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Nematodes from Ecuador
A new genus, four new and a known species (Dorylaimida)

By
I. ANDRÁSSY[*]

Abstract. In the first part a new genus, *Incanema*, gen. n., and two new species of the family Leptonchidae are described from Ecuador. *Incanema* is primarily characterized by the shape and structure of the oesohagus cylindrus: it has a constricted anterior part and it penetrates with posterior end into the intestine. Type species: *I. quondam* sp. n. *Tylencholaimellus neotropicus* has very long spicula; it differs from the two sister-species of long spicula by presence of a conspicuous supplementary papilla in male.

In the second part two new and an old species of nematodes belonging to genera known only from South America so far, *Pachydorylaimus* and *Miodorylaimus*, respectively, are described. *Pachydorylaimus aequatorialis* sp. n. is characterized by a comparatively large body, cup-shaped amphids, well sclerotized vulval lips and long tail. *Pachydorylaimus andreasi* sp. n. differs from the other members of the genus in having unusually wide amphid apertures. *Miodorylaimus decens* ANDRÁSSY, 1986 is redescribed. All three species have been collected in Ecuador.

I. Incanema gen. n., and two new species of the family Leptonchidae

A rich nematode material collected in 1987 in Ecuador by Dr. I. LOKSA and Dr. A. ZICSI contains, among others, two interesting new species of the family Leptonchidae, for one of which a new genus, *Incanema* gen. n., shall be suggested.

Incanema gen. n.

Leptonchidae, Leptonchinae. Subcuticle loose and folded, with refractive elements. Head leptonchid, cap-like, offset by constriction. Spear thin but with distinct lumen. Oesophagus very slender, tubular in most part, then suddenly widened to a short, bulboid cylindrus possessing a distal piriform swelling offset by constriction. Proximal end of cylindrus surrounded by an intestine collar. Prerectum very long; intestine-prerectum junction located far anterior to mid-body. Amphidelphic. Male precloacal supplements spaced and located before the spicula. Tails of both sexes similar, short, rounded.

Type species: *Incanema quondam* sp. n.

The new genus belongs to the family Leptonchidae and to its type subfamily. It shows a combination of characteristics of some leptonchid genera like *Leptonchus* COBB, 1920, *Funaria* VAN DER LINDE, 1938, *Proleptonchus* LORDELLO, 1955 and *Apoleptonchus* SIDDIQI, 1982. In two phenomena however it differs from every of the mentioned as well as the other genera of Leptonchidae. First, a constricted swelling is present on the anterior end of cylindrus, second, the proximal end of cylindrus is penetrated into the intestine. Both these characters are constant and distinctly separate the genus from its relatives.

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Otherwise, *Incanema* can easily been distinguished – mentioning here only one or two characteristics – from *Leptonchus* by oesophagus constriction and straight spear extension, from *Funaria* by conspicuous spear lumen and transverse vulva, from *Proleptonchus* by perceptible spear lumen and amphidelphic gonads, from *Apoleptonchus* by very long prerectum and prevulval position of intestine-prerectum junction.

The word „*Inca*" in the name of the new genus is reverence to the memory of the late inhabitants of Ecuador, the Incas.

Incanema quondam sp. n.

(Figs. 1 A-G and 2 A-D)

Holotype, female: L = 1.34 mm; a = 31; b = 4.4; c = 49; V = 65 %; c' = 1.0.

Female: L = 1.23–1.33 mm; a = 28–30; b = 4.5–4.8; c = 51–57; V = 60–65 %; c' = 0.9–1.1.

Male: L = 1.21–1.29 mm; a = 30–34; b = 4.7–5.4; c = 49–58; c' = 0.9–1.1.

Body 42–44 (female) or 36–40 (male) µm wide. Cuticle + subcuticle 2.5–3 µm thick, occa- sionally thicker; outer layer thin and smooth, inner layer loose and folded, with radial refractive striae. Subcuticle especially at vulva and tail region thick or loose, with conspicuous radial dots. Labial region cap-like, 12–14 µm wide, strongly set off from body. Body at posterior end of oesophagus 2.7–3 times as wide as head. Aphids caliciform, wider than half a corresponding body width.

Spear thin but with distinct lumen. Its length, 8–10 µm or so, cannot be stated with certainty since it is gradually continued – without any transitional junction – into the extension. Aperture small; extension straight. Guiding ring thin. Oesophagus 250–300 µm long, in most part very slender, tubular and non-muscular, suddenly widened in 81–85 % of its length. Cylindrus small, bulboid, 40–48 µm, 2–2.3 times as long as wide. The cylindrus may be characterized by two constant phenomena: *1)* Its anterior end is conspicuously set off and forms a piriform swelling. *2) Its p*osterior end penetrates into the intestine, or in other words, the cardial region of intestine forms a collar-like ring around the proximal end of the cylindrus. This intestine „collar" is either symmetrical – of the same length both ventral and dorsal – or, often, asymmetrical: longer on the one side (mostly ventral). Oesophageal nuclei well discernible, dorsal nucleus quite close to cylindrus constriction, anterior subventral nuclei at mid-cylindrus, posterior subventral nuclei closer to those than usual. Distance between posterior end of oesophagus and vulva 1.9–2 times as long as oesophagus.

Cardia flattened. Intestine consisting of two sections. The anterior, shorter part shows wide lumen and ends in 37–45 % of body length in a transverse „dike". From the latter the intestine goes on as a narrow-lumened tube which is generally called prerectum. (Whether is it homologous with the short and wide-lumened prerectum of other Dorylaimida?) The posterior section of intestine, the „prerectum", is very long, 710–760 µm or 16–20 body widths: it starts always far anterior to vulva, even before the prevulval gonad. The intestine-prerectum junction is simple, not guarded by three cells being frequent in other leptonchid genera. Rectum 1.5–1.6 anal diameters long.

Vulva transverse, vagina as long as or somewhat longer than half a body width, 22–26 µm, not sclerotized. Subcuticle with large lacunae on both sides of vulva. Amphidelphic; anterior gonad 5–5.3 times, posterior 4.4–4.8 times as long as body width. Uterus packed with sperm.

