 68–70 %	PS_2 = 85–88 %

Female. Genital organ amphidelphic. Vulva transverse with small sclerotized lips, lying at a distance of 4.8–5.6 body widths from oesophagus. Vagina 15–18 µm, nearly as deep as half body width. Anterior gonad on the right side, 2.5–3.0 body diameters long or 10–12 % of body length, posterior gonad on the left side, 3.0–3.5 body diameters long or 11–14 % of body length. Ovaries almost reaching to vulva. Spermatheca between uterus and oviduct present. Mature eggs not observed. Distance vulva–anus equal to 8–9 tail lengths. Tail 42–52 µm, 5.0–5.5 % of body length, conoid, gradually tapering to its sharp tip. Posterior half of tail straight or slightly bent dorsad.

Male. Testes two. Genital tract (from anterior tip of the first testis to cloaca) as long as 17 body diameters, occupying 56 % of total length of body. Spermatozoa oval, 4 µm long. Spicula massive, 38 µm long in curvature, with weak venter. Ventromedial supplements seven, well spaced, the posteriormost levelling with the spicula. Prerectum beginning between the 2nd and 3rd supplement. Tail similar to female, 37 µm long, 3.5 % of body, conoid with straight, sharp tip.

Remarks. I originally described this species from Bolivia after seven female specimens. The present description is based on six females and one male.

The present females correspond well to the original description. The male was found for the first time, and it also fits the general criteria of the species. *Oriverutus maturitatis* can be characterized by the body size being around 1 mm, the smooth cuticle, well separated head, moderately long stylet, posterior position of PS nuclei, long rectum, paired gonads, mostly dorsally bent tail, and by the number and arrangement of male supplements.

Including the following new species *(O. masculus)*, males are known in ten species within the genus. Out of them three are characterized in having the posteriormost supplement(s) within the range of spicula: *Oriverutus anisi* Ahmad & Jairajpuri, 1987, *O. arcuatus* Baqri, 1980 and *O. masculus* sp. n. *Oriverutus maturitatis* differs from them, among others, in the number of supplements (7 *vs.* 6, 3 or 10–11 respectively).

Localities. Porto Linares, Bolivia, litter from rain forest, December 1971, coll. J. Balogh (three females). – Flavio Alfaro, Prov. Manabi, Ecuador, soil and detritus from bamboo forest, April 1990, coll. A. Zicsi and Cs. Csuzdi (two females). – Tingo Maria, Peru, 800 m above sea-level, decayed wood rests from a deciduous forest, July 1999, coll. J. Farkas (one female, one male).

It seems that *Oriverutus maturitatis* is generally distributed in the western countries of the South American continent.

Oriverutus masculus sp. n.

(Fig. 2 A–E)

Holotype male: L = 1.28 mm; a = 29; b = 4.1; c = 24; c' = 2.0.

Paratype males (n = 2): L = 1.26–1.47 mm; a = 30–31; b = 3.9–4.5; c = 25–30; c' = 1.8–1.9.

Comparatively large species, body C-shaped or twisted, especially in posterior part. Body width 40–46 µm at mid-region. Cuticle 2 µm thick, apparently smooth. Lip region 14 µm wide, set off by a constriction. Lips well separated, large, lobe-like, labial papillae protruding. Body at posterior end of oesophagus 2.9–3.1 times as wide as head. Amphids broad and deep, nearly as wide as corresponding body.

Odontostyle 22–24 µm long, 1.6–1.7 head diameters or 7–8 % of oesophagus, relatively strong, equal to cuticle in thickness. Stylet aperture seemingly large. Oesophagus 305–315 µm, 24–25 % of body length, slender in its anterior section, gradually widening at 53–57 % of its length. Cylindrus strong. Glandularium 112–120

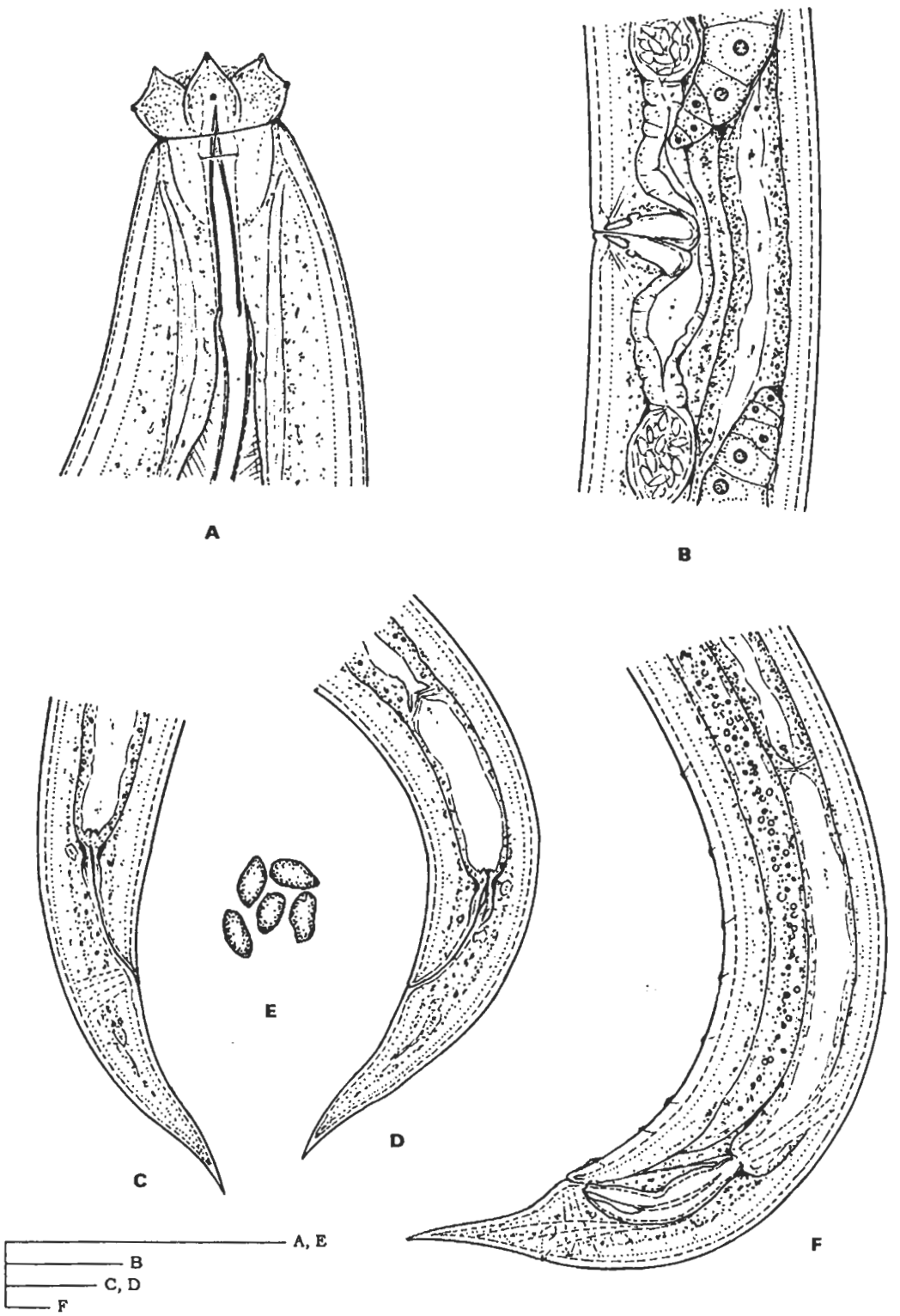

Figure 1. *Oriverutus maturitatis* Andrássy, 1995. A: anterior end with strongly offset head, large lips, very large amphid and sharply pointed odontostyle; B: vulval region with transverse vulva, sclerotized narrow vulval lips, spermathecas containing spermatozoa; C-D: female tails slightly bent posteriorly with sharp tips; E: spermatozoa; F: posterior end of male with seven well-spaced ventromedial supplements and tail similar to that of female. (Scale bars 20 µm each)

µm long. By virtue of the heavy structure of cylindrus, the oesophageal gland nuclei are less visible. Dorsal nucleus located at 15 % of entire length of body. AS_1 closer to its partner than D. PS nuclei one cylindrus width from oesophagus terminus. Cardia hemispheroid. Prerectum beginning at level of the 4th to 6th supplement.

Oesophageal nuclei in Oriverutus masculus

D = 64 %	AS_1 = 35 %
	AS_2 = 40 %
	PS_1 = 81 %
K = 87 %	PS_2 = 84 %

Female. Not found.

Male. Testes paired. Genital tract as long as 11–12 body diameters, occupying 36–38 % of body length. Spermatozoa oval, 4–5 µm. Spicula along the curved axis 44–46 µm long, comes 14 µm. Adcloacal pair of supplements relatively far from cloaca. Ventromedial supplements minute, 10 or 11 in number, separated. Posterior two or three supplements located within the spiculum range. Tail 47–53 µm long, 3–4 % of body length, first ventrally curved then straight. Tip of tail finely rounded.

Diagnosis. Body large, strongly curved or twisted. Cuticle smooth, head separated from neck, lips lobe-like, odontostyle medium slender, more than 1.5 times longer than labial width, anterior subventral oesophageal nuclei close to each other, supplements very small but numerous, a part of them within the range of spicula, posterior half of tail straight. Female not known.

Relationships: In having 1.3 to 1.5 mm long body, *Oriverutus masculus* sp. n. belongs to the largest representatives of the genus. There are two similarly large species, *Oriverutus ivorensis* (Carbonell & Coomans, 1982) Ahmad & Siddiqi, 1997 (1.3–1.5 mm) and *O. longicaudatus* Ahmad & Siddiqi, 1997 (1.1–1.4 mm). The new species can easily be distinguished from them by its much shorter tail (1.8–2.0 *vs.* 6–9 anal body widths) and shorter stylet (22–24 µm or 1.6–1.7 labial diameters *vs.* 26–33 µm or 2.4–3.0 labial diameters). Besides, it differs from every species where male is known in having a high number of ventromedial supplements (10–11 *vs.* 2–8, exceptionally 9) and in having two or three supplements at level of spicula (*vs.* one or none).

Holotype. Male on slide No. 13194. Paratypes: two males. All deposited at the collection of the author.

Type locality. Giron, Prov. Azuay, Ecuador, litter from a deciduous forest, Mai 1988, coll. A. Zicsi and Cs. Csuzdi.

Etymology. The species name *„masculus" is* from the Latin and means: male or masculine, referring to the type population that consists of males only.

Oriverutus orientalis sp. n.

(Fig. 3 A-F)

Holotype female. L = 0.93 mm; a = 32; b = 3.3; c = 22; c' = 2.4; V = 43 %.

Paratype females (n = 3): L = 0.91–1.01 mm; a = 30–32; b = 3.1–3.6; c = 21–22; c' = 2.3–2.5; V = 39–42 %.

Body of medium size, C-shaped in fixed stage, 29–32 µm wide at mid-region. Cuticle 1.5–2.0 µm thick, on tail 2.5 µm, consisting of two layers, very finely annulated especially on anterior body. Lip region set off by a depression, 8-9 µm wide (a' = 90–106), lips separated, papillae distinct. Body at posterior end of oesophagus 3.0–3.2 times as wide as head. Amphids large, nearly equal in diameter to corresponding body.

Odontostyle 17–18 µm, as long as 1.9–2.0 cephalic diameters or 6 % of oesophagus; slender, thinner than cuticle at same level, sharply pointed in its distal tip. Guiding ring quite thin, anterior to mid-stylet. Odontophore weakly sclerotized. Oesophagus 282–290 µm long, occupying 28–32 % of body; slender in its anterior part, gradually expanded at 58–62 %. Glandularium 92–100 µm long, occupying 33–34 % of oesophagus. Oesophageal nuclei, with exception of dorsal nucleus, rather inconspicuous. Dorsal nucleus also small, at 66–67 % of glandularium or 20–21 % of entire length of body. Cardia conoid. Rectum equal to 1.5, prerectum to 2.3–2.5 anal body widths.

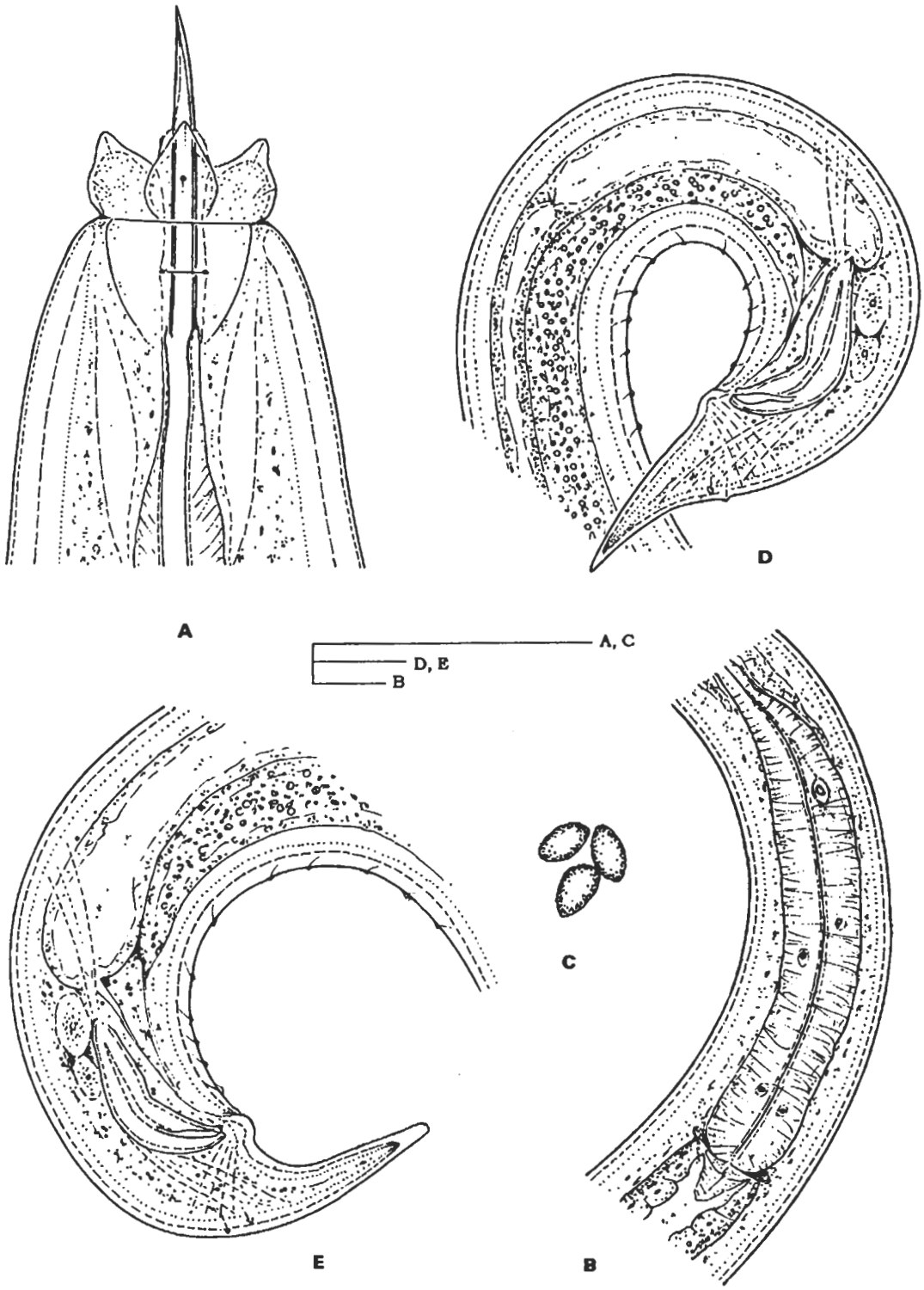

Figure 2. *Oriverutus masculus* sp. n. A: anterior end with strongly separated head, large lobe-like lips, broad amphid, long and sharply pointed odontostyle; B: posterior half of oesophagus (cylindrus) showing the five gland nuclei; C: spermatozoa; D–E: variation in posterior end of males possessing 10 and 11 ventromedial supplements, respectively, and finely rounded tail tips. (Scale bars 20 µm each)

Female. Gonad mono-opisthodelphic, as long as 4.5–5.3 body widths or 4.5–5.0 % of body length. Vulva transverse with sclerotized inner lips, located at 3–4 body diameters or 84–118 µm from oesophagus. Vagina 16–18 µm, reaching midway the body diameter. Prevulval uterine sac practically absent. Ovary reflexed to two-thirds towards vulva. No mature egg in uterus. Vulva–anus distance equal to 10–13 tail lengths. Tail 42–46 µm, only 4.5–5.0 % of body; conoid, first ventrally curved then slightly dorsally bent. Tip of tail finely rounded. Terminal hyaline portion one-sixth one-fourth of tail length.

Male. Not known.

Larve. Similar to adult female in general habit. Tail as long as 2.5 anal body diamters.

Diagnosis. A medium-sized species with finely annulated cuticle, slightly offset head, long and thin stylet, rather inconspicuous oesophageal nuclei, rectum longer than anal body width, unpaired female gonad, medium long and in posterior half straight tail.

Relationships. Out of the nineteen species regarded so far as valid within the genus, seven species have been described as monodelphic. In them, the length of stylet varies between 10 and 26 µm or 1.3 and 2.5 labial diameters. In having a long and slender stylet (2 labial diameters long), *Oriverutus orientalis* sp. n. resembles *O. longistylus* Ahmad & Jairajpuri, 1987 (stylet 2–2.5 labial diameters long), its body is however longer (0.9–1.0 mm *vs.* 0.6–0.7 mm), the tail shorter (42–46 µm, 2.3–2.5 anal body widths *vs.* 60–62 µm, 3.6–5.1 anal body widths) and rounded on tip. In the short and slightly dorsally bent tail it resembles *O. sundarus* (Williams, 1964) Siddiqi, 1971, but the stylet is longer and more slender (1.9–2.0 *vs.* 1.3–1.6 labial diameters) and a prerectal sack is absent.

Holotype. Female on slide No. 13618. Paratypes: three females and three juveniles, in the collection of the author.

Type locality and habitat. Kiunga, New Guinea, wet humus and soil in a rain forest, July 1969, coll. J. Balogh.

Etymology. This species has the easternmost occurrence within the genus, hence the specific epithet „*orientalis*" (Latin).

A SURVEY OF THE GENUS *ORIVERUTUS*

Siddiqi erected the genus *Oriverutus* in 1971 and designated *Eudorylaimus sundarus* as type species. He described a new species, *O. lobatus* and shifted three further species to his genus, a species each of *Eudorylaimus (hastatus), Tylencholaimus (hastatus,* renamed as *hastulatus)* and *Longidorella (impar).* Siddiqi placed *Oriverutus* to the family Qudsianematidae, and distinguished it from *Eudorylaimus* in having large amphids, attenuated stylet, long dorsal oesophageal gland duct and glandular tissue around the oesophago-intestinal valve.

In the course of years passed, several authors gave additional data to the genus. Ahmad, Baqri, Darekar, Dhanachand, Jairajpuri, Joymati, Khan, Mohilal and Siddiqi described not less than twelve species from India. In addition to them, Andrássy, Carbonell, and Coomans described a species each, namely from Africa and South America. Europa had remained „terra incognita" for long, when, in the nineties, Peña-Santiago and Peralta discovered the first species on the continent.

To the present knowledge, *Oriverutus* is considered to belong to the family Nordiidae rather than to Qudsianematidae.

Prior to this paper, 22 species have been included to *Oriverutus:* 16 species were described under the genus name, and 6 species were shifted from other genera. Of the 22 species, 19 could be regarded as true representatives of the genus *Oriverutus,* while 3 species were transferred to other genera. Together with the presently described two new species the number of the valid species amounts to 21.

As follows, I give an emended diagnosis of the genus *Oriverutus,* and enumerate its species. In order to facilitate the identification, I add a key to the species. As for the evolutionary value is concerned, I agree with Peña-Santiago and Peralta (1995) that the *Oriverutus* species constitute a natural (monophyletic) group and can be characterized in having a comparatively low variation of morphological and anatomical characters.

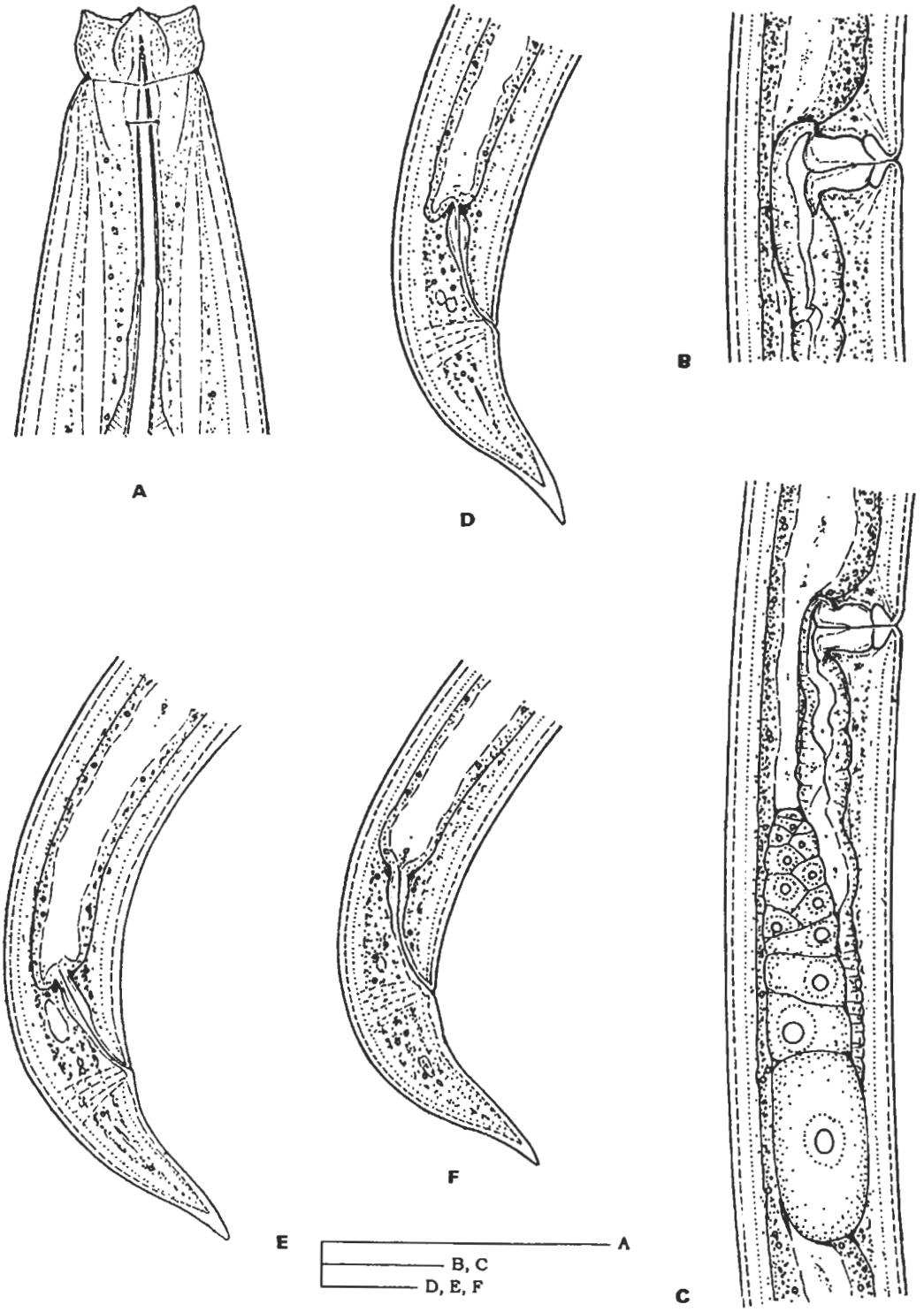

Figure 3. *Oriverutus orientalis* sp. n. A: anterior end with strongly offset labial region, large lips, large amphid and long and sharply tipped stylet; B: vulval region with transverse vulva, sclerotized vulval lips and lacking prevulval uterine sack; C: female genital tract (opisthodelphic) with transverse vulva, strong vagina, uterus, oviduct and ovary; D–E: female posterior ends showing slightly dorsally bent tails with finely rounded tips. (Scale bars 20 µm each)

Genus *Oriverutus* Siddiqi, 1971

Paroriverutus Carbonell & Coomans, 1982
Mammillonema Darekar & Khan, 1981

Diagnosis. Nordiidae. Smaller nematodes, body length varying between 0.6 and 1.5 mm. Cuticle thin, smooth or finely annulated. Labial region set off from adjacent body, lips separated from one another, often lobe-like with protruding papillae. Amphids unusually large, apertures nearly as wide as corresponding body. Odontostyle varying in length from 10 µm to 33 µm, or from 1.2 to 3.3 cephalic diameters, slender to very slender, sharply pointed on its tip. Guiding ring simple, thin. Oesophagus in anterior portion slender, hardly muscular, gradually enlarging posterior to its middle, cylindrus wide and heavily muscular. Oesophageal gland nuclei small, less conspicuous. Female genital organ amphidelphic (in 13 species) or opisthodelphic (in 8 species), vulva transverse, sclerotized. Males rare, known in 10 species. Spicula dorylaimoid. Ventromedial supplements small, separated, 2 to 11 in number. Tails of both sexes similar, conoid, gradually tapering, 2 to 10 anal body widths long, in posterior part often bent dorsally.

Type species: *Oriverutus lobatus* Siddiqi, 1971.

Twenty-one species can be considered valid (see List).

Relationships. Within the family Nordiidae, *Oriverutus* Siddiqi, 1971 has close affinities with the genera *Actinolaimoides* Meyl, 1957 and *Malekus* Thorne, 1974.

The species of *Actinolaimoides* are opisthodelphic with rounded head, amalgamated lips, small labial papillae and not sclerotized pore-like vulva. Seven species are included to this genus: *A. angolensis* (Andrássy, 1963) Siddiqi, 1982, *A. asaccatus* Dhanachand & Jairajpuri, 1980) Siddiqi, 1982, *A. attenuatus* Siddiqi, 1997, *A. impar* (Khan & Khan, 1964) comb. n., *A. peruvianus* Andrássy, 1995, *A. thornei* (Baqri & Jairajpuri, 1976) Siddiqi, 1982 and *A. tobleri* (Menzel & Micoletzky, 1925) Meyl, 1957.

The species of *Malekus* are amphidelphic with offset head, separate lips, protruded labial papillae, needle-like stylet and not sclerotized transverse vulva. Two species belong here: *M. hastatus* (Andrássy, 1963) Andrássy, 1995 and *M. acridens* Thorne, 1974.

Oriverutus can be differentiated from *Actinolaimoides* by the offset head, separate lips and sclerotized vulva, from *Malekus* by the stronger (not needle-like) stylet and the sclerotized vulva. Males are known in neither *Actinolaimoides* nor *Malekus*.

Remarks. Loof (1985) supposed that *Drepanodorylaimus macramphidius* Andrássy, 1971 is an *Oriverutus* species. In agreement with him, I herewith transfer this species to the present genus, its name thus becoming *Oriverutus macramphidius* (Andrássy, 1971) comb. n. At the same time, *Oriverutus longicaudatus* Ahmad & Siddiqi, 1998 shall be considered a junior synonym of *O. macramphidius* because no essential differences can be observed between them. Both species were described from West Africa.

In having a rounded head, not sclerotized vulva combined with mono-opisthodelphic gonad, *Oriverutus impar* (Khan & Khan, 1964) Siddiqi, 1971 seems to belong to *Actinolaimoides* rather than to *Oriverutus:* its name becoming *Actinolaimoides impar* (Khan & Khan, 1964) comb. n.

Distribution. The species of *Oriverutus* are distributed on five continents: Europe (Spain), Asia (India, Fiji), Africa (Nigeria, Ivory Coast, Cameroon, Mauritius), South America (Columbia, Bolivia, Ecuador, Peru) and Oceania (New Guinea). Europe is represented with one species *(occidentalis),* Asia with thirteen species *(anisi, arcuatus, asaccatus, hastatus, hastus, labiatus, lobatus, longistylus, mammillatus, pagarus, papillatus, parangulatus, sundarus),* Africa with six species *(asaccatus, ivorensis, lobatus, longicaudatus, macramphidius, sundarus),* South America with four species *(masculus, maturitatis, microdorus, parahastus)* and Oceania with one species *(orientalis).*

List of the *Oriverutus* species

O. anisi Ahmad & Jairajpuri, 1987

O. arcuatus Baqri, 1980

O. asaccatus (Dhanachand & Jairajpuri, 1980) Ahmad & Jairajpuri, 1987
Enchodelium asaccatum Dhanachand & Jairajpuri, 1980

Actinolaimoides asaccatus (Dhanachand & Jairajpuri, 1980) Siddiqi, 1982

O. hastatus (Siddiqi, 1964) Siddiqi, 1971[1]
Tylencholaimus hastatus Siddiqi, 1964
Oriverutus hastulatus Siddiqi, 1971

O. hastus Ahmad & Jairajpuri, 1982

O. ivorensis (Carbonell & Coomans, 1982) Ahmad & Siddiqi, 1998
Paroriverutus ivorensis Carbonell & Coomans, 1982

O. labiatus Ahmad & Jairajpuri, 1987

O. lobatus Siddiqi, 1971

O. longistylus Ahmad & Jairajpuri, 1987

O. macramphidius (Andrássy, 1971) comb. n.
Drepanodorylaimus macramphidius Andrássy, 1971
Oriverutus longicaudatus Ahmad & Siddiqi, 1998 (syn. n.)

O. mammillatus (Darekar & Khan, 1981) Jairajpuri & Ahmad, 1992
Mammillonema mammillatum Darekar & Khan, 1982

O. masculus sp. n.

O. maturitatis Andrássy, 1995

O. microdorus Ahmad & Siddiqi, 1998

O. occidentalis Peña-Santiago & Peralta, 1995

O. orientalis sp. n.

O. pagarus Ahmad & Jairajpuri, 1987

O. papillatus Ahmad & Siddiqi, 1998

O. parahastus Ahmad & Siddiqi, 1998

O. parangulatus Baqri, 1991

O. sundarus (Williams, 1964) Siddiqi, 1971
Eudorylaimus sundarus Williams, 1964

Species transferred to other genera

Malekus hastatus (Andrássy, 1963) Andrássy, 1995
Eudorylaimus hastatus Andrássy, 1963
Enchodorella hastata (Andrássy, 1963) Siddiqi, 1964
Longidorella hastata (Andrássy, 1963) Jairajpuri & Hooper, 1968
Oriverutus hastatus (Andrássy, 1963) Siddiqi, 1971

Actinolaimoides impar (Khan & Khan, 1964) comb. n.
Longidorella impar Khan & Khan, 1964
Oriverutus impar (Khan & Khan, 1964) Siddiqi, 1971

Acephalodorylaimus attenuatus Ahmad & Jairajpuri, 1983
Oriverutus prodelphus Dhanachand, Mohilal & Joymati, 1992

Key to the species of *Oriverutus* (females and males)

1 Tail long, 7–10 anal body diameters 2
– Tail shorter, 2 to 6 anal body diameters..... 3

2 Tail 110–150 µm long. - ♀: L = 1.1–1.4 mm; a = 34–47; b = 3.5–5.3; c = 8–10; c' = 6.5–9.5; V = 48–53 %. ♂ unknown. ..... *macramphidius* (Andrássy)
– Tail 200–230 µm long. - ♀: L = 1.3–1.5 mm; a = 31–37; b = 3.8–4.4; c = 6.2–6.9; c' = 8.4–9.0; V = 44–46 %. ♂: L = 1.3–1.5 mm; a = 32–39; b = 3.7–4.3; c = 6.2–6.6; PO: 4–5..... *ivorensis* (Carbonell & Coomans)

3 Large species, 1.2–1.5 mm; stylet 22–24 µm long. - ♀ unknown. ♂: L = 1.2–1.4 mm; a = 29–31; b = 3.9–4.5; c = 24–30; c' = 1.8–2.0; PO: 10–11 ..... *masculus* sp. n.
– Smaller species, around 1 mm, only exceptionally longer; stylet generally well under 20 µm 4

4 Female genital system mono-opisthodelphic. 5
– Female genital system amphidelphic 12

5 Stylet 2.0 to 2.5 labial diameters long 6
– Stylet 1.5 to 1.8 labial diameters long 7

6 Stylet very thin, needle-like; body 0.6–0.7 mm. - ♀: L = 0.6–0.7 mm; a = 24–30; b = 3.0–3.5; c = 10–12; c' = 3.6–5.1; V = 37–42 %. ♂ unknown ..... *longistylus* Ahmad & Jairajpuri

[1] When transferred *Tylencholaimus hastatus* Siddiqi, 1964 and *Eudorylaimus hastatus* Andrássy, 1963 to *Oriverutus*, Siddiqi (1971) renamed his species as *O. hastulatus*. Since these species belong at present to different genera, the homonymy is absent and the original name *hastatus* should be reinstated.

– Stylet thicker, not needle-like; body 0.9–1.0 mm. - ♀: L = 0.9–1.0 mm; a = 30–32; b = 3.1–3.6; c = 21–22; c' = 2.3–2.5; V = 39–43 %. ♂ unknown ..... *orientalis* sp. n.

7 Larger animals, 1.0–1.5 mm 8
– Smaller animals, 0.6–0.8 mm 9

8 Prerectum with a short dorsal blind sack; stylet 16–18 µm long. - ♀: L = 0.9–1.3 mm; a = 24–37; b = 3.8–4.4; c = 6.2–6.9; c' = 2–3; V = 44–46 %. ♂: L = 1.3–1.5 mm; a = 32–39; b = 3.7–4.3; c = 6.2–6.6; PO: 3. .... *sundarus* (Williams)
– Prerectum without blind sack; stylet 20–22 µm long. - ♀: L = 1.1–1.3 mm; a = 30–42; b = 3.3–3.5; c = 16–20; c' = 2.8–3.3; V = 39–43 %. ♂ unknown. .... *occidentalis* Peña-Santiago & Peralta

9 Stylet short, about 10 µm; tail short, two anal body widths. - ♀: L = 0.6–0.7 mm; a = 32–37; b = 3.1–3.4; c = 23–26; c' = 1.7–2.0; V = 46–50 %. ♂ unknown. .. *microdorus* Ahmad & Siddiqi
– Stylet longer, to 18–19 µm; tail as long as 3–5 anal body widths 10

10 Tail 3–4 anal body diameters long, slightly ventrally arcuate. - ♀: L = 0.6–0.8 mm; a = 22–30; b = 3.2–4.0; c = 12–19; c' = 3–4; V = 38–43 %. ♂ unknown. .... *asaccatus* (Dhanachand & Jairajpuri)
– Tail 4–5 anal body diameters long, slightly dorsally arcuate 11

11 Stylet 16–19 µm long. - ♀: L = 0.6–0.8 mm; a = 20–37; b = 3.0–3.3; c = 10–14; c' = 3.5–5.0; V = 37–43 %. ♂ unknown. ..... *lobatus* Siddiqi
– Stylet 13 µm long. ♀: L = 0.8 mm, a = 30; b = 3.4, c = 11; c' = 4, V = 41 %. ♂ unknown. .... *hastatus* (Siddiqi)

12 Tail ventrally curved 13
– Tail in distal part straight or dorsally bent . 16

13 Tip of tail sharp 14
– Tip of tail rounded 15

14 Ventromedial supplements 6, posteriormost in spicula range. - ♀: L = 1.1 mm; a = 29; b = 3.8; c = 15; c' = 1.9; V = 55 %. ♂: L = 1.1 mm; a = 32; b = 3.8; c = 19; PO: 6 .... *anisi* Ahmad & Jairajpuri
– Ventromedial supplements 8 or 9, all before the spicula. - ♀: L = 1.0–1.2 mm; a = 26–28; b = 3.2–3.9; c = 20–22; c' = 2.2–2.6; V = 48–53 %. ♂: L 1.1–1.5 mm; a = 31–32; b = 3.6; c = 22–26; PO: 8–9 .. *pagarus* Ahmad & Jairajpuri

15 Tail 4 anal body widths long, strongly curved ventrally; stylet 13–14 µm, supplements 3. - ♀: L = 0.8 mm; a = 33; b = 3.7; c = 15; c' = 4; V = 50 %. ♂: L = 0.8 mm; a = 37; b = 4.0; c = 13; PO: 3 ..... *arcuatus* Baqri
– Tail 3 anal body widths long, slightly curved ventrally; stylet 17–19 µm; supplements 6. - ♀: L = 1.0–1.1 mm; a = 27–38; b = 3.6–3.7; c = 17–22; c' = 2.8–3.0, V = 50–53 %. ♂: L = 1.0–1.2 mm; a = 30–32; b = 3.6–3.7, c = 20–22; PO: 6 ..... *parangulatus* Baqri

16 Lip region narrow, hardly separated from neck 17
– Lip region wide, strongly separated from neck 18

17 Stylet 13–14 µm, as long as 1.4–1.6 labial diameters. - ♀: L = 0.9 mm; a = 30–34; b = 3.0–3.8; c = 19–20; c' = 2.3–2.4; V = 49–50 %. ♂: L = 0.9–1.0 mm; a = 34–42; b = 3.0–3.8; c = 18–23; PO: 2 ..... *hastus* Ahmad & Jairajpuri
– Stylet 18–23 µm, as long as 2.6–3.3 labial diameters. - ♀: L = 0.7–0.8 mm; a = 24–29; b = 3.5–3.7; c = 10–11; c' = 4.0–4.6; V = 59–60 %. ♂ unknown. ..... *parahastus* Ahmad & Siddiqi

18 Stylet 25 µm long. - ♀: L = 1.1–1.2 mm; a = 34–38; b = 3.2–3.5, c = 20–22; c' = 2.4–2.6; V = 48–50 %. ♂ unknown..... ..... *papillatus* Ahmad & Siddiqi
– Stylet 13 to 17 µm long 19

19 Body longer, 1.1–1.2 mm, tail about 4 anal body widths long. - ♀: L = 1.1–1.2 mm; a = 45–47; b = 3.5–4.0; c = 19–20; c' = 3.5–4.0; V = 52–55 %. ♂: L = 1.1–1.2 mm; a = 54–56; b = 3.5–3.7, c = 15–16; PO: 7 .... *mammillatus* (Darekar & Khan)
– Body shorter, 0.8–1.0 mm; tail 2–3 anal body widths long 20

20 Sclerotized pieces in vulva parallel to body axis; lips lobe-like with strongly protruding papillae. - ♀: L = 0.9–1.0 mm; a = 31–37; b = 3.4–3.8, c = 21–24; c' = 2.3–2.6; V = 52–60 %. ♂ unknown. ..... *labiatus* Ahmad & Jairajpuri
– Sclerotized pieces in vulva directed at right angles to body axis; lips not lobe-like, papillae moderately protruding. - ♀: L = 0.8–0.9 mm; a = 24–30; b = 3.2–3.8; c = 17–21; c' = 2.5–3.3; V = 44–49 %. ♂: L = 1.0 mm; a = 30; b = 3.5; c = 28; PO: 7 ..... *maturitatis* Andrássy

Key to males of *Oriverutus* species

1 Tail filiform, 8 anal body widths long .... *ivorensis* (Carbonell & Coomans)
- Tail short, conoid, 3–4 anal body widths long 2
2 Supplements 2 or 3 3
- Supplements 6 to 11 5

3 Posteriormost supplement within range of spicula, tail ventrally arcuate .. *arcuatus* Baqri
- Posteriormost supplement before spicula 4

4 Stylet 13–14 µm long; supplements 2 .... *hastus* Ahmad & Jairajpuri
- Stylet 16–19 µm long; supplements 3 .... *sundarus* (Williams)

5 Supplements 10–11; stylet 20–22 µm long .... *masculus* sp. n.
- Supplements 6–9; stylet 13–19 µm long 6

6 Tail dorsally bent 7
- Tail ventrally bent 8

7 Supplements large, mammillate .... *mammillatus* (Darekar & Khan)
- Supplements minute ..... *maturitatis* Andrássy

8 Posteriormost supplement in spicula range .... *anisi* Ahmad & Jairajpuri
- Posteriormost supplement before spicula 9

9 Supplements 6 ..... *parangulatus* Baqri
- Supplements 8–9 .... *pagarus* Ahmad & Jairajpuri

REFERENCES

AHMAD, W. & JAIRAJPURI, M. S. (1982): Some new and known species of Dorylaimoidea. *Nematologica*, 28: 39–61.

AHMAD, W. & JAIRAJPURI, M. S. (1983): Three new and two known species of dorylaim nematodes with proposal of *Acephalodorylaimus* n. gen. *Nematologica*, 28: 233–246.

AHMAD, W. & JAIRAJPURI, M. S. (1987): Studies on the genus *Oriverutus* (Nematoda: Dorylaimida). *Nematologica*, 33: 10–21.

AHMAD, W. & PEÑA-SANTIAGO, R. (2001): On the status of *Oriverutus prodelphus* Dhanachand, Mohilal & Joymati, 1992. *Journal of Nematode Morphology and Systematics*, 4: 47–48.

AHMAD, W. & SIDDIQI, M. R. (1998): Four new and one known species of *Oriverutus* Siddiqi (Dorylaimida) from tropical rain forests. *International Journal of Nematology*, 7: 182–189.

ANDRÁSSY, I. (1963): Freilebende Nematoden aus Angola. I. Einige moosbewohnende Nematoden. *Servicos Culturais de Companhia de Diamantes de Angola*, 66: 57–79.

ANDRÁSSY, I. (1971): Freilebende Nematoden aus Angola. II. Über zwei *Drepanodorylaimus*-Arten. *Servicos Culturais de Companhia de Diamantes de Angola*, 84: 47–54.

ANDRÁSSY, I. (1995): Tropical nematodes of rare genera (Dorylaimida). *Opuscula Zoologica Universitatis Budapestinensis*, 27–28: 5–24.

BAQRI, Q. H. (1980): Two new species of Dorylaimidae (Dorylaimida: Nematoda) from Tamil Nadu, India. *Bulletin of Zoological Survey of India*, 2: 139–143.

BAQRI, Q. H. (1991): Contribution to the fauna of Sikkim. Nematodes associated with citrus from Sikkim, India. *Occasional Papers of Zoological Survey of India*, 128: 1–103.

CARBONELL, E. & COOMANS, A. (1982): *Paroriverutus ivorensis* n. gen., n. sp. from Ivory Coast (Nematoda). *Revue de Zoologie Africaine*, 96: 898–904.

DAREKAR, K. S. & KHAN, E. (1981): Soil and plant parasitic nematodes from Maharashtra, India. VIII. *Mammillonema mammilatus* gen. n., sp. n. (Dorylaimida: Nematoda). *Indian Journal of Nematology*, 112: 176–179.

DHANACHAND, CH. & JAIRAJPURI, M. S. (1980): Four new and one known species of Dorylaimida from Manipur, India. *Indian Journal of Nematology*, 120: 152–165.

DHANACHAND, CH., MOHILAL, N. & JOYMATI, L. (1992): *Tylencholaimus minutus* n. sp. and *Oriverutus prodelphus* n. sp. (Nematoda: Dorylaimida) from Manipur. *Current Nematology*, 3: 149–152.

JAIRAJPURI, M. S. & AHMAD, W. (1992): Dorylaimida. Free-living, predaceous and plant-parasitic nematodes. *New Delhi*, pp. 458.

KHAN, E. & KHAN, S. H. (1964): *Longidorella impar* n. sp. (Nematoda: Longidorinae) from North India. *Zoologischer Anzeiger*, 173: 345–347.

LOOF, P. A. A. (1985): Taxonomic studies on the genus *Prodorylaimus* Andrássy, 1959 (Nematoda: Dorylaimida). *Revue de Nématologie*, 8: 193–213.

PEÑA-SANTIAGO, R. & PERALTA, M. (1995): Nematodes of the order Dorylaimida from Andalucía Oriental, Spain. *Oriverutus occidentalis* sp. n. and a compendium of the genus. *Afro-Asian Journal of Nematology*, 5: 204–208.

SIDDIQI, M. R. (1964): Six new nematode species in the superfamily Dorylaimoidea from India. *Labdev Journal of Science and Technology*, 2: 136–144.

SIDDIQI, M. R. (1971): *Oriverutus lobatus* gen. n., sp. n. and *Sicaguttur sartum* gen. n., sp. n. (Nematoda: Dorylaimoidea) from cultivated soils in Africa. *Nematologica*, 16: 483–491.

WILLIAMS, J. R. (1964): Studies on the nematode soil fauna of sugar cane fields in Mauritius. 6. *Eudorylaimus sundarus* n. sp. (Dorylaimidae). *Nematologica*, 10: 319–322.

Opusc. Zool. Budapest, 2002, 34: 35-42

Herpetological methods: II. Protocol for monitoring amphibian deformities under temperate zone conditions

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Abstract. Amphibian deformities have become a more and more common phenomenon in the Northern Hemisphere, and from the early 1990s the frequency of deformity was often above the 2 % background value. In spite of its environmental and conservation importance, only a limited number of studies deal with this topic in Europe. On the basis of a three year national study a suggested protocol to recognise, analyse and evaluate amphibian deformities at the juvenile and adult stage is given in this paper together with some findings on this topic in Hungary. Individual records have value but to analyse amphibian deformity cases further at least fifty individuals per site is suggested to be checked from every species with abundance estimations over at least a 400 m^2 area or a 200 metre riverbank together with the recording of additional biotic and abiotic information.

The rapid destruction of many ecosystem types and the disappearance or serious decline of many species in the last three decades of the 20th century stresses the importance of environmental investigations. Among other programmes, large-scale zoological research projects are needed to understand, conserve and improve the present diversity of species, the stability and functioning of ecosystems on Earth (Purvis & Hector, 2000). Standardisation together with the testing of new methods to develop better sampling protocols is a key element of the process, which is also supported by the present series of articles (Puky, 2001).

Amphibians are among those groups of animals which need extra attention due to their biphasic life cycle, high sensitivity and moderate migrating capacity. Their vulnerability was recognised early (Wake, 1991, Griffiths & Beebee, 1992) and the first standardised protocol was compiled already in 1994 (Heyer et al.). Several publications deals with this topic ever since (see e. g. Olson et al., 1997) as there is a growing need for further improvement, regionalisation or just the contrary, generalisation of monitoring methods.