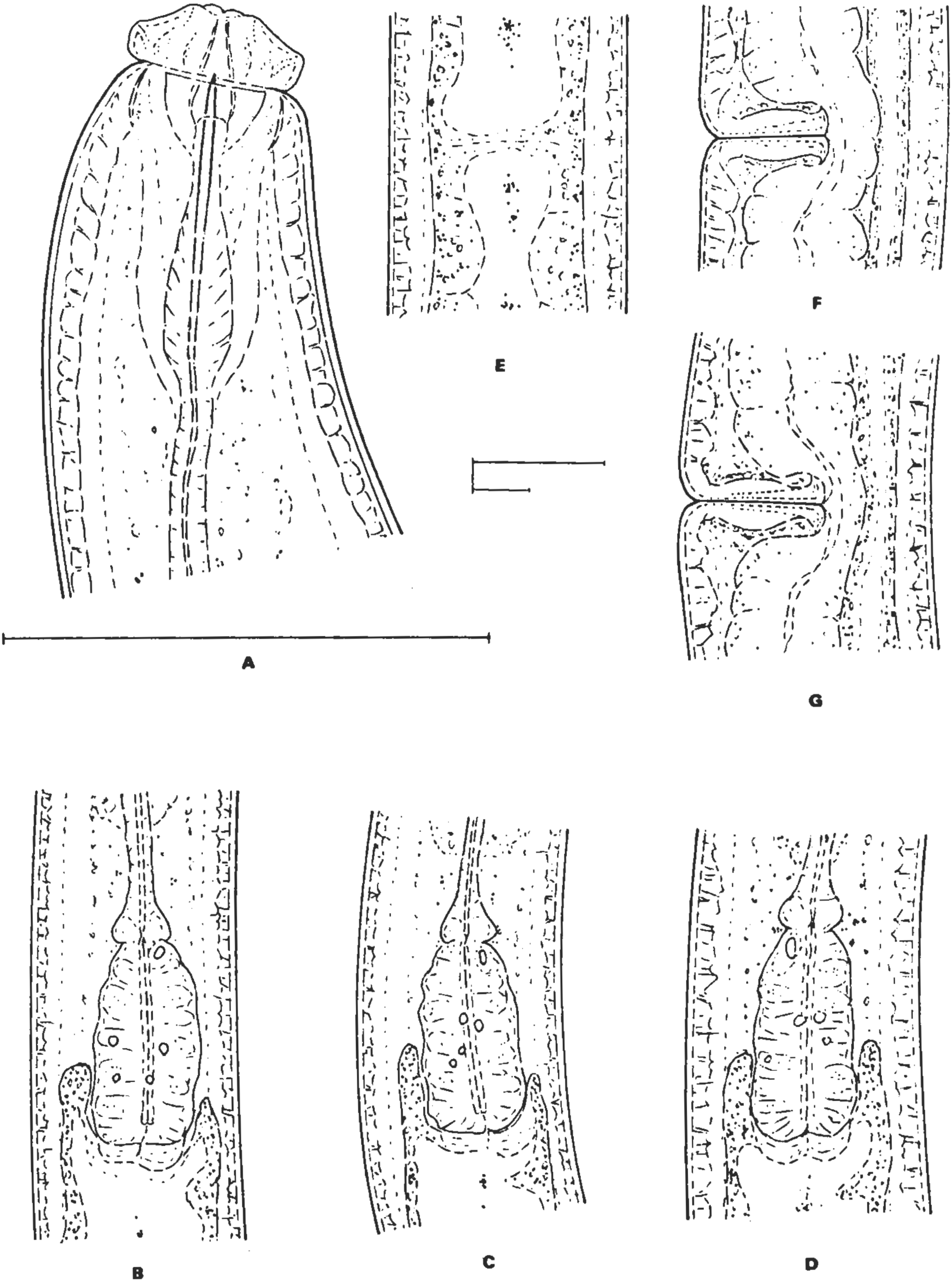

Fig. 1. *Incanema quondam* gen. n., sp. n. A: anterior region, and body width at proximal end of oesophagus; B–D: posterior ends of oesophagus in different specimens; E: intestine-prerectum junction; F–G: vulval regions of two females. (Bars = 10 μm each; upper: A, lower: B–G)