The occurrence of amphibian deformities is known and documented for centuries as the first description dates back to the 18th century (Vallisneri, 1733). In the last thirty years several authors described and categorised different deformity types and summarised the up-to-date knowledge in this field (Quellet, 1999; Johnson et al., 2001). Apart from genetical reasons, various environmental factors from parasites to low temperature have also been proved to cause deformities in the wild (Dubois, 1983; Gardiner & Hoppe, 1990; Quellet, 1997; Rowe et al., 1996, 1998; Rostand, 1958, 1959, 1971; Woitkewitsch, 1961). Others (e.g. high tadpole density, water chemistry modifications, hot temperature, toxins, lack of vitamin D or calcium) led to malformations under laboratory conditions (Berger, 1968, 1971; Cummings, 1987, 1989; Harfenist et al., 1989; Muto, 1969a, 1969b, 1970). Reports on amphibian deformities have become more common from the early 1990s and the deformity frequency was often well above the 2 % background value including a 71 % frequency of a *Bombina bombina* population in the Gemenc floodplain of the River Danube in Hungary (Puky, 2000). As this phenomenon affects thirty-nine countries worldwide,

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intensive research is needed to elucidate the possible causes and make necessary steps to avoid the conservation consequences of amphibian deformities. To help reach this aim the present paper describes a monitoring protocol suitable for professionals as well as volunteers to recognise, analyse and evaluate amphibian deformities at the juvenile and adult stage together with some findings on this topic in Hungary on the basis of a three year national survey.

METHODOLOGICAL DESCRIPTION

The study of amphibian deformities requires similar licences, preparation and safety precautions as other fieldwork with amphibians (see e. g. Heyer et al., 1994; Olson et al., 1997; Puky, 2001). Here only the specific requirements of amphibian deformity recording are discussed.

Sampling strategies and timing

Unless other factors are taken into consideration, sampling can be carried out most efficiently when animals are most abundant. In the temperate zone this is the breeding season for the adults of terrestrial, fossorial or arboreal species (e.g. *Bufo bufo*, *Pelobates fuscus* and *Hyla arborea*, respectively), which usually peaks in an approximately one to three week period for every species according to the weather conditions. Both spring and autumn migration are optimal periods to check the adults of aquatic or semi-aquatic species in case they hibernate on land. Besides, they can be caught easily in large numbers e.g. when crossing roads as at Lake Fertő (Kárpáti, 1988), and it also means less disturbance to the animals than by other methods. If they hibernate in water, netting or torching (Griffiths & Langton, 1998) can also be used to collect them, but it usually requires more time. For newts, the aquatic period is recommended, which is usually two to four months long and might need different sampling stategies (netting seems to be the best though trapping is also useful when more time is available for sampling). Although involving minimal disturbance, visual examination using binoculars is not an adequate method, as some deformities, e.g. ectrodactyly, are small and often hidden, each individual has to be taken in hand for the investigation. Both because of practical reasons (sampling) and theoretical considerations (deformed animals are more vulnerable to predation, consequently, their ratio decreases over time) newly metamorphosed individuals should be checked as near to metamorphosis as possible. However, if abundance, biomass or any other area-related characteristic is also calculated, sampling should be postponed by at least one, or rather two months to allow juvenile dispersal to take place and thus get better estimations. Checking the water edge or transect sampling are usually good methods for common species while it is often difficult to collect the appropriate number of juveniles from the rare species.

Sample size and area

Records of individuals with deformities even if they describe single animals are useful e.g. to prove the occurrence of a given deformity at a site, in a country or any other geographical unit, or the presence of deformities in a particular species such as the work of Borkin & Pikulik, (1986), Dely (1960), Dubois (1979) and Vershinin (1989). However, to be able to analyse the data further (e.g. to give frequency), several individuals should be checked. Twenty-five individuals is an absolute minimum to be studied, fifty individuals per site is a reasonable number with an optimal number of a hundred individual per site especially if the deformity frequency is over 10 %. Under normal field conditions it is not always possible to collect so many amphibians particularly from rarer species. As a consequence, the number of animals on which the deformity rate is calculated must be included. If less than twenty-five animals can be caught it is still worth recording if they are healthy or not and if e.g out of eight caught frogs two show deformities it is well worth checking the site at another time to get more information, especially as the activity of amphibians greatly changes according to the weather (temperature, moisture, cloud cover, etc.). Usually, more than one species is present at one site even if most are in low numbers; the health condition of rarer species is also of interest, especially when the deformity rate is high

Table 1. Short characterisation of amphibian deformity types

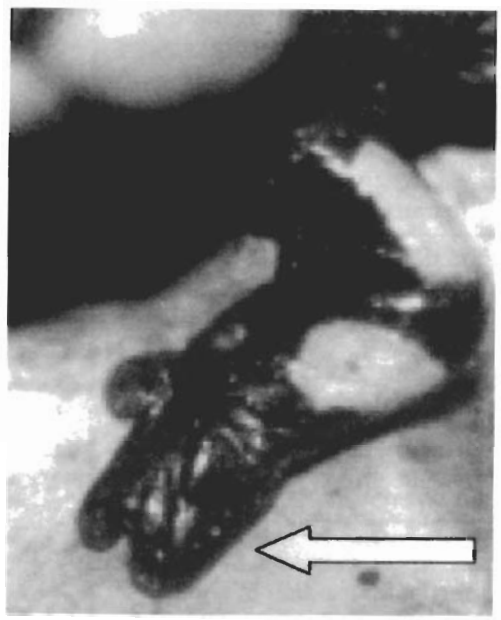
Type of deformity	Short description
Ectrodactyly	Total or partial absence of toe(s)
Ectromely	Total or partial absence of limb(s)
Unilateral anophthalmia	Missing eye
Polyphtalmia	More than two eyes
Syndactyly	Total or partial fusion of toes
Synmely	Total or partial fusion of limbs
Clinodactyly	Curvature of toe(s)
Clinomely	Curvature of limb(s)
Polymely	Supernumerary limb(s)
Polydactyly	Supernumerary toes(s)
Macrophtalmia	Eyes larger than normal
Microphtalmia	Eyes smaller than normal
Subluxatio	Incomplete or partial dislocation of a joint
Tail deformity	Reductive deformity of the tail

in one species. Since disappearance of amphibians can also be a sign of strong negative processes in the environment, the suggested sampling strategy includes abundance estimation over at least a 400 m^2 area or a 200 metre riverbank.

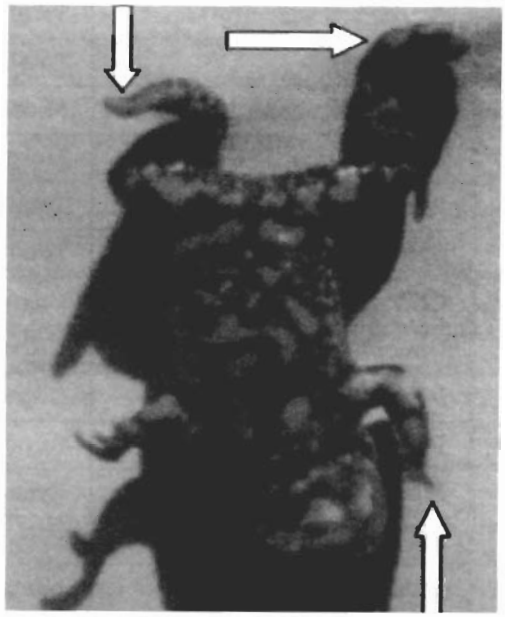
Deformity recording

In amphibians, a highly threatened animal group, deformities may develop in relatively large numbers. When deformities are described, it is important to give detailed information on what deformity type occurred. Table 1 summarises amphibian deformity types according to Quellet (1999). Four important deformity types recorded in Hungary can be seen in Figure 1. In addition to accurate and appropriate categorisation, the indication of the part and side of the body where the malformation occurs can also be relevant. Asconsequence, it is not enough to record e.g. ectrodactyly, but also whether it is on the front or hind legs due to their different development and consequently, the different environmental meaning of the two phenomena. If more than one deformity is present, their symmetry or asymmetry can also be relevant. Figure 2 shows the distribution of leg-related amphibian deformities detected so far in Hungary. Most of them developed on hind legs, which indicates environmental causes (Puky & Fodor, 2002), but front leg deformities and combined front and hind leg deformity cases have also been recorded.

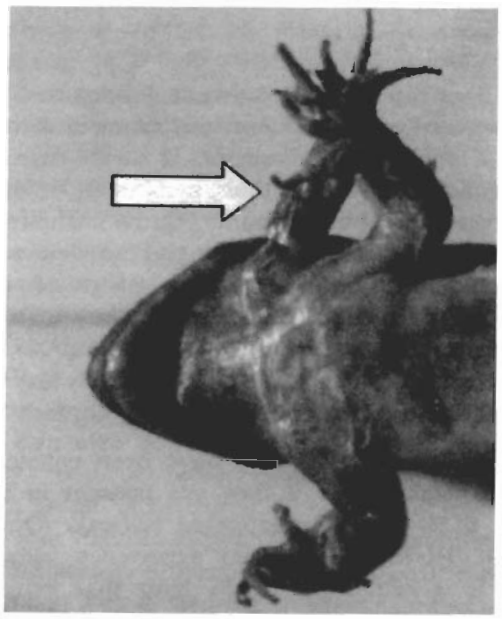
Amphibian deformities have been considered to be mass events if they are present in more than 5 % of the investigated animals (Quellet, 1999). However, our field experience indicates that it is rather the 10 % limit that generally marks the presence of an agent, that affects amphibians. A 2–10 % frequency of amphibian deformities over a longer period, however, can also reveal the presence of an agent that can kill a lot of developing amphibians in an early stage of development (Quellet, 1999). If the size of a popu-



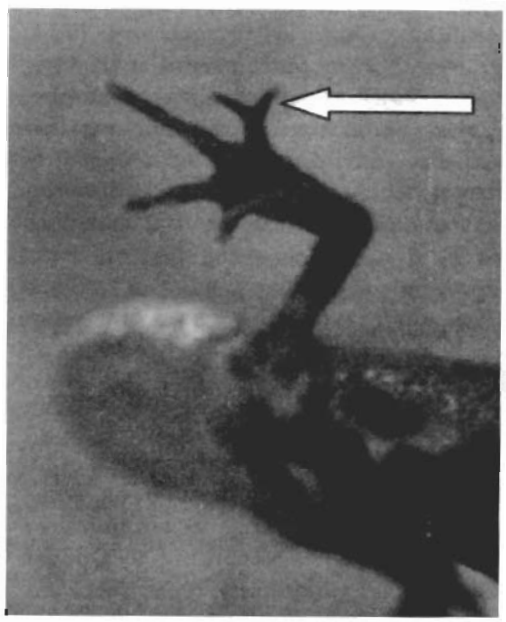
B, Syndactyly *(Salamandra salamandra)*



D, Multiple (clinomely, ectrodactyly) deformities *(Bombina bombina)*



A, Polimely *(Rana esculenta* c.*)*



C, Polidactyly *(Triturus carnifex)*

Figure 1. Amphibian deformities in Hungary. A: Polymely (***Rana esculenta*** complex); B: Syndactyly (***Salamandra salamandra***); C: Polydactyly (***Triturus carnifex***); D: Multiple (clinomely, ectrodactyly) deformities (***Bombina bombina***)

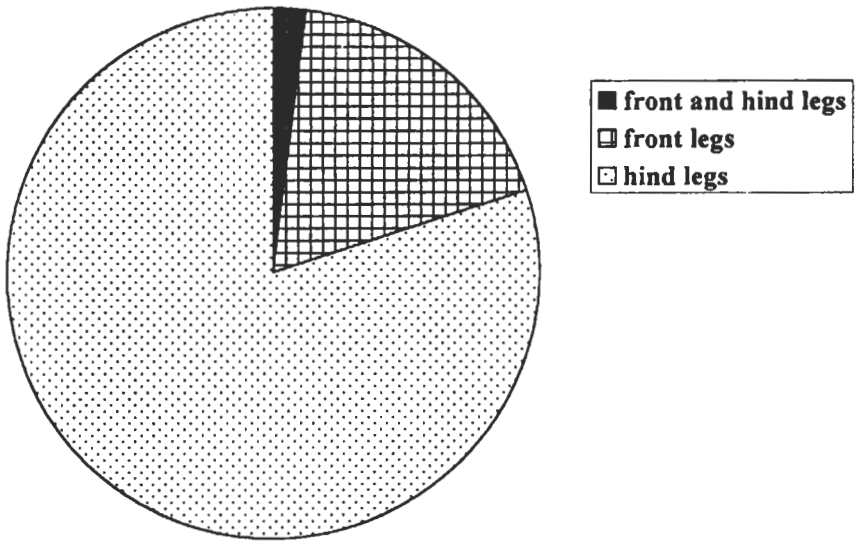


Figure 2. Relative frequency of amphibian deformity types of the front and/or hind legs, recorded in Hungary between 1994 and 2001

lation continuously decreases and also shows a low deformity rate, further studies are urgently needed to find possible causes of this phenomenon before extinction occurs.

Photography can be an important way of making precise records, since the collection of voucher specimens requires an adequate licence. However, if mass occurrence of amphibian deformities is detected or peculiar deformities are found, it is worth contacting nature conservation authorities at once.

Additional information

Additional measurements are strongly encouraged to gain a better understanding of amphibian deformities. Both abiotic (e.g. weather condition, condition of the water monitored, etc.) and biotic information (e.g. body or body and tail length together with weight) are usuful data when the effect of deformities on the population is analysed. Abundance estimation also carries important information on the breeding success and can be in connection with the deformity frequency. The list of possible threats can also be useful in further analysis. Water samples can also be taken but as in most cases water-born pollution is due to a great variety of substances, the usual laboratory analyses may fail to detect the relevant one(s). As a result, water chemistry measurements therefore have a role in more detailed analysis of a site with high deformity rates than in a routine amphibian deformity survey. Even then, negative results are probable reflecting the passage of time before the deformations fully develop.

On the basis of the above considerations, aims and limits, Table 2 summarises the key elements

Table 2. *Description of key elements of an amphibian deformity survey*

Characteristics	Description or size
Timing	Adults: migration, aquatic period. Juveniles: shortly after metamorphosis.
Method	Species specific, but individuals must be taken in hand, consequently catching by hand, netting or torching are the commonest.
Sampling size	Minimal: 25 individuals/site. Optimal: 100 individuals/site.
Important additional information to collect (abiotic)	Description of the locality (name, geo-cordinates, etc.). Weather conditions. Short description of aquatic habitat. List of possible threats.
Important additional information to collect (biotic)	Short description of vegetation. Biological parameters of the animals (length, weight). Health condition of concommittant species. Presence of other important species (e.g. predators or parasites such as leeches).

Table 3. *Recordable parameters in an amphibian deformity survey sheet*

Name of locality	
Nearest settlement	
Date	
Recorders	
Weather conditions	Temperature Cloud cover Precipitation Wind
Type of aquatic habitat	Type (e.g. fish pond) Size Vegetation cover
Type of terrestrial vegetation	
Number of species and individuals	Species No. 1. Species No. 2. etc.
Deformity types and numbers per species	
Occurrence of multiple deformities (types, frequency, species)	
Other relevant species	
List of possible threats	
OPTIONAL	
Geo-coordinates	N EO
Water chemistry	
Growth parameters (length, weight of individuals)	

of a successful amphibian deformity survey while Table 3 lists the recordable parameters.

SUMMARY

1. Amphibians are sensitive indicators of environmental changes. One of the reasons is their sophisticated development, which can easily be disturbed by different factors.

2. Reports on amphibian deformities have become more common from the early 1990s and the frequency of deformity was often above the 2 % background value.

3. Amphibian deformities are a multiple cause phenomenon, which needs to be studied in more detail also in the field.

4. On the basis of a three year national study in Hungary, a protocol suitable for professionals as well as volunteers was developed to monitor amphibian deformities.

5. Reports describing individual animals have value, e.g. to prove the occurrence of a given deformity at a site, in a country or any other geographical unit, or the presence of deformities in a particular species.

6. In addition to accurate and appropriate categorisation, the indication of the part and side of the body where the malformation occurs can also be relevant.

7. To be able to analyse amphibian deformity cases further (e.g. to give frequency data) numerous individuals should be checked. Twenty-five individuals is an absolute minimum, fifty individuals per site is a reasonable number with an optimal number of a hundred individual per site especially if the deformity frequency is over 10 %. However, if only a lower number of animals can be caught, it is still worth recording if they are healthy or not.

8. The health condition of rarer species is also of interest especially when the deformity rate is high in one of the common species at the studied site.

9. Further study of populations with deformity rates higher than 10 % is strongly recommended. Abundance estimations over at least a 400 m^2 area or a 200 metre riverbank proved to be especially helpful.

10. Photography can be an important way of making precise records.

11. If mass occurrence of amphibian deformities is detected or peculiar deformities are found, it is worth contacting nature conservation authorities at once.

12. Traditional water analysis rarely provides relevant information, but the recording of other abiotic or biotic data is important in the future analysis of deformities.

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REFERENCES

BERGER, L. (1968): The effect of inhibitory agents in the development of green-frog tadpoles. *Zool. Polon.*, 18: 381–390.

BERGER, L. (1971): Viability, sex and morphology of F2 generation within forms of *Rana esculenta* complex. *Zool. Polon.*, 21: 345–393.

BORKIN, L. J. & PIKULIK, M. M. (1986): The occurrence of polymely and polydactyly in natural populations of anurans of the USSR. *Amphibia–Reptilia*, 7: 205–216.

CUMMINS, C. P. (1987): Factors influencing the occurrence of limb deformities in common frog tadpoles raised at low pH. *Ann. Soc. R. Zool. Belg.*, 117 (Suppl. 1): 353–364.

CUMMINS, C. P. (1989): Interaction between the effects of pH and density on growth and development in *Rana temporaria* L. tadpoles. *Func. Ecol.*, 3: 45–52.

DUBOIS, A. (1979): Anomalies and mutations in natural populations of the *Rana "esculenta"* complex (Amphibia, Anura). *Mitt. Zool. Mus. Berlin*, 55: 59–87.

DUBOIS, A. (1983): L'anomalie P des grenouille vertes (complexe de *Rana* kl. *esculenta* Linné, 1785) et les anomalies voisines chez les amphibiens. *In: Vago, C.*

& Matz, G. (eds.): Comptes Rendus du Premier Colloque International de Pathologie des Reptiles et des Amphibiens. Angers, France, 215–221.

GRIFFITHS, R. A. & BEEBEE, T. (1992): Decline and fall of the amphibians. *New Scientist*, 1826: 25–29.

GRIFFITHS, R. A. & LANGTON, T. S. (1998): Amphibians: recommended methods. *In: Gent, T. & Gibson, S. (eds.): Herpetofauna Workers' Manual. Peterborough, Joint Nature Conservation Committee*, 34–39.

HARFENIST, A., POWER, T., CLARK, K. L. & PEAKALL, D. B. (1989): A review and evaluation of the amphibian toxicological literature. Ottawa, Ontario, Canada. *CWS. Technical Report Series*, 61: pp. 222.

HEYER, W. R., DONELLY, M. A., MCDIARMID, R. W., HAYEK, L. C. & FOSTER, M. S. (eds.) (1994): Measuring and monitoring biological diversity: Standard methods for amphibians. *Smithsonian Institution Press, Washington*, pp. 364.

GARDINER, D.M. & HOPPE, D. M. (1999): Environmentally induced limb malformations in mink frogs *(Rana septentrionalis). Journ. Exper. Zool.*, 284: 207–216.

JOHNSON, P. T. J., LUNDE, K. B., HAIGHT, R. W., BOWERMAN, J. & BLAUSTEIN A. R. (2001): *Ribeiroia ondatrae* (Trematoda: Digenea) infection induces severe limb malformations in western toads *(Bufo boreas). Canad. Journ. Zool.*, 79: 370–379.

KÁRPÁTI, L. (1988): Massensterben der Herpetofauna (Amphibien und Reptilien) infolge des Kraftverkehrs. Möglichkeiten und Ergebnisse des Schutzes am Südufer des Neusiedlersees. *BFB-Bericht*, 68: 71–79.

MUTO, Y. (1969 a): Anomalies in the hindlimb skeletons of the toad larvae reared at a high temperature. *Cong. Anom.*, 9: 61–73.

MUTO, Y. (1969 b): Hindlimb development and malformations of toes in the larvae reared at high temperature in the toad, *Bufo vulgaris formosus. Cong. Anom.*, 9: 1–12.

MUTO, Y. (1970): Digital malformations in the forelimbs of the toad larvae reared at a high temperature. *Cong. Anom.*, 10: 135–147.

OLSON, D. H., LEONARD, W. P. & BURY, B. R. (1997): Sampling amphibians in lentic habitats: methods and approaches for the Pacific Northwest. Northwest Fauna 4. *Soc. Northwest. Vertebr. Biol.*, pp. 134.

PUKY, M. (2000): Herpetological methods: I. On the use of the road transect method in surveying amphibians with examples from different zoogeographical regions of Hungary. *Opusc. Zool. Budapest*, 32: 75–81.

PUKY, M. (2001): A comprehensive three-year herpetological survey in the Gemenc Region of the Danube–Dráva National Park, Hungary. *Opusc. Zool. Budapest*, 33: 113–128.

PUKY, M. & FODOR, A. (2002): Occurrence of amphibian deformities along the Hungarian section of the River Danube, Tisza and Ipoly. *Limnol. Reports*, 34: 845–852.

PURVIS, A. & HECTOR, A. (2000): Getting the measure of biodiversity. *Nature*, 405: 212–219.

QUELLET, M. (1999): Amphibian deformities: current state of knowledge. *In: Sparling, D. W., Linder, G. & Bishop, C. (eds.): Ecotoxicology of amphibians and reptiles*, 617–661.

ROSTAND, J. (1958): Les anomalies des amphibiens anoures. *Paris, France, SEDES*, pp. 100.

ROSTAND, J. (1959): L'anomalie P chez la grenouille verte (*Rana esculenta* L.). *Bull. Biol. Fr. Belg.*, 93: 7–15.

ROSTAND, J. (1971): Les étangs á monstres: histoire d'une recherche (1949–1970). *Paris, France: Stock*, pp. 85.

ROWE, C. L., KINNEY, O. M. & CONGDON, J. D. (1998): Oral deformities in tadpoles of the bullfrog *(Rana catesbeiana)* caused by conditions in a polluted habitat. *Copeia*, 244–246.

ROWE, C. L., KINNEY, O. M., FIORI, A. P. & CONGDON, J. D. (1996): Oral deformities in tadpoles (*Rana catesbeiana*) associates with coal ash deposition: effects of grazing ability and growth. *Freshwater Biol.*, 36: 723–730.

VALLISNERI, A. (1733): Opere fisico-mediche. Vol. 2. *Venezia, Italy*, pp. 551.

VERSHININ, V. L. (1989): Morphological anomalies in urban amphibians. *Ékologiya*, 3: 58–66.

WAKE, D. B. (1991): Declining amphibian populations. *Science*, 253: 860.

WOITKEWITSCH, A. A. (1961): Le développement des extrémités surnuméraires chez les amphibiens. *Bull. Biol. Fr. Belg.*, 95: 569–600.

Opusc. Zool. Budapest, 2002, 34: 43–50

Distribution of Microcrustacea in different habitats of a shallow lake in the Fertő–Hanság National Park, Hungary

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Abstract. Seventy-seven microcrustacean species (37 Cladocera, 20 Ostracoda, 20 Copepoda) were recorded from the different habitats of the small, shallow Lake Fehér (Fehér-tó) between 1998 and 2001. Significant spatial and seasonal differences were recorded in the composition of microcrustacean assemblages between the different habitats. The presence of emergent and submerged macrophytes increased predation pressure in the open water and near the shore, low oxygen content and extreme water level in the reed belt would be the main factors explaining these differences.

Habitat choice, horizontal and vertical distribution of Microcrustacea species are affected by biotic (resources and predators) and abiotic factors (dissolved oxygen, temperature, light, etc.). Submerged and emergent macrophytes have a major impact on the biological structure and species composition of shallow lakes (Scheffer & Jeppesen, 1998) and dense macrophyte beds can act as a refuge for large zooplankton species against vertebrate and invertebrate predators (Timms & Mos, 1984). In the macrophyte beds the near-edge zone is more important to migrating zooplankton than the central parts (Lauridsen & Buenk, 1996) while a low edge:area ratio would favour the non-migrating macrophyta-associated littoral species (Paterson, 1993).

The crustacean fauna of permanently or periodically flooded reed belts has been given little attention (Löffler 1979; Forró & Metz, 1987) probably due to the rich spatial structure combined with rapidly changing environmental parameters. The Fertő–Hanság area is one of the most important wetlands in Central Europe. Limnological research has a long tradition in the Seewinkel and Lake Fertő, but only limited information is avaible on the hydrographically connected Hanság region. Lake Fehér is situated in the southeastern part of the Hanság Basin, it is a strictly protected area of the Fertő–Hanság National Park. In 1998, within the frame of the Hungarian Danube Research Station, a four-year project was started to study the faunistics (Kiss, 2000, 2002), temporal and spatial distribution of several microcrustacean taxa and the composition of zooplankton assemblages in the different habitats of the lake.

GENERAL DESCRIPTION OF THE STUDY AREA

Lake Fehér (Fehér-tó) (47° 41' N, 17° 21' E) is situated in the northwestern part of Hungary, in the Fertő–Hanság National Park. It is strictly protected and not influenced by human activities. The lake is small (area: 2.69 km^2, open water: 0.25 km^2) and very shallow (mean depth: 50 cm, maximum depth: 110 cm). The hydrology of the lake mainly depends on the interplay of precipitation and evaporation even if through a little channel there is also accidental water supply from the River Rába. The littoral zone is characterised by beds of emergent macrophytes (*Phragmites australis* and *Typha angustifolia*). From 1994 to 1997, there were no open water macrophytes in the lakes, whereas in 1999 and 2000 the open water was covered by dense vegetation of *Najas marina* (95 % PVI). In 1998 and 2001 hypertrophic conditions were recorded, dense blooms of blue-green algae developed in the lake, which was free

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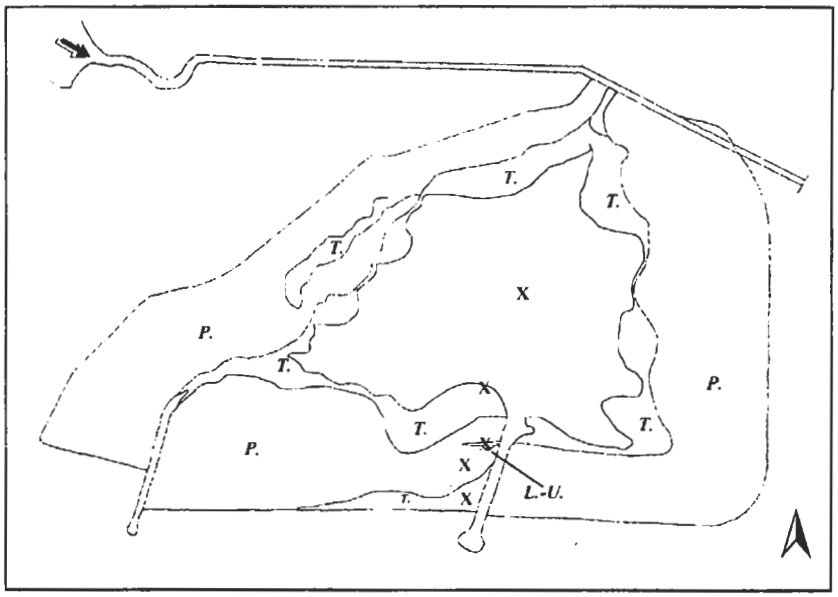

Figure 1. Distribution of the sampling points (X) in the *Phragmites* (P), *Typha* (T) and Lemno-Utricularietum (L-U)

of open water submerged macrophytes.

Lake Fehér is a hydrocarbonated, moderately eutrophic lake. Significant temperature, pH, oxygen content and conductivity differences were measured between the open water and the reed belt (Table 1). Temperature, pH and oxygen content usually decreased while conductivity increased inshore. The open water was well-oxygenated throughout the year and becoming supersaturated in summer months as a result of photosynthesis. When *Najas marina* was present, transparency was high, suspended solid content was low and significant daily vertical differences were developed in the water column especially in temperature, pH and dissolved oxygen content values. In the turbid state (Scheffer & Jeppesen, 1998) turgidity and suspended solid content was high and there was no vertical difference in the water column. The reed belt usually dried up in summer and early autumn. Within the reed belt, three characteristic habitat types were found: *a)* Scirpo-Phragmitetum, *b)* Typhetum angustifoliae (at the edge of the *Phragmites* zone) and between the patches of *Phragmites*, *c)* Lemno-Utricularietum with *Utricularia vulgaris*, *Hydrocharis morsus-ranae*, *Lemna trisulca*, *Lemna minor* and *Spirodela polyrhiza*.

Till 1983 Lake Fehér was a fish pond. Since 1983, when the area became protected, the fish stock has been considerably increased. The fish assemblage is dominated by cyprinids. The most abundant species are *Carassius auratus*, *Rutilus rutilus* and *Perca fluviatilis* (G. Guti, personal communications). Because of the low oxygen concentration and extreme water level, the reed belt is unsuitable for fish except spring when the predation pressure increase in the reed belt because of high abundance of YOY fish.

Table 1. *Main physico-chemical parameters of the examined habitats*

Parameters	Open water	*Najas marina*	Reed belt
Water depth (cm)	28-109	40-85	0-65
Temperature (°C)	0.9-31.2	15.8-22.9	1.1-23.2
pH	7.6-10.46	8.21-9.85	5.76-8.01
Oxygen content (mg/l)	2.64-20.3	2.21-18.77	0-10.79
Oxygen saturation (%)	28.6-242	14.3-226	0-100.5
Conductivity (μS/cm)	436-670	223-463	411-2410
Turgidity (FTU)	9-140	9-14	12-50
Suspended material (mg/l)	10-84	4-23	10-197
Soluble material (mg/l)	8-137	7-8	9-42
HCO_3^- (mg/l)	0.0-442.2	0-30.6	122.2-527

METHODS

The study was carried out from March 1998 to August 2001. Samples were collected at monthly intervals from different habitats of the lake (Fig. 1): *1.* Open water (mid-lake), *2. Najas marina* beds (mid-lake), *3.* Edge of the emergent macrophyte zone, *4.* Lemno-Utricularietum (narrow channel among the *Phragmites* belt), *5. Phragmites* beds, *6. Typha* beds. Temperature, pH, conductivity and dissolved oxygen were measured in the field by using a portable meter. Zooplankton samples were filtered through a 70 μm mesh net then preserved in 5 % formaldehyde. In the emergent and submerged macrophyte beds microcrustaceans were collected in one litre plastic box samplers gently closed over plants. Mixed five litre samples were collected from the macrophyte beds and 50 litres from the open water and the near the edge of the *Typha* beds as well as qualitative sediment samples were also taken from different habitats of the lake with a 70 μm mesh net.

Microcrustaceans were counted by using inverted microscopy and identified to species level. Very dense samples were subsampled. Nauplii were not taken into consideration.

RESULT AND DISCUSSION

Open water

Between 1998 and 2001, 36 Microcrustacea species (24 Cladocera, 4 Ostracoda, 8 Copepoda) were recorded in the open water of the lake (Table 2). The abundance of the species was low throughout the year, the maximum was 103 ind./l^{-1} in 1999 after the decline of *Najas marina*. The composition of the zooplankton assemblages showed marked seasonal and annual differences. The zooplankton communities consisted of the following species: *a)* spring: *Cyclops vicinus* (1998-2000), *Daphnia cucullata* and *D. hyalina* (1999, 2000), *Chydorus sphaericus* (1999), *Bosmina longirostris* (2000), *Acanthocyclops vernalis* (2000), *b)* summer: *Moina brachiata, Diaphanosoma brachyurum, Acanthocyclops vernalis* and *Simocephalus vetulus* (1999 and 2000), *c)* autumn: *Acanthocyclops vernalis, Cyclops vicinus* (1998, 2000), *Alona intermedia, Pleuroxus aduncus* var. *coelatus Chydorus sphaericus* (1999), *Scapholeberis mucronata* and *Bosmina longirostris* (2000), *d)* winter: *Cyclops vicinus* (1998-2000), *Chydorus sphaericus, Bosmina longirostris* (2000). There was a significant

Table 2. *Mean density (ind./50 l-1) of the species in the open water (O; n = 67), at the edge of the reed belt (E; n = 126), and in the reed belt (n = 65), L-U = Lemno-Utricularietum, P = Phragmites, T = Typha, S = found only in the sediment*

	O	N	E	L-U	P	T	
Acroperus harpae (Baird, 1834)				5,65	4	2	Species found only in the reed belt
Fabaeformiscandona balatonica (Daday, 1888)				9,56			
Pseudocandona rostrata (Br. & Norm.,1889)				3,04	1,33	6,66	
Cypridopsis vidua (O. F. Müller, 1776)				1,3	23,3		
Paracyclops affinis (Sars, 1863)				10,43			
Paracyclops poppei (Rehberg, 1880)				5,65	0,66	1,33	
Megacyclops gigas (Claus, 1857)				55,65	7,33	6,33	
Microcyclops varicans (Sars, 1863)				0,86	6	23,3	
Daphnia curvirostris Eylmann, 1887			0,35	176	281,3	98,66	Species characteristic for the reed belt, but also occurring at the edge of the reed belt
Simocephalus exspinosus (Koch, 1841)			+	363,9	61,3	70,66	
Ceriodaphnia megops Sars, 1861			+	298,7	186	116,6	
Ceridaphnia laticaudata P. E. Müller, 1867			+	37,82	25,3	37,3	
Megafenestra aurita (Fischer, 1849)			0,18	11,73	4	6,66	
Bunops serricaudata (Daday, 1888)			0,031	39,56	10,66	16,66	
Tretocephala ambigua (Lilljeborg, 1900)			+	102,2	52,66	84,7	
Oxyurella tenuicaudis (Sars, 1862)			+	3,47		0,66	
Polyphemus pediculus (Linné, 1761)		1,66	+		55,33	7,3	
Candona weltneri Hartwig, 1899			0,09	90,43	7,33		
Fabaeformiscandona fabaeformis (Fischer, 1854)			S	S	S	S	
Fabaeformiscandona fragilis (Hartwig, 1898)			0,031	+	1,33	6,66	
Pseudocandona compressa (Koch, 1838)		+	0,06	27,82	90	73,3	
Candonopsis kingsleii (Brady & Rob, 1870)			S	S	S	2	
Cypria ophtalmica (Jurine, 1820)			+	9,13	40	9,33	
Cyclocypris globosa (Sars, 1863)			+	12,17	42	4,93	
Cyclocypris laevis (O. F. Müller, 1776)			+	16,95	77,33	78,7	
Cyclocypris ovum (Jurine, 1820)			0,31	790	1397	2249	
Notodromas monacha (O. F. Müller, 1776)			+	334,8	95,3	8,66	
Canthocamptus staphylinus (Jurine, 1820)	0,06		0,5	36,95	13,33	4,66	
Canthocamptus microstaphylinus (Wolf,1905)			+		20,6	21,3	
Mixodiaptomus kupelwieseri (Brehm, 1907)			+	0,86	4	26,7	
Macrocyclops albidus (Jurine, 1820)		33,3	0,96	59,13			
Cyclops strenuus Fischer, 1851			+	319,1	422,6	620	
Megacyclops viridis (Jurine, 1820)		31,6	7,65	642,6	220,7	403,3	
Daphnia longispina O. F. Müller, 1785	0,156		0,9	359,5	92	18	Species found in all habitats of the lake
Daphnia hyalina Leydig, 1860	7,25		1,03	0,4			
Ceriodaphnia reticulata (Jurine, 1820)	2,09	35	1,18	204,8	483,3	580	
Simocephalus vetulus (O. F. Müller, 1776)	80,81	9420	310,7	223,7	68	167,3	
Scapholeberis mucronata O. F. Müller, 1785	2,68	40	59,03	37,82	53,33	100,7	
Alona intermedia Sars, 1862	13,56	530	3,78			0,66	
Alonella excisa (Fische, 1854)	0,12	1,66	+	49,13	109,3	63,3	
Pleuroxus aduncus var. *coelatus* Weigold	10,12	315	13,31	26,52	4,66	16	
Chydorus sphaericus (O. F. Müller, 1785)	168,3	1810	45,87	484,8	212,6	146,7	
Fabaeformiscandona protzi (Hartwig, 1898)	S		S	3,91	S	2,66	
Eucyclops serrulatus (Fischer, 1851)	6,09	268,3	8,81	65,21	19,33	80,66	
Ectocyclops phaleratus (Koch, 1838)	0,09	3,33	0,09	17,82	15,33	12,66	
Cyclops insignis Claus, 1857	0,12		0,53	323	39,3	152,7	
Diacyclops bicuspidatus (Claus, 1857)	0,03		0,125	16,52	20,66	22	
Mesocyclops leuckarti (Claus, 1857)	8,78	460	43,4	88,26	111,3	115,3	

Table 2. *(Continuation)*

	O	N	E	L-U	P	T	
Diaphanosoma brachyurum (Liévin, 1848)	8,53	270,8	5,09				Species found in the open water, also occurring or common at the edge of the reed belt
Daphnia cucullata Sars, 1862	47,87	6,66	28,9				
Simocephalus serrulatus (Koch, 1841)	0,66	38,3	0,16				
Moina brachiata (Jurine, 1820)	4,59	20	6,46				
Ceriodaphnia quadrangula (O. F. M., 1785)	3,31	83,3	3,09				
Iliocryptus sordidus (Liévin, 1848)	S		S				
Iliocryptus agilis Kurz, 1878	S		S				
Bosmina longirostris (O. F. Müller, 1785)	58,62	6,66	4,84				
Graptoleberis testudinaria (Fischer, 1851)	83,09	2150	5,96				
Leydigia acanthocercoides (Fischer, 1854)	0,06	1,66	S				
Alona guttata Sars, 1862	0,37	5	0,15				
Disparalona rostrata (Koch, 1841)	S	3,33	0,16				
Physocypria kraepelini G .W. Müller, 1903	0,06	16,6	2,87				
Cyclops vicinus Uljanin, 1875	75,31	1,66	44,7				
Acanthocyclops vernalis (Fischer, 1853)	263,4	383,3	20,87				
Daphnia pulex Leydig, 1860			+				Rare species found only at one or two occasions
Ceriodaphnia dubia Richard, 1894	0,37						
Leydigia leydigi (Schoedler, 1863)	S		S				
Alona affinis (Leydig, 1860)			+				
Alona quadrangularis (O. F. Müller, 1785)			+				
Pseudochydorus globosus (Baird, 1843)	+		+				
Candona candida (O. F. Müller, 1776)			S	S			
Candona neglecta Sars, 1887	S						
Fabaeformiscandona hyalina (B. & R.,1870)			S				
Cypridopsis elongata (Kaufmann, 1900)				S			
Cypridopsis hartwigi Müller, 1900					1,33		
Cryptocyclops bicolor (Sars, 1863)						+	
Macrocyclops fuscus (Jurine, 1820)			S				
Microcyclops rubellus (Lilljeborg, 1901)			+				

mid-summer decline in June and at the beginning of July especially in the large-bodied cladocerans because of the increased predation pressure by the YOY fish (Luecke et al., 1990). Increased temperature and enhanced pH caused by the high photosynthetic activity of the blooming phytoplankton, decreased phytoplankton edibility and the high concentration of suspended sediment strongly affected cladoceran density and species richness during the vegetation period of the turbid state (1998, 2001). Cladocerans are generally more sensitive to elevated pH than cyclopoid copepods and increased suspended sediment content decreases the fecundity and survivorship of cladocerans via reduced ingestion rates of phytoplankton cells (Arruda et al., 1983). The summer presence of *Cyclops vicinus* and *Acanthocyclops vernalis* supported the finding that some cyclopoid copepods are tolerant to high pH (Hansen et al., 1991). High pH has a negative effect on fish spawning (Jeppesen et al., 1990) as well and this may result a temporary reduction of the predation pressure on filter-feeders.

Iliocryptus sordidus, I. agilis, Leydigia leydigi, Disparalona rostrata, Candona neglecta and *Fabaeformiscandona protzi* appeared only on the surface of the sediment. In contrast with the reedbelt, ostracods had a low density and species richness in all cases, and a significant part of the

individuals were juveniles. The density and species richness of ostracods increased inshore.

Najas marina

In small, shallow lakes, most factors which affect zooplankton distribution are temporally variable and unpredictable, but the presence of macrophytes in the open lake markedly changed the zooplankton communities. Fish predation has a smaller impact on the zooplankton community in the more structured environment of macrophyta beds, particularly when the PVI exceeds 15-20 % (Schriver et al., 1995), and this generally invoked to explain the high density of zooplankton in vegetated habitats. In *Najas* beds the zooplankton community mainly consisted of cladoceran species and the ratio of the macrophyte-associated species was high (*Simocephalus vetulus, Graptoleberis tetudinaria, Alona intermedia, Pleuroxus aduncus* var. *coelatus*). In *Najas* beds a small population of *Simocephalus serrulatus* was detected for the first time in the lake in August, 2000. The mean density of the zooplankton was the largest in this habitat (530 ind./l^{-1}) (Table 3) because of the big population of *Simocephalus vetulus* (501 ind./l^{-1}). In *Najas* beds increased pH values and low oxygen content near the sediment (especially during night) decreases the predation risk especially the risk caused by visually hunting predators. The microcrustacean colonization of the *Najas* beds occurred gradually from the surrounding reed belt. *Ceriodaphnia reticulata, Graptoleberis testudinaria, Polyphemus pediculus, Megacyclops viridis* and *Macrocyclops albidus* were present only in 2000 in the *Najas*, however, these species were previously detected from the reed belt. Ostracods did not become prevalent in the open water, except *Physocypria kraepelini*.

Edge of the emergent macrophytes

The mean density of microcrustaceans was the lowest (12.38 ind./l^{-1}) in this habitat (Table 3). Predation risk can be expected to be the highest near the vegetation surface and the edge of the vegetation belt. The edges of macrophyton beds may be sites of intense fish predation as they move inshore and offshore dielly (Smiley & Tessier, 1998). In this habitat type a complex assemblage was formed from the pelagic species of the open water (*Moina brachiata, Diaphanosoma brachyurum, Cyclops vicinus*) and reed belt species (*Daphnia curvirostris, Simocephalus exspinosus, Bunops serricaudata, Tretocephala ambigua* etc.). Species richness was high, 64 out of the 77 detected species appeared in this habitat.

Reed belt

The composition of microcrustacean assemblages remarkably differed from that of the open water because of the distinct habitat parameters (presence of emergent and submers macrophytes, lower water depth, temperature and pH, higher conductivity, decreased fish predation). Out of the detected 77 species, 33 were recorded only from the reed belt and occasionally from the edge of reed belt in low numbers. The following genera common in the open lake were missing from the reed belt: *Diaphanosoma, Moina, Iliocryptus, Bosmina, Physocypria, Acanthocyclops*. The abundance of the calanoid copepod, *Mixodiaptomus kupelwieseri*, was extremely low and was found only in the reed belt in winter and early spring. Considerable seasonal differences were recorded in the zooplankton composition of the three habitats types of. The dominant species were *Daphnia longispina, Simocephalus exspinosus, Chydorus sphaericus, Cyclocypris ovum* and *Megacyclops viridis* in spring, *Daphnia curvirostris, Ceriodaphnia* spp. (*reticulata, megops, laticaudata*), *Bunops serricaudata, Tretocephala ambigua, Notodromas monacha* and *Megacyclops viridis* in summer and autumn. In late autumn and winter the oxygen content was extremely low (1–2 mg/l), all species of Cladocera disappeared, but diverse cyclopoid copepod assemblages were formed from *Cyclops strenuus, C. insignis, Megacyclops viridis* and *Megacyclops gigas*. In winter occasional anaerobic condition tolerating some copepod species (*Megacyclops viridis, Macrocyclops albidus, Eucyclops serrulatus*, etc.) may survive even under ice cover successfully coping with seasonal anoxia and hypoxia (Tinson & Laybourn-Parry, 1985). The open-water, pelagic copepod *Cyclops vicinus* was replaced by *Cyclops strenuus* in the reed belt.

Unlike the open water, diverse and abundant Ostracoda assemblage developed in the reed belt.

Table 3. Mean density (ind./l^{-1}) of zooplankton communities in the different habitats of the lake

	Cladocera	Ostracoda	Copepoda	Total
Open water	8.5	0.0032	7.08	15.58
Najas marina	501	0.66	29	530.6
Edge	9.8	0.067	2.52	12.38
Lemno-Utricularietum	47.48	26	32.8	106.3
Phragmites	31.4	34.3	18	83.7
Typha	25.4	49.7	29.3	104.4

The most frequent species were *Notodromas monacha* and *Cyclocypris ovum* and the ostracod *Cypridopsis hartwigi*, which is new to the fauna of Hungary, and was recorded only once from the *Phragmites* belt. Most ostracods appeared throughout the year, except the stenoterm *Notodromas monacha*, which was detected only from April to October. There was a diverse community of Candonidae (7 species) and most individuals (except *Candona weltneri*) were recorded from sediment samples. *Physocypria kraepelini* was replaced by the closely related *Cypria ophtalmica* in the reed belt.

There was no significant difference between the zooplankton composition of Lemno-Utricularietum, *Phragmites australis* and *Typha angustifolia* (Table 3), but the abundance of some species considerably different. Most species occurred throughout the reed belt, but the abundance of the *Daphnia longispina*, *Simocephalus vetulus*, *S. exspinosus*, *Chydorus sphaericus*, *Candona weltneri*, *Notodromas monacha*, *Cyclops insignis* and *Macrocyclops albidus* was the highest in the Lemno-Utricularietum. The reduced water movement in the reed belts favoured the frequent neuston feeders *Notodromas monacha* and *Megafenestra aurita*.

The reed belt is unsuitable for fish except in spring because of the low oxygen content and extremely low water level. Invertebrates are important predators in the reed belt, and they strongly affect the composition of littoral microcrustaceans (Paterson, 1993). The most important predators were cyclopoid copepods (*Macrocyclops albidus*, *Megacyclops viridis*, *Cyclops strenuus*) followed by tanypod chironomids, odonates and water mites.

CONCLUSIONS

Significant spatial and seasonal differences were recorded in the composition of microcrustacean assemblages between the different habitats of Lake Fehér. The presence of emergent and submerged macrophytes, increased predation pressure in the open water and near the shore, low oxygen content and extremely low water level in the reed belt would be the main factors causing these differences.

The observed 77 species can be divided into the next categories according to their distribution, presence and absence and abundance (Table 3):

1. Frequent in the reed belt and occasionally found at the edge of the reed belt and in *Najas* beds (25 species), typical littoral species, diverse Ostracoda communities, neuston feeders (*Notodromas monacha*, *Megafenestra aurita*).