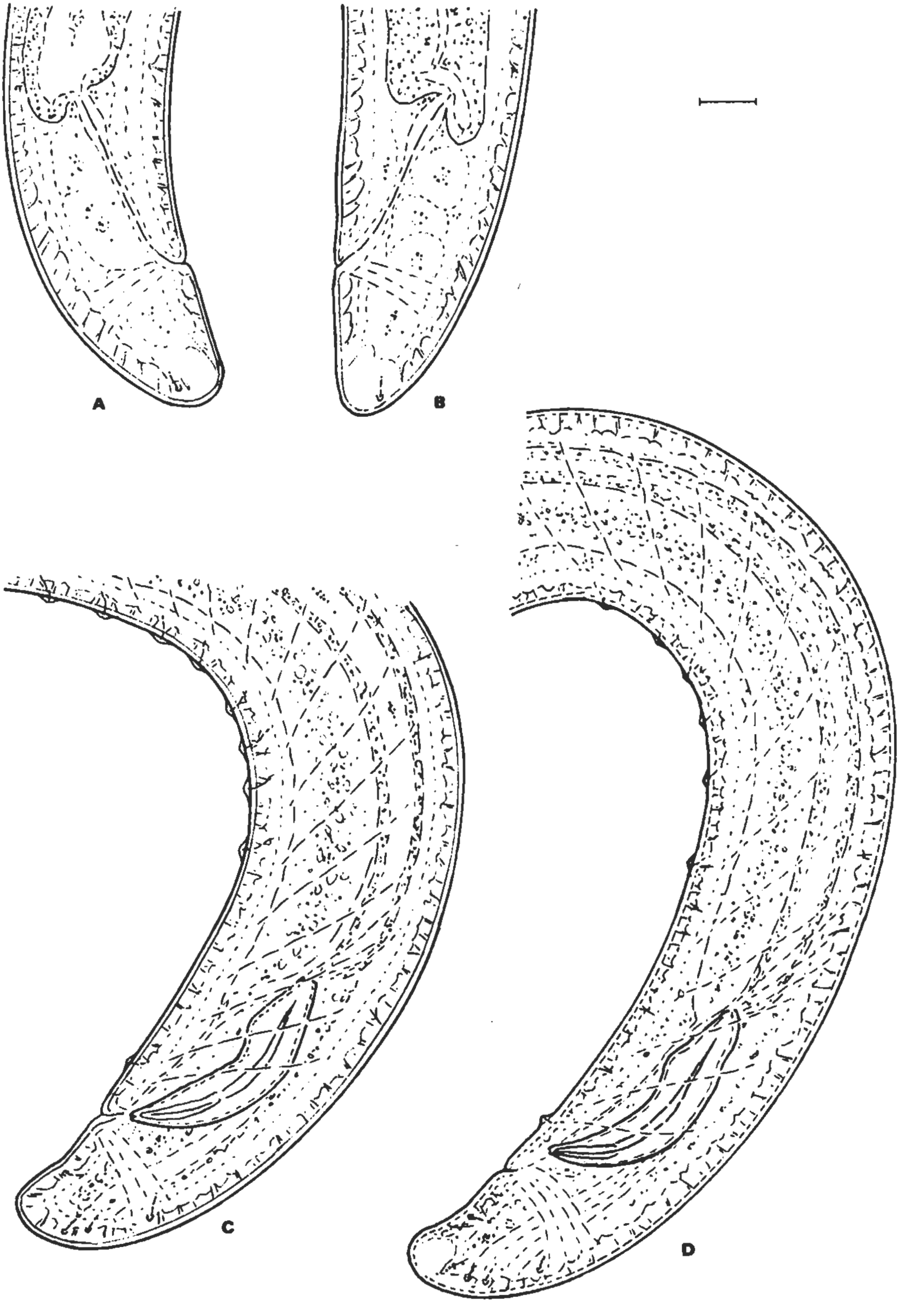

Fig. 2. *Incanema quondam* gen. n., sp. n. A–B: female tails; C–D: posterior ends of two males. (Bar = 10 μm)

Distance between vulva and anus 16–22 times as long as tail. Tail 22–27 μm, 0.9–1.1 anal diameter, 1.7–2 % of body length, short-conoid with rounded terminus.

Male prerectum similar in length to that of female; intestine-prerectum junction located anterior to testes. Testes paired. Spermatozoa fusiform, 8–9 μm, about 1/5 as long as body width. Spicula 38–43 μm, dorylaimid, lateral guiding pieces 1/4 (rarely nearly 1/3) as long as spicula. Preanal supplements 6–8 (6 in five animals and 8 in two), well separated, located anterior to spicula, posteriormost of them lying at 55–70 μm from cloaca. Tail like in female, 22–24 μm, 0.9–1.1 anal diameter, 1.7–2 % of body length.

Holotype: Female; Slide Number 13097. Paratypi: 2 females and two juveniles.

Type locality: Cashca Totoras, Prov. Bolivar, Ecuador; 3000 m above sea-level, rain forest, detritus from stems of *Bromelia* grown on trees; collected in April 1987 by I. LOKSA and A. ZICSI.

Tylencholaimellus neotropicus sp. n.

(Fig. 3 A–G)

Holotype, male: L = 0.94 mm; a = 25; b = 5.1; c = 50; c' = 0.8.

Female: L = 0.96–0.98 mm; a = 23–25; b = 5.1–5.3; c = 44–50; V = 28–32 %; c' = 0.7–0.9.

Male: L = 0.92–1.00 mm; a = 25–28; b = 5.2–5.6; c = 45–48; c' = 0.7–0.8.

Body fairly plump and cylindroid, 39–45 (female) or 33–38 (male) μm wide in mid-region. Cuticle 3–3.5 μm thick, on tail 5–6 μm, consisting of two distinct layers. Cuticle surface smooth, inner layer radially striated, especially marked on tail. Labial region rounded, hardly separated from body, 9–10 μm wide; lips amalgamated. Body at proximal end of oesophagus 3.5–3.7 times as wide as head. Amphids of 1/2 corresponding diameter or somewhat wider.

Spear and extension cannot be separated clearly, their common length is 24–25 μm, 2.5 labial diameters or 13–14 % of entire length of oesophagus. Dorsal stiffening piece distinct, occupying nearly 2/3 spear length. Extension flanged. Oesophagus 180–184 μm long, in 80–82 % expanded, cylindrus short, 33–36 μm, about 20 % of oesophagus, bulb-like. Nuclei conspicuous. Cardia small, discoid. Distance between posterior end of oesophagus and vulva shorter (0.7 times) than oesophagus. Prerectum 2–2.5, rectum 0.5–0.8 anal diameters long.

Vulva transverse, inner lips not sclerotized. Vagina bottle-shaped, plump, 17–18 μm, more than 1/3 body width long. Opisthodelphic species. Posterior gonad 5.5–6.2 times as long as body width or 30 % of body length, anterior uterine sac 1–1.5 body widths long. Ovary reflexed to near vulva.

Distance vulva-anus 30–33 times as long as tail. The latter 21–23 μm, shorter (0.7–0.9 times) than anal body width, only 2 % of body length, broadly rounded with strongly thickened cuticle.