2. Species found only in the reed belt (8).

3. Frequent in the open water and the *Najas* beds but occur at the edge of the reed belt, too (15 species), pelagic species (*Cyclops vicinus*, *Moina brachiata*, *Bosmina longirostris*, *Daphnia cucullata*), mud-living species (*Iliocryptus agilis*, *I. sor–*

didus, Leydigia acanthocercoides), low Ostracoda abundance and species richness.

4. Species found in all habitats of the lake (15).

5. Rare species in the lake (14) and in Hungary as well (*Cryptocyclops bicolor, Pseudochydorus globosus, Microcyclops rubellus*); *Cypridopsis hartwigi* was new to Hungary.

Many Microcrustacea are active swimmers, they can cover large distances and can recognize a wide variety of visual and chemical cues. Consequently, there is a potential for active, individual habitat choice and microhabitat selection, which allow microcrustaceans to balance food search and predation risk adaptively.

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REFERENCES

ARRUDA, J. A., MARZOLF, G. R. & FAULK, R. T. (1983): The role of suspended sediments in the nutrition of zooplankton in the turbid reservoirs. *Ecology*, 64: 1225–1235.

FORRÓ, L. & METZ, H. (1987): Observations on the zooplankton in the reedbelt area of the Neusiedlersee. *Hydrobiologia*, 145: 299–307.

HANSEN, A-M., VAGN CHRISTENSEN, J. & SORTKJAER, O. (1991): Effect of high pH on zooplankton and nutrients in fish-free enclosures. *Arch. Hydrobiol.*, 123: 143–164.

KISS, A. (2000): A hansági Fehér-tó Ostracoda faunája. *Hidrol. Közlem.*, 5–6: 314–315.

KISS, A. (2002): The Cladocera, Ostracoda and Copepoda fauna of the Fehér-tó (Fertő–Hanság National Park). *In: Mahunka, S. (ed.): The fauna of the Fertő–Hanság National Park.* (In press.)

JEPPESEN, E., SONDERGAARD, M., SORTKJAER, O., MORTENSEN, E. & KRISTENSEN, P. (1990): Interactions between phytoplankton, zooplankton and fish in a shallow, hypertrophic lake: a study of phytoplankton collapses in Lake Sobygard, Denmark. *Hydrobiologia*, 191: 149–164.

LAURIDSEN, T. L. & BUENK, I. (1996): Diel changes in the horizontal distribution of zooplankton in the littoral zone of two shallow eutrophic lakes. *Arch. Hydrobiol.*, 137: 161–176.

LÖFFLER, H. (1979): The crustacean fauna of the *Phragmites* belt (Neusiedlersee). *In: Löffler, H. (ed.): Neusiedlersee, the limnology of a shallow lake in Central Europe. The Hague:* 399–406.

LUECKE, C. M., VANNI, J., MAGNUSON, J. J., KITCHELL, J. F. & JACOBSON, P. J. (1990): Seasonal regulation of *Daphnia* populations by planktivorous fish: Implications for the clearwater phase. *Limnol. Oceanogr.* 35: 1718–1733.

PATERSON, M., (1993): Invertebrate predation and the seasonal dynamics of Microcrustacea in the littoral zone of a fishless lake. *Arch. Hydrobiol. Suppl.* 99: 1–36.

SCHEFFER, M. & JEPPESEN, E. (1998): Alternative stable states. *In: Jeppesen, J., Sondergaard, Ma., Sondergaard, Mo. & Christoffersen, K. (eds.): The structuring role of submerged macrophytes in lakes. Springer, New York.*

SCHRIVER, P., BOGESTRAND, J., JEPPESEN E. & SONDERGAARD, M. (1995): Impact of submerged macrophytes on fish–zooplankton–phytoplankton interactions: large-scale enclosure experiments in a shallow eutrophic lake. *Freshwater Biol.*, 33: 255–270.

SMILEY, E. A. & TESSIER, A. J. (1998): Environmental gradients and the horizontal distribution of microcrustaceans in lakes. *Freshwater Biol.*, 39: 397–409.

TIMMS, R. M. & MOS, B. (1984): Prevention of growth of potentially dense phytoplankton populations by zooplankton grazing in the presence of zooplanktivorous fish in a shallow wetland ecosystem. *Limnol. Oceanogr.*, 29: 472–486.

TINSON, S. & LAYBOURN-PARRY, J. (1985): The behavioural responses and tolerance of freshwater benthic cyclopoid copepods to hypoxia and anoxia. *Hydrobiologia*, 127: 257–263.

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The first record of five *Trachyuropoda* species (Acari: Uropodina) from Hungary

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Abstract. Five Trachyuropoda species new to the Hungarian fauna are listed. A short description and the occurrence of each species are added. To the present, 75 Uropodina species have been recorded from Hungary.

Prior to this paper, only four species of the genus *Trachyuropoda* Berlese, 1888 have been observed in Hungary (Wisniewski, 1993). The first data of the genus were published by Balogh (1937, 1938): *T. excavata* (Wasmann, 1899) and *T. bostocki* (Michael, 1894). Later two additional species, *T. formicaria* (Lubbock, 1881) and *T. cristiceps* (Canestrini, 1884), were found by Hirschmann (1990) in the Bátorliget Nature Reserves in northern Hungary.

MATERIAL AND METHODS

The examined material originated partly from the soil samples stored in the Soil Zoology Collection of the Zoological Department of the Hungarian Natural History Museum, Budapest, partly from some new collectings. All the *Trachyuropoda* specimens were collected from anthills.

The specimens studied are deposited in the collection of the Museum.

Trachyuropoda myrmecophila Wisniewski & Hirschmann, 1992

This species belongs to the *bostocki* group. The length of idiosoma is 1300-1395 µm (female) and 1270-1325 µm (male). The idiosoma is oblong, in the dorsal shield there are some strong chitin lines (Fig. 1), but these can be very changeable.

This uropodine species was known from Poland land (Wisniewski & Hirschmann, 1993) and Slovakia (Masan, 2001) so far.

The Hungarian specimen (one male) was collected in the vicinity of Csévharaszt, in grassland, from an anthill, 05. 07. 2002, by J. Kontschán.

Trachyuropoda riccardina (Leonardi, 1895)

It belongs to the *canestriniana* group. The length of idiosoma is 715 µm (female) and 680 µm (male). The idiosoma is oblong; on the lateral sides of the dorsal shield there are strong chitin lines, and in the middle of schield a strong chitin ring (Fig. 2).

This species has hitherto been reported from Austria, Czech Republic, Slovakia, Italy and Romania (Wisniewski & Hirschmann, 1993).

The present two males were collected in Budapest, in Széchenyi Hill, Budai Mountains, from a nest of ants lying under a stone, 05. 05. 1957, by J. Balogh.

Trachyuropoda coccinea (Michael, 1899)

This species belongs to the *coccinea* group. The length of idiosoma is 760-860 µm (female) and 720-775 µm (male). The idiosoma is oval, in the dorsal shield there are no strong chitin lines, only three strong chitinized hills (Fig. 3).

The species occurs in whole Europe (Wisniewski & Hirschmann, 1993).

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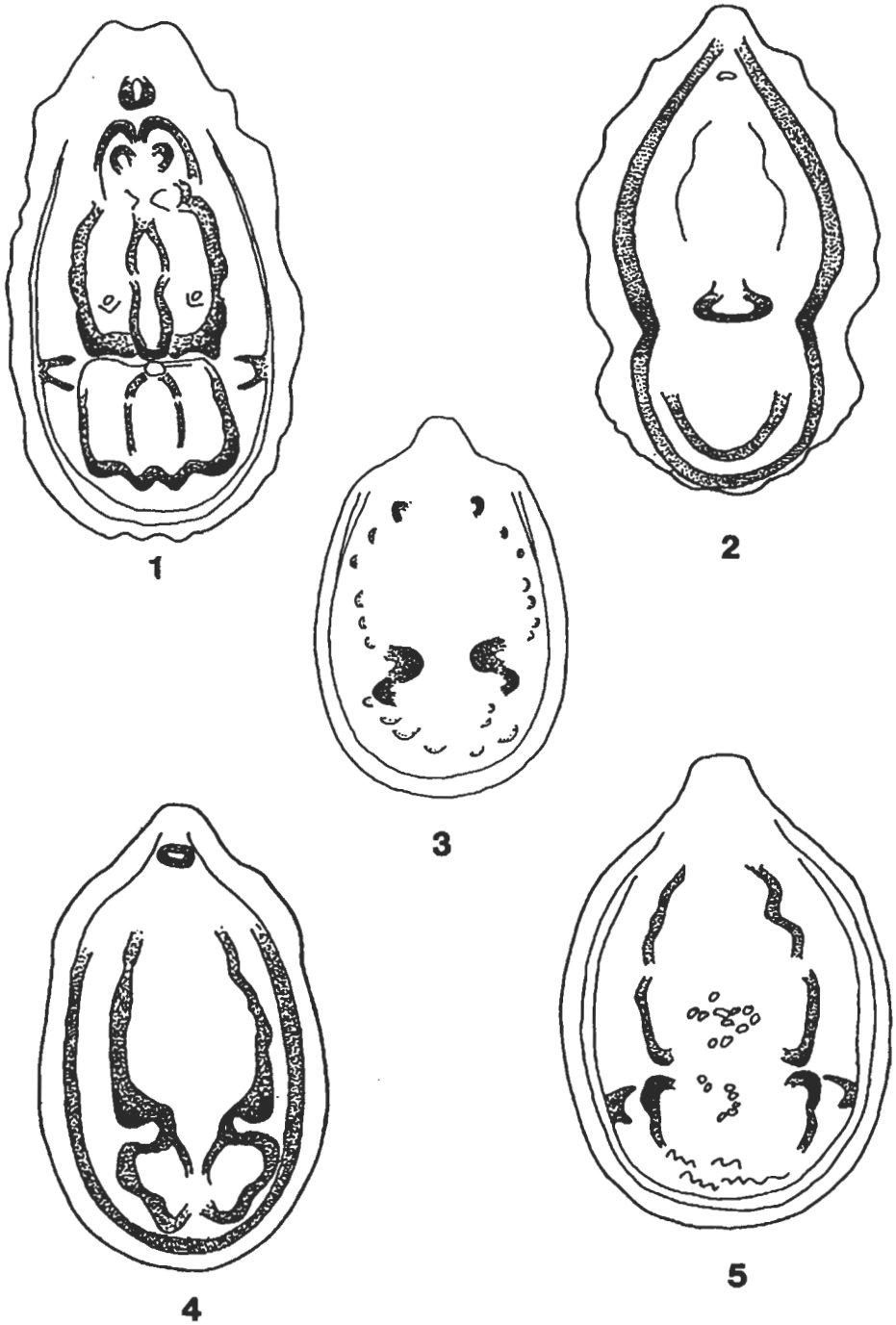

Figures 1–5. Dorsal shields of five *Trachyuropoda* species new to Hungary. 1: *T. myrmecophila* Wisniewski & Hirschmann, 1992; 2: *T. riccardina* (Leonardi, 1895); 3: *T. coccinea* (Michael, 1899); 4: *T. hirschmanni* Pecina, 1980; 5: *T. wasmannia* Berlese, 1903

Three female specimens were collected in Budapest, in Széchenyi Hill (Budai Mountains) from a nest of ants beneath a stone, 05. 05. 1957, by J. Balogh.

Trachyuropoda hirschmanni Pecina, 1980

This uropodine belongs to the *troguloides* group. The length of idiosoma is 660-680 µm (female) and 620-630 µm (male). The idiosoma is oblong, in the dorsal shield there is a stronger medial and a lateral chitin line, and in front of the dorsal shield a chitin ring (Fig. 4).

This species is known from the Czech Republic and Slovakia (Wisniewski & Hirschmann, 1993).

Two male and seven female specimens were collected in Budapest, in Széchenyi Hill (Budai Mountains), from a nest of ants covered by a stone, 05. 05. 1957, by J. Balogh. This is the first record of the male of this species.

Trachyuropoda wasmannia Berlese, 1903

It belongs to the *troguloides* group. The length of idiosoma is 780 µm (female) and 760 µm (male). The idiosoma is oblong, in the dorsal shield there are three pairs of medial lines and one lateral chitin line (Fig. 5).

This species is distributed in whole Europe (Wisniewski & Hirschmann, 1993).

One male and one female specimens were collected close to the village Csévharaszt, in grassland, from a nest of ants, 05. 07. 2002, by J. Kontschán).

DISCUSSION

Together with the five species listed above, 75 Uropodina species are known from Hungary. In two of the neighbouring countries, the number of species known so far counts as follows: in Slovakia 141 (Masan, 2001), in Romania 84 (Wisniewski, 1993).

REFRENCES

BALOGH, J. (1937): Magyarország hangyabolyban élő atkáiról, I. *Folia Entomol. Hung.*, 3: 106–109.

BALOGH, J. (1938): Neue milbenfaunistische Angaben aus dem historischen Ungarn (Uropodina). *Fragm. Faun. Hung.*, 1: 70–71.

MASAN, P. (2001): Mites of the cohort Uropodina (Acari, Mesostigmata) in Slovenska. *Annot. Zool. Bot.*, 223: 1–320.

WISNIEWSKI, J. (1993): Die Uropodiden der Erde nach zoogeographischen Regionen und Subregionen geordnet. (Mit Angabe der Lande.) *Acarologie*, 40: 221–291.

WISNIEWSKI, J. & HIRSCHMANN, W. (1993): Katalog der Gattungen, Untergattungen, Gruppen und Arten der Uropodiden der Erde. (Taxonomie, Literatur, Grösse, Verbreitung, Vorkommen.) *Acarologie*, 40: 1–220.

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Production biological examination of some aquatic Peracarida species (Crustacea: Malacostraca)

J. KONTSCHÁN* and G. GERE**

Abstract. We observed the nutrient consumption of four crustacean species: *Gammarus roeseli* Gervais, 1838, *Synurella ambulans* Müller, 1846, *Niphargus valachicus* Dobreanu & Manolache, 1933 (Amphipoda) and *Asellus aquaticus* (Linnaeus, 1758) (Isopoda) in vitro. We can conclude from the results, that the examined species can be arranged into two groups according to their nutritional habits. *G. roeseli* and *A. aquaticus* shred decaying materials, while *S. ambulans* and *N. valachicus* probably consume floating grains of nutrient. *G. roeseli* prefers litter of softer construction to the oak leaves which are harder and have higher tannin content. The microbiological decay in the water impoverishes the utilisable nutrients of the litter, therefore the examined Amphipoda prefer leaves which have been soaking in the water only for a few weeks. Nevertheless, we suppose that the degree of digestion is influenced by the time spent in the alimentary canal.

The nutritional habits of the amphipods which frequently occur in high quantity in various streams of Hungary, are little-known. In our country, only Ponyi (1955) made nutrition biological experiments with these animals, when he arranged the Hungarian species into two groups according to their nutritional habits (shredders and filters). Some of the researches concentrate on the process how the litter is consumed (Essafi et al., 1994; Malicky, 1985; Qian Rong et al., 1995) while the others deal with the consumption of the fungi settled on the litter (Bärlocher & Kendrik, 1973; Graca et al., 1993 and 1994). These researches concentrate on the quantity of the consumption without analysing the quantity of the FU material (faeces and urine) or the utilisation of the nutrient which derives from the two values.

We were eager to know how the dominant species in our waters take part in the disintegration of the litter fallen into the water.

MATERIALS AND METHODS

First of all, we examined the most frequent species, *Gammarus roeseli* Gervais, 1838, which was collected from the Majki Stream in the northern part of the Vértes Mountains. Its activity was compared to *Synurella ambulans* Müller, 1846, *Niphargus valachicus* Dobreanu & Manolache, 1933 (Amphipoda) and *Asellus aquaticus* (Linnaeus, 1758) (Isopoda).

We used 10 individuals for each experiment, first we weighed them, then put them into a cylindrical plastic vessel (base: 10 cm in diameter, height: 8.5 cm). The vessel was filled up with 300 cm^3 water taken from the living place of the amphipods. The Amphipoda were fed with leaves which had been decaying in the Majki Stream and then had been air-dried. These leaves were collected immediately after falling, then they were placed into the stream for different intervals (one, two, three weeks, and one month) to observe the effect of the stage of decay on the nutrition. The vessels were placed into a LMC EUROCOLD SV230 type of thermostat (12-hours lighting, 12° and 15° C). After the interval of experiment we weighed the animals again, then air-dried the nutrition left, the amphipods and the FU material and weighed them again. We used T-test, F_{max}-test, ANOVA and Turkey-test to evaluate the data.

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RESULTS

Experiment 1. Utilisation of leaves in different stages of decay – *G. roeseli*

In this experiment we worked with 15° C and 12-hour-long lighting. As nutrition we used the leaves of all four types of alder (*Alnus glutinosa*). Both the quantity of the consumption (Table 1) and the FU material (Table 2) were examined by the help of ANOVA, because the F_{max}-test doesn't rule out the possibility of its usage (consumption: F_{max}: 5,64, P <0,05, T_{table}: 7,11; FU material: F_{max}: 1,08, P <0,05, T_{table}: 7,11).

As can be seen in Table 1, ANOVA showed significant difference between the leaves in different stages of decay (F_s: 9,05, P <0,05, T_{table}: 2,84), though there wasn't any significant difference between the consumption of leaves which were left in the stream for 1 and 2, 2 and 3 and 1 and 3 weeks (Turkey-test: P <0,05, MSD: 0,0046). The other comparisons resulted in significant differences.

It can be evaluated from Table 2 that ANOVA showed significant difference between the leaves in different stages of decay (F_s: 7,21, P <0,05, T_{table}: 2,84). The rate of the utilisation decreased and the quantity of FU material increased if the leaves were in more decayed stage (Table 3). It may be deduced from the data that the more utilisable nutrients dissolve out very fast. It causes deterioration in quality which doesn't influence the consumption for the first few weeks. However, the animals found the one-month-old leaves unsuitable for consumption, therefore their consumption decreased significantly. Examining the nutritional habits of the animals, we found that they hasten the decay of the leaves, which have been soaking in the stream only for 1-2 weeks. We found that the rate of the FU material of *G. roeseli* was lower than woodlice and millipedes (Gere, 1962 a, b) which also consume litter, though *G. roeseli* can't utilise it as well as some homoiotherm species (Andrikovics et al., 1997; Gere & Kontschán, 2000).

Table 1. *The consumption (mg) of one individual of G. roeseli*

Time leaves spent in the water	1 week	2 weeks	3 weeks	1 month
Averages	9.6	12.4	12.3	4.5
SD	±1.7	±1.9	±2.85	±1.2

Table 2. *The quantity of FU material (mg) of one individual of G. roeseli*

Time leaves spent in the water	1 week	2 weeks	3 weeks	1 month
Averages	6.7	8.6	10.7	3.9
SD	±1.6	±1.6	±1.6	±1.2

Table 3. *Productional biological rates (C: consumption, A: assimilation, FU: feces and urine)*

Time leaves spent in the water	1 week	2 weeks	3 weeks	1 month
$\frac{A \times 100}{C}$	30.21	30.65	13.22	12.31
$\frac{FU \times 100}{C}$	69.79	69.35	86.78	87.69

Experiment 2. Comparison of *G. roeseli* and three other aquatic Peracarida species

In this research, we compared the productivities of *G. roeseli* and the above mentioned three species. The Amphipoda were fed with litter decayed for two weeks, on 12° C and under 12-hour-long lighting. In case of *S. ambulans* and *N. valachicus* we didn't find any measurable consumption, so we think that these species lead a filtering way of life. This result is supported by the habitat preference: these species occur in slow-flowing or still waters. Ponyi (1955) also mentioned their inclination to filtering, though he suggested that these species are both filters and shredders. We think that they prefer shredding only in the lack of floating nutrient. *G. roeseli* and *A. aquaticus* have the same nutritional habit (shredders), but here were significant differences between the quantity of their consumption and FU material (consumption: T: 6,6, P <0,05, T_{table}: 2,1; FU material: T: 6,6, P <0,05, T_{table}: 2,1). The individuals of *G. roeseli* consumed 10 times as much as *A. aquaticus* and a similar trend could be seen in connection with FU material (Table 4).

We have to notice the different sizes of the two species. While one dried individual of *G. roeseli* weighs 9.34 mg (±3.65), one dried individual of *A. aquaticus* weighs only 2.1 mg (±1.85). If we take 1 g of dried body weight as a base of comparison, the consumption is three times as much as that of *A. aquaticus*. So the difference is still considerable, especially in case when we observe the law of surface. Therefore, we assume that different types of food (plants and carcasses) are dominant in the nutrition of *A. aquaticus*. On the other hand, the utilisation rates of the consumed nutrients are very similar in the two species (Table 5).

Table 4. *The quantity of consumption and FU material of one individual*

	Consumption		FU material	
Species	*G. roeseli*	*A. aquaticus*	*G. roeseli*	*A. aquaticus*
Averages	9.05	0.62	6.76	0.44
SD	±2.00	±0.17	±1.50	±0.12

Table 5. *Productional biological rates*

	G. roeseli	*A. aquaticus*
$\frac{A \times 100}{C}$	25.30	29.03
$\frac{FU \times 100}{C}$	74.70	70.97

Table 6. *The quantity of consumption and FU material of one individual*

	Consumption		FU material	
Food	Alder	Oak	Alder	Oak
Averages	9.05	0.64	6.76	0.34
SD	±2.00	±0.15	±1.50	±0.25

Experiment 3. Examination of the nutrient utilisation of *G. roeseli* feeding on litter from two different species of trees

In this experiment some animals were fed by alder (*Alnus glutinosa*) leaves, while the others got oak (*Quercus cerris*) leaves. Both types of leaves had been soaked for 2 weeks. The experimental temperature was 12° C, the lighting time was 12 hours a day. The results – both the consumption and FU material – showed significant differences (consumption: T: 6,6, P <0,05, T_{table}: 2,1; FU material: T: 6,68, P <0,05, T_{table}: 2,1).

Comparing the consumption of the alder and oak litter, the consumption of oak litter was significantly lower than the alder's (Table 6). The utilisation of nutrient can be evaluated by the help of Table 7. The utilisation of the oak litter was better; we only have an assumption as an explanation. We suppose that the animals assimilate better the food they like less, because it passes through the alimentary canal slower as a result of less consumption. The same observation was made by Gere (1962 a, b) concerning Diplopoda and Isopoda living in forest litter.

Table 7. *Productional biological rates*

	Alder	Oak
$\frac{A \times 100}{C}$	25.30	46.88
$\frac{FU \times 100}{C}$	74.70	53.12

DISCUSSION

We can conclude from the results that two of the examined species are shredders (*G. roeseli* and *A. aquaticus*) and the other two are filters (*S. ambulans* and *N. valachicus*). *G. roeseli* prefers litter of softer construction to the oak leaves which are harder and have higher tannin content. The microbiological decay in the water impoverishes the utilisable nutrients of the litter, therefore the examined Amphipoda prefer those leaves which have been soaking in the water only for few weeks. Nevertheless, we suppose that the degree of digestion is influenced by the time spent in the alimentary canal.

REFERENCES

ANDRIKOVICS, S., GERE, G. & FUTÓ, E. (1997): The nutrition of greylag goose and its effect on the eutrophication of Kisbalaton (Hungary). *Limnology and Waterfauna, Wetlands Internat. Publ.*, 43(3): 199–210.

BÄRLOCHER, F. & KENDRICK, B. (1973): Fungi and food preferences of Gammarus pseudolimnaeus. *Arch. Hydrobiol.*, 72(4): 501–516.

ESSAFI, K., CHERGUI, H., PATTEE, E. & MATHIEU, J. (1994): The breakdown of dead leaves buried in the sediment of permanent stream in Morocco. *Arch. Hydrobiol.*, 130(1): 105–112.

GERE, G. (1962 a): Ernährungsbiologische Untersuchungen an Diplopoden. *Acta Zool. Hung.*, 8(1–2): 25–38.

GERE, G. (1962 b): Nahrungsverbrauch der Diplopoden und Isopoden in Freilandsuntersuchungen. *Acta Zool. Hung.*, 8(34): 385–415.

GERE, G. & KONTSCHÁN, J. (2000): A comparison of the nutrition utilization abilities of small mammals and song-birds. *Opusc. Zool. Budapest*, 32: 97–102.

GRACA, M. A. S., MALTBY, L. & CALOW, P. (1993): Importance of fungi in the diet of *Gammarus pulex* and *Asellus aquaticus*. I. Feeding strategies. *Oecologia*, 93:139–144.

GRACA, M. A. S., MALTBY, L. & CALOW, P. (1994): Comparative ecology of *Gammarus pulex* (L.) and *Asellus aquaticus* (L.). II. Fungal preferences. *Hydrobiologia*, 281: 163–170.

MALICKY, H. (1985): Frassversuche mit einigen Fliesswassertieren an verschiedenem Fallaub. *Jahresber. Biol. Stat. Lunz*, 8: 59–63.

PONYI, J. (1955): Ökológiai és táplálkozásbiológiai vizsgálatok a Gammarusok köréből. (Ökologische und ernährungsbiologische Untersuchungen an verschiedenen Gammarus-Arten). *Állatt. Közlem.*, 45: 75–90.

QIAN RONG, K., SRIDHAR, R. & BÄRLOCHER, F. (1995): Food selection in three leaf-shredding stream invertebrates. *Hydrobiologia*, 316: 173–181.

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Data on the feeding biology of otter (*Lutra lutra* L.) in the lakes Balaton and Kis-Balaton in Hungary

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Abstract. Feeding biology of otter was studied at Balaton and Kis-Balaton, using scat analysis. On Balaton eel *(Anguilla anguilla)*, bleak *(Alburnus alburnus)* and various Cyprinidae are the most important species in the food composition of otter, while in Kis-Balaton Cyprinidae are dominating. Ruffe *(Gymnocephalus cernuus)* and various Percidae were more important at both locations as prey item compared to previous investigations. Amphibians are represented only in trace amounts in the diet of otter, while birds appear as new prey items. Comparing the seasonal changes of prey composition of otter, the pattern may reflect some difficulties of fishing in winter.

Otters (Lutrinae) are flagship species of nature preservation throughout the world. In Europe, only one species of the family, the common or Eurasian otter *(Lutra lutra)* is indigenous. It is a kind of symbol of nature, for example as the emblem of the Bern Convention. Not only for being an attractive species, but also for being in great danger, otter deserves attention. Dramatic decline of this species has been reported since the early 60's, but the major causes are still debated (Foster-Turley et al., 1990). Hungary has been in a fortunate position that the population of otter has been strong and viable throughout these decades. This pattern has two reasons. First, otter was declared to be a protected species, and strictly protected quite early, in 1974. Second, fishing ponds formed an important part of the agriculture of the past, they were subsidised, and so otters could survive and expand. Indeed, their damage to fish stock could be indirectly refunded through these subsidies. For almost a decade fishing ponds have become primarily privately owned. Therefore the protected status of otters, despite the strong legal background, seems instable. Illegal hunting, unsustainable cultivation methods and changing agricultural status of wetlands are increasing problems for nature protection, and so also for otters. Illegal hunting originating from real or presumed damages to fishing ponds could be suppressed by a hopefully soon establishing compensation fund, or other economically relevant methods (tax, credit or other state relief; Gera, 2001). Judgement of these types of claims should be supported by scientific research.

Diet of otters is an aspect of their ecology that has been studied intensively in Western Europe (Erlinge, 1967; Mason & MacDonald, 1986; Kruuk, 1995), and this is the most frequent field of interest for the few Hungarian otter researchers, too (Lanszki & Kõrmendi, 1996; Lanszki et al., 2001). Even less work has been published in this area on habitats of Lake Balaton and Kis-Balaton so far (Kemenes & Nechay, 1990; Kemenes, 1993). Hungarian fish composition and different types of habitats (shallow lakes, as most fishing ponds and Balaton itself) justify new investigations on otter feeding.

In addition, Balaton and Kis-Balaton (Lesser Balaton) are important wetland areas of Hungary. Understanding the feeding biology of otter, as one of the top predators of wetlands may lead us to learn more about these lakes. Also, biologists have adequate information on the communities of Balaton and Kis-Balaton, especially fish stocks, so these areas could be good model systems for research on the feeding of otters. Unfortunately very few publications were issued about the role of otter at community level, even in Western Europe (Kruuk et al., 1991; Kruuk et al., 1993).

Otter is considered as fish specialist. Prey other than fish usually forms only a smaller part of the diet. Occasions, when food consists mainly of non-fish specimens (for example Sulkava, 1996;

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Lanszki & Körmendi, 1996), can be declared as exceptions. This occurs when there is too little fish mass in the habitat and otter should stay resident (for example migration is not possible because of the distance and barriers or occupied territories), and it occurs probably temporarily.

The composition of fish in diet in different places gives room to some generalisation (Kruuk, 1995). Otter usually feeds on small, bottom living, eel shaped, slow moving, frequent species. This picture is an idealised one, and can be modified by the composition of the fish community, characteristics of water, etc. Consumption is sometimes adjusted by profitability or energy value (Kruuk, 1995) and vulnerability of prey, for example pike (in this publication) and salmon (Carrs et al., 1990) after breeding. Adult males or females with cubs more frequently take larger fish, but even then they reject > 1000 g prey.

The first data about diet of otter on Balaton and Kis-Balaton was published by Kemenes and Nechay (1990). In their opinion, available food resources determine the otters' food-compositions, preference was not detectable. Fish was the prevalent food (87 %). Fish composition of diet was dominated by bleak *(Alburnus alburnus)*. Other Cyprinids were also important, as rudd *(Scardinius erythrophthalmus)*, bream *(Abramis brama)*, Prussian carp *(Carassius auratus)*. Eel *(Anguilla anguilla)* was also frequent. It was a tendency that otter consumed smaller pike *(Esox lucius)*, Cyprinidae, and medium sized eel. Remains of mammals or insects were rare (3.6 % and 3.9 % respectively). Birds were not detectable. On Kis-Balaton Cyprinids were more important, especially carp *(Cyprinus carpio)* and rudd. Bleak was less important than in Balaton. Kemenes (1993) found similar results. Altogether, fish was predominant (91 %), mainly Cyprinids in the food of otters in Balaton. Bleak was predominant (69 %), followed by rudd. Pikeperch *(Stizostedion lucioperca)* was not detectable, but eel was important. In Kis-Balaton also Cyprinids dominated, rudd was the most frequent prey (39 %), followed by bleak (18 %). Carp and other economically important species appeared in the diet of otter with fewer specimens, but in significant weight.

In the present investigation I would like to describe the pattern of the diet of otters in Balaton and Kis-Balaton. Repeating the investigations of Kemenes (1993) and Kemenes and Nechay (1990) makes sense in terms of the changing composition of fish communities of the two lakes, for example decay of eel in Balaton, Prussian carp in Kis-Balaton (Bíró, 1993). Previous investigations was based on autumnal-winter data, hereby I add annual data in terms of Balaton.

MATERIAL AND METHODS

Diet of otter was studied by analysis of scats (spraints) being the most frequent method for examining the prey composition of otters (for example: Erlinge, 1967; Wise, 1980).

Samples from Balaton were collected at Badacsony near the pier, towards Tomaj, from Kis--Balaton at Reservoir I, around the "cassette" (central pool), towards "4T" and "2T" crosses on the dam.

There was at least monthly sampling at Badacsony. I collected and processed 128 spraints between 1998 February and 1999 April, and 35 from Kis-Balaton between the autumn of 1998 and winter of 1998/99.

I collected spraints in small paper envelopes. Scats could dry in these containers, but if this was not satisfactory, they were owen-dried at 70° C. Dry spraints were taken apart into identifiable pieces. Remains of fish were identified using compendiums (Kemenes, 1993; Knollseisen, 1996) and a reference collection. When possible, remains were identified on the species level. Family level identification was only used when there were no species-specific bones (skull bones), only scales or vertebrae. Size of fish was determined by using methods and data developed by Wise (1980) and the data of Pintér's handbook (1989). Data on fish of Balaton and Kis-Balaton were collected from Paulovits et al. (1998); Bíró (1994, 1997); Bíró et al. (1998).

RESULTS

The results according to prey composition in frequency and bulk percent can be found in the Fig. 1 for annual data and Fig. 2 for data according to seasons.

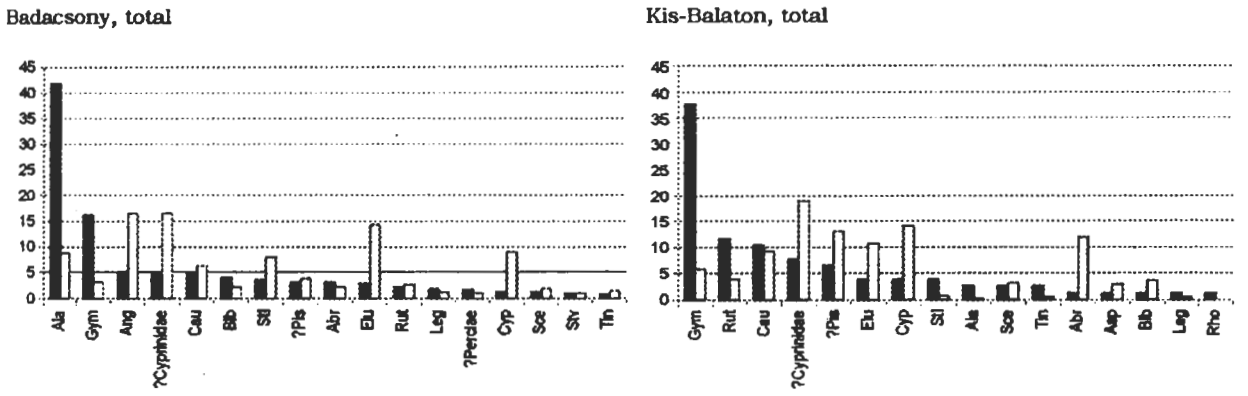


Figure 1. Annual fish composition of diet of otters at Balaton (February 1998 – April 1999, n = 128) and Kis-Balaton (1998 autumn and winter, n = 35). Filled bars: frequency; open bars: weight percent. (List of abbreviations: Ala – *Alburnus alburnus*, bleak; Ang – *Anguilla anguilla*, eel; Asp – *Aspius aspius*, asp; Blb – *Blicca bjoerkna*, white bream; Cyp – *Cyprinus carpio*, carp; Pef – *Perca fluviatilis*, perch; Rho – *Rhodeus sericeus amarus*; Rut – *Rutilus rutilus*, roach; Sce – *Scardinius erythrophtalmus*, rudd; Stl – *Stizostedion lucioperca*, pikeperch; Stv – *Stizostedion volgense*; Tin – *Tinca*; ? Cyprinidae – unidentifiable cyprinids; ? Percidae – unidentifiable Percidae; ? Pis – unidentifiable fish)

Comparing the annual data of both waters, it is clear that the fish composition of food of otter shows similarity. The most frequent species are rather small size fishes: bleak and ruffe *(Gymnocephalus cernuus)* at Balaton and ruffe, roach *(Rutilus rutilus)* and Prussian carp (*Carassius* spp.) at Kis-Balaton, although they were less important in weight. Larger species such as carps, pike and unidentifiable Cyprinids (mainly heavier ones) produced the bulk of prey in biomass. Whereas eel was highly significant in the diet of otters at Balaton, some unidentifiable fish species (heavier ones, similar to Cyprinids) composed the diet at Kis-Balaton. Bream shows significant level in bulk percent of consumed fish at Kis-Balaton, but this was resulted by a few, really big specimens (as only 35 spraints were processed, it could be a biased result). Another similarity is, that amphibians were represented only in trace amounts. The most important difference between the data of Balaton and Kis-Balaton was that bleak was in insignificant proportion at Kis-Balaton. Another, but smaller difference was that Percidae (and Centrarchidae, maybe Gobiidae, except for ruffe could be found in smaller proportion at Kis-Balaton.

Considering the seasonal variation of feeding, I mention the results of Balaton, because the data from Kis-Balaton covers only a single autumn–winter period. However, summer results of Balaton may be biased, due to the small sample size of collected spraints (Fig. 3).

Otter catches pike mainly in spring (probably due to the breeding of pike). Carp is the most important species by weight in winter, but not by frequency. This means that otters catch larger carp in wintertime. Eel is very important by consumed mass throughout the year, except in winter. The frequency of bleak seems quite stable throughout the year (over 40 %), but in winter it reaches nearly 15 % in weight (compared to ca. 5 % in other times).

Median weight is between 10-15 g in the whole sample and seasonally in both waters. Average weights of identified fish differ according to seasons, smaller in winter in both lakes, also do deviations, which are quite high (Fig. 3). Birds reach 5.2 % at Kis-Balaton (in autumn nearly 10 %) and 3.9 % at Badacsony (Fig. 4). This result can be also significant in terms of weight. Determination of taxa of bird remains is under preparation.

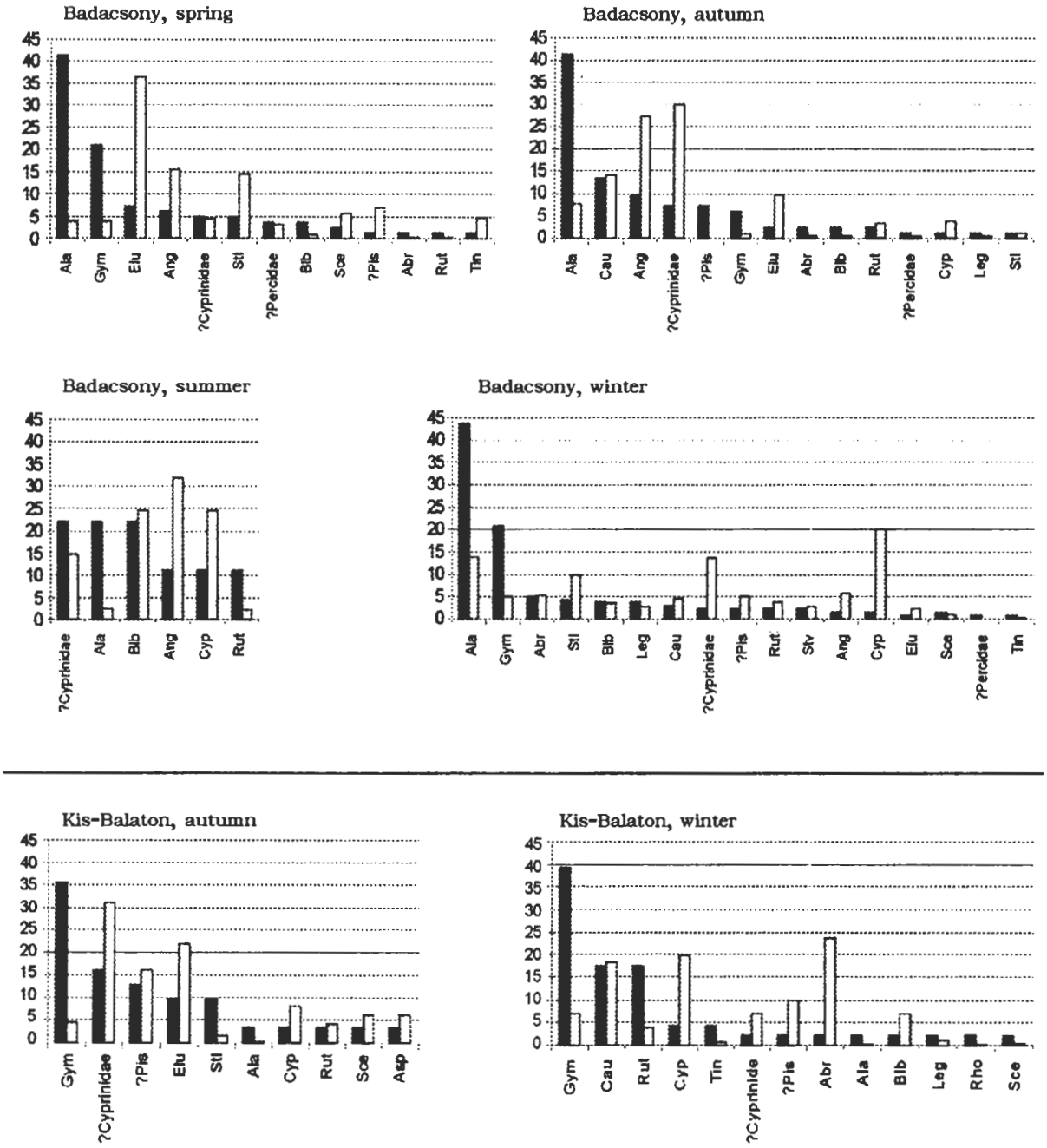
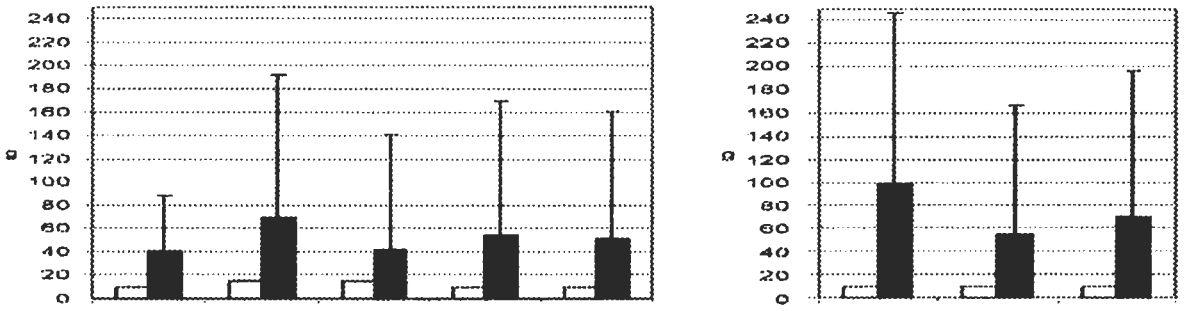


Figure 2. Seasonal fish composition of diet of otters at Balaton (February 1998 – April 1999, n = 128) and Kis-Balaton (1998 autumn and winter, n = 35). Filled bars: frequency; open bars: weight percent. For abbreviations see Fig. 1



	summer	autumn	winter	spring	total	autumn	winter	total
n	5	35	57	31	128	21	15	36
number of identified preys	10	75	132	81	298	25	46	71
number of fish taxa	5	11	14	10	14	8	11	14
prey items/spraints	2.00	2.49	2.63	2.87	2.64	1.62	3.33	2.33

Figure 3. The average (filled bars) and median weight (open bars) of fish consumed by otter in Balaton (left) and Kis-Balaton (right). Standard deviation of mean was calculated from individual weight of fish preys. On the diagrams there are data on fish is presented. In the tables below the diagrams *n* means collected number of spraints. *„Prey item / spraints"* includes, whereas *„number of identified preys"* excludes non-fish prey items

DISCUSSION

The distribution of spraints by season was similar to other authors' data (Kemenes, 1993; Mason & Macdonald, 1986; Lanszki & Kőrmendi, 1996; Harna, 1993): in winter the collectable number of spraints was about ten times higher than in summer (Fig. 3). This pattern causes the overrepresentation of the winter season in the annual data. This bias can be compensated later, on a longer time-scale, provided that the data are homogeneous (sample collections have been consecutive since 1998). However, the number of taxa as function of sample number reached plateaux in every season except for summer data gained at Badacsony (Nagy, 1999).

Comparing my data with those on fish composition of the two lakes presented by the earlier mentioned authors, one can find both similarities and differences. In lake Balaton the presence of bleak – with 47 % frequency and 8.7 % weight – differs little from the composition of diet of otters in my investigation (41.7 % and 8.7 %). Despite of their high abundance in the lake, bream and white bream do not appear in the diet of otter in significant proportion. However, these species can appear in the Cyprinidae and in the unidentifiable category (these categories make up important entities in weight composition). Carp reach 4-5 % in frequency and 35 % in weight at reeds (where otters probably fish intensively), but appears with 1.3 % and 9 % respectively in the food of otter. Still, we must consider, that carp can also appear in the Cyprinidae and unidentifiable category. Ruffe forms 2.3 % of fish in Balaton, but I can report it as high as 16.2% in frequency (although only 3.2 % in weight due to the small individual mass) among the prey of otter. According to faunistical investigations (Biró et al., 1997), pikeperch makes up 2 % in frequency. Its consumption of 4 % by the otter seems realistic. Unfortunately, I could not find any data on eel..

The data on fish stocks of Kis-Balaton seems problematic. Data are published on independent

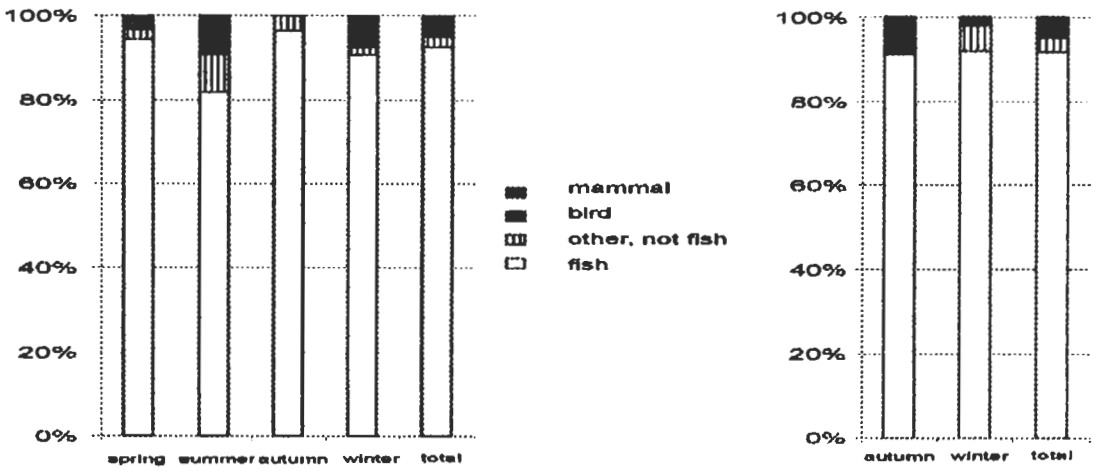


Figure 4. Frequency of prey categories according to seasons in Balaton (left) and Kis-Balaton (right)

cassettes, moreover these data differ according to years and authors (Bíró, 1994). Since reservoirs are independent, data on fish do not match to the feeding habits of otter, which can travel between the cassettes. Considering the mean of data of 1990 (Bíró, 1994), it can be concluded that the abundant *Carassius* spp. *(C. auratus)* takes part in a lower proportion (around 10 % in both frequency and weight) among the prey of the otter. However, Cyprinidae group may consist of *Carassius* spp, which group is significant in frequency and the largest in weight. Roach and pike appear in the food of otter similarly to their natural frequency and biomass. Bleak, as mentioned above, is underrepresented in the composition of feeding of otter in Kis-Balaton, although it was described as a frequent species in fish stock (Bíró, 1994) and as a prey item (Kemenes, 1993). This pattern may occur because of the different (changing) habitat structure (less reed) and/or different behaviour of this species (bleak probably become more pelagic in Kis-Balaton).