Testes two. Spermatozoa 8 μm long, fusiform, 1/4–1/5 as long as body width. Spicula long, 42–45 μm, the double of tail length, very slender, differing from general dorylaimid type. Adcloacal papillae a little more distant from cloaca than usual, levelling one with other. A single conspicuous ventromedial supplement present, located at 36–46 μm from cloaca, somewhat anterior or posterior to proximal end of spicula. Copulatory musculature more oblique than in other dorylaims. Tail 20–24 μm, somewhat shorter than anal

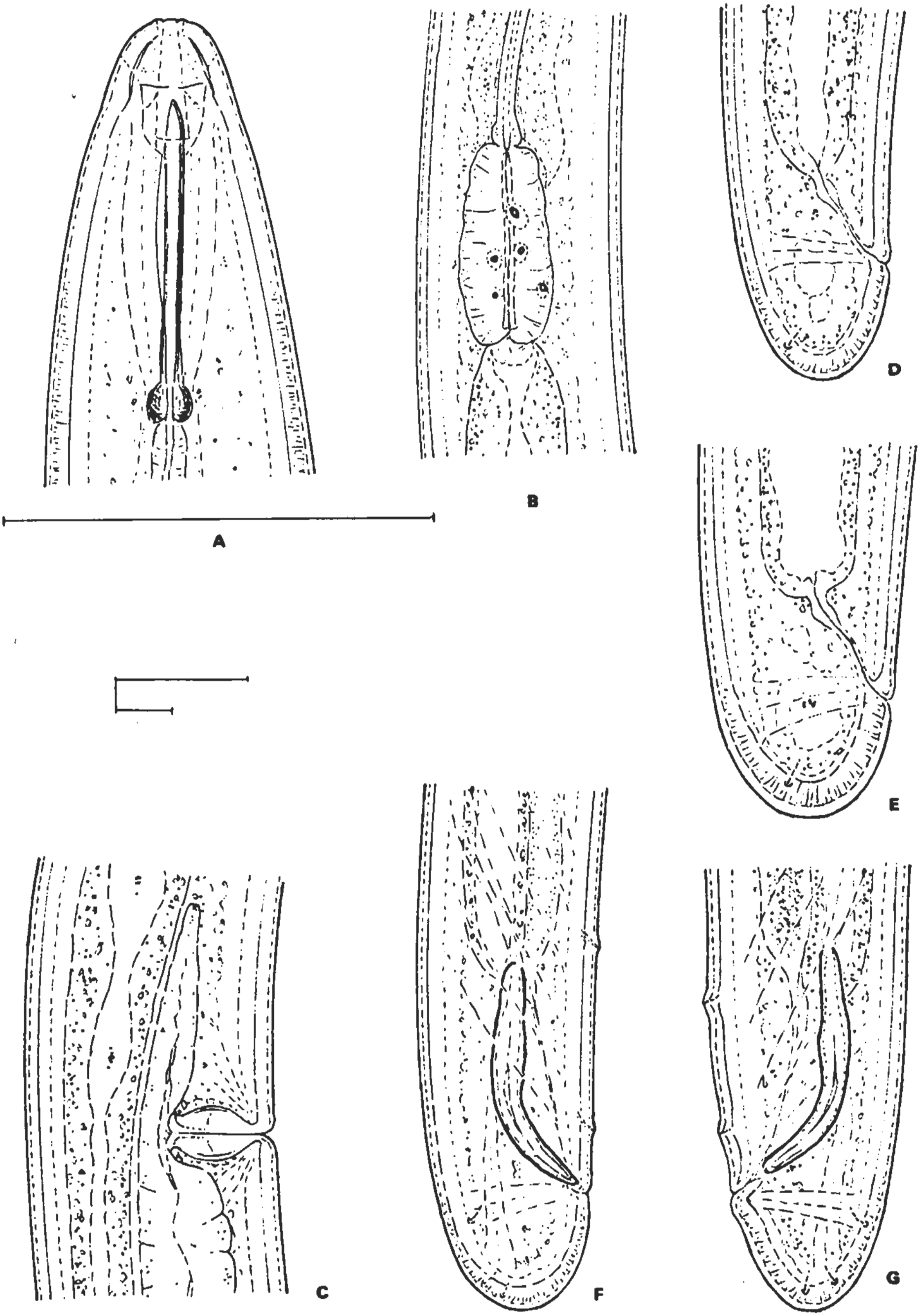

Fig. 3. *Tylencholaimellus neotropicus* sp. n. A: anterior end, and body width at posterior end of oesophagus; B: oesophagus cylindrus; C: vulval region; D–E: female tails; F–G: posterior ends of two males. (Bars = 10 μm each; upper: A, lower: B–G)

diameter (0.7–0.8 times), about 2 % of body length, similar to that of female, with three pairs of small papillae.

The genus *Tylencholaimellus* COBB in COBB, 1915 counts 40 nominal species. Among them, only two are known which possess very long spicula of about two tail lengths: *T. macrophallus* THORNE, 1964 and *T. cylindricus* PEÑA SANTIAGO, PERALTA & SIDDIQI, 1993. Both *macrophallus* and *cylindricus* are characterized in having no precloacal supplement at all. The new species, *T. neotropicus* sp. n., unambiguously differs from them in having a conspicuous ventromedial supplement. Unfortunately, it is not clear how many males had THORNE studies; he wrote: „Holotype female, allotype and 19 other specimens". PEÑA SANTIAGO and co-authors observed three males all showing no trace of supplement, while each male (3 specimens) of the recent material was provided with a well discernible supplementary papilla. We may suppose that presence/absence of supplements is characteristic and constant for a species.

In their *Tylencholaimellus* revision, GOSECO, FERRIS and FERRIS (1975) described a male specimen under the name *T. macrophallus*. An identity with *macrophallus* may be argued by the fact that they – just like THORNE – collected that male around palm roots in Puerto Rico. Whereas, it shall be mentioned as counter-argument for identification that their animal was provided with an „indistinct" (?) supplementary papilla. Farther, the spear showed an other shape. While „the dorsal accessory piece of spear extending about half its length" (THORNE), it was illustrated as occupying two-thirds of spear length by GOSECO. Last but not least, another difference weakens the identification of GOSECO and colleagues: the length of spicula amounted about 60 μm at THORNE (calculated from the drawing), but it was only 44 μm in the other authors. For this it is questionable that the 1975 male really belonged to THORNE's species.

Holotype: Male; Slide Number 13429. Paratypi: 2 females, 2 males and 1 juvenile.

Type locality: Pusuno, Prov. Napo, Ecuador; fallen leaves from a „young" rain forest, 300 m above sea-level; collected in April 1987 by I. LOKSA and A. ZICSI.

II. Pachydorylaimus Siddiqi, 1983 and Miodorylaimus Andrássy, 1986, two nematode genera known, heretofore, from South America

The distribution of free-living species of Nematoda is predominantly determined by ecological conditions (humidity, microclimate, food chances etc.), geographical factors play only secondary role in their occurrence. Similar case is seen in supraspecific categories: the number of genera, even families circumscribed to definite geographical units is small. Best known in this respect is the family Actinolaimidae: not every but the overwhelming majority of its species inhabits the subtropical-tropical zones of our Globe.

In this part of the present article two dorylaimid genera are presented which do show a geographical limitation: both have been described from South America, and their species, in our present-day knowledge, are distributed only in the neotropics. *Pachydorylaimus* SIDDIQI, 1983 (Qudsianematidae) is the one. SIDDIQI erected this genus for four species all had been discovered in rain forests of Colombia. The other is *Miodorylaimus* ANDRÁSSY, 1986 (Dorylaimidae). It was proposed for two species discovered in Peru.

In a rich nematode material originated from Ecuador I found now some species of the above mentioned genera – two new and a known – which shall be reported below. The present material was collected between 1986 and 1990 in different parts of Ecuador by the late Dr. I. LOKSA, furthermore by Dr. A. ZICSI and Dr. CS. CSUZDI (Department of Systematic Zoology and Ecology of the Loránd Eötvös University, Budapest). The material was fixed on the pot in 4 % formaldehyde, and after separation from soil in the laboratory the nematodes were mounted in anhydrous glycerine.

Pachydorylaimus SIDDIQI, 1983

A well outlined dorylaimid genus, it may be characterized, after SIDDIQI's description, by small body, truncate lip region, narrow amphids of oval apertures, short but heavily sclerotized odontostyle showing rounded tip and posteriorly bifurcate walls, weakly flanged odontophore, paired gonads possessing short arms, conoid-elongate tail being similar in both sexes, and few and weakly expressed copulatory supplements in male.

SIDDIQI regarded his genus as belonging to the type subfamily of Qudsianematidae. In general morphology, *Pachydorylaimus* suits well this family indeed, only the comparatively long tail is strange a little for the group. A quite similar spear shape can be found in an other dorylaimid genus, *Metadorylaimus* JAIRAJPURI & GOODEY, 1966. The type and only species was described from West Africa; it differs from every representative of *Pachydorylaimus* by the cap-like leptonchid head, very thick cuticle, non-flanged spear extension, and the short, broadly rounded tail.

Four species of *Pachydorylaimus* have been described: *P. furcatus* SIDDIQI, 1983; *P. longicaudatus* SIDDIQI, 1983; *P. notabenus* SIDDIQI, 1983; *P. pachyvulvus* SIDDIQI, 1983. It is remarkable that all of these species have been discovered in one country: in rain forest regions of Colombia. Every species is a real unit well separated from the others. In my Ecuador material I found two representatives of SIDDIQI's genus. Although in shape of the amphids some difference can be observed, the Ecuadorian nematodes – two distinct species – do belong undoubtedly to *Pachydorylaimus*. Nevertheless, they can not be identified with one or other of the Colombian species; both represent further members of the genus. Thus, *Pachydorylaimus* can be considered, in all likelihood, a characteristic genus in the neotrope region where it shows an interesting evolutionary trend in splitting up into sister-species. That there is a tendency of tearing up within the genus itself as well, it is expressed in the different appearance of amphids in the four Colombian species on the one hand and in the two Ecuadorian ones in the other hand.

Pachydorylaimus aequatorialis sp. n.

(Figs. 4 A-D, 5 A-C and 6 A-B)

Holotype, female: L = 1.06 mm; a = 24; b = 4.0; c = 6.1; V = 48 %; c' = 6.5.

Female: L = 0.90–1.03 mm; a = 20–23; b = 3.9–4.3; c = 5.3–6.3; V = 43–51 %; c' = 6.5–7.8.

Male: L = 1.13 mm; a = 34; b = 5.3; c =6.3; c' = 7.5.

Body fairly robust, 43–47 (female) or 33 (male) μm wide in mid-region. Cuticle 1.3–1.5 μm thick, smooth, subcuticle with fine radial striation. Labial region truncate, anteriorly flattened, 19–20 μm wide, slightly separated from neck region. Lips rounded, amalgamated. Amphids broad cup-like, 40–50 % of corresponding body width, aperture a narrow slit. Body at posterior end of oesophagus 2.2–2.4 times as wide as head.

Atrium of buccal cavity slightly sclerotized. Spear (odontostyle) short and massive, 15–16 μm long and 3.3–3.5 μm thick, 1/14–1/17 of oesophagus length; in male somewhat shorter, 13 μm, 1/16 of oesophagus, at least twice as thick as cuticle at the same level. Tip of spear rounded, aperture small; walls very thick, posteriorly bifurcate. Odontophore 28–