Carp is important in weight but less significant in frequency in the fauna of Kis-Balaton. Species, other than Cyprinids are rare in both waters, but a little more frequent in Balaton (Bíró et al., 1998; Bíró, 1994). These patterns also can be found in the diet composition of otter.

Interesting is that the mean weight of prey items (and the deviation of mean) is the smallest in winter (if we reject summer data of Badacsony because of the sample size). This pattern may reflect some difficulties of fishing in winter (Kruuk, 1995). The winter of 1998/99 was quite cold, there was regularly ice cover on the water for longer periods of time.

It can be concluded that there are many similarities with the previous investigations (Kemenes & Nechay, 1990; Kemenes, 1993). On Balaton eel, bleak and various Cyprinidae are the most important species in the food composition of otter, while in Kis-Balaton Cypriniae are dominating. Another similarity is, that amphibians are represented only in trace amounts in the diet of otter. However, species composition of consumed fish is different in some aspects. Ruffe is important in frequency in both lakes (even it is less significant in weight). This prey item is an "ideal" one as being a small, bottom-living, slow moving species (Kruuk & Hewson, 1978). Percidae appear more frequently than in the previous investigations (Kemenes & Nechay, 1990; Kemenes, 1993) (for example *Stizostedion* spp. turn up in the food of otters of both lakes). This result seems surprising, because Kemenes and Nechay (1990) studied autumnal and winter prey of otters, when, according to my investigation, the role of these taxa becomes significant. This new result needs revising based on recent data on changes in fish stock. Presence of Percidae in the food of otter

can be high according to other authors (Lanszki, 1993; Skarén, 1993; Wise et al., 1981; Erlinge, 1972).

Birds are new prey items in both waters, compared to the previous investigations. The accurate determination of bird remains will hopefully discover its relevance.

REFERENCES

BÍRÓ, P. (1993): A Balaton halállományának változásai és jelenlegi helyzete. *Halászat*, 86; 22–24.

BÍRÓ, P. (1994): A Kis-Balaton halállományának változásai. *Hidrobiol. Értesítő*, 32–36.

BÍRÓ, P. (1997): Temporal variation in Lake Balaton and its fish populations. *Ecol. Freshwater Fish*, 6: 196–216.

BÍRÓ, P., SPECZIÁR, A. & TÓLG, L. (1998): A Balaton halállományának minőségi–mennyiségi felmérése (1995–98). – In: Salánki, J. & Padisák, J. (ed.): A Balaton kutatásának 1997-es eredményei. *MTA VEAB, Miniszterelnöki Hiv. Balatoni Titk. Veszprém*, pp. 134-137.

CARSS, D. N., KRUUK, H. & CONROY, J. W. H. (1990): Predation on adult Atlantic salmon, *Salmo salar* L., by otters (Lutra lutra L.) whitin the River Dee system, Aberdeenshire, Scotland. *Journ. Fish Biology*, 37: 935–944.

ERLINGE, S. (1967): Food habits of the fish-otter (Lutra lutra L.) in South Sweden habitats. *Viltrevy*, 4: 371–443.

ERLINGE S. (1972): Interspecific relations between otter (Lutra lutra) and mink (Mustela vison) in Sweden. *Oikos*, 23: 327–335.

FOSTER-TURLEY, P., MACDONALD, S. M. & MASON, C. F. (1990): Otters, an action plan for conservation. *Intern. Union Conserv. Nature, Gland.*

GERA, P. (2001): Az európai vidra (*Lutra lutra* Linnaeus, 1758) állományfelméréseinek összefoglaló jelentése, 1995–2001. *Alapítvány a vidrákért, Budapest.*

HARNA, G. (1993): Diet composition of the otter (*Lutra lutra*) in the Bieszczady Mountains, south-east Poland. *Acta Theriologica*, 38: 167–174.

KEMENES, I. (1993): Egy védett ragadozó, a vidra (Lutra *lutra*) elterjedése, táplálkozása és az ezeket befolyásoló tényezők Magyarországon. *(Candidate thesis). Magyar Természettud. Múzeum, Budapest.*

KEMENES, I. & NECHAY, G. (1990): The food of otters *(Lutra lutra)* in different habitats in Hungary. *Acta Theriologica*, 35: 17–24.

KNOLLSEISEN, M. (1996): Fischbestimmungsatlas, wie Grundlage für nahrungsökologische Untersuchungen. *Boku-Reports on Wildlife Research & Game Management. Inst. Wildbiol. Jagdwirtsch. Univ. Bodenkultur, Wien.*

KRUUK, H. (1995): Wild otters, predation and populations. *Oxford Univ. Press.*

KRUUK, H., CARSS, D. N., CONROY, J. W. H. & DURBIN , L. (1993): Otter *(Lutra lutra)* numbers and fish productivity in rivers in NE Scotland. *Symp. Zool. Soc. London*, 65: 171–91.

KRUUK, H., CONROY, J. W. H. & MOORHOUSE, A. (1991): Recruitment to a population of otters *(Lutra lutra)* in Shetland, in relation to fish abundance. *Journ. Appl. Ecology*, 28: 95–101.

LANSZKI, J. (1993): Egy biotópban élő menyétfélék táplálékösszetételének vizsgálata (a fonói halastó körzetében). *(Diploma work.) Pannon Agrártud. Egyet., Keszthely.*

LANSZKI, J. & KÓRMENDI, S. (1996): Otter diet in relation to fish availability in a fish pond in Hungary. *Acta Theriologica.*, 41: 127–136.

LANSZKI, J., KÓRMENDI, S., HANCZ, C. & MARTIN, T. G. (2001): Examination of some factors affecting selection of fish prey by otters *(Lutra lutra)* living by eutrophic fish pond. *Journ. Zool. London*, 255: 97–103.

MASON, C. F. & MACDONALD, S. M. (1986): Otters, conservation and ecology. *Cambridge Univ. Press.*

NAGY D. (1999) Adatok a vidra *(Lutra lutra)* táplálékösszetételéről a Balatonon és a Kis-Balaton néhány élőhelyén. *Thesis. ELTE Állatrendszertani és Ökológiai Tanszék, Budapest.*

PAULOVITS, G., TÁTRAI, I., MÁTYÁS, K., KORPONAI, J. & KOVÁTS, N. (1998): Az ezüstkárász *(Carassius auratus gibelio* Bloch) szerepe a Kis-Balaton tározó anyagforgalmában. – In: Salánki, J. & Padisák, J. (ed.): A Balaton kutatásának 1997-es eredményei. *MTA VEAB, Miniszterelnöki Hiv. Balatoni Titk. Veszprém*, pp. 138–141.

PINTÉR, K. (1989): Magyarország halai, biológiájuk és hasznosításuk. *Akad. Kiadó, Budapest.*

SKARÉN, U. (1993): Food of *Lutra lutra* in Central Finland. *IUCN Otter Spec Group Bull.*, 8: 31–34.

SULKAVA, R. (1996): Diet of otters *(Lutra lutra)* in Central Finland *Acta Theriologica*, 41: 395–408.

WISE, M. H. (1980): The use of fish vertebrae in scats for estimating prey size of otters and mink. *Journ. Zool. London*, 192: 25–31.

WISE, M. H., LINN, I. J. & KENNEDY, C. R. (1981): A comparison of the feeding biology of mink *(Mustela vison)* and otter *(Lutra lutra)*. *Journ. Zool. London*, 195: 181–213.

Opusc. Zool. Budapest, 2002, 34: 67–76

Beiträge zur Kenntnis der Dipsocoromorpha-Arten (Insecta: Heteroptera) in Ungarn

D. RÉDEI* und L. HUFNAGEL**

Abstract. Contributions to the knowledge of Dipsocoromorpha species occurring in Hungary (Insecta: Heteroptera). Our knowledge of dipsocoromorphan bugs in Hungary are very insufficient. The occurrence of four species (Ceratocombidae: *Ceratocombus coleoptratus*; Dipsocoridae: *Cryptostemma alienum*, *C. pusillimum*, *C. waltli*) was proved in the territory, but very few specimens of them were collected so far. The authors examined a rich material collected by Dr. I. Loksa from pitfall traps and Berlese funnels between 1953 and 1990. In the material, 384 dipsocoromorphan specimens were found. The locality data of the specimens are given. Based on the Loksa-collection, the distribution, ecology, wing polymorphism and phenology of the Hungarian species are discussed.

Die Arten der Familiengruppe Dipsocoromorpha sind recht kleine, am Boden unter Laub, im Moos oder unter Steinen lebende Wanzen. Ihre Biologie ist nur wenig bekannt. In Europa umfasst die Familiengruppe ungefähr 11 Arten aus drei Familien (Kerzhner, 1995). In Ungarn sind zwei Familien mit zwei Gattungen und vier Arten bekannt. Bei uns wurden bis jetzt sehr wenige Exemplare gefunden (Vásárhelyi, 1978; Kondorosy & Földessy, 1998), deshalb ist ihre heimische Verbreitung und Phänologie sozusagen unbekannt.

MATERIAL UND METHODEN

Die Mitarbeiter des Lehrstuhls für Tiersystematik und Ökologie der Eötvös-Loránd-Universität (Budapest) haben unter Leitung von Dr. I. Loksa zwischen 1953–1990, in verschiedenen Gegenden des Landes Sammlungen mit Bodenfallen durchgeführt. Ausserdem wurden auch zahlreiche Bodenproben (Laub, Moos, Bodenstreu) ausgelesen, deren Material in 70%igem Alkohol aufbewahrt wurde. Aus diesen wurden die Wanzen zum größten Teil sortiert und bestimmt.

ERGEBNISSE

Im untersuchten Material wurden insgesamt 384 Exemplare der Dipsocoromorphen angetroffen. Ausser dem Fundort werden folgende Angaben angeführt: Funddatum (bei Bodenfallen Datum der Aussetzung und der Ausleerung), in Anführungszeichen die Anmerkungen von Loksa; Abkürzung der Sammelmethode (AA = Auslese-Apparat nach Berlese, Bf = Bodenfallen); in Klammern Zahl der Exemplare, bei Imagines auch das Geschlecht und die Flügellängenform (M = macropter, B = brachypter). Auf den Verbreitungskarten (Abb. 1 und 2) bedeuten die leeren Zeichen die Literaturangaben, die schwarzen Zeichen die neuen Angaben.

Familiengruppe DIPSOCOROMORPHA Miyamoto, 1961

Familie CERATOCOMBIDAE Fieber, 1860

Ceratocombus (Ceratocombus) coleoptratus (Zetterstedt, 1819)

Literaturangaben: **Budapest** („Rákos-Palota"), **Örkény** (Horváth, 1900); **Simontornya**: IX. (Vá-

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sárhelyi, 1978); **Bugac** (Bakonyi & Vásárhelyi, 1987).

Neue Angaben: **Ásotthalom**: 15. XI. 1972, „Bodenmoos, Rand angepflanzter Bestockung von *Pinus sylvestris* (nudum)", AA (1 B ♂). — **Baktalórántháza**: 13–15. IX. 1973, „nach der Abzweigung von Baktalórántháza in Richtung nach Nyíregyháza, Querceto-Carpinetum, Fleck mit *Asperula*", AA (1 B ♀). — **Balástya**: 5. IX. 1972, „in Richtung nach Szatymaz beim Kilometerstein Nr. 7, Rand von Phragmitetum", AA (1 B ♀). — **Bátorliget**: 11. VI–18. VII. 1990, „Fényi-erdő, links vom Kanal, Lichtung, Rasen", Bf (1 B ♀). — **Cece**: 28. V. 1971, „degradierter Rasen, *Festuca vaginata*", AA (2 Larven). — **Csanytelek**: 5. IX. 1972, „Theissufer auf der Höhe von Csanytelek, Weidengebüsch in Vertiefung hinter dem Damm", AA (1 B ♂), „Weidengebüschrand, Laub unter *Amorpha fruticosa*", AA (1 B ♀), „Pappelwald am Ufer, Laub und Boden", AA (7 B ♂♂, 2 B ♀♀, 2 Larven). — **Csaroda**: 13–15. IX. 1973, „Moor bei Csaroda, Báb tava, Dryopteridi-Alnetum populatosum", AA (1 Larve). — **Csongrád**: 5. IX. 1972, „zwischen Csongrád und Bokros, feuchte Vertiefung mit dicker Moosdecke", AA (1 B ♂). — **Egerbakta**: 19. VII. 1974, „Moor bei Egerbakta, *Salix*-Gebüsch, *Sphagnum*-Polster", AA (1 B ♂, 1 B ♀, 14 Larven), „Moor bei Egerbakta, unterer abgestorbener Teil eines *Sphagnum*-Polsters", AA (1 B ♂, 4 Larven). — **Esztergom (Búbánatvölgy)**: 30. VI. 1972, „Kerek-tó, Boden und Bodenstreu unter hoher dürrer Bülte am Bachufer", AA (1 B ♀); 17. X. 1972, „Kerek-tó, südlich vom Teich, auf trockenem Sandboden", AA (1 B ♀), „Kerek-tó, südlich vom Teich, Fleck mit *Cirsium* und Unkräutern", AA (1 B ♀).— **Fertőboz**: 1982, „in trockenem Röhricht", Bf (1 B ♂, 1 M ♀, 3 B ♀♀), „Übergangszone (zwischen Röhricht und Juncetum)", Bf (1 B ♂, 1 B ♀, 1 Larve), „Juncetum", Bf (1 B ♀), „tiefer", Bf (1 B ♀); 23. V–11. VII. 1983, „Übergangszone (zwischen Röhricht und Juncetum)", Bf (1 B ♂). — **Fertőrákos**: 1982, „kleiner Wald", Bf (1 B ♂); 10. VII–26. IX. 1985, „Röhricht, Linie der ehemaligen Grenzsperre", Bf (3 B ♂♂, 1 B ♀), „Au mit Bäumen und Gesträuch", Bf (17 B ♂♂, 4 B ♀♀, 1 B Imago*, 1 Larve); 26. IX–11. XII. 1985, „Au mit Bäumen und Gesträuch", Bf (1 B ♂), „hinter VIZIG-Labor, *Lysimachia*", Bf (1 B ♂). — **Hegykő**: 10. VII–27. IX. 1985, „Wiese (nahe am Teich)", Bf (1 B ♂); 26. IX–11. XII. 1985, „Wiese (nahe dem Weg)", Bf (1 B ♂), „Röhricht neben dem Kanal", Bf (1 B ♂); 21. IV–10. VII. 1986, „Wiese (nahe dem Weg)", Bf (1 B ♂). — **Kelebia**: 15. XI. 1972, „Festuco-Quercetum (?) Fragment, kultiviert", AA (1 B ♀). — **Kelemér**: 25–26. IX. 1972, „Mohos-tavak bei Kelemér, Kis Mohos, modriger Stamm von *Salix cinerea*", AA (1 B ♂), „Mohos-tavak bei Kelemér, Kis Mohos, dürrer Mulm von *Salix cinerea*", AA (1 B ♀). — **Marcali (Boronka)**: 30. VII. 1971, „Quercetum petraeae-cerris mit *Pteridium aquilinum*", AA (2 B ♂♂, 1 B ♀), „alter Robinienwald", AA (1 B ♂). — **Mesztegnyő**: 6. IX. 1974, „hinter dem Fischteich bei Mesztegnyő, frisch aufgebrochene Weide", AA (1 B ♂), „nach dem Fischteich bei Mesztegnyő, Holzverhau", AA (1 B ♀). — **Nagybajom**: 8. IX. 1964, „Alnetum glutinosae, Laub", AA (2 B ♂♂). — **Nagyiván**: 27. IV. 1971, AA (1 Larve). — **Naszály**: 21. VII. 1972, „NW-Naszály, Munyók-patak, Caricetum vulpinae (grösstenteils *Carex*-Stöcke)", AA (1 Larve). — **Nemesvid**: 30. VIII. 1971, „Weide, *Festuca*-Stöcke", AA (3 Larven). — **Neusiedler See („Fertővidék")** (ohne nähere Angabe des Fundortes): 1981, Bf (1 B ♂, 1 B ♀); 1983, Bf (3 B ♂♂); 7. V–23. VII. 1984, Bf (1 B ♂). — **Pásztó (Mátrakeresztes)**: 4. VI. 1971, „neben Békás-tó, Bergweide mit *Festuca pratensis*", AA (1 B ♂, 1 Larve). — **Pusztavacs**: VII. 1973, „alter Eichenwald mit Haselbüschen, subnudum", AA (1 B ♂, 4 Larven), „alter Eichenwald mit Haselbüchen, grasig", AA (1 B ♂, 1 B ♀), „Festuco-Quercetum", AA (1 B ♂, 1 Larve). — **Sándorfalva**: 5. IX. 1972, „in Richtung nach Sövényháza, Theissufer beim Damm, Pappelgruppe in ca. 40 jährigem Robinienwald", AA (2 Larven). — **Somogyzsitfa**: 30. VIII. 1971, „*Salix cinerea*-Gebüsch", AA (1 Larve). — **Sopron**: 11. VII–12. IX. 1983, „«Szent Antal», Steppengebiet", Bf (1 B ♂), „Kecske-hegy, Mischwald über Röhricht bei Kis-Tómalom", Bf (2 B ♂♂); 7. V–23. VII. 1984, „Pinty-tető, unter alten Buchen-Überhältern", Bf (1 B ♂); 23. VII–17. IX. 1984, „Pinty-tető, unter alten Buchen-Überhältern", Bf (4 B ♂♂), „Szárhalmi-erdő, Wald mit Büschen", Bf (1 B ♂); 17. IX–8. XI. 1984, „Szárhalmi-erdő, Wald mit Büschen", Bf (3 B ♂♂), „Pinty-tető, unter alten Buchen-Überhältern", Bf (5 B ♂♂, 2 B ♀♀); 8. XI. 1984–23. IV. 1985, „Pinty-tető, ausgeforstetes und neugepflanztes Gebiet", Bf (1 B ♂). — **Sopron (Balf)**: 10. VII–26. IX. 1985, „Goldraute, trocknende", Bf (2 B ♂♂), „*Equisetum*", Bf (5 B ♂♂, 5 B ♀♀), „Ginster", Bf

* Schadhaftes Exemplar.

Abbildung 1. Fundorte von *Ceratocombus coleoptratus* in Ungarn

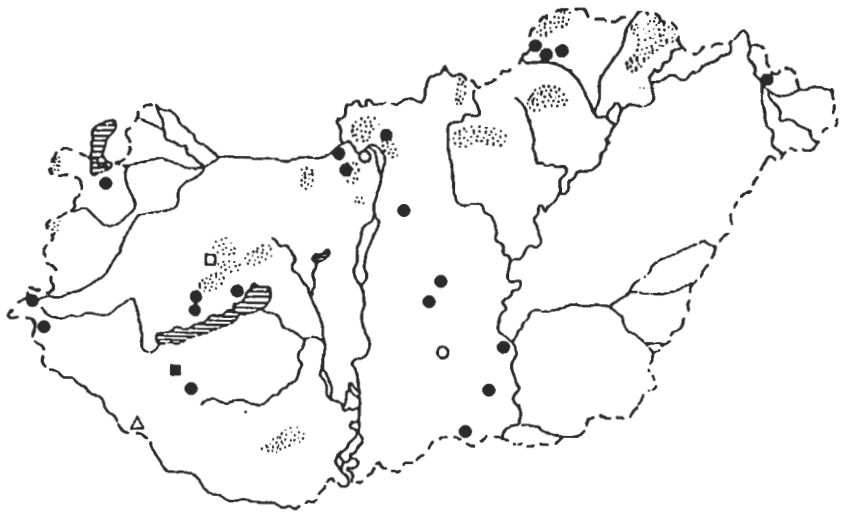

Abbildung 2. Fundorte der *Cryptostemma*-Arten in Ungarn. (Dreieck = *C. alienum*, Kreise = *C. pusillimum*, Quadrate = *C. waltli*)

(18 B ♂♂, 1 M ♀, 5 B ♀♀); 26. IX–11. XII. 1985, „Goldraute, trocknende", Bf (1 B ♂), „*Equisetum*", Bf (1 B ♂), „Ginster", Bf (3 B ♂♂, 2 B ♀♀); 21. IV–10. VII. 1986, „*Equisetum*", Bf (1 B ♂, 3 B ♀♀, 1 Larve). — **Sopron (Sopronkőhida, Tómalom)**: 1982, „Kis-Tómalom", Bf (2 B ♂♂); 23. V–11. VII. 1983. „Nagy-Tómalom, in Röhricht", BF (2 B ♂♂). — **Szigetmonostor**: 16. VI. 1971, „Auenwald beim Hafen bei Szigetmonostor", AA (3 Larven). — **Vámosatya**: 19. VI. 1974, „Bockerek-erdő, Brennessel bei Hamvas-tó", AA (2 Larven), „Bockerek-erdő, Salicetum cinereae, Wurzeln mit Moos", AA (1 Larve); 25. IX. 1974, „Bockerek-erdő, angepflanzter Robinienwald, Laub", AA (1 B ♂).

Insgesamt: 112 B ♂♂, 2 M ♀♀, 44 B ♀♀, 1 Imago, 46 Larven.

Familie DIPSOCORIDAE Dohrn, 1859

Cryptostemma (Cryptostemma) alienum Herrich-Schäffer, 1835

Literaturangaben: **Gyékényes**: 30. IV. 1993 (1 Imago) (Kondorosy & Földessy, 1998).

Neue Angaben: Keine.

Cryptostemma (Pachycoleus) pusillimum (J. Sahlberg, 1870)

Literaturangaben: **Visegrád** (1 Imago) (Vásárhelyi, 1978); **Bugac** (Bakonyi & Vásárhelyi, 1987).

Neue Angaben: **Alsószuha**: 23. XI. 1973, „unter Büdös-kút-tető, Juncetum (effusi?)", AA (2 B ♂♂, 1 B ♀, 3 Larven), „unter Büdös-kút-tető, Caricetum (vulpinae?) mit Moosdecke", AA (2 B ♂♂, 2 B ♀♀, 3 Larven), „Gyomol-Tal, Phragmitetum", AA (1 B ♀). — **Ásotthalom**: 15. XI. 1972, „sumpfige Wiese mit *Carex* und mit dicker Moosdecke", AA (1 B ♂, 2 B ♀♀, 1 Larve), „alte angepflanzte Pappelbestockung", AA (1 B ♀). — **Bajánsenye (Dávidháza)**: 16–18. X. 1974, „Tal von Kerka, *Sphagnum*", AA (1 B ♂). — **Balástya**: 5. IX. 1972, „alkalische Vertiefung, stellenweise unter Wasser stehend, Puccinelietum", AA (1 B ♂, 1 Larve), „alkalische Vertiefung, stellenweise unter Wasser stehend, Fleck mit *Aster pannonicus*", AA (1 B ♂), „in Richtung nach Szatymaz beim Kilometerstein Nr. 7, Potentilletum anserinae", AA (2 B ♀♀, 1 Larve), „in Richtung nach Szatymaz beim Kilometerstein Nr. 7, Rande von Phragmitetum", AA (1 M ♂, 2 M ♀♀). — **Cserhát**: 13. VI. 1973, „Tal von Munyók-patak, Phragmitetum (mit *Carex vulpina*)", AA (1 B ♂, 1 B ♀). — **Csongrád**: 5. IX. 1972, „zwischen Csongrád und Bokros, feuchte Vertiefung mit dicker Moosdecke", AA (10 Larven), „zwischen Csongrád und Bokros, Wiesemit *Potentilla anserina*", AA (1 Larve). — **Esztergom (Búbánatvölgy)**: 30. VI. 1972, „Kerek-tó, Schachtelhalm und dickes Bodenmoos", AA (1 B ♂, 4 B ♀♀, 16 Larven); 17. X. 1972, „Kerek-tó, südlich vom See, Fleck mit *Cirsium* und Kräuter", AA (5 B ♀♀). — **Fülöpháza**: 13. XI. 1972, „Kondor-tó, Phragmitetum, Mulm", AA (1 B ♀). — **Hegykő**: 11. XII. 1985–21. IV. 1986, „Wiese (nahe dem Teich)", Bf (1 B ♂, 1 B ♀). — **Jákfalva**: 23. XI. 1973, „Tal von Szuha-patak, *Bolboschoenus maritimus*-Stöcke", AA (1 B ♀, 4 Larven), „Tal von Szuha-patak, *Cyperus* mit Moosdecke", AA (1 B ♂, 2 B ♀♀). — **Kelemér**: 25–26. IX. 1972, „Mohostavak bei Kelemér, Kis Mohos, Cariceto-Sphagnetum, *Sphagnum*-Polster", AA (1 M ♀). — **Kékkút**: 26. X. 1973, „Juncetum neben Wasserlauf, feuchtes Moos", AA (3 B ♀♀). — **Lajosmizse**: 13. XI. 1972, „nach der Abzweig von Lajosmizse und Kunbaracs, Rasen neben Potentill. anserinae (?)", AA (1 B ♀). — **Lovas**: 29. III. 1973, „oberhalb Lovas, Királykút-völgy, Caricetum elatae", AA (2 B ♂♂, 3 B ♀♀, 2 Larven). — **Nagybajom**: 8. IX. 1964, „Bolboschoenetum", AA (1 B ♂, 1 B ♀, 1 Larve); 24. XI. 1964, „Caricetum elatae, Boden", AA (1 B ♂, 1 B ♀). — **Naszály**: 21. VII. 1972, „NW-Naszály, Munyók-patak, Caricetum vulpinae (grösstenteils *Carex*-Stöcke)", AA (1 B ♀, 2 Larven). — **Pécel**: 15. V. 1973, „Scirpetum", AA (1 B ♂, 2 B ♀♀). — **Piliscsév**: 3. XI. 1972, „Tatárszállás, Tal vom Topolyka-patak, Juncetum subnodulosi", AA (2 B ♂♂, 7 B ♀♀, 3 Larven). — **Sajókaza**: „Pocsány, in Richtung nach Sajókaza, Caricetum (vulpinae?) mit Moosdecke", AA (1 B ♂, 2 B ♀♀). — **Szendehely**: 14. III. 1974, „nördlicher Fuss von Naszály, Tal vom Munyók-patak, Caricetum vulpinae, Mulm und Boden", AA (1 B ♀). — **Szentbékkálla**: 16. IX. 1974, „Teiche bei Szentbékkálla, nördlicher Teich, *Calamagrostis*-Bülte", AA (2 B ♂♂, 1 B ♀, 5 Larven), „Teiche bei Szentbékkálla, nördlicher Teich, Farnicht", AA (1 B ♂, 2 Larven), „Teiche bei Szentbékkálla, nördlicher Teich, Moos zwischen *Calamagrostis*-Bülten (nicht *Sphagnum*!)", AA (1 Larve). — **Szentgotthárd (Feketetó)**: 16–18. X. 1974, „untere Wiese, Flachmoor, Moos (nicht

Sphagnum!)", AA (1 B ♀). — **Vámosatya**: 30. V–1. VI. 1973, „Bockerek-erdő, die Umgebung von Hamvas-tó, Agrostio-Caricetum, *Carex acutiformis* Stöcke", AA (1 B).

Insgesamt: 1 M ♂, 24 B ♂♂, 3 M ♀♀, 48 B ♀♀, 56 Larven.

Cryptostemma (Pachycoleus) waltli (Fieber, 1860)

Literaturangaben: **Németbánya**: IV. (Vásárhelyi, 1978).

Neue Angaben: **Mesztegnyő**: 6. IX. 1974, „hinter dem Fischteich bei Mesztegnyő, Mulm von *Carex elata*", AA (17 B ♂♂, 12 B ♀♀, 14 Larven), „hinter dem Fischteich bei Mesztegnyő, mit *Carex pilosa*", AA (1 B ♀), „hinter dem Fischteich bei Mesztegnyő, frisch aufgebrochene Weide", AA (2 B ♀♀), „hinter dem Fischteich bei Mesztegnyő, Holzverhau", AA (1 B ♂).

Insgesamt: 18 B ♂♂, 15 B ♀♀, 14 Larven.

DISKUSSION

Die Verbreitung von Dipsocoromorpha in Ungarn

Ceratocombus coleoptratus

Dies ist die einzige aus Ungarn bekannte Art der Familie Ceratocombidae, mit eurosibirischer Verbreitung. In Ungarn kann die Art sowohl in der Ebene wie auch im Hügelland und im Mittelgebirge angetroffen werden (Abb.1). Sie ist weiter verbreitet als dies auf Grund der bisher sehr spärlichen Publikationen bekannt geworden ist. Einerseits kann dies durch die niedrige Zahl der bisher bekannten Fundorte, der winzigen Gestalt und versteckten Lebensweise der Tiere, anderseits durch die spärlichen Untersuchungen über Bodenwanzen gedeutet werden. Bemerkenswert ist es, dass im Fertő-Hanság Nationalpark, wo Loksa die grösste Zahl der Bodenfallen gelegt hatte, in fast jeder Bodenfalle relativ viele Exemplare gesammelt werden konnten.

Die Art *C. brevipennis* Poppius, 1910, die der Untergattung *Xylonannus* Reuter, 1891 angehört, wurde aus Nord- und Mitteleuropa gemeldet, ist zwar auch in der Slovakei gefunden worden (Kerzhner 1995), so dass ihr Vorkommen in Ungarn auch zu erwarten wäre. In der Loksa-Sammlung konnte kein einziges Exemplar angetroffen werden.

Cryptostemma alienum

Alle drei heimischen Arten der Gattung *Cryptostemma* aus der Familie Dipsocoridae besitzen eine europäische Verbreitung. In Ungarn war nur ein einziger Fundort von *Cryptostemma alienum* bisher bekannt (Abb. 2). In der Sammlung von Loksa sind keine Exemplare angetroffen worden. Die Art scheint in allen Gegenden des Landes selten zu sein, aber die Biotope, in denen sie vorkommt, sind völlig unerforscht.

Cryptostemma pusillimum

Diese Art scheint unter den heimischen *Cryptostemma*-Arten die häufigste zu sein, kommt zerstreut in allen Teilen Ungarns vor (Abb. 2). Die niedrige Zahl der bisher bekannten Fundorte kann wahrscheinlich auf gleiche Gründe wie bei *Ceratocombus coleoptratus* zurückgeführt werden.

Cryptostemma waltli

Diese Art scheint viel seltener als *C. pusillimum* zu sein; in der Loksa-Sammlung war sie nur in wenigen Proben (alle am gleichen Fundort gesammelt) vorhanden. Die Art wurde bisher in Ungarn ausschließlich in Transdanubien gesammelt (Abb. 2).

Die Zönologie der ungarischen Dipsocoromorpha

Ceratocombus coleoptratus

In Ungarn wurde die Species in folgenden Biotopen angetroffen:

1. Klimazonale, meso- oder xero-mesophile Waldgesellschaften wie Hainbuchen-Eichenwälder (Querco petraeae-Carpinetum) und geschlossene Eichenwälder (Quercetum petraeae-cerris).

2. In der Grossen Ungarischen Tiefebene (Alföld), trockene Waldsteppen-Wälder auf Sandboden (Festuco-Quercetum).

3. In wasserreichen Gebieten, Auenwälder (Salicetum albae-fragilis), Erlenauen (Alnetum glutinosae-incanae) und Waldmoore wie Weidengebüsch (Calamagrosti-Salicetum cinereae) oder Erlenbrüche (Dryopteridi-Alnetum).

4. In der Nähe von Gewässern oder in anderen mehr oder weniger wasserreichen Gebieten Röhrichte (Scirpo-Phragmitetum); hygrophile Wiesen; Hochmoore (Carici-Sphagnetum) (bei Csaroda und Kelemér).

5. Auf trockenen Wiesen, Rasen, Bergweiden, Steppengebieten.

6. Kulturgemeinschaften (angepflanzter Kiefernwälder und Robinienwälder, Holzverhaue usw.).

Die Biotope des Vorkommens von *Ceratocombus coleoptratus* in Ungarn sind sehr verschieden: es sind dies Waldgesellschaften und waldfreie Gebiete, sehr feuchte, mesophile, aber auch trokkene Orte. Die Art kann sowohl in Bodenfallen, wie auch in Auslese-Apparaten nach Berlese aus *Sphagnum* und andere Moose, Laub, Mulm, Bülten, dürre Riedstöcke, moderige Baumstämme oder aus der oberen Erdschicht erbeutet werden. Mit beiden Methoden wurden stellenweise und gelegentlich relativ viele Exemplare gesammelt; wir sind der Meinung dass die Art an geeigneten Orten wahrscheinlich nicht selten ist, aber aus Mangel von quantitativen Angaben lassen sich die verschiedenen Biotope nicht vergleichen.

Die Art *C. coleoptratus* wurde in Proben der Auslese-Apparate mit 17 Wanzenarten zusammen angetroffen, sie scheint aber mit keiner charakteristisch vorzukommen. Die Arten sind: *Cryptostemma pusillimum* und *C. waltli*; *Hebrus ruficeps* Thomson, 1871 [Hebridae]; *Acalypta carinata* (Panzer, 1806), *A. marginata* (Wolff, 1804), *A. gracilis* (Fieber, 1844), Larven verschiedener *Acalypta*-Arten und *Derephysia foliacea* (Fallén, 1807) [Tingidae]; *Myrmedobia exilis* (Fallén, 1807) [Microphysidae]; *Halticus apterus* (Linnaeus, 1758) [Miridae]; *Piesma maculatum* (Laporte, 1832) [Piesmatidae]; *Berytinus minor* (Herrich-Schäffer, 1835) und *B. montivagus* (Meyer-Dür, 1841) [Berytidae]; *Plinthisus pusillus* (Scholz, 1847), *Drymus brunneus* (R. F. Sahlberg, 1848), *Scolopostethus thomsoni* Reuter, 1874 und *Pachybrachius fracticollis* (Schilling, 1829) [Rhyparochromidae]; *Legnotus limbosus* (Geoffroy, 1785) [Cydnidae].

Cryptostemma alienum

Die Exemplare dieser Art wurden weder mit dem Auslese-Apparat noch in Bodenfallen gesammelt. Nach Štys (1990) kommt die Art in verschiedenen Biotopen, aber immer an Flussufern, unter Steinen vor, deswegen kann sie nur manuell gesammelt werden.

Cryptostemma pusillimum

Diese Species wurde in Ungarn in folgenden Biotopen gesammelt:

1. Waldgesellschaften in wasserreichen Gebieten wie angepflanzter Pappelbestockung.

2. In der Nähe von Gewässern oder in anderen wasserreichen Gebieten: Röhrichte (Scirpo-Phragmitetum); sumpfige, moorige oder andere feuchte Wiesen (oder Weiden) wie Caricetum elatae, Juncetum subnodulosi, Juncetum effusi; Hochmoore (Carici-Sphagnetum) (bei Kelemér); und auf natronhaltigen Böden wie Bolboschoenetum maritimi, Agrosti-Caricetum oder Puccinellietum.

Die Art lebt hauptsächlich in sehr feuchten, waldfreien Biotopen. In Bodenfallen kommt sie seltener als die vorige Art vor (es sind nur zwei Exemplare gefangen wurden). Es ist anzunehmen, dass ihre Mobilität weit niedriger ist, sie wurde meistens durch Auslese aus *Sphagnum* und anderen Moosen, Boden, Mulm, Bülten oder dürre Riedstöcke, stellenweise und gelegentlich in relativ grosser Anzahl, gefunden. Die Art ist an günstigen, feuchten Orten wahrscheinlich nicht selten.

Die Art *C. pusillimum* wurde zu 38,9 % durch Auslese in Gesellschaft von *Hebrus ruficeps* Thomson, 1871 [Hebridae] ausgesiebt. Sie wurde weiterhin mehr oder weniger oft mit *Acalypta platycheila* (Fieber, 1844) [Tingidae] und mit verschiedenen *Acalypta*-Larven (27,8 % der Proben), sowie mit *Ceratocombus coleoptratus* (8,3 % der Proben) zusammen angetroffen. Je ein Exemplar wurde mit *Hebrus pusillus* (Fallén, 1807) [Hebridae], *Agramma confusum* (Puton, 1879) [Tingidae], *Piesma capitatum* (Wolff, 1804) [Piesmatidae], *Pachybrachius fracticollis* (Schilling, 1829) [Rhyparochromidae] und *Adomerus biguttatus* (Linnaeus, 1758) [Cydnidae] gemeinsam gefunden.

***Tabelle 1.** Anteile der vier Flügellängenformen bei Ceratocombus coleoptratus in Ungarn*

	Macropter	Cryptobrachypter	Brachypter	Extrem brachypter	Insgesamt
♂	0 (0%)	0 (0%)	112 (100%)	0 (0%)	112 (100%)
♀	2 (4,4%)	0 (0%)	44 (95,6%)	0 (0%)	46 (100%)

***Tabelle 2.** Anteile der vier Flügellängenformen bei Ceratocombus coleoptratus in Nordwestdeutschland (nach Melber & Köhler, 1992)*

	Macropter	Cryptobrachypter	Brachypter	Extrem brachypter	Insgesamt
♂	0,1%	0%	0,6%	99,3%	996 (100%)
♀	0,7%	0,3%	1,0%	98,0%	308 (100%)

Cryptostemma waltli

Unsere Angaben über Habitatpräferenz von *Cryptostemma waltli* sind noch sehr lückenhaft. Sie wurde in Ungarn auf feuchten Wiesen, Weiden und Holzverhauen gefangen; wahrscheinlich lebt sie in ähnlichen Biotopen wie *Cryptostemma pusillimum* und kommt stellenweise in relativ grosser Zahl vor. Die Art wurde durch Auslese in Gesellschaft der Arten *Ceratocombus coleoptratus*, *Gerris argentatus* Schummel, 1832 [Gerridae] und *Acalypta*-Larven [Tingidae] angetroffen.

Die Larven von *Ceratocombus coleoptratus*, *Cryptostemma pusillimum* und *C. waltli* kommen regelmässig in Gesellschaft ihrer Imagines vor; sie haben wahrscheinlich (wie die grosse Mehrheit der Wanzen) eine ähnliche Habitatpräferenz und auch eine ähnliche Lebensweise wie die Imagines.

Flügelpolymorphismus

Ceratocombus coleoptratus

Bei *Ceratocombus coleoptratus* können nach Linnavuori (1951) vier Flügellängenformen unterschieden werden:

1. Macropter: Halbdecken die Hinterleibsenden weit überragend; Hinterflügel voll ausgebildet, die Hinterleibsenden erreichend (Abb. 2: A).

2. Cryptobrachypter: Halbdecken wie bei macropteren Exemplaren; Hinterflügel zurückgebildet, reicht nur bis zur Mitte des Hinterleibs.

3. Brachypter: Halbdecken verkürzt und verengt, aber in der Regel die Hinterleibsenden erreichend (oder etwas länger oder kürzer); Hinterflügel stark zurückgebildet, schuppenförmig, reicht nur bis zum ersten oder zweiten Hinterleibssegment (Abb. 2: B, C).

4. Extrem brachypter: Halbdecken stärker verkürzt, weit kürzer als der Hinterleib, die Aderung oft unerkennbar; Hinterflügel fast vollkommen reduziert.

Die grosse Mehrheit der von uns untersuchten Exemplare ist brachypter, es wurden aber auch zwei macroptere Weibchen gefunden. Auf Grund der vorhandenen Angaben ist Macropterismus unter den Weibchen vielleicht etwas häufiger als unter den Männchen (Tab. 1).

Es ist interressant, dass unter den in Nordwestdeutschland gesammelten Exemplaren bei beiden Geschlechtern die extrem brachypteren

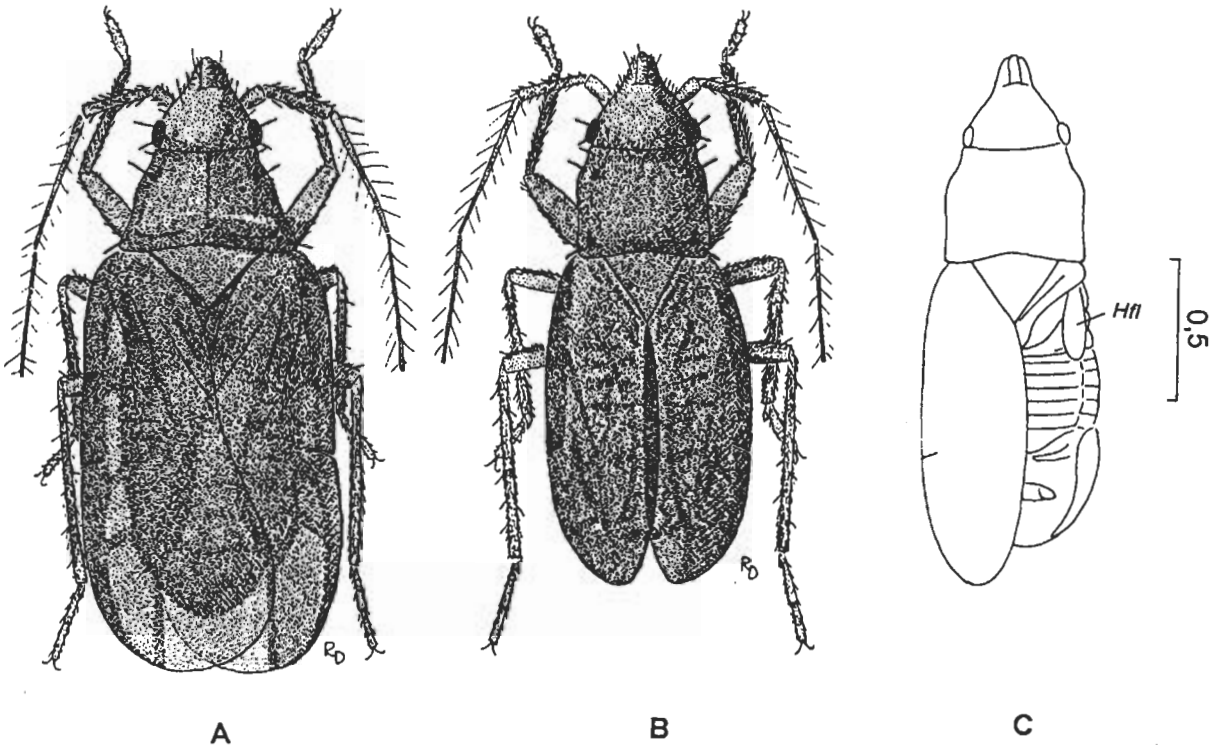

Abbildung 3. Flügellängenformen bei *Ceratocombus coleoptratus*. A: macropter ♀, B: brachypter ♂, C: brachypter ♂ ohne rechte Halbdecke. *Hfl* = Hinterflügel. (Massstab in Millimeter)

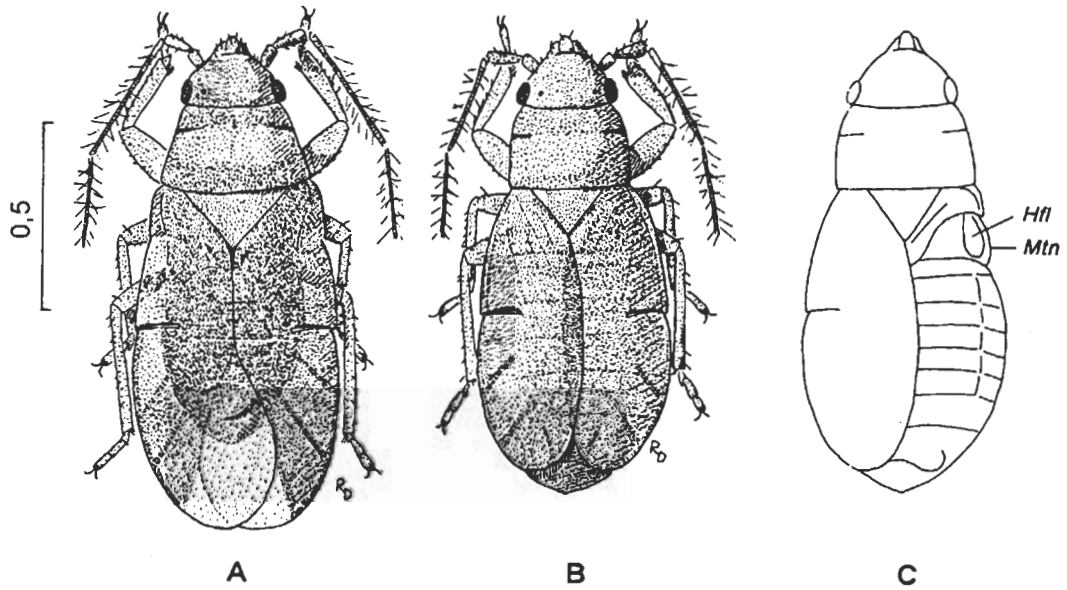

Abbildung 4. Flügellängenformen bei *Cryptostemma pusillimum*. A: macropter ♂, B: brachypter ♀, C: brachypter ♀ ohne rechte Halbdecke. *Hfl* = Hinterflügel; *Mtn* = Metanotum. (Massstab in Millimeter)

Tabelle 3. Anteile der zwei Flügellängenformen bei Cryptostemma pusillimum in Ungarn

	Macropter	Brachypter	Insgesamt
♂	1 (4,0%)	24 (96,0%)	25 (100%)
♀	3 (5,9%)	48 (94,1%)	51 (100%)

Formen dominieren (Tab. 2; Melber & Köhler, 1992).

Cryptostemma pusillimum

Bei *Cryptostemma pusillimum* haben wir folgende Flügellängenformen gefunden:

Macropter: Halbdecken die Hinterleibsenden weit überragend; Hinterflügel voll ausgebildet, so lang wie die Halbdecken (Abb. 3: A).

Brachypter: Halbdecken verkürzt, die Hinterleibsenden fast erreichend, die Aderung mehr oder weniger schwer erkennbar; Hinterflügel sehr stark reduziert, Ende des Metanotums in der Regel nicht erreichend, schuppenförmig, durchscheinend, schwer erkennbar (Abb. 3: B, C).

Die grosse Mehrheit der untersuchten Exemplare ist brachypter (Tab. 3).

Cryptostemma waltli

Alle Exemplare von *Cryptostemma waltli*, gesammelt von Loksa, sind brachypter: Halbdecken und Hinterflügel ungefähr ähnlich wie bei brachypteren Exemplaren von *C. pusillimum*.