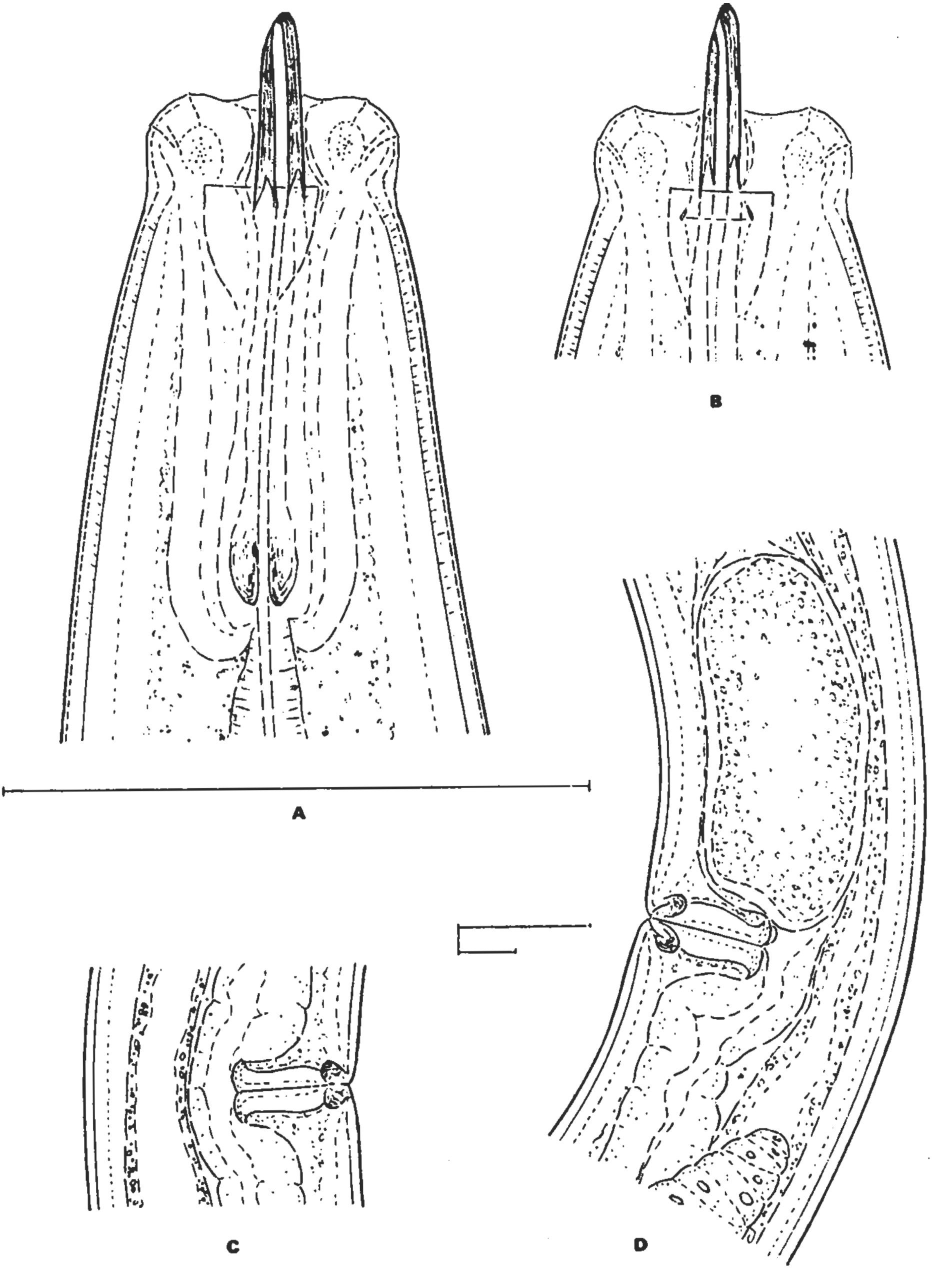

Fig. 4. *Pachydorylaimus aequatorialis* sp. n. A: anterior ends of two specimens; C–D: vulval regions of two females. (Bars = 10 µm each; upper: A–B, lower: C–D)

30 μm, 1.9–2 times as long as spear, weakly flanged proximally. Oesophagus 224–263 μm long, in 52–53 % widened. Cylindrus – the proximal widened region of oesophagus – 123–137 μm long, 5–6 times as long as wide. Oesophageal nuclei well discernible; dorsal nucleus close to the beginning of cylindrus, anterior subventral pair at middle of cylindrus, posterior pair about one cylindrus width before oesophagus terminus. Cardia tongue-shaped. Distance between oesophagus end and vulva equal with oesophagus. Intestine thin-walled with wide lumen, often filled with a compact mass of food rests. Prerectum short, 1.4–1.8, rectum 1.1–1.2 anal diameters.

Vulva transverse with distinctly sclerotized inner lips. Vagina 23–24 μm, nearly half as long as body diameter. Female genital organ amphidelphic, gonads short, each as long as 2.3–3 body widths. Anterior gonad mostly on the right, posterior on the left side of body. Ovaries consisting of few cells (9–14 each). One egg was observed: 68 × 30 μm, 1.5 body diameters long.

Distance between vulva and anus 2–2.3 times as long as tail. The latter 173–198 μm, 6.5–7.8 anal body widths long, or 16–19 % of body length, elongate with fine conoid tip. Protoplasmatic core reaching to posterior third of tail (to 60–70 % of tail length). Tail often dorsally bent, and possessing two pairs of small papillae.

Male similar to female but more slender. Testes two. Spermatozoa fusiform, 8–9 μm, as long as 1/4 body width. Spicula dorylaimid, 46 μm, about as long as 1/4 tail. Lateral guiding pieces of 1/3 spicula length. Adcloacal papillae not levelling completely. Ventromedial supplements somewhat uncertain; only five widely separated fine innervations can be seen which are unpaired-ventral (that is they do not belong to paired subventral papillae) and lie far each from other. The anteriormost of them is located at a distance of 175 μm or about at one tail length from cloaca. Prerectum much longer than in female: 6.5 anal body widths, its junction with mid-intestine located at level of the first supplementary canal. Tail 180 μm, 7.8 anal diameters.

Pachydorylaimus aequatorialis sp. n. well corresponds to the general criteria of the genus, except, the amphids do not show that narrow shape and oval aperture described and drawn by SIDDIQI for all his four species. The new species distinctly differs from every other in having a longer body, wider amphids with slit-like aperture, conspicuously sclerotized vulva and long tail. It differs from the longest-tailed species known so far, *P. longicaudatus* SIDDIQI, 1983: body distinctly bigger (0.90–1.13 vs. 0.54–0.66 mm), spear longer (15–16 vs. 7.5–10 μm), vulval lips sclerotized, ovary consisting of more cells (9–14 vs. 4–7), tail longer (173–198 vs. 94–110 μm).

Holotype: Female; Slide Number 13045. Further specimens: 3 females, 1 juvenile.

Type locality: Cosanga, Las Caucheras, Prov. Napo, Ecuador: soil from a primary rain forest at 2100 m above sea-level; collected in February (2 females). Other localities: *a)* Rio Jondachi, Prov. Napo, Ecuador; soil from a gallery forest; collected in April (1 male). *b)* Santa Barbara, Prov. Carchi, Ecuador; soil from a secondary rain forest; collected in April (2 females). Every sample was collected by I. LOKSA and A. ZICSI.

Pachydorylaimus andreasi sp. n.

(Fig. 7 A–D)

Holotype, female: L = 0.76 mm; a = 19; b = 4.1; c = 9.2; V = 50 %; c' = 4.2.