Die Phänologie der ungarischen Dipsocoromorpha

Wegen der spärlichen Angaben können nur qualitative Anmerkungen gemacht werden. Nach Štys (1990) und Kerzhner (1995) überwintern die paläarktischen Arten der Familie Ceratocombidae im Eistadium. Imagines von *Ceratocombus coleoptratus* wurden in Ungarn frühestens am 15. Mai gefangen, sie wurden aber auch im Spätherbst (15. November) gesammelt. Ein Männchen wurde in zwischen Anfang November und Ende April ausgesetzten Bodenfallen gefangen. Larven wurden zwischen dem 27. April und 15. September gefunden. Auf Grund der vorhandenen Angaben ist es anzunehmen, dass die Art auch in Ungarn vorwieglich als Ei oder als Larve überwintert; Larven erscheinen im April, Imagines können von Mitte Mai bis Mitte November gesammelt werden.

Imagines von *Cryptostemma pusillimum* wurden zwischen dem 14. März und 24. November, Larven zwischen dem 29. März und 23. November gefunden. Wahrscheinlich überwintert die Art in Ungarn sowohl als Imago wie auch als Larve (und vielleicht auch als Ei). So die Imagines wie die Larven erscheinen schon Mitte oder Ende März und können bis Ende November gesammelt werden; es ist anzunehmen, dass die Art, wie dies Štys (1990) auch vermutet, azyklisch ist.

Alle von Loksa gesammelten *Cryptostemma waltli* Exemplare wurden am 6. September eingefangen. Nach Vásárhelyi (1978) wurden Imagines bei Németbánya im April gefunden. Es ist anzunehmen, dass die Art eine ähnliche Phänologie wie *C. pusillimum* besitzt.

ZUSAMMENFASSUNG UND AUSBLICK

Unsere Kenntnisse über die ungarischen Disocoromorpha sind noch sehr lückenhaft. Zahlreiche Biotope der Arten in Ungarn wurden auf Grund der Sammlung von Loksa nachgewiesen, jedoch ohne quantitative Angaben ihrer Abundanz. Über ihre Phänologie in Ungarn können nur Vermutungen ausgesprochen werden.

Nur durch gründlichen Untersuchungen der bekannten Biotope und Substrate könnten quantitative Angaben und phänologische Daten ge-

wonnen werden. Durch die Untersuchung der von Štys (1990) mitgeteilten, aber in Ungarn bisher völlig unerforschten Habitate von *Cryptostemma alienum* könnte die Verbreitung und Phänologie der Art in Ungarn festgestellt werden.

Danksagung. Auch an dieser Stelle möchten wir für die Überlassung der Sammlung von Dr. Loksa Frau Prof. Dr. Klára Dózsa-Farkas unseren herzlichen Dank aussprechen.

SCHRIFTTUM

BAKONYI, G. & VÁSÁRHELYI, T. (1987): The Heteroptera fauna of the Kiskunság National Park. – In: Mahunka, S. (ed.): The Fauna of the Kiskunság National Park, II. *Akadémiai Kiadó, Budapest*, pp. 85–106.

HORVÁTH, G. (1900): Ordo Hemiptera. – In: Paszlavszky, J. (ed.): A Magyar Birodalom Állatvilága (Fauna Regni Hungariae), III. (Arthropoda). *Kir. Magyar Természettud. Társulat, Budapest*, pp. 1–72.

KERZHNER, I. M. (1995): Infraorder Dipsocoromorpha. – In: Aukema, B. & Rieger, Ch. (eds.): Catalogue of the Heteroptera of the Palaearctic Region, 1. *Netherlands Entomol. Soc. Amsterdam*, pp. 6–12.

KONDOROSY, E. & FÖLDESSY, M. (1998): Adatok a Duna–Dráva Nemzeti Park Dráva menti területei poloska (Heteroptera) faunájához. [Beiträge zur Wanzenfauna der an der Drau gelegenen Gebiete des Duna–Dráva Nationalparks.] – In: Uherkovich, Á. (ed.): A Dráva mente állatvilága, II. *Dunántúli Dolg. Term.-tud. Sorozat*, 9: 159–176.

LINNAVUORI, R. (1951): Studies on the family Cryptostemmatidae. *Ann. Entomol. Fennici*, 17: 93–103.

MELBER, A. & KÖHLER, R. (1992): Die Gattung *Ceratocombus* Signoret, 1852 in Nordwestdeutschland (Heteroptera, Ceratocombidae). *Bonn. Zool. Beitr.*, 43 (2): 229–246.

ŠTYS, P. (1990): Enicocephalomorphan and dipsocoromorphan fauna of W. Palaearctic (Heteroptera): Composition, distribution and biology. *Scopolia Suppl.*, 1: 3–15.

VÁSÁRHELYI, T. (1978): Poloskák, V. (Heteroptera, V.) – In: Magyarország Állatvilága (Fauna Hungariae), XVII, 5. *Akadémiai Kiadó, Budapest*, 76 pp. (Dipsocoridae, inklusive Ceratocombidae: pp. 72–76.)

Opusc.Zool. Budapest, 2002, 34: 77-83

Comparison of species richness of light trap-collected caddisfly assemblages (Insecta: Trichoptera) using rarefaction

D. SCHMERA*

Abstract. Conservation value of light trap-collected caddisfly assemblages (Insecta: Trichoptera) was evaluated on the basis of their species richness. The assemblage coming from an artificial stream showed a higher conservation value based on species richness than the natural ones. In contrast, using rarefaction, the conservation value of the assemblage in the artificial stream was lower in comparison with assemblages in natural habitats. Further examples are given to demonstrate the importance of rarefaction in comparing species richness of assemblages.

Human environmental disturbance and its effect on biota are one of the most important phenomena for community ecologists (Pianka, 1970; Southwood, 1977). Falling biodiversity (Juhász-Nagy, 1993) has been the first and most significant sign calling our attention to changes in structure in the biosphere. This process is of global scale, however, could also be demonstrated by local studies. For instance, butterfly communities at the foot of Fuji Mountains (Japan) show sensitivity (reduction in species richness) to human disturbance (Kitahara & Fujii, 1994; Kitahara & Sei, 2001). Nowadays, it is generally accepted that degradation processes could be measured through various community structural characteristics. Among others, species richness is the simplest measurement to indicate degradation. Generally, a wide array of species represents a "well being" state of community (high conservation value), while low species richness does not (low conservation value) (Magurran, 1988). This conception is strongly supported in aquatic ecology, where biotic indices (for instance Ephemeroptera-Plecoptera-Trichoptera index) are chiefly based on species richness (Stone & Wallace, 1998). Accordingly, numerous studies have been conducted using species richness as a measure of environmental conditions (Ivol & al., 1997; DeWalt & al., 1999; Ruse & Herrmann, 2000; Lomond & Colbo, 2000). In addition, species richness is also commonly used in measuring seasonality of phytoplankton (Padisák, 1993) or in comparing macroinvertberate assemblages in streams (Schmera, 1999; Andrikovics & Kiss, 2000; Csõrgits, 2000; Kiss & al., 2001) or carabid communities (Magura & Tóthmérész, 1996). The number of species in a sample would be a proper measure of the species richness of a studied community, however, we scarcely are in the position to collect all the organisms (species and individuals) in the given community. Based on field observations (Gotelli & Graves, 1996), the more individuals are sampled, the species richness rises until an asymptote is reached. Several hypothesises have been proposed to explain the phenomenon. The most commonly known hypothesis include a passive sampling model, where richness is larger because of the statistically greater probably of sampling new species in a large sample (Giller & Malmqvist, 1998). Consequently, species richness yielding from samples significantly differing in sizes (number of specimens) could not be compared.

Therefore, the general purpose of this study was to demonstrate the advantages using rarefaction in community comparisons based on species richness. Rarefaction is a mathematical method, thereby the species richness of communities could be compared, as if their number of individuals where the same. This method has been used in comparing carabid communities (Magura & Tóthmérész, 1996) or macroinvertebrate assemblages (McCabe & Gotelli, 2000). As species richness of stream dwelling caddisflies is strongly de-

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Table 1. Comparison of sampling circumstances

Code	Place	Sampling year	Name of the water	Habitat type	Note	Reference
A	Bernecebaráti	1998	Bernecei	stream	natural	Schmera, 2001
B	Gyepükaján	1987	Meleg-víz	stream	artificial	Uherkovich & Nógrádi, 1999
C	Királyrét	1999	Morgó	stream	natural	Schmera, 2001
D	Göd	1999	Danube	river	natural	Andrikovics & al., 2001
E	Tiszaszőlős	2001	Tisza	river	natural	unpublished
F	Verőce	1980	Danube	river	natural	Chantaramongkol, 1983

pendent on the stream order (Wiberg-Larsen & al., 2000) and size (Vilson & Hawkins, 1998), therefore assemblages representing streams and rivers were separately studied. Specifically, caddisfly (Insecta: Trichoptera) assemblages collected by light traps on the bank of streams and rivers were separately compared using the collected by light traps on the bank of streams and rivers were separately compared using the collected number of species and the rarefaction of each caddisfly assemblages from own and a literature data set.

MATERIAL AND METHODS

Origin of the data

Six caddisfly assemblages of streams and rivers were collected by light traps installed at the bank of the waters (Table 1). Assemblages *A* and *C* were collected at an undisturbed, nature reaches of the streams, while assemblage *B* sprang from an artificial stream ("Meleg-víz"; Uherkovich & Nógrádi, 1999). "Meleg-víz" carries the warm karstic water of a bauxite mine. Thus, in February, its temperature does not fall below 17°C even approximately 15 km away from the pumping station (Uherkovich & Nógrádi, 1999). Rivers were represented by assemblages *D*, *E* and *F*. Assemblages *D* and *F* came from the River Danube, while assemblage *E* from the River Tisza. Danube, as other large rivers in Europe, is heavily affected by domestic and industrial sewage, therefore its water quality can be classified as 2-3 (betamesosaprobic to alpha-mesosaprobic, Chantaramongkol, 1983).

The identification of *Hydropsyche* females is currently not possible to species level (Malicky, 1983), so they are used as a new „species" in the analysis. Consequently, species richness could be increased (*S*+1) comparing with one in the published data.

The rarefaction solution

The number of species shows increasing function as the number of collected individuals growth. To solve this phenomenon, rarefaction intends to evaluate the number of species of a theoretical assemblage defined by its number of individuals. Consequently, assemblages differing in number of individuals can be compared in a way, as if their number of individuals were the same. The rarefaction could be calculated on the basis of a probably calculation or randomisation. The expected number of species of a theoretical community could be evaluated on the basis of the theoretical number of individuals and on the basis of the relative abundance vectors of the realistic community (Hulbert, 1971; Tóthmérész, 1995):

$$ES(m) = ST - \sum_{i=1}^{ST}(1-p_i)^m$$

where *ES* is the expected number of species at *m* theoretical number of individuals, while p_i is the relative abundance of the *i*-th species in the realistic community characterised by *ST* species.

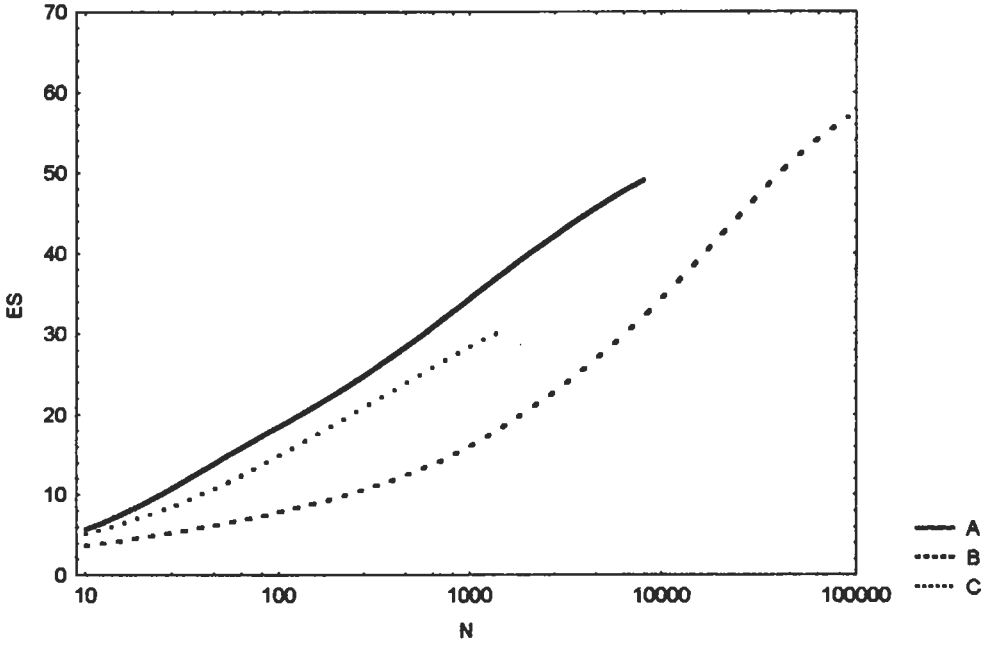

Figure 1. The comparison of species richness of stream assemblages (A, B and C) using rarefaction

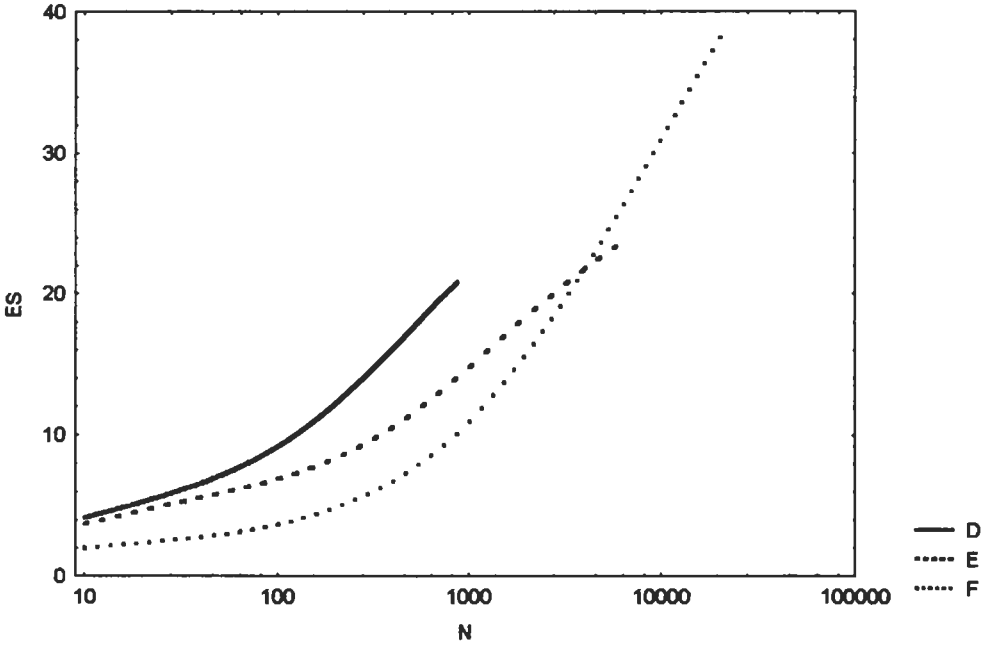

Figure 2. The comparison of species richness of river assemblages (D, E and F) using rarefaction

Table 2. Species richness and number of individuals of the studied assemblages

Assemblage	Species richness	Number of individuals
A	53	8065
B	62	90506
C	34	1395
D	26	831
E	27	6164
F	48	22882

At each comparison, *ES* was calculated between m =10 to $min(N_j)$, where N_j represents the number of individuals of j assemblage (Table 1). *ES(m)* was calculated using the DIVORD computer program (Tóthmérész, 1993, 1994).

Unfortunately, such a kind of evaluation of species richness makes it impossible the statistical comparison of different assemblages, as only the expected number of species with the highest probably is given. By comparison of two assemblages using randomisation, the assemblage (x) represented by higher number of individuals was rarefied to the abundance level (number of individuals, a) of the smallest assemblage (y) 1000 times in the following way: a individuals were randomly sampled from the assemblage x (Gotelli & Graves, 1996). In each case, the number of species will also be obtained. Thereby, mean and variance of the expected number of species of assemblage x could be obtained at the abundance level of the assemblage y. The difference between the two values could be calculated on the basis of the normal distribution (Gotelli & Entsminger, 2001). Randomisation and the mean and variance of the expected number of species were calculated using the ECOSIM computer program (Gotelli & Entsminger, 2001). The differences between the two values were calculated on the basis of the probably distribution calculator of STATISTICA computer program (StatSoft 2000).

RESULTS

Species richness of stream dwelling caddisfly assemblages

Among the stream assemblages, the species richness of assemblage *B* is the highest followed by *A* and *C* (Table 2). Based on the measurement of species richness, the assemblage of an artificial stream represents a high conservation status, while the nature ones do not. Stream dwelling caddisfly assemblages showed the following rank of species richness obtained on the basis of rarefaction measured through probably: assemblage *A* had the highest estimated species richness followed by *C* and *B* (Fig. 1). Using rarefaction with randomisation, significant difference was found in stream assemblages between species richness of assemblage *A* and assemblage *B* and between assemblage *B* and *C*, respectively (Table 3). No significant difference was found between the species richness of assemblage *A* and *C* (Table 3).

Species richness of river dwelling caddisfly assemblages

Comparing species richness of assemblages came of the rivers, assemblage *F* is the most valuable one followed by *E* and *D*, respectively (Table 2). However, caddisfly assemblages coming from the rivers show the following rank after rare-

*Table 3. Expected number of species of stream assemblages (observed value is given as mean ± variance, NS denote non significant difference, *** means highly significant (p<0.001) difference)*

Assemblage	Rarefied to the abundance level of assemblage *A*		Rarefied to the abundance level of assemblage *C*	
	observed value	significance	observed value	significance
A	---	---	37.6 ± 5.1	NS
B	32.8 ± 7.8	***	18.4 ± 4.9	***

*Table 4. Expected number of species of river assemblages (observed value is given as mean ± variance, NS denote non-significant difference, *** means highly significant (p<0.001) difference)*

Assemblage	Rarefied to the abundance level of assemblage *D*		Rarefied to the abundance level of assemblage *E*	
	observed value	significance	observed value	significance
E	14.3 ± 3.4	***	---	---
F	9.9 ± 4.1	***	27.5 ± 7.3	NS

faction: assemblage *D* has the highest estimated species richness at all *m* values followed by *E* and *F* (Fig. 2). The curve of *E* and *F* cross each other, therefore the rank of the estimated species richness depends upon the abundance level (number of individuals), at which the comparison would made. In river assemblages (Table 4), significant difference was found between assemblages *D* and *E* and between *D* and *F*. No significant difference was found between assemblages *E* and *F*.

DISCUSSION

Species richness is the simplest way to describe community or regional diversity (Magurran, 1988). Species richness shows sensitivity to human activity (Kitahara & Fujii, 1994; Kitahara & Sei, 2001), therefore, it can be used as a measure of conservation value.

The comparison of species richness in stream assemblages showed the *B*>*A*>*C* rank, while on the basis of rarefaction using probably calculations *A*>*C*>*B*. However, rarefaction based on randomisations could not confirm the obtained rank as no significant difference was found between the species richness of assemblage *A* and *C*. By comparing assemblages representing rivers, species richness indicated the reversed order than on the basis of rarefaction (*F*>*E*>*D* vs. *D*>*E*~*F*). Consequently, if conservation value would be measured through the number of species or number of expected species, different solutions could be obtained. For instance, even though species richness indicated the highest conservation value of an assemblage coming from an artificial stream, rarefaction rejected this assumption indicating another rank of conservation value.

Obviously, the differences between the two approaches (species richness and rarefaction solutions) came chiefly from the differences in number of individuals (sampling effort, Table 2) and from the distribution of individuals among species (abundance). For instance, while assemblage *B* was represented by 90,506 individuals, assemblage *C* by only 1,395. While at a small assemblage size, the presence of a rare species was small, in a big one it was higher. Therefore, a

specific species–individual curve could be obtained: number of species grows as the number of collected species increases (Magurran, 1988). The concept of rarefaction was efficiently used in comparison of species richness of stream macroinvertebrates (McCabe & Gotelli, 2000) or in comparison of number of passerine bird species at different territorial pairs (Gjerde & Saetersdal, 1997). In addition, Gjerde & Saetersdal (1997) noted that diversity indices, like Shannon (H') or Simpson's index (D), could not always be used in comparison of diversity of communities.

In spite of its importance, ecologists do not always consider the effects of abundance and sampling effort on species richness measures and comparisons. Overall, rarefaction solution allows for meaningful standardisation and comparison of datasets (Gotelli & Colwell, 2001). This study demonstrated that using rarefaction in comparison of assemblages with great differences in number of individuals was recommended.

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REFERENCES

ANDRIKOVICS, S. & KISS, O. (2000): Bioindication by macroinvertebrates in the Danube. 3. Investigation on the aquatic insect larvae in the Hungarian Section of Danube. *Hidrol. Közlöny*, 80: 272–274. (In Hungarian.)

ANDRIKOVICS, S., KISS, O., NOSEK, J. & OERTEL, N. (2001): Bioindication by macroinvertebrates in the Danube. 7. Possibility of light-trapping for the study of aquatic macroinvertebrates. *Hidrol. Közlöny*, 81: 314–315. (In Hungarian.)

CHANTARAMONGKOL, P. (1983): Light-trapped caddisflies (Trichoptera) as water quality indicators in large rivers: Results from the Danube at Verőce, Hungary. *Aquatic Insects*, 5: 33–37.

CSÖRGITS, G. (2000): Comparison of long-term changes of invertebrate macrofauna in two streams of the Pilis Mountains, Hungary. *Opusc. Zool. Budapest*, 32: 27–49.

DEWALT, R. E., WEBB, D. W. & HARRIS, M. A. (1999): Summer Ephemeroptera, Plecoptera, and Trichoptera (EPT) species richness and community structure in the Lower Illinois River Basin of Illinois. *The Great Lakes Entomol.*, 32: 115–132.

GJERDE, I. & SAETERSDAL, M. (1997): Effects of avian diversity of introduction spruce Picea spp. plantations in the native pine Pinus sylvestris forests of Western Norway. *Biol. Conservation*, 79: 241–250.

GOTELLI, N. J. & COWELL, R. K. (2001): Qualifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. *Ecol. Letters*, 4: 379–391.

GOTELLI, N. J. & ENTSMINGER, G. L. (2001): EcoSim: Null models software for ecology. Version 7.0. Acquired Intelligence Inc. & Kesey-Bear. http://homepages.together.net/~gentsmin/ecosim.htm.

GOTELLI, N. J. & GRAVES, G. R. (1996): Null models in ecology. *Smithsonian Inst. Press, Washington DC.*

HULBERT, S. H. (1971): The nonconcept of species diversity: a critique and alternative parameters. *Ecology*, 52: 577–585.

IVOL, J.-M., GIUNAND, B., RICHOUX, P. & TACHET, H. (1997): Longitudinal changes in Trichoptera and Coleoptera assemblages and environmental conditions in the Loire River (France). *Arch. Hydrobiol.*, 138: 525–557.

JUHÁSZ-NAGY, P. (1993): The fading diversity. (In Hungarian.) *Sciencia Kiadó, Budapest.*

KISS O., ANDRIKOVICS, S., MURÁNYI, D. & LIPPÓCZY, Á. (2001): The aquatic insect fauna in the Csörgő Stream of the Mátra Mountains (Hungary). (In Hungarian.) *Hidrol. Közlöny*, 81: 392–393.

KITAHARA, N. & FUJII, K. (1994): Biodiversity and community structure of temperate butterfly species within a gradient of human disturbance: an analysis based on the concept of generalist vs. specialist strategies. *Research in Population Ecology*, 36: 187–199.

KITAHARA, N. & SEI, K. (2001): A comparison of diversity and structure of butterfly communities in semi-natural and human-modified grassland habitats at the food of Mt. Fuji, central Japan. *Biodiversity & Conservation*, 10: 331–351.

LOMOND, T. M. & COLBO, M. H. (2000): Variations in lake-outlet Ephemeroptera, Plecoptera, and Trichoptera communities amongst regions of eastern Newfoundland, Canada. *Canad. Journ. Zool.*, 78: 1536–1543.

MAGURA, T. & TÓTHMÉRÉSZ, B. (1996): Comparison of the

carabid communities of a zonal Querceto-Carpinetum and pine plantations. *Proc. "Research, Conservation, Management" Conf. Aggtelek, Hungary*, p. 131–135.

MAGURRAN, A. E. (1988): Ecological diversity and its measurement. *Croom Helm Ltd., London.*

MALICKY, H. (1983): Atlas of European Trichoptera. *Junk, The Hague.*

MCCABE, D. J. & GOTELLI, N. J. (2000): Effects of disturbance frequency, intensity, and area on assemblages of stream macroinvertebrates. *Oecologia*, 124: 270–279.

PADISÁK, J. (1993): The influence of different disturbance frequencies on the species richness, diversity and equitability of phytoplankton in shallow lakes. *Hydrobiologia*, 249: 135–156.

PIANKA, E. R. (1970): On r- and K-selection. *American Naturalist*, 102: 592–597.

RUSE, L. P. & HERRMANN, S. J. (2000): Plecoptera and Trichoptera species distribution related to environmental charactersitics of the metal-polluted Arkansas River, Colorado. *Western N. American Naturalist*, 60: 57–65.

SCHMERA, D. (1999): Change of structural characterstics of caddisflies (Insecta: Trichoptera) along the Bernecei Stream (Börzsöny Mountains, Northern Hungary). (In Hungarian.) *Természetvéd. Közlem.*, 8: 173–183.

SCHMERA, D. (2001): Seasonal activity of caddisflies (Insecta: Trichoptera) in the Börzsöny Mountains, North Hungary. *Opusc. Zool. Budapest*, 33: 83–89.

SOUTHWOOD, T. R. E. (1977): Habitat, the templet for ecological strategies? *Journ. Animal Ecol.*, 46: 337–365.

StatSoft, Inc. (2000): STATISTICA for Windows (Computer program manual). *Tulsa, OK.*

TONE, M. K. & WALLACE, J. B. (1998): Long-term recovery of a mountains stream from clearcut logging: the effects of forest succession on benthic invertebrate community structure. *Freshwater Biology*, 39: 151–169.

TÓTHMÉRÉSZ, B. (1993): DivOrd 1.50: A program for diversity ordering. *Tiscia*, 27: 33–44.

TÓTHMÉRÉSZ, B. (1994): DivOrd 1.60: Diversity ordering: finite and infinite samples. *Tiscia*, 28: 63–65.

TÓTHMÉRÉSZ, B. (1995): Comparison of different methods for diversity ordering. *Journ. Vegetation Science*, 6: 283–290.

UHERKOVICH, Á. & NÓGRÁDI, S. (1999): Caddisflies (Trichoptera) of artificial water courses in the Bakony Mountains, Central Hungary. *Braueria*, 26: 21–23.

VILSON, M. R. & HAWKINS, C. P. (1998): Biodiversity of stream insects: variation at local, basin and regional scale. *Ann. Rev. Entomol.*, 43: 271–293.

WIBERG-LARSEN, P., BRODERSEN, K. P., BRICKHOLM, S., GRON, P. N. & SKRIVER, J. (2000): Species richness and assemblage structure of Trichoptera in Danish streams. *Freshwater Biology*, 43: 633–647.

Opusc. Zool. Budapest, 2002, 34: 85–94

Seasonal changes in Rotifera assemblages of a shallow lake in the Fertő–Hanság National Park, Hungary

K. SCHÖLL*

Abstract. In the framework of hydrobiological studies of an extremely shallow lake, we sampled planktonic Rotifera from five characteristic sites in the lake. Besides the collection of rotifers several abiotic parameters were also recorded at every site on every occasion. We have examined the structure and the seasonal changes of the rotifer assemblages. SYN-TAX 5.1 Multivariate Statistical Program Package also was used to analyse our data. We searched relationships between the parallel measured abiotic parameters and the rotifer community with multivariate analysis. We have found, that the conductivity and the temperature have some effects on the qualitative and quantitative composition of the planktonic rotifer community.

Lake Fehér (Fehér-tó), located in the Hanság region, is a protected wetland habitat of high natural value in the Fertő-Hanság National Park. It is situated in the northwestern part of Hungary (47° 41' N, 17° 21' E) at an altitude of 110 m above sea level, covering 2.69 km², with an average depth of 50 cm. The lake had been intensively used for fish breeding and had been starting to become heavily eutrophic until 1987, when it was placed under legal protection mainly due to its valuable avifauna.

In 1998, the basic hydrobiological survey of the lake was starzted by the Hungarian Danube Research Station of the HAS, including water chemistry, zoological, and botanical investigations (Kiss, 2002). Studying planktonic rotifers, I joined this research project in 1999.

Today, only few researchers work on Rotifera in Hungary, but the previously published literature contains several valuable data. Since the abiotic alterations of shallow (or even temporal) waters are promptly followed by the qualitative and quantitative changes of rotifer assemblages, our results may be applied for the description of similarly unstable standing waters. The aim of our research was to describe the rotifer community of the lake and its seasonal variations by the analysis of rotifer samples and the most significant abiotic parameters at several sites for two years.

MATERIALS AND METHODS

Samples were taken between August 1999 and July 2001 at monthly intervals from 5 (occasionally 7) characteristic sites in the lake, by filtering 20-20 litres of water through a 50 µm-mesh plankton net. The sampling sites represented characteristically different parts of the lake:

No. 102. Border of open water, reed bed and *Typha* bed.

No. 103. Border of open water and reed bed in the northern part of lake.

No. 104. Open water in the middle of lake.

No. 107. Shore end of an artificial channel opening southeast from lake.

No. 304. Thin reed bed in the south-western part of lake.

Samplings always took place in the morning hours. Sampling sites were visited by boat. Two 20-litre samples were collected from the depths of 15–25 cm. One sample was taken to the laboratory; the other was instantly preserved in a 4 % formaldehyde solution. Live specimens were collected to be able to make accurate identification (Varga, 1943).

Live specimens were identified within 4-5 hours (Bancsi, 1986; Koste, 1978). Specimens in

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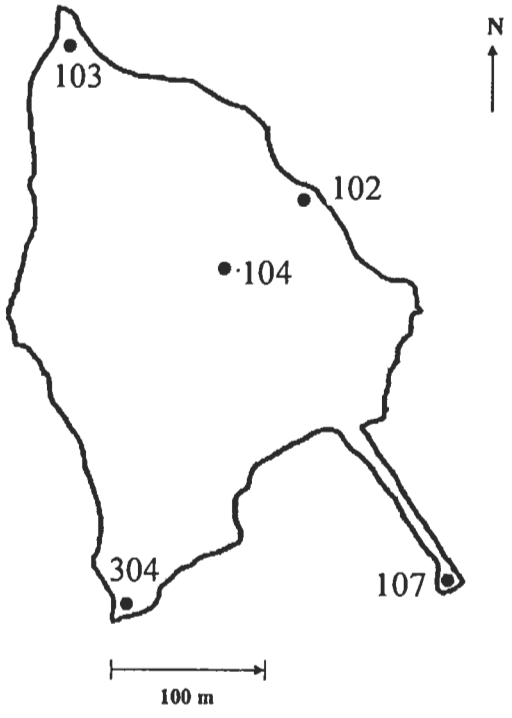

Figure 1. Lake Fehér and the sampling sites

the preserved samples were counted in a Sedgewick-Rafter Chamber, data were expressed as individual per 10 litres and stored in an EXCEL database.

Besides the collections of rotifers, the following abiotic parameters were also recorded with a Multiline-P field device at every site on every occasion: water temperature, pH, conductivity, dissolved oxygen content and oxygen saturation. Air pressure was also measured and weather conditions were noted. Detailed water chemical analyses were carried out on several occasions with a Dionex 120 ion analyser, by Gábor Horváth at the laboratory of the Hungarian Danube Research Station of the HAS. The concentrations of the following ions were examined: F^-, Cl^-, NO_2^-, NO_3^-, PO_4^{2-}, SO_4^{2-}, HCO_3^-, CO_3^{2-} (anions), Li^+, Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+} (kations). Besides these parameters, the amount of suspended solids, total dissolved material, and total dry material were measured, together with alkalinity, hardness, and chemical oxygen demand (analysed by Mónika Gánti, Table 1).

Data analysis

A species list of Rotifera found in Lake Fehér in the study period was compiled, and was compared with literature data from the lake. SYN-TAX 5.1 Multivariate Statistical Program Package was used to analyse our data. Several analyses were run and evaluated with SYN-TAX on the database, to form the final conclusions. However, only few are presented here to demonstrate the processes. Every analysis was run both for objects and variables [Hufnagel, Bakonyi & Vásárhelyi, 1999).

The temporal and spatial comparison of samples was based on both presence-absence and quantitative data. Distance matrix was created using Euclidean Distance. Qualitative data were analysed with and without standard deviation, as well. Ordination was carried out through non-metric multi-dimensional scaling (NMDS). Hierarchic classification was done using unweighted pair group method (UPGMA) within distance optimisation.

Table 1. Hydrochemical parameters in Lake Fehér

Parameters	Sampling dates							
	08.24. 1999	10.25. 1999	02.22. 2000	04.26. 2000	05.30. 2000	06.27. 2000	07.26. 2000	08.28. 2000
Suspended solids (mg/l)	0,012		7,3	1,2	30,0	5,5	4,0	23,0
Total diss. material (mg/l)	0,200			17,0	23,0	31,0	8,0	7,0
Total dry material (mg/l)	0,242							
Alkalinity (W°)	2,61		6,51	7,33	6,7	2,5	1,0	1,3
HCO_3^- (mg/l)	0	300,1	370,9	442,2	408,7	54,9		30,6
CO_3^{2-} (mg/l)	36,78	0	0	0	0	48	24,0	24,1
Total hardness (nk°)	6,94		18,43	20,16	200,1	274,7	57,5	65,4
Ca hardness (nk°)	3,27		10,63	10,2				
Mg hardness (nk°)	3,67		7,80	9,96				
Ca^{2+} content (mg/l)	23,39	44,06	75,94	72,91	87,26	153,1	21,14	29,1
Mg^{2+} content (mg/l)	15,96	24,83	33,90	43,27	33,43	25,9	13,6	10,7
KOI_{sMn} total (mg O_2/l)	19,12		15,81	18,38	15,95	16,6	9,2	5,65
KOI_{sMn} diss (mg O_2/l)	14,28		12,83	15,7	13,95	15,5	8,7	5,13
KOI_{sMn} formed (mg O_2/l)	4,84		2,98	2,68	2	1,12	0,5	0,52
F^- content (mg/l)	0,144	0,191				0,135	0,133	0,145
Cl^- content (mg/l)	15,62	35,52				46,94	38,57	35,75
NO_2^- content (mg/l)		0				0		0
NO_3^- content (mg/l)	0	0		0	0	0	0	0,11
PO_4^{3-} content (mg/l)	0,59	0			0,12	0	0	0
SO_4^{2-} content (mg/l)	11,99	22,50		14	21	51,80	40,88	46,31
Li^+ content (mg/l)	0	0				0	0	0
Na^+ content (mg/l)	21,71	39,10				32,55	42,16	30,20
NH_4^+ content (mg/l)	0	0				0	0	0
K^+ content (mg/l)	1,333	14,79				4,24	2,08	5,18

The measured chemical and physical parameters and the qualitative data of rotifers were also correlated using the ordinations [Hufnagel, Bakonyi & Vásárhelyi, 1999; Podani, 1993, 1997].

RESULTS

Hydrology and water chemistry

Water chemistry measurements were carried out in the field with the assistance of Anita Kiss. Both field and laboratory data reflected the high instability of the chemical state of the lake, originating from its shallowness and the strong fluctuation of the water level.

The direct effects of certain chemical parameters are known only for few species [Dumont, 1977; Hofmann, 1977]. Water chemistry measurements could serve as basic background information on the environment. They also help to determine the ecological tolerance values of a given species, or to make already existing data more accurate.

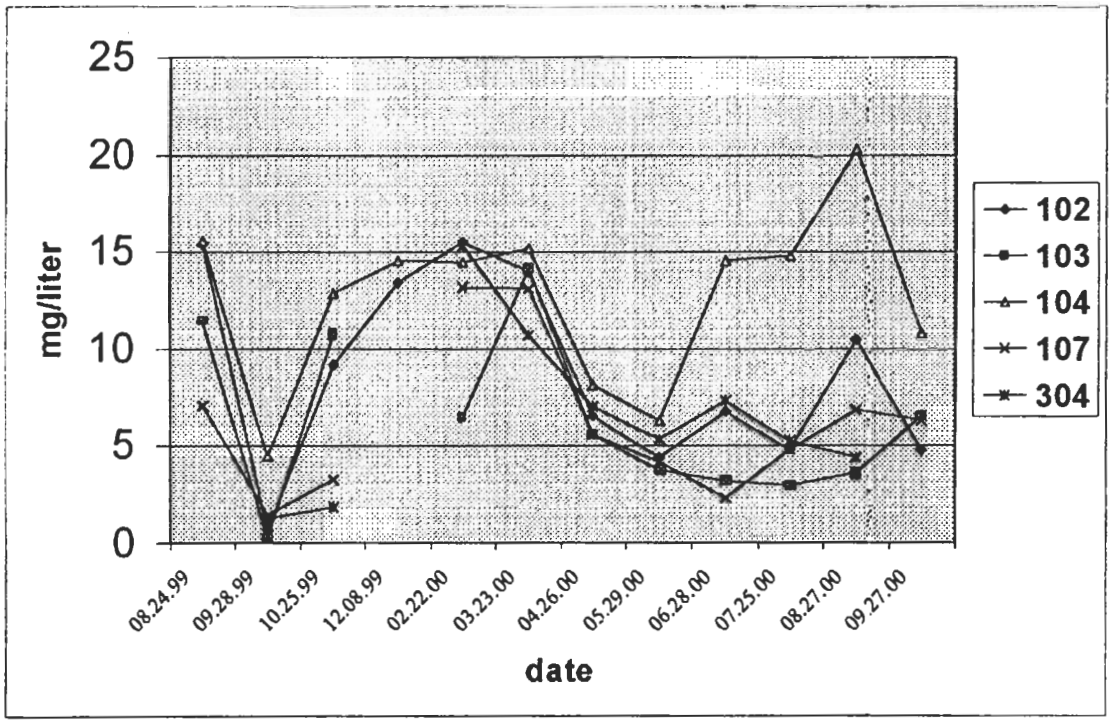

Figure 2. The amount of dissolved oxygen at the sampling sites

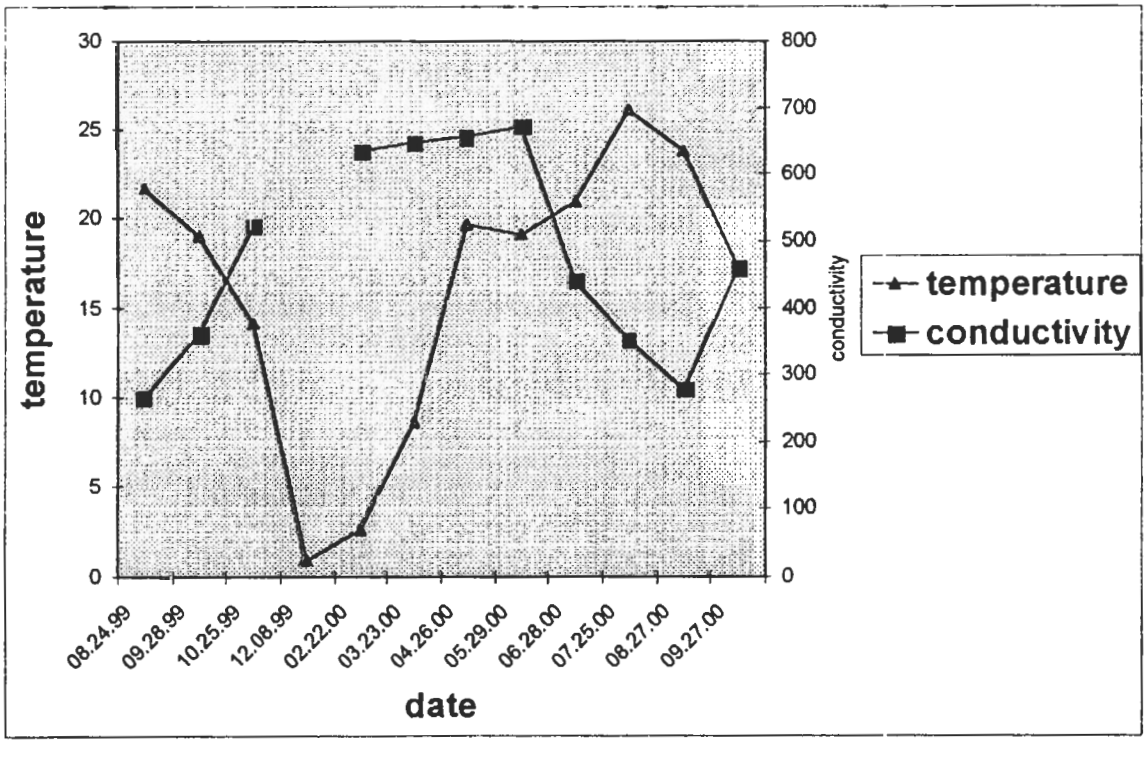

Figure 3. Water temperature and conductivity at the sampling site 104

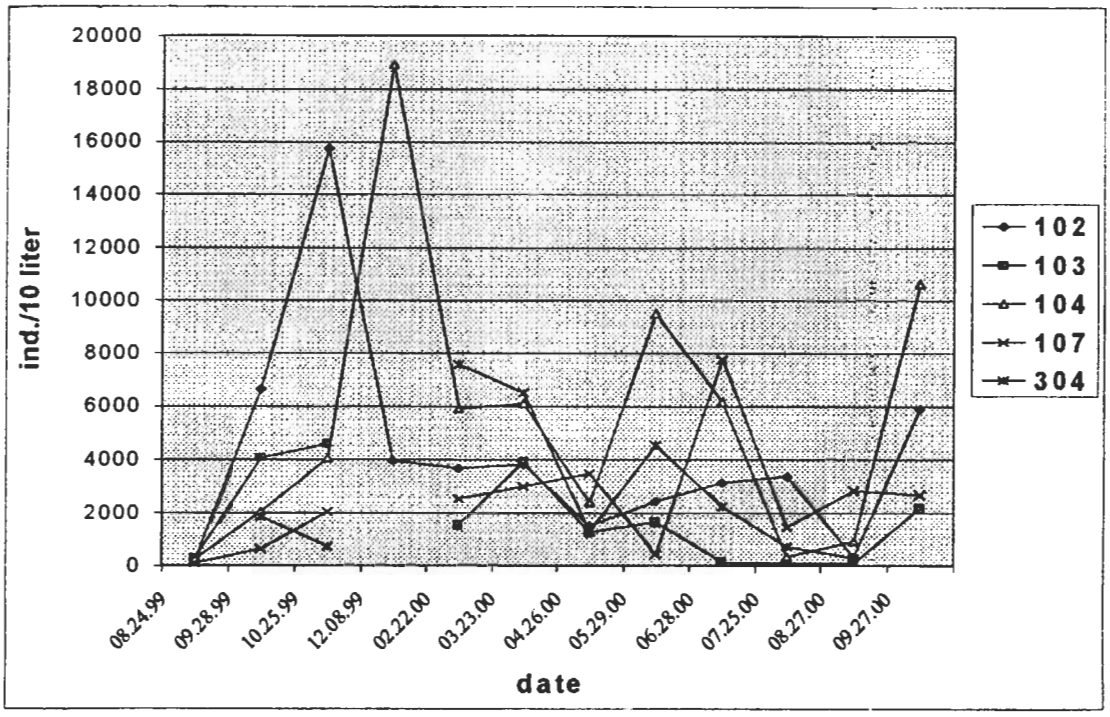

Figure 4. The abundance of rotifers in all sampling sites

The following aberrations had to be taken into consideration when analysing physical/chemical parameters:

1. During summer droughts water was supplied from a small brook (Rábca-Keszeg Brook), which may explain low conductivity values measured in summer.

2. Weather conditions (e.g. the mixing effect of moderate wind) strongly influenced the measured values.

3. In May 2000, buffaloes were introduced to the lake, which stirred and polluted the water, biasing the measured parameters.

From among the parameters measured, even water depth clearly reflected high instability and water volume fluctuations. Water depth changed from 81 to 14 centimetres within four months at sampling site 304. Water temperature also fluctuated in a wide range. Conductivity was lowest in summer (Fig. 3), probably for the reasons mentioned above.

Increasing values in winter were likely caused by the absence of affluent waters (frost), and ions dissolving from the lake bed and mud. Besides continuous spatial differences, the value of pH changed seasonally, as well. It was always higher at site 104 than at sampling sites 107 and 304. This was probably due to the greater production of the open water, as the amount of dissolved oxygen was also the highest here (Fig. 2).

List of Rotifera found in Lake Fehér

The following 35 species of Rotifera were found in the lake during the study period:

Bdelloidea

Fam. Philodinidae

Rotaria citrina Ehrenberg
R. sordida Western

Monogononta

Fam. Asplanchnidae

Asplanchna brightwelli Gosse *
A. girodi de Guerne
A. sieboldi Leydig
Asplanchnopus multicerps Schrank *

Fam. Brachionidae

Brachionus angularis Gosse *
B. budapestiensis Daday
B. calyciflorus Pallas *
B. diversicornis Daday
B. leydigi Cohn *
B. plicatilis O. F. Müller
B. quadridentatus Hermann
Keratella cochlearis Gosse *
K. quadrata O. F. Müller *
Notholca acuminata Ehrenberg
Platyias quadricornis Ehrenberg

Fam. Collurellidae

Lepadella acuminata Ehrenberg *
L. patella O. F. Müller *

Fam. Conochilidae

Conochilus hippocrepis Schrank

Fam. Euchlanidae

Euchlanis dilatata Ehrenberg *

Fam. Lecanidae

Lecane quadridentata Ehrenberg

Fam. Synchaetidae

Polyarthra longiremis Carlin
P. minor Voigt
Synchaeta pectinata Ehrenberg *
S. tremula O. F. Müller *

Fam. Notommatidae

Scaridium longicaudum O. F. Müller *

Fam. Filiniidae

Filinia cornuta Weisse
F. longiseta Ehrenberg
F. terminalis Plate

Fam. Hexarthridae

Hexarthra mira Hudson

Fam. Trichocercidae

Trichocerca intermedia Stenroos
T. pusilla Lauterborn
T. weberi Jennings *

Fam. Trichotriidae

Trichotria pocillum O. F. Müller *

The species marked by asterisks (*) had already been recorded in the surroundings of the lake by Varga [1935].

All but two of the species listed above belong to the class Monogononta. This emerges from the fact that planktonic rotifers were collected, and therefore sessile bdelloids were not or only sporadically sampled (nevertheless, the samples contained several tychoplanktonic species).

Oligotrophic lakes in the temperate zone are characterised by *Keratella cochlearis, Conochilus hippocrepis, Polyarthra longiremis, P. minor, Synchaeta pectinata, S. tremula, Filinia terminalis.* However, when *Euchlanis dilatata, Trichocerca intermedia, T. pusilla, T. weberi* also appear, it indicates eutrophy.

Members of the genera *Brachionus* (*angularis, budapestiensis, calyciflorus, diversicornis, leydigi, plicatilis, quadridentatus*), *Keratella* (*cochlearis, quadrata*) and *Polyarthra* (*longiremis, minor*), and the species *Euchlanis dilatata* clearly indicate extreme shallowness [Bancsi, 1986; Koste, 1978; Varga, 1966].

Conochilus hippocrepis exists both in brackish and saltwater, forming colonies, which are kept together by a round, jelly-like mantle [Bancsi, 1986]. In April 2000, colonies consisting of 20–30 indivuals were found. They fell apart within hours, and the animals shrank because of the formaldehyde, making identification impossible. The same phenomenon could be observed in the case of *Hexarthra mira, Rotaria sordida* and *R. citrina*, therefore we do not have reliable qualitative data for these species.

In late May 2000, buffaloes were introduced to the lake. This fact might correlate with the mass appearance of *Brachionus leydigi* in June, a species that had not been detected from the lake before, and which is described in the literature as characteristic to waters used by cattle [Bancsi, 1986; Koste, 1978]. Nevertheless, the amount of *B. leydigi* decreased and finally disappeared during summer, although buffaloes stayed by the lake. A remarkably high number of rotifer species have been recorded from the lake, which also exist in brackish or saltwater. However, they are not strictly confined to saltwater, only their tolerance is wide towards salinity. Their presence in the lake

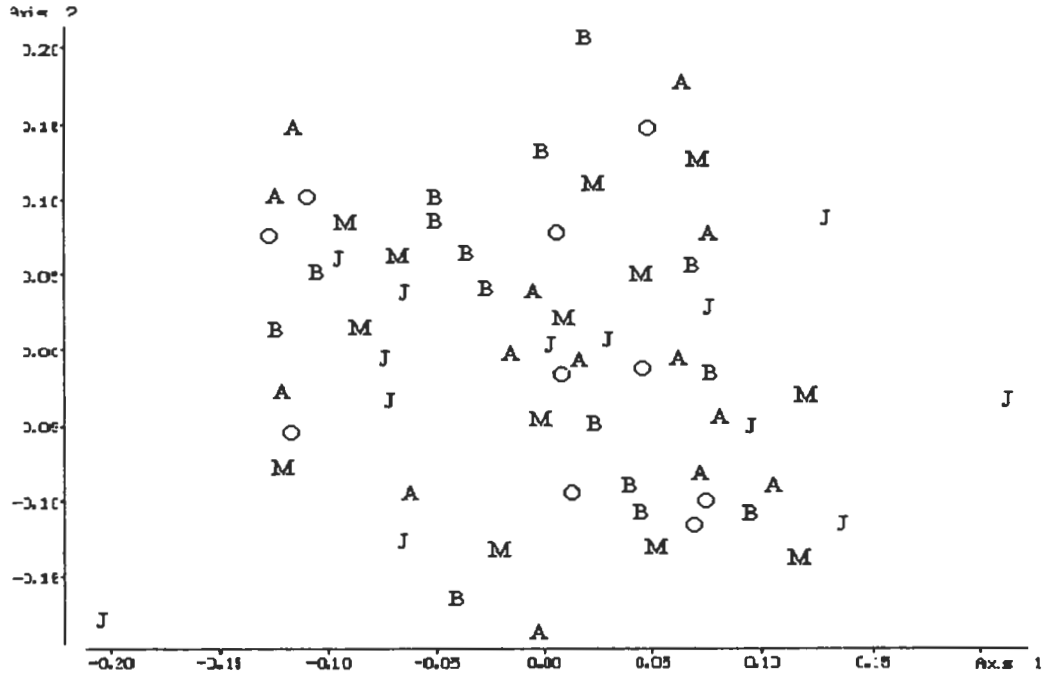

Figure 5. Ordination plot of NMDS analysis. (The different letters denote the samples, which was collected at the same sampling site)

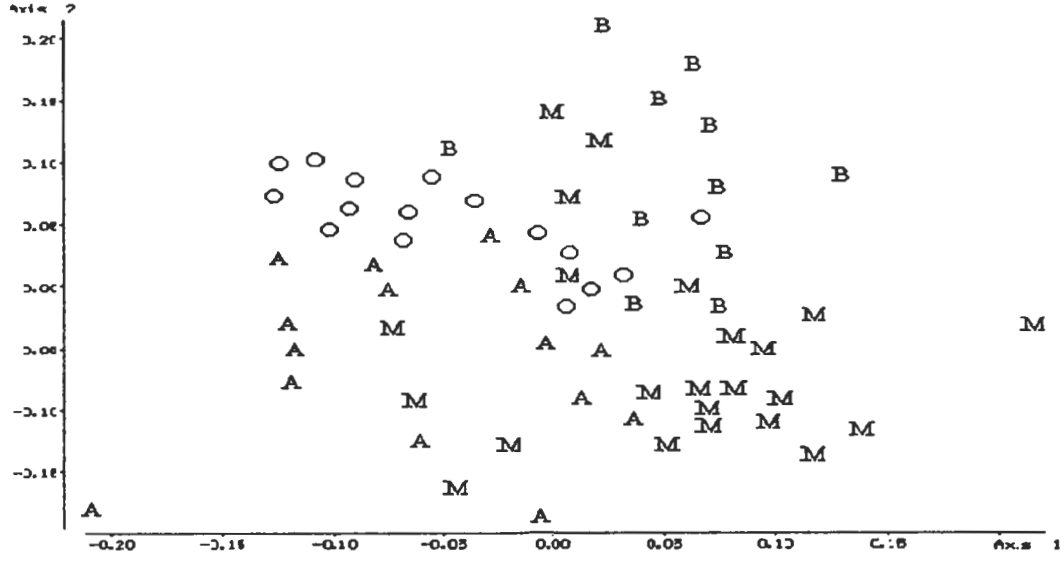

Figure 6. Ordination plot of NMDS analysis. (The different letters denote the samples, which was collected at the same
sampling time)

can be explained by its extreme shallowness and water level fluctuations.

Qualitative data clearly show that both the species number and the abundance of rotifers strongly decreased by the middle or end of summer in 1999 and 2000. In July 2001, however, high abundance of rotifers could be observed. During that summer there was a heavy algal bloom in the lake, and the formerly clear water – „clear state" – dominated by *Najas marina* was replaced by the „turbid state". The abundance of rotifers reached its highest value in late autumn (November, December) and late spring (end of May) in the years examined (Fig. 4).

The abundance of one or occasionally two species was much higher than that of the other component species in each sampling occasion. The dominant species were not the same throughout the year, but four or five taxa played this role in turns. In summary, this pattern clearly reflects the diversity in environmental conditions, which the assemblage dynamics of rotifers flexibly follows.

Based on the dominance and constancy values, Rotifera found in the species list could be put in three characteristic groups:

1. Species with high constancy and dominance: *Keratella cochlearis, Polyarthra longiremis, Brachionus angularis, Filinia terminalis.*

2. Species with high constancy but low dominance: *Brachionus quadridentatus, Lepadella patella.*

3. Species with the lowest constancy but great dominance: *Synchaeta tremula, Brachionus leydigi, Trichocerca weberi.*

The multivariate analysis of both presence/absence and quantitative data, based on both ordination (NMDS) and classification (cluster analysis - UPGMA) methods, showed that the composition of rotifer assemblages depended rather on the date of sampling than the sampling site. The species composition of samples collected at the same date was much more similar to each other than that collected at the same sampling site at different times (Figs. 5, 6).

Among the chemical and physical environmental parameters (temperature, pH, conductivity, oxygen content, oxygen saturation) measured simultaneously with rotifer samplings, temperature and conductivity were found to have strong influence on both the species composition and the quantitative composition of planktonic rotifer assemblages in Lake Fehér. On the other hand, multivariate methods failed to show explicit relationship between the assemblage structure of rotifers and the other abiotic factors (Figs. 7, 8).

CONCLUSIONS

Extreme shallowness and fluctuating water volume cause high chemical variability in Lake Fehér. Rapid changes in the species composition and the quantitative composition of planktonic rotifer assemblages reflect these changes well. The majority of the thirty-five detected species are cosmopolitan, well adapted to such unstable habitats with their wide ecological tolerance. In spite of this, the species composition changed cyclically. Among the species detected in the lake, fifteen had been formerly found in its vicinity by Varga (1933, 1935).

Exploring the relationships between samples by multivariate methods, it turned out that species composition – in case of planktonic samples – depended mainly on the sampling date, i.e. on environmental parameters changing cyclically throughout the year. The place of sampling is not a determining factor in this respect (Figs. 5, 6). Among the physico-chemical parameters measured directly at the sampling site (temperature, pH, conductivity, oxygen content, oxygen saturation), temperature and conductivity proved to be the most important factors to determine the assemblage dynamics of Rotifera (Figs. 7, 8).

Acknowledgements. This survey was supported by the KVM-MTA/F-H Program and the Danubius Project of the Hungarian Academy of Sciences.

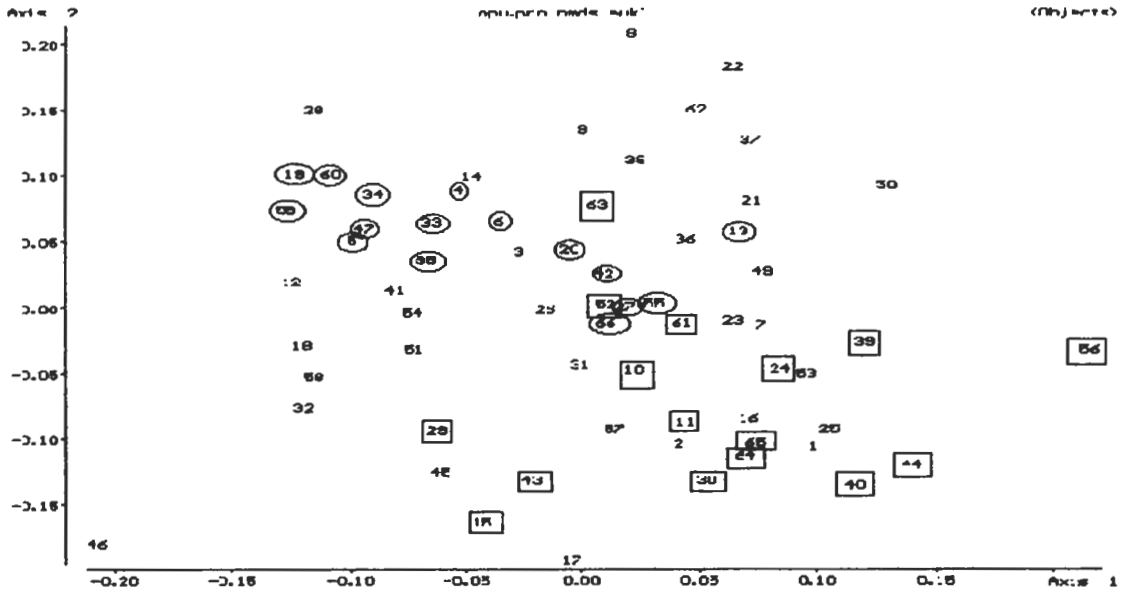

Figure 7. Ordination plot of NMDS analysis. (The different objects denote the samples, wich was sampled by under 10°C and over 20°C water temperature)

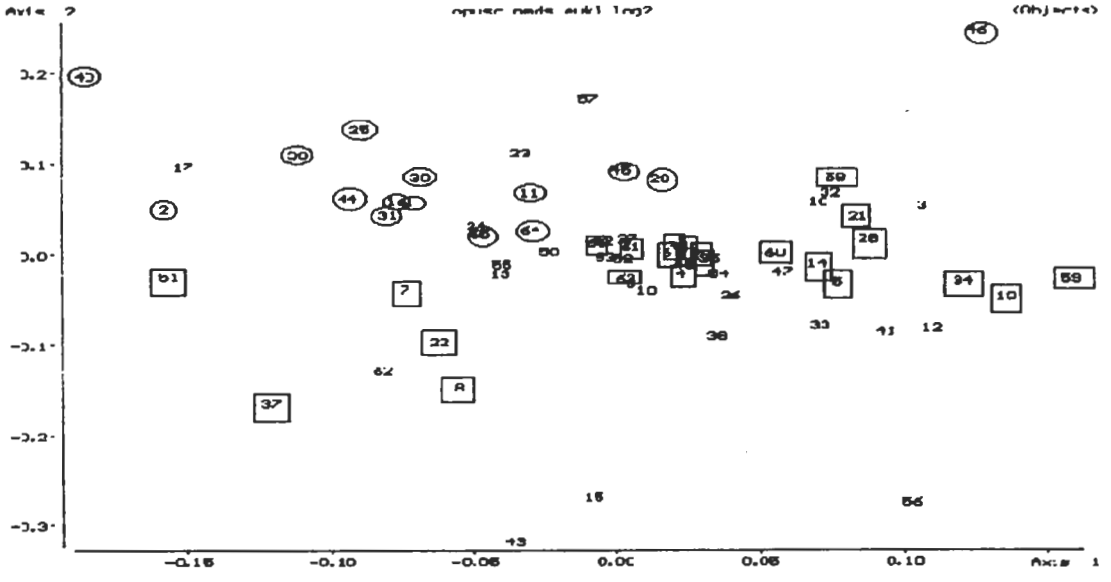

Figure 8. Ordination plot of NMDS analysis. (The different objects denote the samples, wich was sampled by under 450 µS/cm and over 600µS/cm conductivity)

REFERENCES

BANCSI, I. (1986): A kerekesférgek kishatározója, I-II. *Vízgazdálkodási Intézet, Budapest*, pp. 577.

DUDICH, E. (1965): Contribution to the literature of Lajos Varga (1890-1963). *Opusc. Zool. Budapest*, 5: 183–192.

DUMONT, H. J. (1977): Biotic factors in population dinamics of rotifers. *Arch. Hydrobiol. Beiheft*, 8: 98–122.

HOFMANN, W. (1977): The influence of abiotic environmental factors on population dinamics in planktonic rotifers. *Arch. Hydrobiol. Beiheft*, 8: 77–83.

HUFNAGEL, L., BAKONYI, G. & VÁSÁRHELYI, T. (1999): New approach for habitat characterization based on species list of aquatic and semiaquatic bugs. *Env. Mon. Asses.*, 58: 305–316.

KISS, A. (2002): The Cladocera, Ostracoda and Copepoda fauna of the Fehér-tó (Fertő–Hanság National Park). *In: Mahunka, S. (ed.): The fauna of the Fertő–Hanság National Park.* (In press.)

KOSTE, W. (1978): Die Rädertiere Mitteleuropas. *Gebr. Borntraeger, Berlin*, pp. 673.

PODANI, J. (1993): SYN-TAX version 5.0 Users Guide. *Scientia, Budapest*, pp. 104.

PODANI, J. (1997): Bevezetés a többváltozós biológiai adatfeltárás rejtelmeibe. *Scientia, Budapest*, pp. 412.

VARGA, L. (1935): A Hanság limnológiai viszonyai, különös tekintettel kerekesféreg faunájára. *Állatt. Közlem.*, 32: 101–118.

VARGA, L. (1943): A kerekesférgek gyűjtése és konzerválása. *Fragm. Faun. Hung.*, 3: 113–128.

VARGA, L. (1966): Kerekesférgek, I. *In: Magyarország állatvilága. Budapest*, pp. 144.

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Structure and seasonal dynamics of Orthoptera assemblages living in a fragmented habitat in North Hungary

G. SZÖVÉNYI*

Abstract. Seasonal dynamics and community structure of Orthoptera assemblages were studied in 2000 by a non-destructive sampling method in a chain of steppe meadow-covered nearby forest clearings. The similarity and temporal changes of the local assemblages were analysed by multivariate statistical methods. The phenological characters of species occurring in the assemblages and the significant phenological differences between sexes of two dominant species were also demonstrated.

The Orthoptera fauna of Hungary is fairly well known, especially that of national parks and other protected areas (e.g. Nagy & Nagy, 2000; Nagy & Rácz, 1996; Nagy, Rácz & Varga, 1999; Nagy & Szövényi, 1997, 2001; Szövényi & Nagy, 1999 a). The structure (e.g. Nagy, 1949/50; Nagy, Šušlik & Krištin 1998; Nagy & Szövényi, 1998; Szőnyi & Kincsek, 1986) and especially the seasonal dynamics of the orthopteran assemblages (e.g. Szövényi & Nagy, 1999 b) are, however, much less investigated.

The aim of this study was to describe and analyse the structure, seasonal dynamics and phenological characteristics of an orthopteran meta-assemblage existing as a group of local assemblages interconnected by migration of individuals (Szövényi, 2001).

MATERIAL AND METHODS

The field investigations were carried out in 2000, on a hilly woodland area of the Buda Hills Landscape Conservation Area near Budapest (northern Hungary, 47° 33' N, 18° 54' E, ca. 480 metres above sea-level). There was a group of six nearby clearings selected having steppe-meadow vegetation (see details on Fig. 1 and Table 1) surrounded by an oak forest matrix with other more remote clearings. For sampling the local Orthoptera assemblages, a non-destructive sampling procedure, the mark-recapture method was applied by group marking the adult orthopterans. The sampling efforts were similar in all clearings (collecting specimens by net sweeping during ca. 1/2 to 3 hours on a clearing depending on its area). In Hungary, the main time for most orthopterans is summer and the first half of autumn. The sampling regime covered this period. Following the first marking on 19-20th of June, marks and recaptures were made every two weeks (altogether 8 sampling periods) until the end of September (27th Sept.) by which time the size of Orthoptera populations already strongly decreased. Individual insects captured at any time got a new, time- and clearing-specific mark and were released. The marks were coloured paint marker dots on the pronotum.

To classify the local assemblages and demonstrate phenological changes of the meta-assemblage, multivariate statistical analyses such as cluster analysis (CA) and non-metric multidimensional scaling (NMDS) were applied. To show significant correlation the Spearman rank-order correlation analysis was applied. For the statistical analyses Statistica 5.0 (StatSoft Inc., 1994) and SYN-TAX 2000 (Podani, 1997) programs were used.

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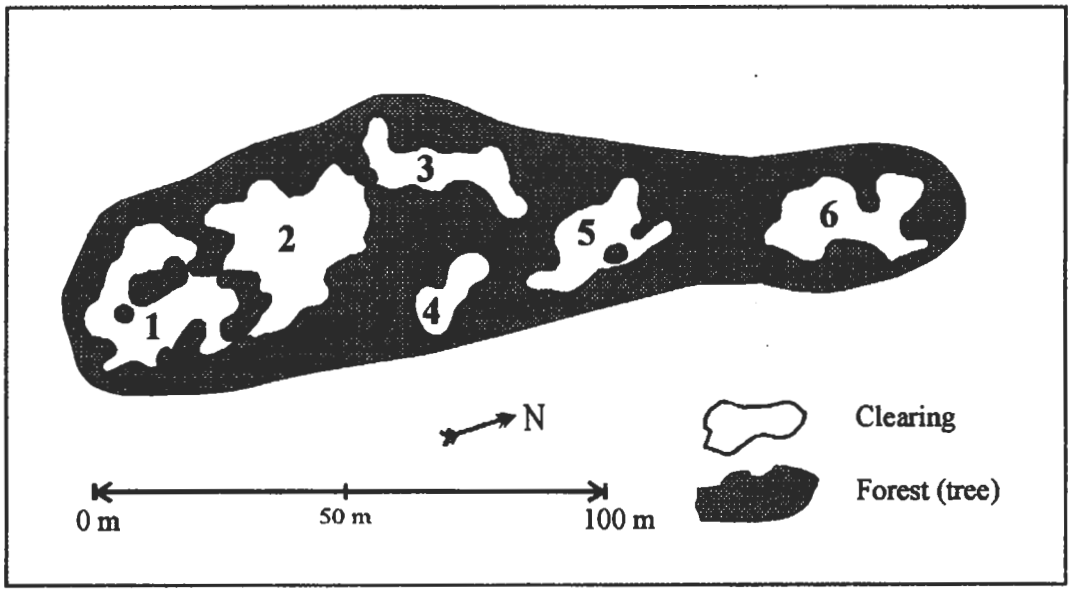

Figure 1. The ground plan of investigated clearings. Clearings 1-2-3 are interconnected by corridors, however, clearings 4, 5 and 6 are isolated by forest each others

Table 1. *Specifications of the investigated clearings*

Clearing No.	Area (m^2)	Exposition and degree of slope	Vegetation
1	510	S-SE, ca. 5-10°	Meso-xeric steppe grassland dominated by *Festuca* and *Arrhenatherum*
2	670	S-SE, ca. 5°	Rocky meso-xeric steppe grassland dominated by *Festuca* and *Arrhenatherum*
3	280	E-SE, ca. 3-5°	Xero-mesic steppe grassland dominated by *Arrhenatherum*
4	140	E-SE, ca. 5°	Small, shady clearing dominated by *Arrhenatherum* and *Melica*
5	320	E, ca. 5°	Rocky xero-mesic steppe grassland dominated by *Arrhenatherum* and *Festuca*
6	400	NE, ca. 5-8°	Xero-mesic steppe grassland dominated by *Arrhenatherum*, *Agropyron pallens* and *Festuca*

Table 2. List of Orthoptera species occurring on the clearings investigated in order of their total dominance in the assemblage, percentage dominance values and presence (+) in local assemblages of clearings. Thick lines separate three types, such as dominant, constant and rare species of assemblage (downwards from top). Dom. means dominance

Species	Total dom. (%)	Occurrence on clearing No.					
		1	2	3	4	5	6
Euthystira brachyptera (Ocskay, 1836)	48.9	+	+	+	+	+	+
Stenobothrus lineatus (Panzer, 1796)	22.7	+	+	+	+	+	+
Gomphocerus rufus (Linnaeus, 1758)	6.3	+	+	+	+	+	+
Pholidoptera griseoaptera (De Geer, 1773)	5.5	+	+	+	+	+	+
Chorthippus apricarius (Linnaeus, 1758)	3.5	+	+	+	+	+	+
Metrioptera bicolor (Philippi, 1830)	3.3	+	+	+		+	+
Chorthippus parallelus (Zetterstedt, 1821)	3.0	+	+	+	+	+	+
Pholidoptera fallax (Fischer, 1853)	2.6	+	+	+	+	+	+
Chorthippus brunneus (Thunberg, 1815)	1.3	+	+	+		+	+
Leptophyes albovittata (Koller, 1873)	1.1	+	+	+		+	+
Isophya kraussii (Brunner, 1878)	0.6	+	+	+	+	+	+
Chorthippus mollis (Charpentier, 1825)	0.2	+	+	+			
Chrysochraon dispar (Germar, 1834)	0.2		+	+	+		+
Platycleis albopunctata grisea (Fabricius, 1781)	0.2		+	+		+	+
Pholidoptera aptera (Fabricius, 1781)	0.2			+	+	+	+
Calliptamus italicus (Linnaeus, 1758)	0.1			+		+	+
Tetrix bipunctata (Linnaeus, 1758)	0.1						+
Euchorthippus pulvinatus (Fischer-Waldheim, 1846)	0.1		+				+
Pachytrachis gracilis (Brunner, 1861)	0.03						+
Ephippiger ephippiger (Fiebig, 1784)	0.03		+				
Stenobothrus nigromaculatus (Herrich-Schäffer, 1840)	0.03					+	
Omocestus haemorrhoidalis (Charpentier, 1825)	0.03					+	
Myrmeleotettix maculatus (Thunberg, 1815)	0.03	+					
Species richness:	**23**	**13**	**16**	**16**	**10**	**15**	**18**

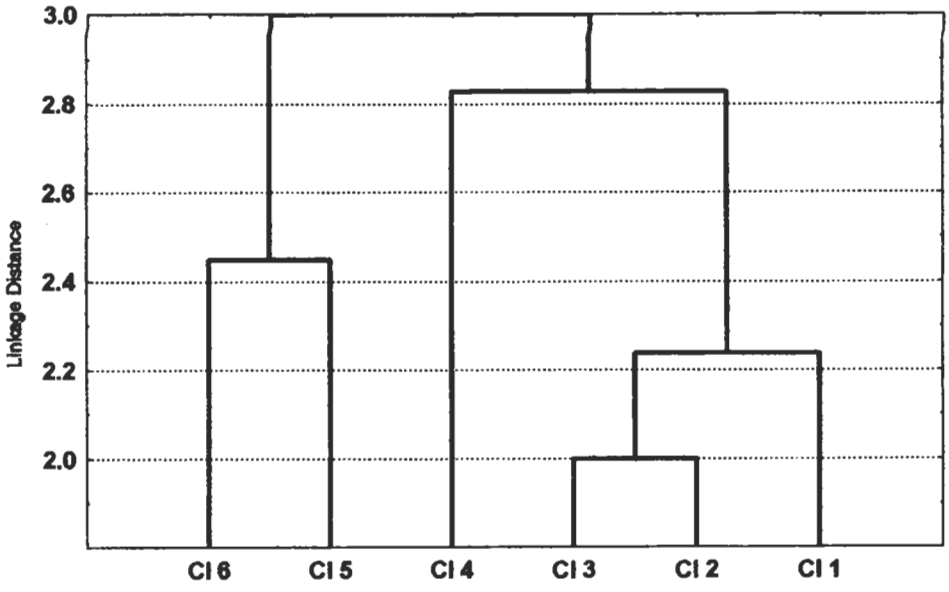

Figure 2. Result of cluster analysis of local Orthoptera assemblages of clearing No. 1-6 based on species composition

RESULTS

During three months altogether 23 Orthoptera species (3054 adult specimens of 9 Tettigonioidea, 13 Acridoidea and 1 Tetrigoidea species) were captured on one or more clearings showing varying dominance (Table 2). According to the type of habitat, most species are xero- and mesophilous grassland inhabitants (e.g. the dominant *Euthystira brachyptera* and *Stenobothrus lineatus*). However, *Chrysochraon dispar* which was represented only by a very low population size (0.2 % of total dominance) is known to be a hygrophilous species. Several others (e.g. *Pholidoptera griseoaptera, Ph. aptera, Gomphocerus rufus*) are typical forest and forest edge inhabitants. Categories of dominance were established on the basis of greater changes between neighbouring dominance values of dominance ranks (Table 2). For instance, the change from dominant to constant was 22.7/6.3 = 3.6 and from constant to rare 0.6/0.2 = 3. In addition to dominant species that occurred on all habitats patches sampled, constant ones were absent at most but one. However, rare species with very low population size (or as one specimen) were present only on few clearings.

The cluster analysis of the local assemblages (using Euclidean distance and complete linkage methods) separated three groups of local assemblages of clearings (Fig. 2). The first contains clearings 1, 2, 3 and the second contains clearings 5 and 6. Clearing No. 4 is separated from the rest at a relative high level.

The NMDS ordination of the whole assemblage (based on dominance data, using Euclidean distance) sampled at different points of time during the season throw light to a general trend of change in the structure of the assemblage from sampling period 1 to 8 along the axis 1 (Fig. 3).

The size and species number changes of local assemblages, as well as the entire assemblage through the sampling season are shown on Figs. 4 and 5. The size of assemblage and the number of species on clearing No. 4 differ from those of other clearings. Clearings No. 1, 2, 3, 5 and 6 are similar

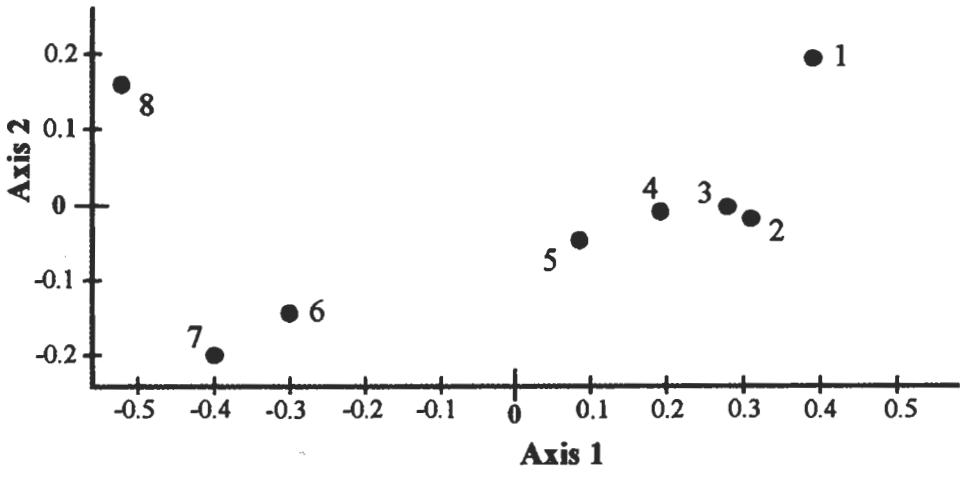

Figure 8. NMDS ordination of samples of the whole assemblage collected at different time periods. Numbers 1-8 mean the serial number of two weeks sampling periods from 19-20th of June (1) to 27th of September (8)

to the whole assemblage (on figures "total") showing an increasing and following a peak, a decreasing phase in time in both cases. On the contrary, the local assemblage of clearing No. 4 demonstrates only a fluctuating phase between weak increasing and decreasing phases.

The phenological patterns of assemblages investigated are shown in Fig. 6. Species represented in samples by more than 5 specimens could be characterised by the time of appearance and fading out and by a "peak" population size in the season. In case of two dominant species, a phenological asynchrony between males and females could be demonstrated (Fig. 7). Rank-order correlation in both species showed a significant decrease of male/female ratios through the sampling season (*E. brachyptera*: Rs = –0.93, p = 0.0009; *St. lineatus*: Rs = –0.97, p = 0.00003).

DISCUSSION

The species richness detected on the study area is high; about 20 % of all orthopterans known in Hungary. One of the reasons of high species richness of the Orthoptera assemblage on such a small area (ca. 2300 m² total area of clearings investigated) could be the relatively high diversity of habitats and microhabitats (see in Table 1). The xerophilous *Chorthippus mollis* occurred only on the south-faced sunny clearings No. 1, 2 and 3, while the north-faced No. 6 clearing and also the shady edges of others (No. 2, 3, 4) were suitable for the hygrophilous *Chrysochraon dispar*, too. Another reason could be the possible connection with more remote clearings through migration. Species appearing as wandering specimens without resident populations on investigated clearings (e.g. *Myrmeleotettix maculatus, Omocestus haemorrhoidalis, Stenobothrus nigromaculatus*) belong to the group of "rare" species (Table 2).

The results of cluster analysis (Fig. 2) show a topology- and habitat type-based distinction of assemblages; the latter being known in orthpterans (e.g. Kemp et al., 1990). The most closely related local assemblages belong to clearings No. 1, 2, and 3 (first group) which have similar type of vegetation and - it could be more important - are physically interconnected by grassland-covered corridors (Fig. 1). Members of local assemblages can easily transmigrate between the neighbour-

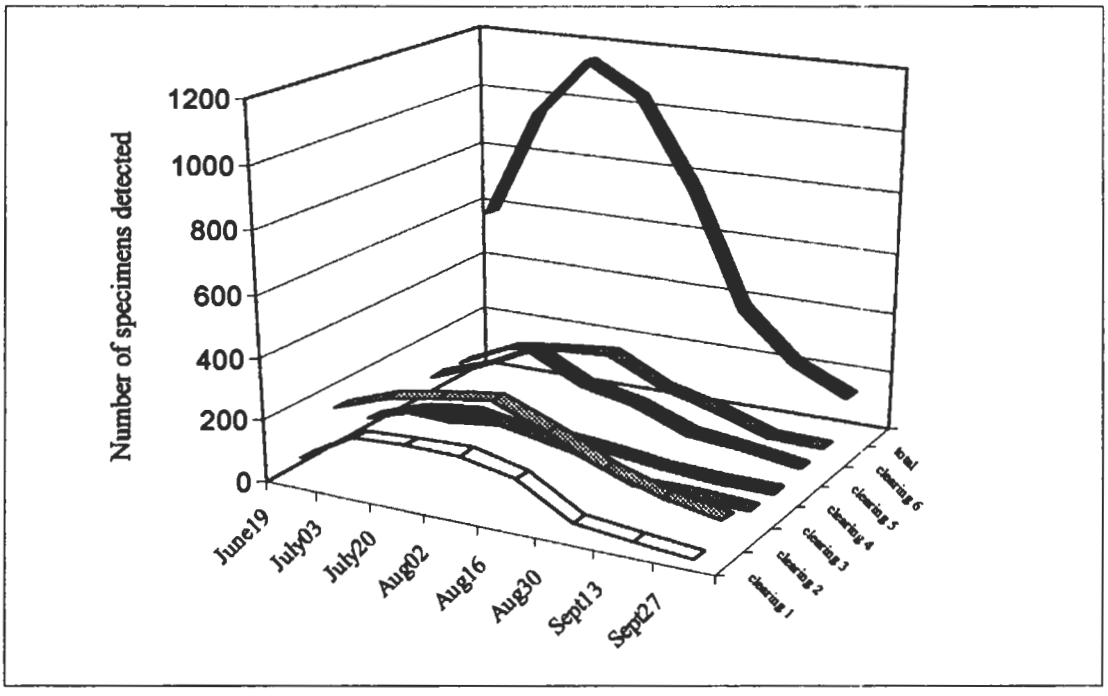

Figure 4. The number and sum of individuals collected on clearings at different sampling dates

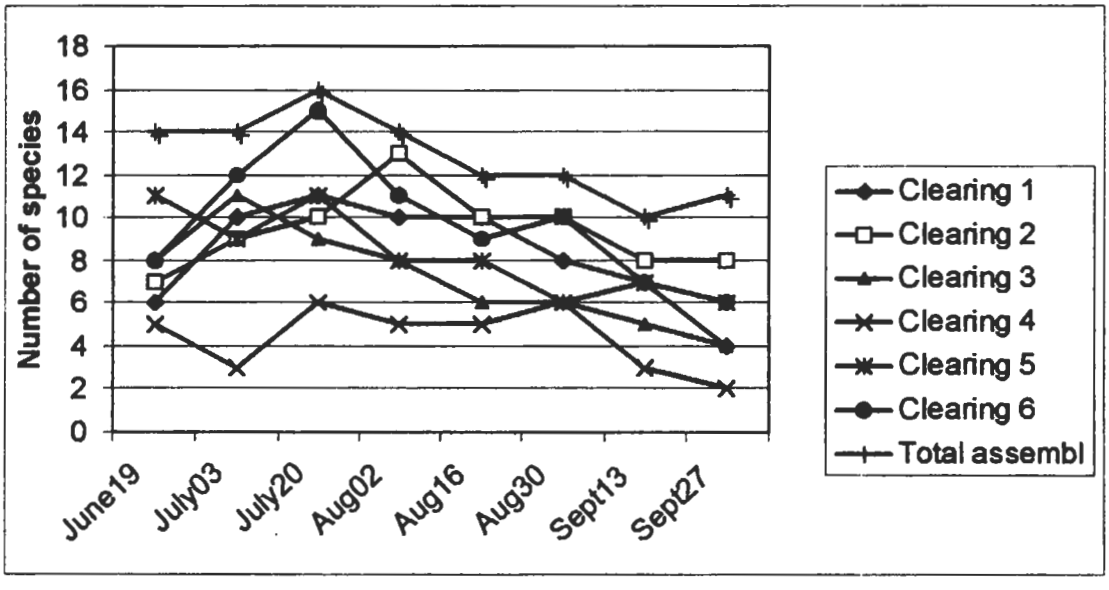

Figure 5. The number and sum of species found on clearings on sampling dates

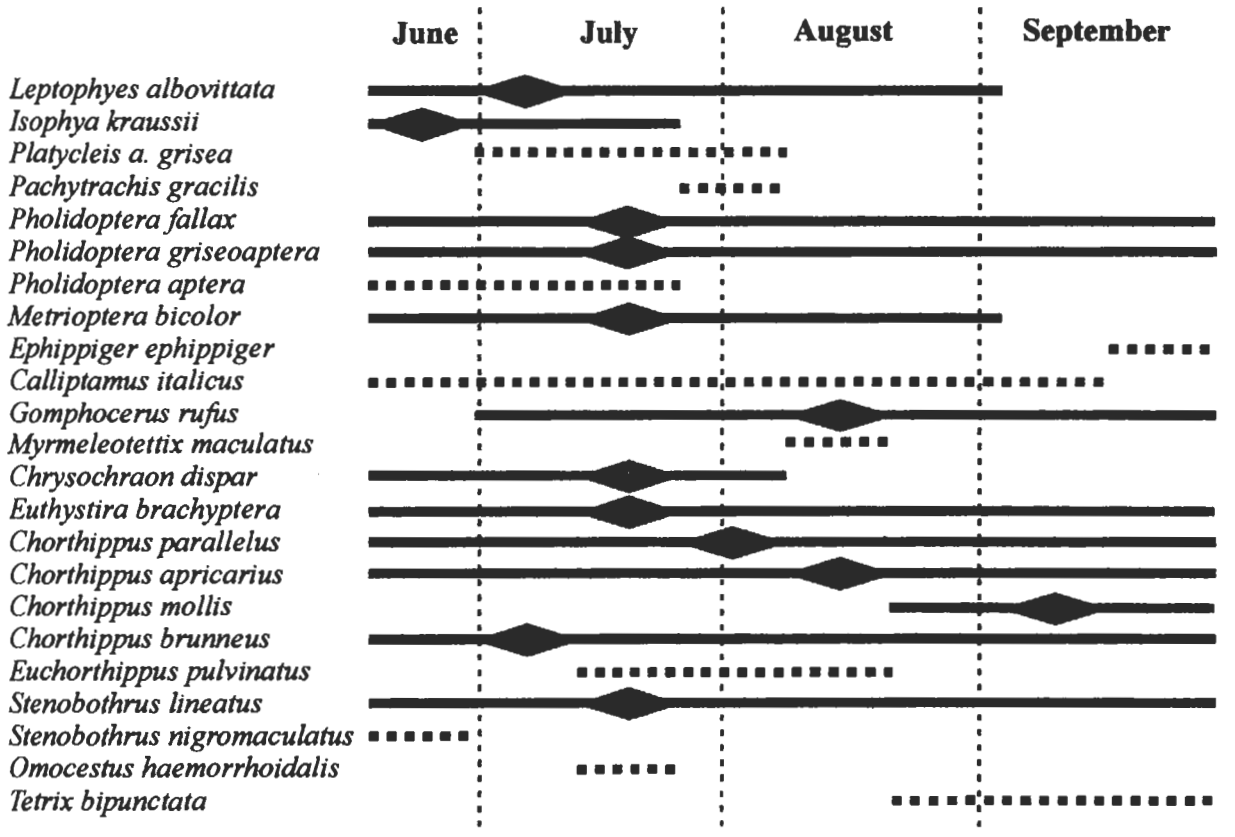

Figure 6. Phenological characteristics of species occurring in the assemblage based on the number of specimens detected. Black line denotes the occurrence of the adult population, dotted lines denote the scattered occurrence of 1-5 adults of species. The thickenings of black lines mark the period when species occurred at their highest abundances during the sampling season

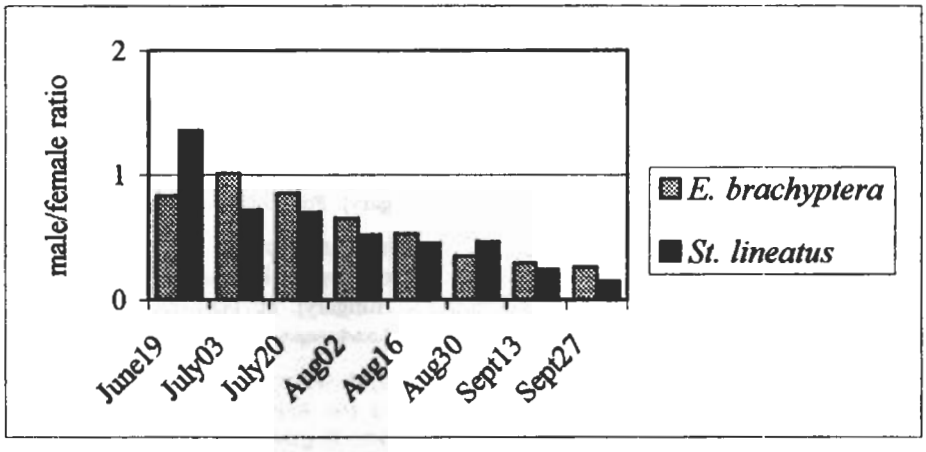

Figure 7. Change of sex ratio (number of males/number of females) of two dominant species of the assemblage studied from middle June to the end of September, 2000

ing and similar habitat patches by these corridors (Szövényi, 2001) that results in very similar assemblages. Local assemblages of clearings No. 5 and 6 are not similar, therefore, they form another group. Although these clearings have similar vegetation, they are isolated by forest from each other. The separation of no. 4 clearing's assemblage can be explained primarily by its extremely small size, which produces a microclimate and, by this way a vegetation different from others (see Table 1). In addition, because of small size, it can support only very small or transient populations. This effect results in a low species richness (Fig. 5) and a small number of specimens (Fig. 4) of this local assemblage.

Most Central European species of Orthoptera overwinter as egg, hatch in late spring, become adults in summer and die in autumn (except e.g. the family Tetrigidae; Ingrisch & Köhler, 1998). The number of adults of these species increases at the beginning of summer and then decreases in late summer and in autumn. Within this type of life cycle there are characteristic phenological differences between species (Fig. 6). The first one at about the end of spring among the early species is *Isophya kraussii* in the assemblage studied. Its population was already in a decreasing phase when I started samplings and disappeared in July. Other early species (e.g. *Leptophyes albovittata*, *Chorthippus brunneus*) survived until September. Most species reached the highest population size in July, while some typical late species peaked in August (*Gomphocerus rufus*, *Chorthippus apricarius*) or in September (*Chorthippus mollis*). The appearance of one or few wandering specimens of rare species seems to be independent of its phenological characters.

The result of NMDA (Fig. 3) also correctly demonstrates these seasonal changes. The distinct jump from stage 5 to 6 is parallel with the strongest decrease in the number of specimens shown on the cumulative curve of assemblage in the same period (curve "total" on Fig. 4).

The marked phenological difference between adult males and females is known for some Central European orthopteran species (Janssen & Reich, 1998; Wagner, 2000). Our study detected an asynchrony of males and females with both dominant species of the investigated assemblage (Fig. 7). Similarly to other studies, it was found that the males appeared earlier than females in the mating season and the decreasing ratio of males/females through the season was significant in both cases.

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REFERENCES

JANSSEN, B. & REICH, M. (1998): Zur Populationsstruktur und Mobilität von Psophus stridulus in einer alpinen Wildflusslandschaft. *Articulata*, 13: 121–125.

INGRISCH, S. & KÖHLER, G. (1998): Heuschrecken Europas. *Magdeburg: Westarp-Wiss.*, pp. 460.

KEMP, W. P., HARVEY, S. J. & O'NEILL, K. M. (1990): Patterns of vegetation and grasshopper community composition. *Oecologia*, 83: 299–308.

NAGY, B. (1949/1950): Quantitative and qualitative investigations of the Saltatoria of the Tihany Peninsula. *Ann. Inst. Biol. Prevest. Hung.*, 1: 95–122.

NAGY, B. & NAGY, A. (2000): The Orthoptera fauna of the Villány Hills (South Hungary). *Dunántúli Dolg. Term. Tud. Sorozat*, 10:147–156.

NAGY, B. & RÁCZ, I. (1996): Orthopteroid insects in the Bükk Mountains. *In: Mahunka, S. (ed.): The fauna of the Bükk National Park:* 95–123.

NAGY, B., RÁCZ, I. & VARGA, Z. (1999): The orthopteroid insect fauna of the Aggtelek Karst Region (NE Hungary) referring to zoogeography and nature conservation. *In: Mahunka, S. (ed.): The fauna of the Aggtelek National Park:* 83–102.

NAGY, B., ŠUŠLIK, V. & KRIŠTIN, A. (1998): Distribution of species and structure of assemblages along Slanské - Zemplén Mountains Range (SE Slovakia - NE Hungary). *Folia Entomol. Hung.*, 59: 17–27.

NAGY, B. & SZÖVÉNYI, G. (1997): Orthopteroid insects of the Őrség Landscape Conservation Area (Western Hungary). *In: Vigh, K. (ed.) Natural History of Őrség Landscape Conservation Area III:* 7–23.

NAGY, B. & SZÖVÉNYI, G. (1998): Orthoptera assemblages in the Körös–Maros National Park. (In Hungarian with English summary.) *Crisicum*, I: 126–143.

NAGY, B. & SZÖVÉNYI, G. (2001): Orthopteran insects (Orthoptera) of Somogy County. (In Hungarian with English summary.) *Natura Somogyiensis*, I: 107–117.

PODANI, J. (1997): SYN-TAX 5.1: A new version for PC and Macintosh computers. *Coenoses*, 12: 149-152.

STATSOFT. INC. (1994): Statistica. *Tulsa, Oklahoma.*

SZÓNYI, G. & KINCSEK, I. (1986): Indication of spatial heteromorphy and community structure of Acridoidea-communities in a sandy grassland. *Acta Biol. Szeged.*, 32: 141–156.

SZÖVÉNYI, G. (2001): Movement patterns of local Orthoptera assemblages in a naturally fragmented habitat. *Metaleptea (Special Meeting Issue)*: 72.

SZÖVÉNYI, G. & NAGY, B. (1999 a): Critical survey of the Orthoptera fauna of the Kőszeg Mountains (Western Hungary). (In Hungarian with English summary.) *Savaria*, 25: 99–126.

SZÖVÉNYI, G. & NAGY, B. (1999 b): Comparative analysis of the Orthoptera assemblages occurring in the protected areas of the Körös-Maros National Park. *Crisicum*, II: 115–122.

WAGNER, G. (2000): A population vulnerability analysis of the red winged grasshopper, *Oedipoda germanica* (Latr. 1804) (Caelifera, Acrididae). *Articulata, Beiheft*, 9: 1–126.