Body plump, 19 μm wide at middle. Cuticle smooth, 1.2–1.3 μm thick, subcuticle very finely striated. Head 15 μm wide, broad, distinctly separated from neck region. Lips

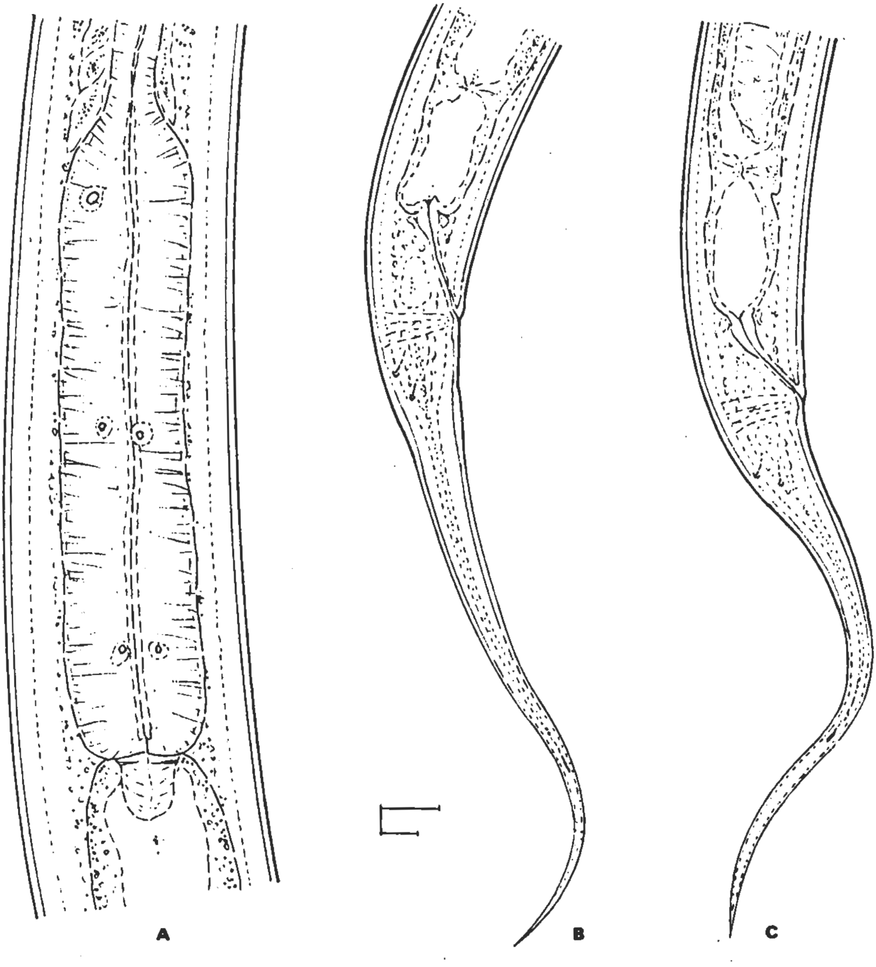

Fig. 5. *Pachydorylaimus aequatorialis* sp. n. A: posterior end (cylindrus) of oesophagus; B–C: female tails. (Bars = 10 μm each; upper: A, lower: B–C)

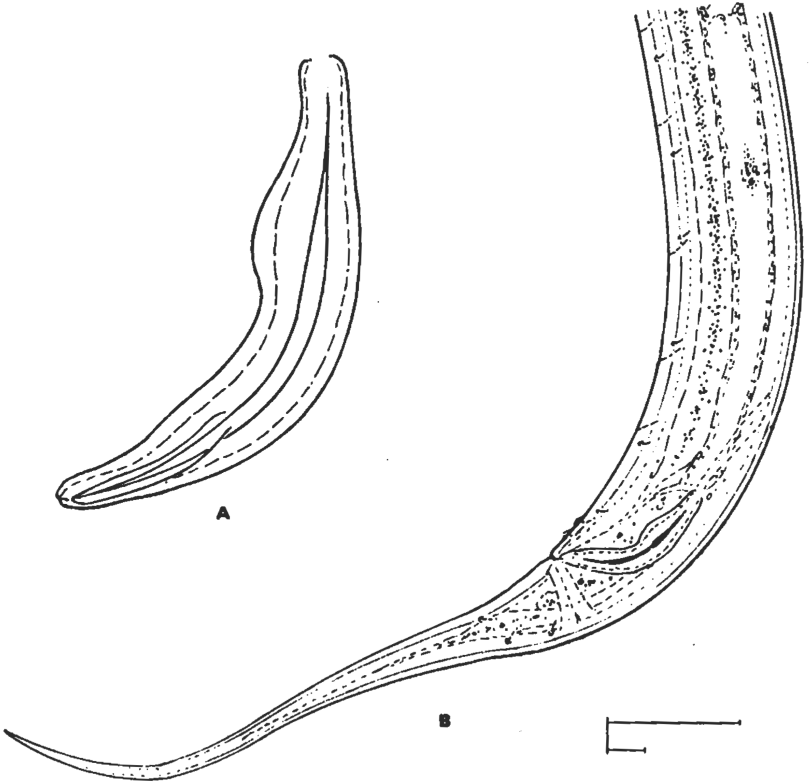

Fig. 6. *Pachydorylaimus aequatorialis* sp. n. A: spiculum; B: posterior end of male. (Bars = 10 μm each; upper: A, lower: B)