Opusc. Zool. Budapest, 2002, 34: 105-112

The composition of intestine content of *Orchesella cincta* (Linné) (Insecta: Collembola)

J. VARGA*, Z. NAÁR* and CS. DOBOLYI**

Abstract. The composition of intestine content of the collembolan species *Orchesella cincta* (L.) was studied. The specimens were collected from soil covering moss, *Tortella tortuosa* (Hedw.) Limp. cushions at two sites. The composition of cultivable mycobiota of this Collembola was compared with that of mosses to show, whether collembolans feed selectively on fungi occurring on mosses. The intestine content was composed of detritus, moss particles, and fungal propagules. Difference in diversity of mycobiota found both in moss and in Collembola was similar at the two collecting sites. Comparing the mycobiota of the moss as diet and that of the intestine content, clear evidences of selective feeding were observed. The preference of Collembola for particular fungi differed between the collecting sites.

The examinations of the intestine content of Collembola species collected from the original habitat and the experiments made in laboratory can answer for the question: what kind of food can be eaten by Collembola species and which food resources do they prefer?

It is generally known from the literature that collembolans feed with little algal cells, musci, detritus.

Fungi which are found in bryophyte cushions play important role in the decomposition of organic material. The examination of the feeding Collembola species and other invertebrates have importance because these animals may influence the rate of decomposition, which has an effect in an indirect way for the feeding with mycobiota. The composition of mycobiota association may change if these animals feed selectively with fungi in bryophyte, and therefore the intensity of decomposition processes will change, too.

According to feeding studies in connection with Collembola species during Hungarian and international examinations, it can be seen that one part of them eat saprophytic and phytopathogenic fungi (Lartey et al., 1989; Wittaker, 1981; Bengston et al., 1983; Hedlund et al., 1991; Leonard & Anderson, 1991), other species eat living and dead bryophyte fragments, decayed leaf materials and mycelia (Ulber, 1980; Sadaka & Poinsot-Balaguer, 1989; Bakonyi, 1998). By means of feeding with mycobiota and of their motility, collembolans may have an important role in the dispersion of heterotrophyc mycobiota (Christen, 1975; Petersen & Luxton, 1982).

Walsh and Bogler (1990, 1993) studied the preference of Collembola species for fungi. According to their results, the food preferences can be frequently detected in connection with the offered mycobiota, but the rate of it can be different. It is also known that the preferred and eaten mycobiota may influence the population dynamics, growth and reproduction of the Collembola species.

The common soil fungal taxa (e.g. *Alternaria, Fusarium, Trichoderma*) can be found in bryophytes. Mycobiota settling in bryophytes are important factors in the life of animal associations as it is supported by feeding preference examinations (Bakonyi, 1989; Bakonyi et al., 1995; Walsh & Bolger, 1993). The mycobiota living in bryophytes can be served as food for the animals occurring in bryophytes. For all of these facts, it is an im-

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portant study to examine the composition of mycobiota occurring in bryophytes.

In the first step of our examination, we isolated and identified the fungi occurring in bryophyte *Tortella tortuosa*. In the second step, we surveyed the alimentary content of *Orchesella cincta*, and separated the food fragments. We examined the food structure and the ratio of different food types. After all, in order to get an overall picture about the composition of the eaten mycobiota, we isolated and identified the fungi occurring in the alimentary of *Orchesella cincta*.

MATERIAL AND METHODS

Sampling area and collecting sites

The collecting sites were chosen in different plant communities at the village Szarvaskő (Bükk National Park) in the Northern Mountain Range of Hungary. Collecting Site I: A rocky habitat with south exposition, Puls. Fest. rupicolae. Collecting Site II: A dry habitat divide with big rocks, Potentillo Festucetum. It has a south-west exposition.

Collecting the bryophyte samples

For the examination of the alimentary, collections were taken by aspects (1997–98) and the samples were analysed in the chosen communities during the investigation. Five bryophyte cushions of 10 × 10 cm size were taken from both sites according to the statements of Cohran (1963): in order to know the animal associations of bryophytes, the size of the bryophytes cushions must be at least 20 times bigger than that of the animals collected in them. The collection of Collembola species was made by prespan funnel (Berlese System) in room temperature. Berlese–Balogh's Salting Method was applied to separate invertebrates from debris. The lactic acid clearing of Collembola species were made in Gisin's Fluid (10 cm^3 lactic acid, 2 cm^3 glycerol, 40 % formalin), then they were picked up and identified in open preparations.

Examination of mycobiota in the bryophyte cushion

Five pieces (10 g) of each examined bryophyte sample were separated and washed through in 100 ml of sterile distilled water. The mycobiota were cultured from the inoculum washed from the surface of the bryophyte. The washed byrophyte fragments were ground in a tissue homogenizer to culture the fungi living in bryophyte. Aliquots of both suspensions (washed or suspended) were spread on Martin-agar or glucose-pepton agar plates. Inoculated plates were cultured at 27–28° C in thermostat. Each developing fungal colony was picked up and transferred on glucose-pepton agar slants. Isolates were identified microscopically in lactophenol-anilin blue stained preparations.

Microscopic examinations of the intestine content

The whole intestine of collembolans (10 individuals/species per collection site) was prepared with needles in three replicates.

The intestine contents were homogenized in 5 cm^3 of distilled water, dropped with lactophenol-aniline blue stain and spread on microscopic slides.

At the separation of the food types we rely on the microscopic morphological features. During the analyses of the intestinal content, we used the method of Hodkinson et al. (1994) by which the particles (bryophytes, mycelia, bryophyte spores, detritus) are counted on the examined surface along linear transects. Percent value data were logarithmically transformed before statistical analyses.

The assessment of mycobiota of collembolan intestine and the bryophyte cushion

Collembolans collected alive from the moss samples were washed 10 times with sterile distilled water to clean them from soil fragments and fungal spores. During the exploration of the mycobiota occurring in the intestine, they were homogenized in 5 cm^3 of sterile water with tissue homogenizer. The suspensions were spread on agar plates as it was applied for bryophytes.

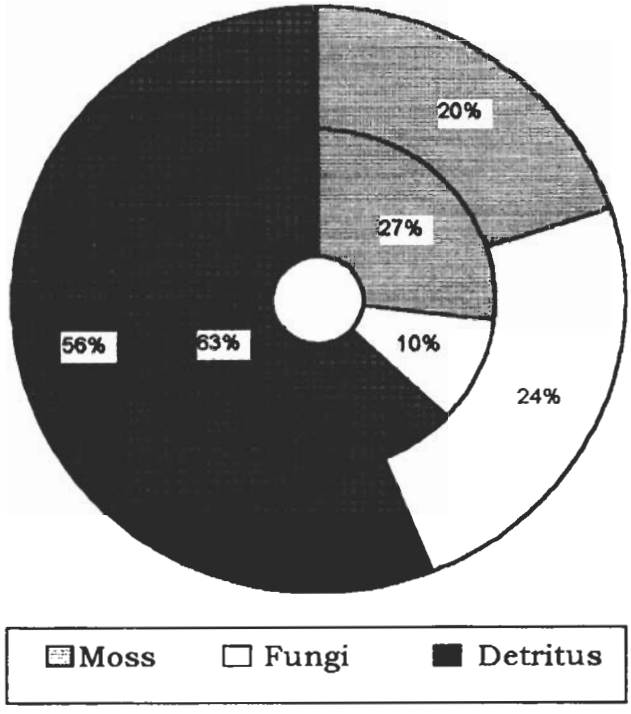

Figure 1. The composition of the bowel content at the Collecting Site I (inner ring) and II (outer ring)

The evaluation of the preference of collembolans for fungi

Fungi occurring in bryophytes mean a kind of food for Collembolan species. The preference can be calculated with Ivlev's (1961) formula:

$$E_i = \frac{r_i - n_i}{r_i + n_i}$$

where E_i = Ivlev's Electivity Index measure for species, r_i = percentage of species i in the diet, n_i = percentage of species i in the environment.

The electivity index shows the relative density of food types exactly, including many of them. The electivity variations extend from –1 to +1. The values from 0 to +1 refer to the degree of preference while the values between 0 and –1 indicate avoidance.

During the evaluation of Ivlev's Electivity Index, it became clear that fungi are not consumed in equal rates, so there may be a difference between the supply and demand. It can be seen in the supply of the two collecting sites and it can be extended for the choose of the analysed Collembola species, too. The Ivlev's Index allows to make consequences for the preference. Because of the characteristics of the index, avoidance does not mean exactly that the species does not feed with the given food type, even if there was a little quantity of it in the food of the species.

In order to evaluate the preference of mycobiota, the Manly's Alfa Index was calculated as well. Using the index, the lack of selectivity in feeding can be estimated and in the case of selective feeding one could estimate the degree of preference for each food type. Manly's Alfa Preference Index was calculated with the formula:

$$\alpha_i = \frac{r_i}{n_i} \quad \frac{1}{\sum r_j / n_j}$$

Table 1. *Fungi recovered from the intestine of Orchesella cincta*

Fungal taxa	Collecting sites	
	I.	II.
Absidia spinosa Lendner	1	6
Aspergillus sp. Micheli ex Fries	0	5
Gliocladium sp. Corda	1	0
G. roseum Bain.	0	6
Isaria arachnophila Ditmar	0	5
Papulaspora sp. Preuss	1	0
Paecilomyces sp. Bainier	0	2
Penicillium sp. Link	10	13
Stachybotris alternans Bonorden	2	6
S. lobulata Berkeley	2	25
Trichoderma atroviride Bisett	1	0
T. harzianum Rifai	3	0
T. koningii Oud.	0	7
T. longipilis Bissett	0	3
Verticillium lateritium Berkeley	2	7
Diversity (Shannon)	1.95	2.13
Total colony number	26	85

where a_i = Manly's Alfa (Preference) Index, r_i and r_j = proportion of food types i and j in the diet (i and j = 1, 2, 3...m), n_i and n_j = proportion of food type i and j in the environment, m = number of the possible food types.

When selective feeding doesn't exist then a_i = 1/m. When a_i > 1/m, then food type i is preferred in the diet. So, when a_i <1/m then food type i is avoided and it is not preferred in the diet of the examined species. The alfa values measure the probability of the selection of a food type (in our case a fungal species) from the main food type of all the species in the supply when all of the presented food types are choosable food sources. It must be noted that there is no general agreement in the literature for the best index to measure preference, but many researchers drafted that Manly's Alfa is one of the most frequently used preference indices that can be used in most situations (Ellis, 1976; Stephens & Krebs, 1986; Rogers, 1984).

RESULTS

The mycobiota of the bryophyte species

Ten genera and species of fungi were identified from the bryophyte species *Tortella tortuosa*. The mycobiota of the bryophyte cushion collected from Collecting Site II had a wider spectrum. This might

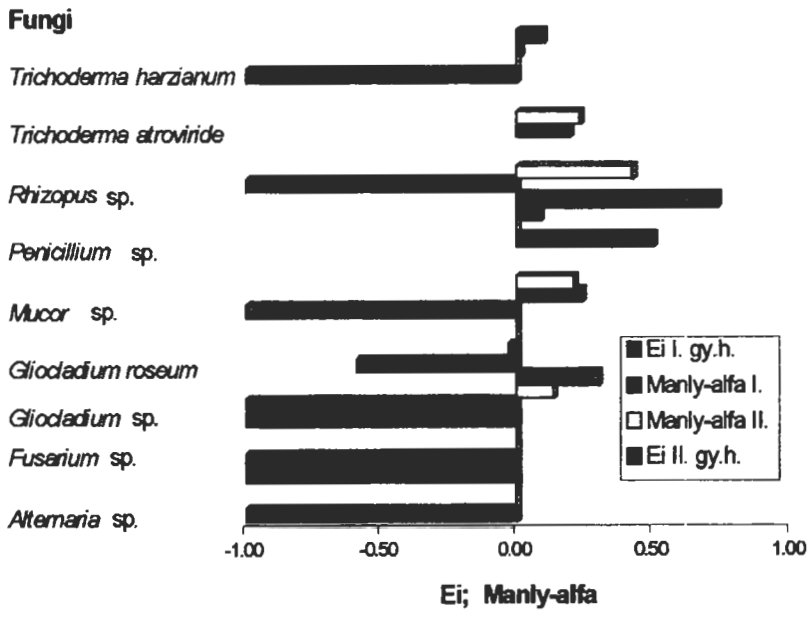

Figure 2. Electivity (E_i) and preference (Manley's Alfa) index of *Orchesella cincta* at the Collecting Site I and II

be the result of the microclimatic differences in the two different types of plant communities. We did not find *Aspergillus* sp., *Mucor* sp. and *Trichoderma atroviride* on the bryophyte cushion collected from Collecting Site I.

The intestine content and its mycobiota

During the microscopic examination of the intestine content, it was observed that *O. cincta* utilized various food sources. There was no individual with only one type of food in its intestine. The foregut was extremely green due to the presence of algae, bryophyte fragments or both of them. Some members of mycobiota with characteristic features could be recognized directly, e.g. an *Alternaria* colony on a consumed bryophyte fragment. There were indigested food fragments of animal origins (legs, wings, etc.) in the detritus.

The percentage composition of intestine content is shown in Fig. 1. The rate of bryophyte fragments was higher on Collecting Site I than on Site II. It was the reverse in the case of fungal propagules. Collembolans eaten two times more fungi on Collecting Site II than on the Site I. There were no essential differences in the rate of detritus. These differences in the rate of bryophyte fragments in fungal propagules might be the consequence of the different developing digestive process because the individuals were collected in different feeding phase.

In all, fifteen fungal taxa were identified from the intestine content with cultivation-isolation method (Table 1). Nine and eleven taxa were observed on Collecting Site I and II, respectively. Five out of them occurred on both sites. The intestine mycobiota on Collecting Site II was both more diverse and abundant. Nine fungal species or genera occurring in the intestine were not found in the bryophyte samples. We think that these fungi were eaten by collembolans when they grazed out of the bryophyte cushion. It is presumable that these fungi are preferred by *O. cincta* because their rate in the culturable mycobiota overcame 58 % and 28 % on Collecting Site I and II, respectively.

Preference

During the preference examinations, we analyzed the degree of utilization of the bryophyte's mycobiota by *O. cincta* as a food-base and its preference for members of mycobiota. The rest of the intestine content (detritus and mycelia) could not be analyzed because of lack of distinguishable features that would inform us about their origin.

As the preference indices show on Fig. 2, *O. cincta* searched and feed with *Penicillium* species but it did not prefer *Alternaria* and *Fusarium*; it avoided these fungi and did not feed with them. In some cases, individuals avoided some fungal taxa on one of the collecting sites, but they eat them on the other one. They avoided *Gliocladium* spp. on both sites, although they did eat a less quantity of them. *Rhizopus* sp. was eaten by *O. cincta*, but it occurred only on Collecting Site II.

The preference for six fungi common in bryophyte and intestine content at both sites is represented in Fig. 3 with rate of Manly's Alfa values. It can be stated that the preference of *O. cincta* greatly varied by sites. *Gliocladium* sp. was the only fungus, of which values were similar; the other ones were eaten only at one of the sites.

DISCUSSION

The aim of our study was to detect whether *O. cincta* feed with bryophyte fragments of its habitat and the fungi in that, and to determine the rate of the eaten fungi in the feed of *O. cincta*. The exploration of intestine and the analysis of its content supported the observation that the individuals of this Collembola species, like those of other ones, are feeding continuously (Anderson & Healey, 1972). We observed that the food consisted of fragments of different origin in the most individuals. The different colour and structure of the fragments showed that animal fed with one kind of food first and then changed for another food source (in the bryophyte or out of it) and fed with it. The recognization and separation of the food types became harder along the intestine as the digestive processes were going on.

More examinations show that Collembola species prefer a kind of food source to the other ones provided them in laboratory experiments (e.g. Lartey et al., 1989; Leonard & Anderson, 1991; Walsh & Bolger, 1993). However, the animals do not distinct food types in that manner in the nature, where a more wide and complex food-base is available. We found *O. cincta* to be an opportunist species considering its feeding habits. It has a wide taste and flexibility, thus it can explore the variably consisted food-base at different microhabitats. For instance, the rate of fungal propagules in the intestine content was considerably higher on Collecting Site II, where the bryophyte mycobiota was more diverse and abundant. However, the major part of components of fungal origin was changed to bryophyte fragments at Collecting Site I, where a more sparse mycobiota was available. Furthermore, the preference rank for particular fungi differed at the sites giving a reason to doubt the reliability of laboratory preference examinations. We expect that the different microclimatic conditions resulted in a different physiological status of fungi leading to changed taste for *O. cincta*.

There are examinations under laboratory conditions, which emphasize the importance of *Trichoderma* spp. for the collembolans. During a population dynamics study of collembolans, Walsh and Bolger (1993) noted that these animals select among the provided fungi, even if they were in mixed culture. Collembolans feeding with not liked *Trichoderma viride* produced the fastest growth rates and the highest population size. This fact leads to the consequence that the preference for some food types and their physiological importance are not cover each other. In fact, the less preferred food may have a fundamental importance for the animal. It may occur that fungi having a good effect for the reproductive processes contain some not liked compounds. Thus, the animals eat less quantities of this food type, but continuously, so it seems to be less preferred food type during the preference examinations.

Also our examinations supported that collembolans hold high quantities of fungal spores, thus it can be stated that collembolans may play an important role in the distribution of the fungi living in or out of the bryophyte cushion (Varga & Naár, 2002). These animals are not tied with the bryophyte species; they go from the one kind to the other, delivering the spores with their faeces.

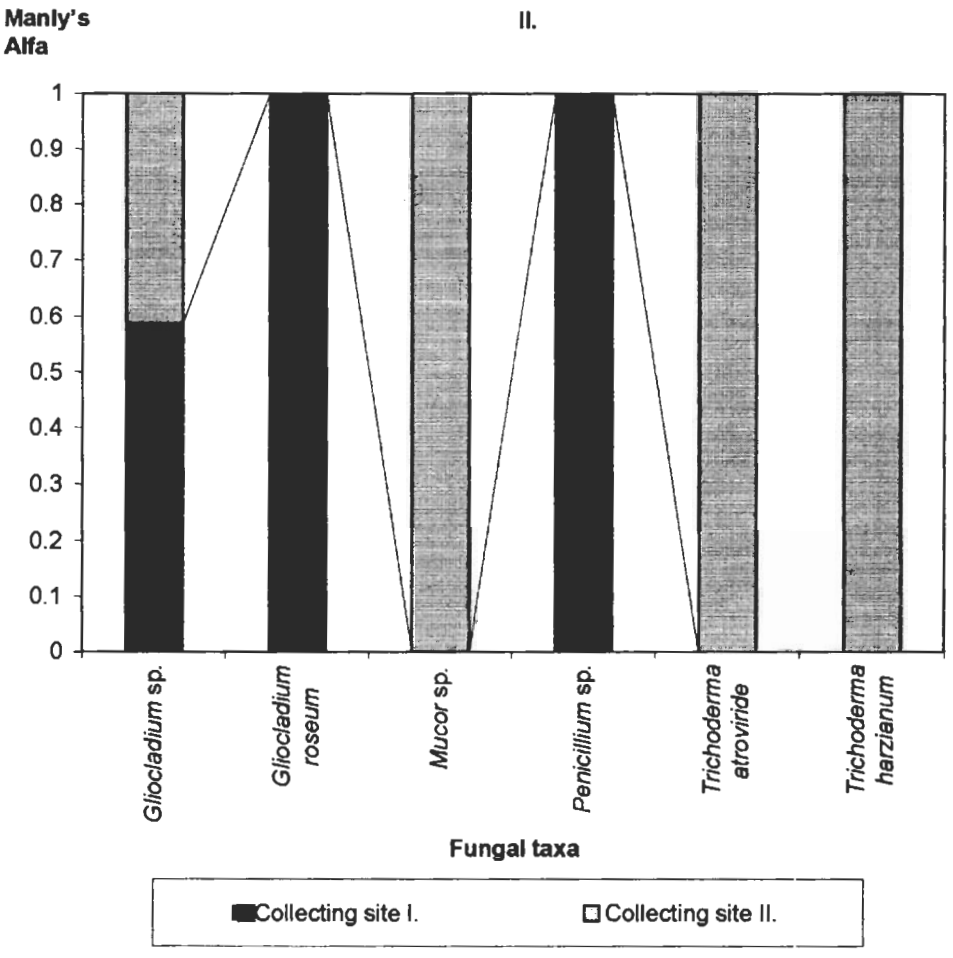

Figure 3. The diet of *Orchesella cincta* on the basis of preference index (Manly's Alfa) at the Collecting Site I and II

The cultivation of fungi from the intestine of Collembola species can be used not only as a control examination, but it may contribute to the mycologists with selective isolation of such fungi that are preferred by collembolans and are hard to culture because of their low rate in the mycobiota.

The cultivation of fungal content of intestine gives a good mean to identify the fungi that are actually eaten under natural conditions.

REFERENCES

ANDERSON, J. M. & HEALEY, I. N. (1972): Seasonal and inter-specific variation in major components of the gut contents of some woodland Collembola. *Journ. Anim. Ecol.*, 41: 359–368.

BAKONYI, G. (1989): Effects of *Folsomia candida* (Collembola) on the microbial biomass in a grassland soil. *Biol. Ferti. Soils*, 7: 138–141.

BAKONYI, G., DOBOLYI, Cs. & LE BICH THUY (1995): 15N uptake by Collembolans from bacterial and fungal food sources. *Acta Zool. Fennica*, 196: 136–138.

BAKONYI, G. (1998): Nitrogen turnover of *Sinella coeca* (Collembola: Entomobryidae). *Eur. Journ. Entomol.*, 95: 321–326.

BENGTSSON, G., GUNNARSSON, T. & RUNDGREN, S. (1983): Growth changes caused by metal uptake in a population of *Onychiurus armatus* (Collembola) feeding on metal polluted fungi. *Oikos*, 40: 216–225.

CHRISTEN, A. A. (1975), Some fungi associated with Collembola. *Rev. Ecol. Sol*, 12: 723–728.

COCHRAN, W. G. (1963): Sampling techniques, 2nd ed. *Wiley, New York.*

HEDLUND, K., BODDY, L. & PRESTON, C. M. (1991): Mycelial responses of the soil fungus *Mortiella isabellina* to grazing by *Onychiurus armatus* (Collembola). *Soil Biol. Biochem.*, 23: 361–366.

LARTEY, R. T., CURL, E. A., PETERSON, C. M. & HARPER, J. D. (1989): Mycophagous grazing and food preference of *Proisotoma minuta* (Collembola: Isotomidae) and *Onychiurus encarpatus* (Collembola: Onychiuridae). *Environ. Entomol.*, 18: 334–337.

LEONARD M. A. & ANDERSON J. M. (1991): Growth dynamics of Collembola (*Folsomia candida*) and a fungus (*Mucor plembeus*) in relation to nitrogen availability in spatially simple and complex laboratory systems. *Pedobiologia.*, 35: 163–173.

PETERSEN, H. & LUXTON, M. (1982): A comparative analysis of soil fauna populations and their role in decomposition process. *Oikos*, 39: 287–388.

SADAKA, N. & POINSOT–BALAGUER, N. (1989): Relations trophiques feuilles de chêne vert (*Quercus ilex* L.): Collemboles. Influence de la qualité du material foliare sur la croissance ponderale d'*Onychiurus zschokkei* Handschin. *Rev. Ecol. Biol. Soil*, 26: 197–204.

ULBER, B. (1980): Untersuchungen zur Nahrungswahl von *Onychiurus fimatus* Gisin (Onychiuridae, Collembola), einem Schädling der Zukkerrübe. *Zeitschr. Angew. Entomol.*, 90: 333–346.

VARGA, J. & NAÁR, Z. (2002): A Collembolák mint a mohákban élő gombák lehetséges terjesztői. *Folia Hist. Nat. Mus. Matraensis*, 26: 115–120.

WALSH, M. I. & BOLGER, T. (1990): Effects of diet on the growth and reproduction of some Collembola in laboratory cultures. *Pedobiologia*, 34: 161–171.

WALSH, M. I. & BOLGER, T. (1993): Effects of diet on the interactions between *Hypogastrura denticulata* Bagnall and *Onychiurus furcifer* Börner in laboratory cultures. *Eur. Journ. Soil Biol.*, 29: 155–160.

WHITTAKER, J. B. (1981): Feeding of *Onychiurus subteinus* (Collembola) at snow melt in aspen litter in the Canadian Rocky Mountains. *Oikos*, 36: 203–206

WILLIETS, H. M., THOMSON, A. R. & MORRIS, G. E. L. (1989): Laboratory studies on the selection of *Pythium ultinum*, plant-pathogenic fungus by *Onychiurus auranticus* (Collembola). *Aspects Appl. Biol.*, 23: 373–378.

Opusc. Zool. Budapest, 2002, 34: 113–123

Eine neue Art der Gattung *Zongodrilus* Righi, 1995 sowie weitere Arten der Familie Glossoscolecidae (Oligochaeta) aus Ekuador

Regenwürmer aus Südamerika, 37

A. ZICSI*

Abstract. A new species of the genus *Zongodrilus* Righi, 1995, and other species of the family Glossoscolecidae (Annelida) from Ecuador. Earthworms from South America, 37. The genus *Zongodrilus* Righi, 1995 is revalued, and a new species, *Zongodrilus multipapillatus* sp. nov. described from southern Ecuador. Additional data on the distribution of other species belonging to the family Glossoscolecidae are presented. The morphological data of *Martiodrilus* (*Botaria*) *poncei* Zicsi, 1988 are completed, and some ecological observations added.

Das Abtrennen supraspezifischer Taxa in der Familie Glossoscolecidae hatte aufgrund der Struktur von Chylustaschen schon in der Sammelgattung *Thamnodrilus* Beddard, 1891 begonnen und wurde später auch fortgesetzt (*Inkadrilus* Michaelsen, 1918 mit 8 Paar Saumleistentaschen, *Quimbaya* Michaelsen, 1935 mit 7 Paar Saumleistentaschen, *Martiodrilus* Michaelsen, 1936 mit 7 oder 8 Paar Kompositenschlauch- bzw. Wabentaschen und *Tamayodrilus* Zicsi, 1995, mit 6 Paar Rispenschlauchtaschen).

Im späteren veranlasste die Anordnung und Zahl der Chylustaschen eine weitere Aufspaltung der inzwischen über 50 Arten besitzende Sammelgattung *Martiodrilus* durchzuführen (*Zongodrilus* Righi, 1995 mit 8 Paar Samentaschen, *Maipure* Righi, 1995 mit 7 Paar Samentaschen, *Tupinaki* Righi, 1995 mit 5 Paar Samentaschen).

Bei einer weiteren Revision von *Martiodrilus* Michaelsen, 1936 wurde die Sammelgattung in vier Untergattungen geteilt. Zur Trennung der Untergattungen wurden alleinstehende Kennzeichen wie rosettenförmiges Nephrostom: *M.* (*Cordilleroscolex* Zicsi & Csuzdi, 1997), Fehlen von rosettenförmigen Nephrostom mit verdickten Dissepimenten hinter dem Muskelmagen: *M.* (*Martiodrilus* Michaelsen, 1936), Fehlen von verdickten Dissepimenten hinter dem Muskelmagen und drei Paar Samentaschen: *M.* (*Botaria* Zicsi, 1998), Fehlen von verdickten Dissepimenten und vier Paar Samentaschen: *M.* (*Maipure* Righi, 1995) berücksichtigt.

In einer vorausgehenden Arbeit (Zicsi & Csuzdi, 1999) wurde die Gattung *Zongodrilus* Righi, 1995 eliminiert und zur Gattung *Inkadrilus* eingezogen. Durch das freundliche Entgegenkommen von Herrn Dr. J. Römbke haben wir vom gleichen Fundort weitere Exemplare dieser Art zur Einsicht erhalten, die sich vollkommen identisch mit dem Holotypus erwiesen. Da wir einwandfrei Saumleistentaschen bei ihr nachweisen konnten, haben wir die als *Martiodrilus bolivianus* Righi & Römbke, 1987 bechriebene, später als Typusart von *Zongodrilus* betrachtete Spezies, in die Gattung *Inkadrilus* gestellt (Zicsi & Csuzdi, 1997, 1999; Zicsi, 2001). Dies auch deswegen, weil die als *Inkadrilus* beschriebenen Arten *I. aberratus* Michaelsen, 1900 und *I. octocystis* Michaelsen, 1900 auch über 8 Paar Chylustaschen verfügen, mit dem Unterschied jedoch, dass diese im 7.–14. Segment liegen.

Vorausgehend (Zicsi & Csuzdi, 1999) waren wir der Meinung, dass aufgrund so weniger Exemplare (*I. bolivianus:* zwei adulte Tiere, Samentaschen im 8.–15. Segment; *I. aberratus* und *I. octocystis* je ein adultes Tier, Samentaschen im

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7.–14. Segment; *I. hanagarthi* ein adultes Tier, Samentaschen im 7.–15. Segment; *I. silvestris* ein adultes Tier, Samentaschen im 8.–15. Segment) im südlichen Teil der Kordilleren einer höheren Zahl und Verschiebung der Chylustaschen bei gleicher Struktur keine supraspezifische Bedeutung zugemessen werden soll.

Inzwischen ist weiteres von uns gesammeltes Material aus Ekuador bearbeitet worden. Hier wurden u. a. zahlreiche Exemplare einer neuen Art entdeckt, die ebenfalls 8 Paar Chylustaschen im 8.-15. Segment wie die Typusart, *Zongodrilus bolivianus* (Righi & Römbke, 1987), besitzen. Da jetzt auch im südlichen Teil Ekuadors mehrere Exemplare, die ebenfalls Saumleistentaschen im 8.–15. Segment besitzen, entdeckt wurden, ist die in verschiedenen Segmenten liegende höhere Zahl der Saumleistentaschen im südlichen Teil des Verbreitungsgebietes bewiesen worden. Eine weitere Aufspaltung der Gattungen aufgrund dieses Kennzeichen scheint dadurch erforderlich zu sein. Deswegen wird nachstehend die eliminierte Gattung *Zongodrilus* Righi, 1995 zurückgestellt.

Gattung *Zongodrilus* Righi, 1995
(emend. Zicsi, 1995)

Typusart: *Zongodrilus bolivianus* (Righi & Römbke, 1987).

Weitere Art: *Zongodrilus silvestris* (Zicsi, 1995).

Diagnose. Borsten 8 Paar auf einem Segment, selten am Körperende perechitin angeordnet. Männliche Poren intraclitellar. Muskelmagen im 6. Segment. Herzen im 7.–11. Segment. 8 Paar Chylustaschen im 8.–15. Segment, Saumleistentaschen. 2 Paar Hoden und Samentrichter im 10. und 11. Segment. Samensäcke kurz im 11. und 12. Segment. Pretesticulare Samentaschen vorhanden.

Zongodrilus multipapillatus sp. n.

(Abb. 1–3)

Fundorte. Ekuador Prov. Zamora-Chinchipe. Holotypus AF/4381, 16 km von Zamora in Richtung Loja, 1000 m Wiese, 29. 4. 1988, leg. Zicsi & Csuzdi. Paratypen AF/1557, 8+1 juv. Ex., Fundort wie beim Holotypus. AF/1561, 6 Ex., 30 km von Loja in Richtung Zamora, 1300 m, 29. 4. 1988, leg Zicsi & Csuzdi.

Äussere Merkmale. Länge des Holotypus 5,3 mm, Breite 3 mm, Segmentzahl 185. Paratypen: Länge 4,9–5,4 mm, Breite 2,9–3,1 mm, Segmentzahl 175–186.

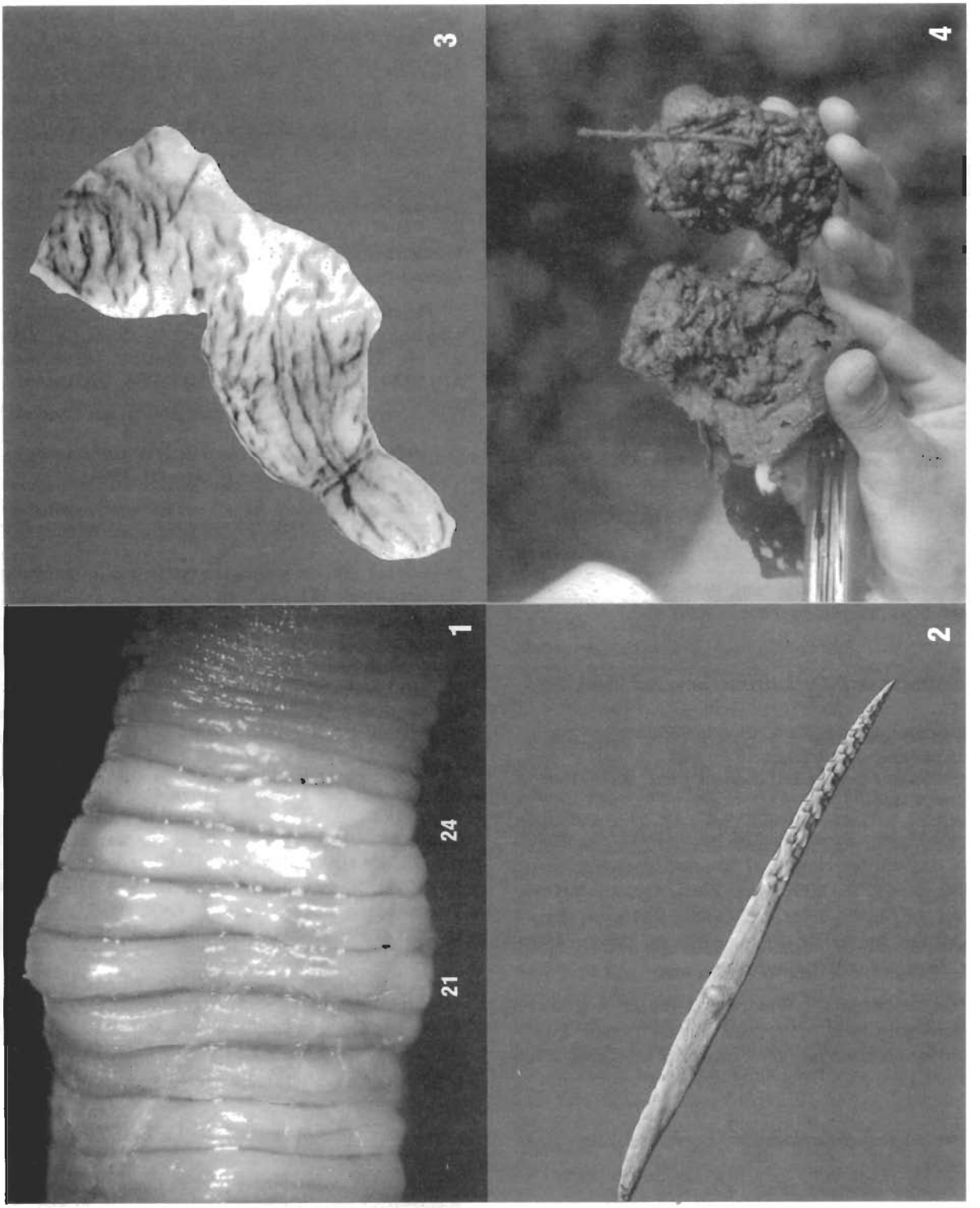
Farbe fixiert weiss, unpigmentiert. Kopf eingezogen. 1.–2. Segment verwachsen, 3. Segment längs gefurcht. Borsten vor dem Gürtel ungepaart, Borstenreihe *aa* auf kleinen Erhebungen vom 13.–20. Segment. Borstenreihen hinter dem Gürtel undeutlich zu erkennen, vom 90. Segment perechitin angeordnet. Mächtig querligende Papillen am 21.–24. Segment (Abb. 1). Die Borsten *a* und *b* des 21.–23. sowie *a*, *b* und *c* des 24. Segments zu Geschlechtsborsten verwandelt. Spitze der Geschlechtsborsten schnabelförmig zugespitzt. Länge der Geschlechtsborsten 0,52–0,60 mm, Breite 0,028–0,030 mm, Zahl der Narben 10–12 (Abb. 2).

Gürtel durch Verfärbung angedeutet vom 15.–25. Segment, Pubertätsstreifen vom 21.–½24. Segment. Weibliche Poren hinter dem 14. Segment zwischen der Borstenlienie *ab*. Männliche Poren auf Intersegmentalfurche 21/22, in Höhe der Pubertätsstreifen.

Innere Organisation. Dissepimente 6/7–12/13 verdickt, Muskelmagen im 6. Segment, gross. Herzen im 6.–11. Segment. Chylustaschen 8 Paar im 8–15. Segment, Saumleistentaschen (Abb. 3). Chylustaschen des 8., 9. u. 10. Segments mit abgeschnürtem Kopf, die hinteren 5 Paar fächerförmig ausgebildet. Hoden und Samentrichter im 10. und 11. Segment in perioesophageale Testikelblasen eingeschlossen. Samensäcke im 11. und 12. Segment, kleine runde Gebilde. Ovarien im 13. Segment. Mitteldarm im 17., Typhlosolis im 26. Segment beginnend. Nephridien ohne büschelförmigem Nephrostom, Nephridialblasen vorhanden.

Drei Paar Samentaschen im 7.–9. Segment, mit langem, dünnem Ausführungsgang und löffelförmiger Ampulle.

Verwandtschaft. Die neue Art unterscheidet sich von *Z. bolivianus* und *Z. silvestris* durch die Lage des Gürtels und der Pubertätsstreifen, durch die mächtigen Papillen auf den Gürtelsegmenten sowie durch die perchitine Borstenanordnung am Körperende.



Abbildungen 1–3. *Zongodrilus multipapillatus* sp. n. **1:** Ventralansicht des Gürtels mit den Papillen auf dem 21.-24. Segment. **2:** Geschlechtsborste des 24. Segments. **3:** Chylustasche aus dem 10. Segment. – **Abbildung 4.** *Martiodrilus (Botaria) poncei* Zicsi, 1988. 5–7 cm grosse Exkremente mit abgeschlossenem Ausführungsgang

Etymologie: Die neue Art wird aufgrund der grossen Warzen auf dem Gürtelsegment benannt.

Gattung *Martiodrilus* Michaelsen, 1936

Hypogeon partim, Schmarda, 1861: 12.
Rhinodrilus partim, Benham, 1890: 254; Beddard, 1895: 636.
Anteus partim, Beddard, 1895: 652; Rosa, 1896: 90.
Rhinodrilus (Thamnodrilus) partim, Cognetti, 1906: 170.
Thamnodrilus (Thamnodrilus) partim, Michaelsen, 1918: 86.
Martiodrilus Michaelsen, 1936: 1172.
Martiodrilus, Righi, 1971: 4; Righi, 1995: 512; Brinkhurst & Jamieson, 1971: 735; Zicsi, 1988 a: 436, 1988 b: 954, 1990: 367, 1995: 600; Zicsi & Feijoo, 1994: 59; Zicsi & Csuzdi, 1999: 125.
Thamnodriloides, Gates, 1968: 14.

Untergattung *Martiodrilus (Martiodrilus* Michaelsen, 1936)

Martiodrilus (part.) Michaelsen, 1936: 1172.
Martiodrilus (Martiodrilus), Zicsi, 2000: 140.

Martiodrilus (Martiodrilus) devriesi Zicsi, 1988

Martiodrilus devriesi Zicsi, 1988 b: 956.
Martiodrilus devriesi, Righi, 1995: 513.
Martiodrilus (Martiodrilus) devriesi, Zicsi, 2000: 163; Zicsi, 2001: 127.

Fundorte. Prov. Pichincha, AF/4103, 32+25 juv. Ex., hinter Nono, 50 km von Quito entfernt, 2250 m, 19. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4123, 1 Ex., AF/4180, 2+16 juv. Ex., 1 u. 12 km hinter St. Rosa, 1750 m, 26. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes.

Es ist der erste Wiederfund dieser Art, deren Verbreitung, wie auch aus diesen neuen Fundorten zu ersehen ist, sehr begrenzt ist (Zicsi, 1988 b).

Martiodrilus (Martiodrilus) kuehnelti Zicsi, 1990

Martiodrilus kuehnelti Zicsi, 1990: 377.
Martiodrilus kuehnelti, Righi, 1995: 513.
Martiodrilus (Martiodrilus) kuehnelti, Zicsi, 2000: 161, 2001: 127.

Fundort. Prov. Napo, AF/4001, 1 Ex., zwischen Pifo und Papallacta, beim Denkmal der St. Maria, 4100 m, 14. 4. 1989, leg. Zicsi & Loksa.

Martiodrilus (Martiodrilus) lojaensis (Michaelsen, 1918)

Thamnodrilus (Thamnodrilus) lojaensis Michaelsen, 1918: 97.
Martiodrilus lojaensis, Righi, 1995: 513.
Martiodrilus (Martiodrilus) lojaensis, Zicsi, 2000: 156.

Fundorte. Prov. Azuay, AF/3786, 5 praead. Ex., oberhalb der Hacienda el Cortijo, 2000 m, Wiese, 27. 4. 1988, leg. Zicsi & Csuzdi. Prov. Loja, AF/4354, 1 Ex., Quilonga, 12. 1986, leg. Onore.

Martiodrilus (Martiodrilus) acanthinurus acanthinurus (Cognetti, 1904)

Thamnodrilus acanthinurus acanthinurus Cognetti, 1904: 10.
Rhinodrilus (Thamnodrilus) acanthinurus acanthinurus, Cognetti, 1906: 211.
Thamnodrilus (Thamnodrilus) acanthinurus acanthinurus, Michaelsen, 1918: 106.
Martiodrilus acanthinurus acanthinurus, Righi, 1995: 513.
Martiodrilus (Martiodrilus) acanthinurus acanthinurus, Zicsi, 2000: 150.

Fundorte. Prov. Tungurahua, AF/4302, 2 Ex., 9,5 km von der Laguna Pisayambo entfernt, 4150 m, 6. 5. 1993, leg. Zicsi, Csuzdi & Florenzio. Prov. Napo, AF/4213, 3 Ex., 1,5 km vor San Pedro, 500 m, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/4220, 2 Ex., 37 km von Tena 4 km vor der Verzweigung Coca, 1200 m, 4. 5. 1990, leg. Zicsi, Csuzdi & Paredes. Prov. Azuay, AF/4355, 11 Ex., zwischen Sigsig und Chiguinda, 3300 m, 27. 3. 1993, leg. Onore. Prov. Pastaza, AF/4047, 1 Ex., 16 km von Puyo in Richtung Macas, 650 m, 1. 5. 1988, leg. Zicsi & Loksa. Prov. Zamora-Chinchipe, AF/3808, 25 Ex., 30 km von Loja in Richtung Zamora, 1300 m, 29. 4. 1988, leg. Zicsi & Csuzdi.

Martiodrilus (Martiodrilus) loksai Zicsi, 2000

Thamnodrilus acanthinurus partim, Cognetti, 1904: 10.
Rhinodrilus (Thamnodrilus) acanthinurus partim, Cognetti, 1906: 211.
Martiodrilus (Martiodrilus) loksai Zicsi, 2000: 158.

Fundorte. Prov. Napo, AF/4361, 1 Ex., Cayambe Vulkan, Oyacachi, 3200 m, 7. 4. 1993, leg. Onore. Prov. Carchi, AF/4349, 2 Ex., St. Barbara, Guanderal, 2980 m, 12. 4. 1991, leg. Onore. AF/3974., 1 Ex., hinter der Verzweigung nach La Libertad, 3300 m, 25. 4. 1989, leg. Zicsi, Loksa & Lopez.

Untergattung *Martiodrilus (Cordilleroscolex* Zicsi & Csuzdi, 1997)

Martiodrilus (part.), Michaelsen, 1936: 1172.
Martiodrilus (Cordilleroscolex) Zicsi & Csuzdi, 1997: 87.

Martiodrilus (Cordilleroscolex) iserni (Rosa, 1895)

Anteus iserni Rosa, 1895: 152.
Thamnodrilus buchwaldi, Michaelsen, 1902: 30.
Rhinodrilus (Thamnodrilus) iserni, Cognetti, 1906: 186.
Thamnodrilus (Thamnodrilus) iserni, Michaelsen, 1918: 86.
Martiodrilus iserni, Zicsi, 1990: 371.
Martiodrilus iserni, Righi, 1995: 515.
Martiodrilus (Cordilleroscolex) iserni, Zicsi & Csuzdi, 1997: 84.

Fundort. Prov. Imbabura, AF/3983, 2 juv. Ex., 53 km südlich von Otavalo, 2850 m, Wald, 20. 4. 1989, leg. Zicsi, Loksa & Troya.

Martiodrilus (Cordilleroscolex) beddardi (Cognetti, 1904)

Thamnodrilus beddardi Cognetti, 1904: 8
Rhinodrilus (Thamnodrilus), Cognetti, 1906: 224.
Matiodrilus beddardi, Righi, 1995: 514
Martiodrilus (Cordilleroscolex) beddardi, Zicsi & Csuzdi, 1997: 95.
Martiodrilus (Cordilleroscolex) beddardi, Zicsi,2001: 128.

Fundort. Prov. Napo, AF/4211, 1 Ex., zwischen Puerto Napo und Ahuano, 27 km von Tena entfernt, Wald, 400 m, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes.

Die von uns gesammelten und bestimmten Tiere wurden mit dem Typenmaterial von Cognetti (OL 423, Vale del Rio Santiago, leg. Festa) verglichen und identisch gefunden (Zicsi & Csuzdi, 1997). Die Annahme Righis (1995, p. 516), dass *M. (C.) ischuros* Zicsi, 1990 ein Synonym von *M. (C.) beddardi* sei, ist mit Sicherheit auszuschliessen. Ausser den Unterschieden der morphologischen Merkmale sind die Verschiedenheiten in der Lebensweise und Vorkommen der beiden Arten so bedeutend, dass bereits beim Sammeln die beiden Taxa auseinander gehalten werden können.

Untergattung *Martiodrilus* (*Botaria* Zicsi, 1998)

Martiodrilus (part.), Michaelsen, 1936: 1172.
Martiodrilus (Botaria) Zicsi, 1998: 150.

Martiodrilus (Botaria) euzonus (Cognetti, 1904)

Thamnodrilus euzonus Cognetti, 1904: 474.
Rhinodrilus (Thamnodrilus), Cognetti, 1906: 194.
Rhinodrilus (Thamnodrilus) euzonus, Michaelsen, 1910 a: 131, 1910 b: 149, 1913: 234.
Martiodrilus (Martiodrilus) euzonus, Michaelsen, 1918: 117.
Martiodrilus euzonus, Righi, 1981: 244, 1984: 456, 1995: 516.
Martiodrilus euzonus, Zicsi, 1988 a: 436; Zicsi & Feijoo, 1994: 61.
Martiodrilus gara part., Righi, 1995: 525
Martiodrilus (Botaria) euzonus, Zicsi, 1998: 151, 2001: 129.

Fundorte. Prov. Imbabura, AF/3978, 5+1 juv. Ex., 16 km südlich von Otavalo, Wiese, 21. 4. 1989, leg. Zicsi & Loksa. AF/3981, 2 Ex., AF/3982, 5+2 Ex., AF/3989, 1 Ex., in Richtung Selva Alegre, 10, 26 bzw. 28 km von Otavalo entfernt, 2650–3500 m, Wiese, 18–21. 4. 1989, leg. Zicsi & Loksa. AF/4041, 1 Ex., 30 km von Otavalo bei Tablachupa, 3350 m, Schwarzerde, 20. 4. 1989, leg. Zicsi, Loksa & Troya. AF/4005, 6+3 juv. Ex., Otocique, 30 km von Otavalo entfernt in Richtung Apuela, 3250 m, 10. 4. 1989, leg. Zicsi, Loksa & Troya. AF/4012, 1 Ex., aus Otavalo in Richtung Mohanda Laguna, 3700 m, 19. 4. 1989, leg. Zicsi, Loksa & Troya. AF/4221, 5 Ex., AF/4225, 3 Ex., AF/4227, 1 Ex., Umgebung der Mohanda Laguna, Paramo Schwarzerde, 3800-3850 m, 9. 5. 1990, leg. Zicsi, Csuzdi & Paz. AF/4229, 3 Ex., 21 km von Otavalo in Richtung Apuela, 3480 m, Schwarzerde, 7. 5. 1990, leg. Zicsi, Csuzdi & Paz. AF/4360, 1 Ex., Lago San Pablo, 26. 2. 1987, leg. Paredes. Prov. Napo, AF/3976, 6 Ex., AF/4000, 3 Ex., zwischen Pifo und Papallacta, beim Denkmal der Madonne,

4150 m, 14. 4. 1989, leg. Zicsi & Loksa. AF/4335, 3+5 Ex., Wiese gegenüber dem Denkmal der Madonne, zwischen Pifo und Papallacta, 4100 m, 11. 5. 1993, leg. Zicsi & Csuzdi. AF/4219, 4+5 juv. Ex., 12 km vor Cosanga, Wiese, 4. 5. 1990, leg. Zicsi, Csuzdi & Paz. AF/4044, 1 Ex., 20 km von Santa Barbara in Richtung Julia Andrade, 2900 m, 26. 4. 1989, leg. Zicsi, Loksa & Troya. AF/4174, 4 Ex., Laguna San Marcos, 3850 m, Wiese, 28. 4. 1990, leg. Zicsi, Csuzdi & Nonn. Prov. Pichincha, AF/3984, 4+1 juv. Ex., 2 km hinter Cayambe, Acker, 19. 4. 1989, leg. Zicsi, Loksa & Troya. AF/4124, 1+2 juv. Ex., 12 km hinter St. Rosa, 1900 m, 19. 4. 1990, leg. Zicsi & Csuzdi. AF/4294, 2 Ex., bei St. Rosa, 1800 m, 1. 5. 1993, leg. Zicsi & Csuzdi. AF/4171, 1 Ex., Pichincha Geb. hinter Lloa, 4050 m, 27. 4. 1990, leg. Zicsi & Csuzdi. AF/4339, 5 Ex., Ayora, 3000 m, 13. 5. 1993, leg. Zicsi & Csuzdi. Prov. Cotopaxi., AF/4362, 1 Ex., Limpiopuwgo, 28. 1. 1984, leg. Narudez. Prov. Tungurahua, AF/4300, 9 Ex., AF/4305, 1 Ex., AF/4312, 1 Ex., AF/4318, 1+2 juv. Ex., Umgebung der Laguna Pisayambo, 3700-4150 m, 6. 5. 1993, leg. Zicsi, Csuzdi & Florenzio.

Martiodrilus (Botaria) bicolor (Michaelsen, 1913)

Thamnodrilus (Thamnodrilus) bicolor Michaelsen, 1913: 230.
Thamnodrilus (Thamnodrilus) bicolor, Michaelsen, 1918: 119.,
Martiodrilus bicolor, Zicsi, 1988a: 438.
Martiodrilus bicolor, Righi, 1995: 516.
Martiodrilus (Botaria) bicolor, Zicsi, 1998: 153, 2001: 129.

Fundorte. Prov. Carchi, AF/3973, 4 Ex., bei der Verzweigung in Richtung nach La Libertad, 3300 m, Schwarzerde, 25. 4. 1989, leg. Zicsi, Loksa & Lopez. AF/3979, 6 Ex., hinter La Libertad in Richtung Tulcan, 25. 4. 1989, leg. Zicsi, Loksa & Lopez. Prov. Imbabura, AF/4014, 1 Ex., 43 km südlich von Otavalo, 3200 m, 20. 4. 1989, leg. Zicsi, Loksa & Lopez. AF/4015, 2 praead. Ex., vor Selva Alegre, 62 km von Otavalo entfernt, 1700 m, 24. 4. 1989, leg. Zicsi, Loksa & Lopez. AF/4035, 2 Ex., Umgebung der Laguna Mohanda, 3000 m, 19. 4. 1989, leg. Zicsi, Loksa & Troya.

Martiodrilus (Botaria) poncei Zicsi, 1988

(Abb. 4)

Martiodrilus poncei Zicsi, 1988 b: 441.
Martiodrilus poncei, Righi, 1995: 516.
Martiodrilus (Botaria) poncei, Zicsi, 1998: 162, 2001: 129.

Fundorte. Prov. Tungurahua, AF/4056, 2 Ex., 5 km von Rio Verde in Richtung Puyo, 1430 m, 30. 4. 1989, leg. Zicsi, Loksa & Ponce. Prov. Napo, AF/4207, 1 Ex., zwischen Puerto Napo und Ahuano, 12 km von Tena entfernt, Kakaoplantage, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/4208, 3+1 juv Ex., 13 km von Tena entfernt, hinter der Brücke, 430 m, Wald, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/4210, 1 Ex., AF/4212, 2 Ex., zwischen Puerto Napo und Ahuano, 24 u. 27 km entfernt, Wald, 400 m, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/421, 1 Ex., 1,5 km vor San Pedro, 35 km von Tena entfernt, 500 m, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. Prov. Pastaza, AF/4042, 2+2 juv. Ex., hinter Madre Tierra, 800 m, Wald, 2.5. 1989, leg. Zicsi, Loksa & Ponce. AF/4023, 1 juv. Ex., 23 km von Pujo entfernt, 900 m, 1. 5. 1989, leg. Zicsi, Loksa & Ponce.

Wie auch aus den neueren Fundorten zu ersehen, erstreckt sich die Verbreitung von *M. (B.) poncei* auf einen beschränkten Teil der Prov. Napo sowie der angrenzenden Prov. Tungurahua und Pastaze. Laut neueren Aufzeichnungen ist die Art lebend grün und nicht wie in der Originalbeschreibung angeführt, rötlich braun. Die grüne Farbe geht in der Konservierungsflüssigkeit verloren, es bleibt eine rötlichbraune Verfärbung zurück, die auch bei anderen Arten irreführend sein kann (Zicsi, 2000). Bei der Erstbeschreibung von *poncei* wurde die Lage der männlichen Poren mit einem Fragezeichen auf dem 19. Segment angegeben. Eine Überprüfung des neueren Materials erbrachte den Nachweis, dass sie auf Intersegmentalfurche 20/21, in Höhe der Pubertätsstreifen, liegen. Ferner müssen die Gürtelangaben von *poncei* Zicsi, 1988 und *benhami* (Cognetti, 1904) in der Bestimmungstabelle (Zicsi, 2001, p. 129) richtiggestellt werden. Der Gürtel von *poncei* erstreckt sich vom 20.–25., von *benhami* vom 20.–26. Segment.

Besonders interessant sind die Exkrementhäufchen: kleine Türme, die von dieser Art auf der Bodenoberfläche abgelegt, bzw. aufgebaut werden.

Da die Tiere vorwieglich im Inundationsgebiet von Flüssen anzutreffen sind, werden die 5–7 cm hohen und 4–6 cm breiten Gebilde (Abb. 4) am oberen Ende mit Kot fest abgeschlossen. Dieser Verschluss lässt selbst die Fangflüssigkeit nicht durch, so dass diese Art mit der Formolmethode nur nach Abbruch der Türme aus dem Boden getrieben werden konnte.

Martiodrilus (Botaria) vassae Zicsi & Csuzdi, 1999

Martiodrilus vassae Zicsi & Csuzdi, 1999: 129.
Martiodrilus (Botaria) vassae, Zicsi, 2001: 129.

Fundorte. Prov. Manabi, AF/4115, 2 Ex., 7 km von Flavio Alfaro entfernt, 21. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4132, 1+1 juv. Ex., 20 km von San Miguel entfernt, Bananenplantage, 500 m, 22. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. Prov. Los Rios, AF/4129, 3+20 juv. Ex., 10 km von Quevedo entfernt, 200 m, Regenwald, 23. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes.

Untergattung *Martiodrilus* (*Maipure* Righi, 1995) (emend. Zicsi, 2001)

Martiodrilus (part.), Michaelsen, 1936: 1172.
Martiodrilus (Maipure) Righi, 1995: 531.
Martiodrilus (Maipure), Zicsi, 2001: 114.

Martiodrilus (Maipure) agricola (Cognetti, 1904)

Thamnodrilus savanicola partim + *Th. agricola* Cognetti 1904: 5.
Rhinodrilus (Thamnodrilus) agricola, Cognetti, 1906: 198.
Thamnodrilus (Thamnodrilus), Michaelsen, 1918,: 140.
Martiodrilus agricola, Righi, 1971: 75, 1995: 520.
Martiodrilus agricola, Zicsi, 1988 a: 444, 2001: 119; Zicsi & Feijoo, 1994: 61.

Fundorte: Prov. Pichincha., AF/4162, 3 Ex., AF/4164, 14 Ex., AF/4167, 3 Ex., AF/4169, 1 Ex., AF/4179, 2 Ex., Pichincha-Gebirge oberhalb Lloa, 3280-3900 m, 27. 4. 1990, leg. Zicsi & Csuzdi. AF/4195, 4 Ex., zwischen St. Rosa und Bancos, 1900 m, 26. 4. 1990, leg. Zicsi, Csuzdi & Nonn. Prov. Cotopaxi, AF/4151, 4 Ex., Zumbahua, 3800 m, 24. 4. 1990, leg. Zicsi & Csuzdi. AF/4182, 10 praead. Ex., AF/4185, 7 Ex., AF/4191, 6 praead. Ex., 72-82 km von Latacunga 3900-4200 m, Paramo Vegetation, 24. 4. 1990, leg. Zicsi & Csuzdi. AF/4198, 1 Ex., AF/4236, 6 Ex., AF/4342, 1+4 juv. Ex., zwischen Pujili und Zumbahua, 3750-3900 m, 24. 4. 1990 u. 16. 5. 1993, leg. Zicsi & Csuzdi. AF/4295, 2 Ex., AF/4296, 3 Ex., Latacunga , 3900 m, 4. 5. 1993, leg. Zicsi & Csuzdi. AF/4329, 15 Ex., AF/4331, 13 Ex., Cotopaxi, 3350-3450 m, 8. 5. 1993, leg. Zicsi & Csuzdi. Prov. Tungurahua, AF/4291, 7 Ex., AF/4326, 1 Ex., San Jose de Poala, 3200-3450 m, 5.-7. 5. 1993, leg. Zicsi, Csuzdi & Florenzio. AF/4293, 1 Ex., oberhalb Insilivi, Paramo Vegetation, 4150 m, 4. 5. 1993, leg. Zicsi, Csuzdi & Florenzio. AF/4299, 1 Ex., AF/4323, 31 Ex., oberhalb des Kraftwerks Pucara, 3600 m, 5. 5. 1993, leg. Zicsi, Csuzdi & Florenzio. AF/4301, 2 Ex., 9 km vor Laguna Pisayambo, 4150 m, 6. 5. 1993, leg. Zicsi, Csuzdi & Florenzio.

Martiodrilus (Maipure) savanicola (Michaelsen, 1900)

Anteus savanicola Michaelsen, 1900 a: 244.
Thamnodrilus savanicola, Michaelsen, 1900 b: 435.
Thamnodrilus savanicola (partim), Cognetti, 1904: 5.
Rhinodrilus (Thamnodrilus) savanicola, Cognetti, 1906: 178.
Rhinodrilus (Thamnodrilus) incertus, Cognetti, 1906: 179.
Rhinodrilus (Aptodrilus) savanicola, Michaelsen, 1913: 241.
Thamnodrilus (Th.) savanicola, Michaelsen, 1918: 153.
Martiodrilus savanicola savanicola, Righi, 1971: 75.
Martiodrilus savanicola, Zicsi, 1988 a: 446; Zicsi & Feijoo, 1994: 59.

Fundorte. Prov. Manabi, AF/4122,, 1 Ex., zwischen Calderon und Quevedo, 70 km von Manta entfernt, Wald, 450 m, 22. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4127, 1 Ex., 22 km hinter Flavio Alfaro, 250 m, 21. 4. 1990, leg Zicsi, Csuzdi & Gavilanes. AF/4137, 1 Ex., hinter Calderon, Bambuswald, 22. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. Prov. Tungurahua, AF/4309., 2+7 juv. Ex., AF/4313 12 Ex., AF/4315 2 Ex., Laguna Pisayambo, 3800 m, 6. 5. 1993, leg Zicsi, Csuzdi & Florenzio.

Gattung *Pontoscolex* Schmarda, 1861

Pontoscolex Schmarda, 1861: 11.
Pontoscolex, Beddard, 1895: 653.
Pontoscolex, Michaelsen, 1900 b: 424, 1918: 233.
Pontoscolex, Righi, 1984: 460 emend.

Pontoscolex (P.) corethrurus (Müller, 1857)

Lumbricus corethrurus Müller, 1857: 13.
Pontescolex corethrurus, Michaelsen, 1918: 234.
Pontoscolex corethrurus, Righi, 1984: 163.
Pontoscolex corethrurus, Zicsi & Csuzdi, 1987: 274, 1988: 217, 1999: 132.
Pontoscolex corethrurus, Zicsi, 1995 a: 602, 1995 b: 60.
Pontoscolex corethrurus, Zicsi, Römbke & Garcia, 2001: 160.

Fundorte. Prov. Napo, AF/2290, 8+3 juv. Ex., 1,5 km vor San Pedro, 500 m, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/3740, 7 Ex., bei Puzuno, hinter der Hängebrücke, 400 m, 11. 4. 1987, leg. Zicsi, Loksa & Ponce. AF/3990, 3 Ex, Coca, Oriente, 27. 4. 1989, leg. de Vries. AF/4199, 2 Ex., Muyuna, 600 m, Maisfeld, 3. 5. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/2204, 1 Ex., 7 km hinter Loreto, Kaffeeplantage, 500 m, 2. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/4209, 7 Ex., 18 km von Tena entfernt, 450 m, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/4216, 3 Ex., San Pedro, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/4217, 14 Ex., zwischen Puerto Napo und Ahuano, 500 m, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/4218, 5 Ex., hinter Muyuna, Wald, 350 m, 3. 5. 1990, leg. Zicsi, Csuzdi & Paredes. AF/4348, 8 Ex., Coca, 2. 1986, leg. Onore. Prov. Pichincha, AF/385, 7 Ex., 30 km vor Santo Domingo, Wald, 700 m, 7. 5. 1988, leg. Zicsi & Csuzdi. AF/4009, 6 Ex., Tumbaco Garten, 23. 4. 1989, leg. Zicsi & Loksa. AF/4017, 4 Ex., 3 km vor Santo Domingo, 300 m, Strassengraben, 12. 4. 1989, leg. Zicsi & Loksa. AF/4037, 9 Ex., 25 kmvor Santo Domingo, 500 m, Golfplatz, 12. 4. 1989, leg. Zicsi & Loksa. AF/4055, 9 Ex., vor der Verzweigung nach Santo Domingo, 550 m, Bananenplantage, 12. 4. 1989, leg. Zicsi & Loksa. AF/4237, 4 Ex., Nanegal-Nanegalito, 1300 m, 27. 7. 1996, leg. Mariscal. Prov. Manabi, AF/4102, 9 Ex., 10 km vor El Carmen, 400 m, 20. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4113, 22 Ex., AF/4116, 1 Ex., AF/4118, 5 Ex., 7 km hinter Flavio Alfaro, Kakaoplantage, 300-350 m, 20.–21. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4126, 3 Ex., 22 km hinter Flavio Alfaro, Kakao- und Bambusplantage, 250 m, 21. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4133, 2 Ex., 20 km von San Miguel entfernt, Bananenplantage, 500 m, 22. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4150, 1 Ex., San Miguel, 500 m, 22. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4136, 2 Ex., hinter Calderon in Richtung Quevedo, 550 m, 22. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. Prov. Cotopaxi, AF/4143 2, Ex., AF/4130, 3 Ex., 20 & 26 km von La Mana entfernt, 750-800 m, Wald, 23. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4135, 1 Ex., 7 km von La Mana, unter Moos und Bromelien, 400 m, 23. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4141, 1 Ex., El Guayacon, Kakaoplantage, 500 m, 23. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. Prov. Los Rios, AF/4128, 23 Ex., 10 km hinter Quevedo, Wald, 200 m, 23. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/4147, 1 Ex., AF/4344 1 Ex., 2 km hinter Quevedo, 150 m Kakao- und Bananenplantage, 23. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. Prov. Tungurahua, AF/4020, 3 Ex., bei Banos, Obstplantage, 1500 m, 30. 4. 1989, leg. Zicsi, Loksa & Ponce. AF/4033, 5 Ex., Prov. Chimborazo, Rio Verde, Wald, 1450 m, 30. 4. 1989, leg. Zicsi, Loksa & Ponce. Prov. Pastaza, AF/4022, 1 Ex., 10 km von Puyo in Richtung Macas, 900 m, 1. 5. 1989, leg. Zicsi, Loksa & Ponce. AF/4024, 1 Ex., 23 von Puyo, 900 m, 1. 5. 1989, leg. Zicsi, Loksa & Ponce. AF/4025, 2+5 juv. Ex., zwischen Puyo u. Palora, 800 m, Wald, 2. 5. 1989, leg. Zicsi, Loksa & Ponce. AF/4026, 26 Ex., AF/4027 6+8 juv. Ex., Umgebung von Madre de Tierra, 850 m, 2. 5. 1989, leg. Zicsi, Loksa & Ponce. AF/4029, 2+4 juv. Ex., Puyo, Wald, 900 m, 2. 5. 1989, leg. Zicsi, Loksa & Ponce. AF/4028, 11+7 juv. Ex., 22 km von Puyo in Richtung Banos, 1100 m, 3. 5. 1989, leg. Zicsi, Loksa & Ponce. AF/1445, 6 Ex., 1 km vor Madre de Tierra, neben der Hängebrücke, 450 m, 2. 5. 1989, leg. Zicsi, Loksa & Ponce. AF/4031, 16 Ex., hinter Madre de Tierra, Wald, 1100 m, 2. 5. 1989, leg. Zicsi, Loksa & Ponce. Prov. Zamora-Chinchipe, AF/3810, 5 Ex., AF/3823, 4 Ex., Chinchipe 4 km vor Loja, hinter der grossen Brücke, 900 m, 24. u. 29. 8. 1988, leg. Zicsi & Csuzdi. Prov. El Oro, AF/3825, 4 Ex., 36 km vor Santa Rosa, 500 m, 1. 5. 1988, leg. Zicsi & Csuzdi. AF/3827, 3 Ex., 5 km hinter Santa Rosa in Richtung Loja, Bananenplantage, 500 m, 2. 5. 1988, leg. Zicsi & Csuzdi. AF/3830, 11 Ex., 24 km hinter Santa Rosa in Richtung Loja, 600 m, 2. 5. 1988, leg. Zicsi & Csuzdi. AF/3834, 2 Ex., 11 km hinter Santa Rosa in Richtung

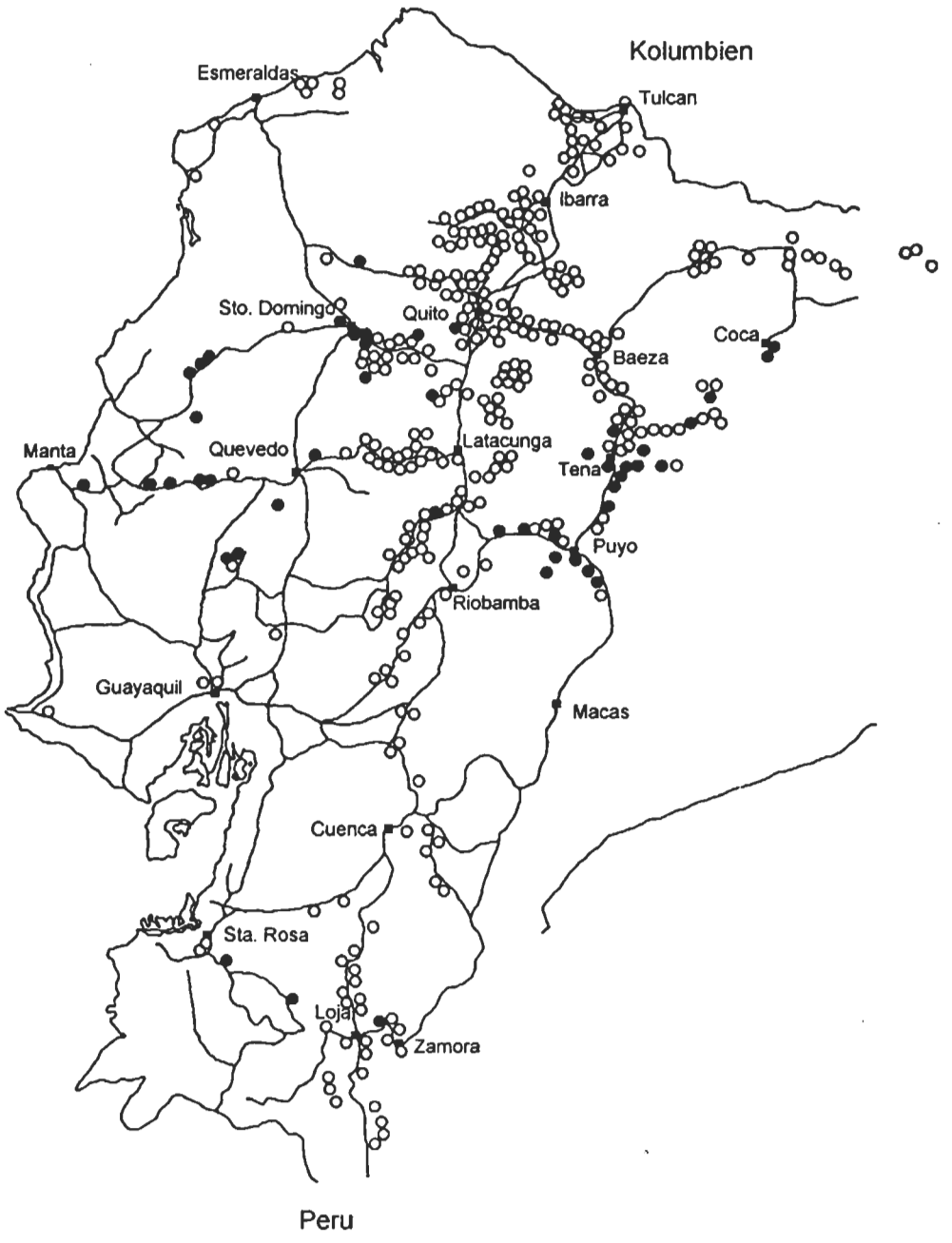


Abbildung 5. *Pontoscolex (P.) corethrurus* (Müller, 1857). Verbreitung der Art in Ekuador (schwarze Kreise)

Loja, 800 m, Flussufer und Wald, 2. 5. 1988, leg. Zicsi & Csuzdi.

Diese zirkumtropisch weitverbreite Art wurde im vorigen Jahrhundert nur von Festa an drei Orten in den südlichen Teilen Ekuadors, in der Prov. Zamora gesammelt (Cognetti, 1904). Wie aus den vorausgehenden Angaben (Zicsi & Csuzdi, 1988) sowie den jetzigen Fundorten zu ersehen, ist diese Art von der Provinz Pichincha und davon südlich weit verbreitet (Abb. 5). Mit Ausnahme einiger Fundorte wurde sie vorwieglich in Höhenlagen unter 1000 m, hauptsächlich auf landwirtschaftlich bebauten Böden, gesammelt. Da solche Fundorte beim Sammeln grösstenteils gemieden wurden, ist es anzunehmen, dass diese Art eine weit grössere Verbreitung besitzt, als dies aus den angeführten Sammelstellen hervorgeht. Es ist überhaupt nicht auszuschliessen, dass diese Art auch nördlich der Provinz Pichincha in tieferen Höhenlagen beiderseits der Andenketten vorkommt.

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SCHRIFTTUM

BEDDARD, F. E. (1891): The classification and distribution of earthworms. *Proc. R. Phys. Soc. Edinburgh*, 10: 235–290.

BEDDARD, F. E. (1895): A monograph of the order of Oligochaeta. *Calderon Press, Oxford*, pp. 769.

BENHAM, W. B. (1890): An attempt to classify earthworms. *Quart. Journ. Microsc. Sci.*, 31: 201–315.

BRINKHURST, R. O. & JAMIESON, B. G. M. (1971): Aquatic Oligochaeta of the world. *Oliver & Boyd Pres, Edinburgh*, pp. 860.

COGNETTI DE MARTIIS, L. (1904): Oligocheti dell'Ecuador. *Boll. Mus. Zool. Anat. Comp. Torino*, 19/474/: 1–18.

COGNETTI DE MARTIIS, L. (1906): Gli Oligocheti della regione neotropicale, II. *Mem. Accad. Torino*, 56: 147–262.

GATES, G. E. (1968): On a glossoscolecid earthworm from Panama and its genus. *Megadrilogica*, 1(1): 1–15.

MICHAELSEN, W. (1900 a): Die Terricolen-Fauna Columbiens. *Arch. Naturgesch.*, 66: 231–266.

MICHAELSEN, W. (1900 b): Oligochaeta. In: *Das Tierreich, Berlin*, 11: 1-575.

MICHAELSEN, W. (1902): Neue Oligochaeten und neue Fundorte altbekannter. *Mitt. Mus. Hamburg*, 19: 1-54.

MICHAELSEN, W. (1910 a): Sur quelques Oligochètes de l'Équateur. *Miss. Mer. Équat. Amer. Sud.*, 9 (3): 127-138.

MICHAELSEN, W. (1910 b): Oligochaeten von verschiedenen Gebieten. *Mitt. Mus. Hamburg*, 27: 47–169.

MICHAELSEN, W. (1913): Die Oligochaeten Columbias. *Mem. Soc. Neuchâtel*, Sc., 5: 202-252.

MICHAELSEN, W. (1918): Die Lumbriciden, mit besonderer Berücksichtigung der bisher als Familie Glossoscolecidae zusammengefassten Unterfamilien. *Zool. Jahrb. Syst.*, 41: 1–389.

MICHAELSEN, W. (1936): On the Genus *Thamnodrilus* Beddard. *Proc. Zool. Soc. London*, 1936: 1171–1173.

MÜLLER, F. (1857): Lumbricus corethrurus, Bürstenschwanz. *Arch. Naturgesch.*, 23: 113–116.

RIGHI, G. (1971): Sobre a familia Glossoscolecidae (Oligochaeta) no Brasil. *Arq. Zool. São Paulo*, 20: 1–96.

RIGHI, G. (1981): Alguns Oligochaeta cavernicolas do Ecuador. *Pap. Avul. Zool., S. Paulo*, 34 (22): 235-249.

RIGHI, G. (1984): *Pontoscolex* (Oligochaeta, Glossoscolecidae), a new evaluation. *Stud. Neotrop. Fauna*, 19 (2): 94–120.

RIGHI, G. (1995): Colombian Earthworms. *Stud. Trop. Andean Ecosystems*, 4: 487-607.

ROSA, D. (1895): I lombrichi del Museo di Storia Naturale di Madrid. *An. Soc. Espanola Hist. Nat.*, 4(2): 151–154.

ROSA, D. (1896): Contributo allo studio dei terricoli neotropicali. *Mem. Acc. Sc. Torino*, 45(2): 89–152.

SCHMARDA, L. K. (1861): Neue wirbellose Thiere beobachtet und gesammelt auf eine Reise um die Erde, 1853. 7. Oligochaeta, 2: 7–14.

ZICSI, A. (1988 a): Weitere neue und bekannte Martiodrilus-Arten aus Ekuador und Kolumbien (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 7. *Acta Zool. Hung.*, 34: 435–446.

ZICSI, A. (1988 b): Beiträge zur Kenntnis einiger *Martiodrilus*-Arten aus Ekuador (Oligochaeta: Glosso-

scolecidae). Regenwürmer aus Südamerika, 6. *Rev. suisse Zool.*, 95: 953–959.

ZICSI, A. (1990): Über neue Riesenregenwürmer und andere Martiodrilus-Arten aus Ekuador (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 8. *Acta Zool. Hung.*, 36: 367–380.

ZICSI, A. (1995 a): Regenwürmer aus Bolivien (Oligochaeta). *Rev. suisse Zool.*, 102(3): 585–608.

ZICSI, A. (1995 b): Ein weiterer Beitrag zur Regenwurm-Fauna der karibischen Region (Oligochaeta). Regenwürmer aus Südamerika, 24. *Mitt. Hamb. Zool. Mus. Inst.*, 92: 53–64.

ZICSI, A. (1998): Revision weiterer *Martiodrilus*-Arten (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 30. *Opusc. Zool. Budapest*, 31: 149–164.

ZICSI, A. (2000): Revision der Untergattung *Martiodrilus* (Martiodrilus Michaelsen, 1936) (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 29. *Opusc. Zool. Budapest*, 32: 139–167.

ZICSI, A. (2001): Revision der Untergattung *Martiodrilus* (Maipure Righi, 1995) (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 33. *Opusc. Zool. Budapest*, 33: 113–131.

ZICSI, A. & CSUZDI, Cs. (1987): Neue und bekannte Glossoscoleciden-Arten aus Südamerika, 2. (Oligochaeta: Glossoscolecidae). *Acta Zool. Hung.*, 33: 269–275.

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

ZICSI, A. & CSUZDI, Cs. (1997): Über weitere Riesenregenwürmer aus Ekuador. Regenwürmer aus Südamerika, 28. (Oligochaeta). *Ber. Nat.-Med. Ver. Innsbruck*, 84: 81–103.

ZICSI, A & CSUZDI, Cs. (1999): Neue und bekannte Regenwürmer aus verschiedenen Teilen Südamerikas. Regenwürmer aus Südamerika., 26. *Senckenb. Biol.*, 78: 123–134.

ZICSI, A. & FEIJOO, A. (1994): Regenwürmer aus der Zentralkordillere Kolumbiens (Oligochaeta: Glossoscolecidae). Regenwürmer aus Südamerika, 21. *Mitt. Hamb. Zool. Mus. Inst.*, 89: 55–62.

ZICSI, A., RÖMBKE, J. & GARCIA, M. (2001): Regenwürmer (Oligochaeta) aus der Umgebung von Manaus (Amazonien). Regenwürmer aus Südamerika, 32 *Rev. suisse Zool.*, 108(1): 153–164.

Opusc. Zool. Budapest, 2002, 34: 125-127

Eine neue *Xibaro*-Art aus Ekuador (Oligochaeta: Ocnerodrilidae)

Regenwürmer aus Südamerika, 38

A. ZICSI und CS. CSUZDI*

Abstract. A new *Xibaro* species from Ecuador (Oligochaeta: Ocnerodrilidae). Earthworms from South America, 38. A remarkable earthworm species, *Xibaro medioporus* sp. n. is described from Ecuador. The unusual condition of its spermathecae is discussed.

Die Arten verschiedener Gattungen der Familie Ocnerodrilidae sind z. T. durch Verschleppung auch weltweit verbreitet. Ohne auf die Verbreitung der nahezu 30 Gattungen hier eingehen zu müssen, sei bloss erwähnt, dass holoandrische Gattungen mit zwei Muskelmagen im 6. und 7. Segment vor den Hodensegmenten bis vor kurzem nur aus Südamerika, meroandrische Gattungen ebenfalls mit zwei Muskelmagen im 6. und 7. Segment in Südamerika und Afrika gleicherweise angetroffen werden konnten (Zicsi, 1997).

Die Vertreter dieser Familie wurden bisher, mit Ausnahme von *Xibaro ashmolei* Righi, 1981 (Prov. Morona-Santiago, Los Tajos, in einem ausgetrocknetem Flussbett), in Ekuador nicht angetroffen. Auch in unseren Sammlungen in den Jahren 1986–93 sind, mit Ausnahme der zur Beschreibung vorliegenden neuen Art *Xibaro medioporus* sp. n., keine anderen Mitglieder der Familie Ocnerodrilidae bisher bestimmt worden.

Gattung *Xibaro* Righi, 1981

Xibaro Righi, 1981: 241.
Xibaro: Zicsi, 1997: 176.

Xibaro medioporus sp. n.

(Abb. 1 A–B)

Fundort. Ekuador, Prov. Manabi. Holotypus: AF/4383, hinter Calderon in Richtung Quevedo, Bambuswäldchen, 22. 4. 1990, leg. Zicsi, Csuzdi & Gavilanes. AF/3320, 6+1 juv. Ex., Fundort wie beim Holotypus.

Äussere Merkmale. Länge des Holotypus 83 mm, Breite 2,5 mm, Segmentzahl 176. Paratypen: Länge 76–85 mm, Breite 2,3–2,5 mm, Segmentzahl 162–182.

Farbe fixiert weiss, unpigmentiert. Kopf epilobisch, durch einen Querbalken abgeschlossen. Borsten gepaart, Borstendistanz hinter dem Gürtel *aa: ab: bc: cd: dd* wie 7: 1: 6,5: 1: 28. Grosse, querliegende Papillen auf dem 14., 15., 16., 20., und 21. Segment oder auf einigen dieser Segmente (Abb. 1 A). Medioventral liegende, unpaarige Samentaschenporen im vorderen Teil des 8. und 9. Segments. Nephridialporen nicht erkannt. Rükkenporen fehlen.

Gürtel sattelförmig, auf dem ½14., 14. – ½25., 25. Segment. Zwei Paar Prostataöffnungen auf dem 17. und 19. Segment, die durch schwach S-förmige Geschlechtsfurchen verbunden sind.

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Männliche Poren auf dem 18. Segment in den Geschlechtsfurchen. Weibliche Poren nicht erkannt.

Innere Organisation. Dissepimente 5/6–8/9 etwas verdickt, 9/10–13/14 nur schwach angedeutet. Muskelmagen im 6. und 7. Segment. Ein Paar an den Oesophagus angepresste Kalkdrüsen im 9. Segment. Herzen im 7.–11. Segment. Hoden und Samentrichter im 10. und 11. Segment von perioesophagealen Testikelblasen umgeben. Zwei Paar kleine, traubenförmige Samensäcke im 11. und 12. Segment. Ovarien im 13. Segment. Zwei Paar Prostata im 17.–19. Segment; dünne, mehrfach aufgewickelte Gebilde, die entweder weit nach hinten reichen oder aufgewickelt den Mitteldarm umfassen. Mitteldarm im 13. Segment beginnend, keine Typhlosolis vorhanden.

Nephridien vor dem Gürtel spiralenförmige Gebilde ohne Nephridialblase. Hinter dem Gürtel sind die Nephridien breite weisse Gebilde, z. T. mehrfach unterbrochen, ohne Nephridialblasen.

Samentaschen im 7. und 8. Segment unpaarig, ventromedial ausmündend. Ampulle sackförmig mit halbsolangem Ausführungsgang (Abb. 1 B).

Verwandtschaft. Die neue Art steht ihrem einzigen Artgenossen, *X. ashmolei* Righi, 1981 am nächsten. Unterscheidet sich von dieser in der Lage des Gürtels, in der Form und Unpaarigkeit der Samentaschen sowie der Papillen auf dem Gürtelsegment.

Bemerkung. Bei einem der sechs Paratypen waren die ventromedialen Samentachen paarig angeordnet, auf der linken Seite befanden sich drei, auf der rechten Seite zwei Samentaschen. Die fadenförmigen Prostata lagen bei diesem Exemplar mehrfach aufgewickelt in einem Knäuel nach vorne gerichtet im 7. Segment und waren fest an den Oesophagus gepresst. Da nur ein Exemplar mit paarigen Samentaschen angetroffen wurde, muss angenommen werden, dass es sich um eine Anomalie handelt.

Bei Vertretern der Familie Octochaetidae sind Arten mit unpaarigen medioventralen Samentaschen bekannt, die unter Berücksichtigung auch anderer Merkmale in supraspezifische Taxa (*Wegeneriella* Michaelsen, 1933, emend. Zicsi &

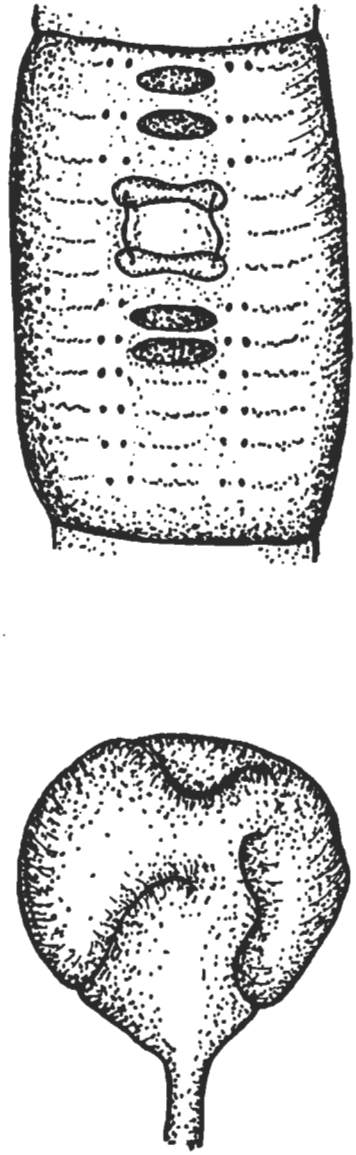

Abbildung 1. *Xibaro medioporus* sp. n. A: Ventralansicht der Gürtelregion mit Papillen; B: Samentasche aus dem 8. Segment

Csuzdi, 1989; *Wegeneriona* Černosvitov, 1939) zusammengefasst werden (Csuzdi, 1993). Wegen der niederen Zahl der Exemplare im vorliegenden Material und dem von uns als Anomalie angesehenen Tier, muss weiteres Material entscheiden, ob der Unpaarigkeit der Samentaschen in dieser Familie ein supraspezifischer Wert zugemessen werden kann.

SCHRIFTTUM

ČERNOSVITOV, L. (1939): Oligochaeta, VIII. In: Résultats scientifiques des croisières du Navire École Belge »Mercator«. *Mém. Mus. Roy. Hist. Nat. Belgique*, 15: 115–129.

CSUZDI, Cs. (1993): Über die taxonomischen Probleme einiger amphiatlantischer Regenwurm-Gattungen (Oligochaeta, Octochaetidae). Regenwürmer aus Südamerika, 18. *Acta Zool. Hung.*, 39: 61–69.

MICHAELSEN, W. (1933): Die Oligochätenfauna Surinames. Mit Erörterung der verwandtschaftlichen und geographischen Beziehungen der Octochätinen. *Tijdschr. Nederl. Dierk. Ver.*, 3: 112–130.

RIGHI, G. (1981): Alguns Oligochaeta cavernicolas do Equador. *Pap. Avul. Zool.*, 34: 235–249.

ZICSI, A. (1997): Weitere Regenwürmer (Oligochaeta) aus der Volksrepublik Kongo. *Rev. Suisse Zool.*, 104: 171–183.

ZICSI, A. & CSUZDI, Cs. (1989): Eine neue *Wegeneriella*-Art aus dem Kongo-Gebiet (Oligochaeta: Octochaetidae). *Misc. Zool. Hung.*, 5: 29–31.

Opusc. Zool. Budapest, 2002, 34: 129–130

An interesting new record of *Macrogastra borealis bielzi* Nordsieck, 1993 (Gastropoda: Clausiliidae) in Hungary

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Abstract. *Macrogastra borealis bielzi* Nordsieck, 1993, a rather rare clausilid snail in Hungary, is distributed in the Carpathian-Baltic area. In the course of collecting trips between 1974 and 2002 in the Duna–Ipoly National Park, Börzsöny Mountains, the presence of this species was proved. The new data is the southernmost and westernmost point of its occurrence.

Within the scope of the Hungarian Malacological Fauna Mapping (and EIS), I carried out, from 1974, faunistical and ecological investigations in the Duna–Ipoly National Park, Börzsöny Mountains, northern Hungary. I could note several new and zoogeographically interesting data of snail occurrences in the northern regions of the country (Erőss, 1980, 1981). The most interesting of them was the finding of the clausilid species *Macrogastra borealis bielzi* Nordsieck, 1993. This snail species is distributed in the Carpathian–Baltic geographical area, and was only sporadically observed in Hungary.

In the northern mountains of the country, *M. borealis bielzi* has already been observed in the Aggteleki Karszt, Zemplén and Karancs Mountains, Mátra Mountains, and in some occasions also in the Bükk Mountains (Pintér, Richnovszky, & Szigethy, 1979).

Although Varga (1976) reported this species from the Börzsöny, the probably very small population has meanwhile disappeared. I had spent many years in trying to rediscover this clausilid in the Börzsöny region.

At least, in 1998, I found it, 6 km away in the direction North-east and 650 metres higher at Tátralátó (915 m above sea-level), part of Magosfa, in an old beech wood, under the bark of a fallen trunk. One (dead) specimen of this population is deposited in the Natural History Museum, Budapest, Hungary.

From zoogeographically point of view, this discovery is more interesting, because this is the outermost occurrence of the species in the directions of south-west, quite far from the Carpathian-Baltic region, the true distribution area of it.

The present occurrence is so isolated, that rather *Macrogastra plicatula rusiostoma* Held, 1836 had been prospective than *Macrogastra borealis bielzi* (Fehér & Gubányi, 2001).

It is worth mentioning a small and special Gastropoda coexistence that could be observed under the bark of the same trunk where *M. borealis bielzi* was detected. Of the twelve species, five belonged to the strictly protected snails of our fauna (marked with stars):

Balea biplicata
*Cochlodina cerata**
Cochlodina laminata
Clausilia pumila
Discus perspectivus
Discus rotundatus
*Discus ruderatus ruderatus**
*Ena montana**
Macrogastra borealis bielzi
Macrogastra ventricosa
*Ruthenica filograna**
*Vestia turgida**

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REFERENCES

ERÓSS, Z. P. (1980): Adatok a Déli-Börzsöny puhatestű faunájához. (Beiträge zur Molluskenfauna des südlichen Börzsöny-Gebirges.) *Soosiana*, 8: 49-54.

ERÓSS, Z. P. (1981): *Vertigo substriata* (Jeffreys, 1833) a Börzsöny-hegységben. (*Vertigo substriata* [Jeffreys, 1833] im Börzsöny-Gebirge.) *Soosiana*, 9: 47-48.

FEHÉR, Z. & GUBÁNYI, A. (2001): A magyarországi puhatestűek elterjedése. *A Magyar Természettudományi Múzeum Puhatestű Gyűjteményének katalógusa., Budapest*, 466 pp.

KERNEY, M. P., CAMERON, R. A. D. & JUNGBLUTH, J. H. (1984): Die Landschnecken Nord- und Mitteleuropas. *P. Parey, Hamburg-Berlin*, 384 pp.

PINTÉR, L., RICHNOVSZKY, A. & SZIGETHY, A. (1977): A magyarországi recens puhatestűek elterjedése. *Soosiana, Suppl.*, 351 pp.

VARGA, A. (1976): Adatok a Börzsöny-hegység puhatestű faunájához. (Beiträge zur Molluskenfauna des Börzsöny-Gebirges.) *Soosiana*, 4: 47-50.

Eremocoris abietis (Linnaeus, 1758), eine für die Fauna Ungarns neue Wanze (Insecta: Heteroptera)

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Abstract. *Eremocoris abietis* (Linnaeus, 1758), a new bug to the Hungarian fauna. A heteropteran species, *Eremocoris abietis* (family Rhyparochromidae) proved to be new to the fauna of Hungary.

Die Mitarbeiter des Lehrstuhls für Tiersystematik und Ökologie der Eötvös-Loránd-Universität (Budapest) haben unter Leitung von Dr. I. Loksa zwischen 1953–1990, in verschiedenen Gegenden des Landes Sammlungen mit Bodenfallen durchgeführt. Ausserdem wurden auch zahlreiche Bodenproben (Laub, Moos, Bodenstreu) ausgelesen, deren Material in 70 %igem Alkohol aufbewahrt wurde. Aus diesen wurden die Wanzen zum grössten Teil sortiert und bestimmt. Im Material wurden einige Exemplare einer in der Fauna Ungarns bisher unbekannten Art, *Eremocoris abietis* (Linnaeus, 1758) auch angetroffen. Fundort: Gödöllő, 1980, Bodenfalle, leg. Loksa (2 ♂♂, 2 ♀♀).

In der Gattung *Eremocoris* Fieber, 1860 (Familie Rhyparochromidae) sind etwa 50 Arten bekannt, von denen kommen in der Paläarktik 18, in der euro-mediterranen Region 10 Arten vor. Von den in Mitteleuropa lebenden vier Arten waren drei lange auch aus Ungarn bekannt (Kondorosy, 1999). Das Vorkommen der Art *E. abietis*, die eine eurosibirische Verbreitung besitzt, war auch zu erwarten, da viele Exemplare von ihr in den Nachbarländern wie Österreich, Slovakei und Ukraine gesammelt wurden. In den Ländern, die südlich von Ungarn liegen, scheint sie viel seltener zu sein, aber einige Exemplare wurden auch aus Rumänien und Kroatien gemeldet. In Nordeuropa hält sich die Art auf dem Boden trockener Nadelwälder auf und ernährt sich ausschliesslich von Kerne verschiedener *Pinus*-Arten. In Mittel- und Südeuropa, und wahrscheinlich auch in Ungarn, lebt sie in Laubwäldern unter Laub und konsumiert die Kerne verschiedener Bäume (*Ulmus*-, *Quercus*-, *Acer*- und *Fraxinus*-Arten) (Péricart, 1998).

SCHRIFTTUM

KONDOROSY, E. (1999): Checklist of the Hungarian bug fauna (Heteroptera). *Folia Entomol. Hung.*, 60: 125–152.

PÉRICART, J. (1998): Hémiptères Lygaeidae Euro-Méditerranées. – In: Faune de France: France et régions limitrophes, 84 A–C. *Fédération Française des Sociétés des Sciences Naturelles*, Vol. 1: XX + 468 pp., Vol. 2: 453 pp., Vol. 3: 487 pp.

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