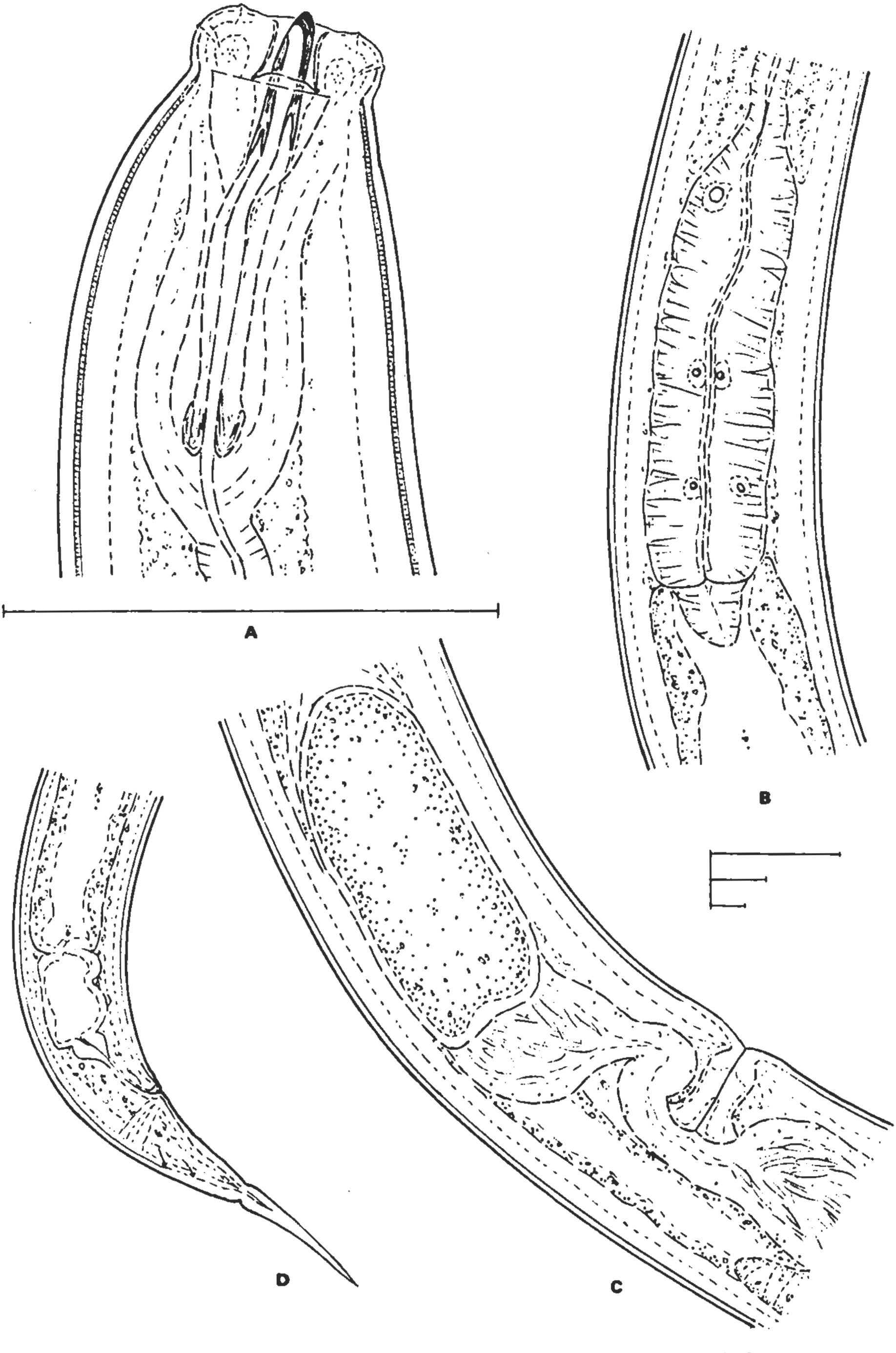

Fig. 7. *Pachydorylaimus andreasi* sp. n. A: anterior end, and body width at proximal end of oesophagus; B: oesophagus cylindrus; C: vulval region with egg; D: female posterior end. (Bars = 10 μm each; upper: A, middle: B–C, lower: D)

rounded. Body at proximal end of oesophagus 2.6 times as wide as head. Amphids unusually large, 65 % of corresponding body diameter, stirrup-shaped; aperture slit-like.

Atrium weakly sclerotized. Spear short and robust, 13 μm long and 3.3 μm wide, shorter than labial diameter, 1/14 of oesophagus length; aperture small. Tip of spear rounded, posterior end – especially the ventral wall – bifurcate. Odontophore 26 μm, twice as long as odontostyle, showing faint flanges. Oesophagus 187 μm long, widened in 56 % of its length. Cylindrus 82 μm, nearly four times as long as wide. Arrangement of oesophageal nuclei similar to that of the previous species. Cardia short, tongue-like. Intestine with thin wall and wide lumen. Prerectum and rectum equal in length, 1.2 times as long as anal body width. Distance between posterior end of oesophagus and vulva equal with oesophagus length.

Vulva transverse, inner lips practically not sclerotized. Vagina shorter than half a body width. Gonads amphidelphic, anterior branch 4.3, posterior 4 body diameters long. Anterior gonad reaching to the vicinity of cardial region. Ovaries consisting of 11–12 cells each. One egg could be observed: 96 × 28 μm, 1.6 times as long as body width. Uterus packed with fusiform spermatozoa. Both gonads lying on the right body side.

Distance between vulva and anus 3.6 times as long as tail. Tail 83 μm, 4.2 anal diameters long, 11 % of body length, elongate-conoid with sharply pointed tip; at mid-region a dorsal constriction can be seen (probably an individual feature only). Protoplasmatic core occupying 55 % of tail length. Two pairs of small papillae present.

Male not found.

In shape of tail, *Pachydorylaimus andreasi* sp. n. resembles *P. furcatus* SIDDIQI, 1983, it can be distinguished however from that in having somewhat longer spear (13 vs. 9–11 μm), longer gonads (4–4.3 vs. 1.7–2.1 body widths), longer core in tail (55 vs. 40 %), and above all, in having much larger amphids. This new species differs from the other new one, *P. aequatorialis* sp. n.: body smaller (0.76 vs. 0.9–1.13 mm), spear shorter (13 vs. 15–16 μm), gonads and egg longer, tail considerably shorter (83 vs. 173–198 μm, or 4.2 vs. 6.5–7.8 anal diameters), amphids more larger.

Holotype: Female; Slide Number 13181. Paratypi: 2 juveniles.

Type locality: Santo Domingo, Prov. Pichincha, Ecuador; fallen leaves on the shore of a lake, 3000 m above sea-level; collected in April 1988 by A. ZICSI and CS. CSUZDI.

This species is named in honour of Dr. ANDRÁS (=ANDREAS) ZICSI, to whom I am indebted for the very valuable nematode collections from Ecuador.

Miodorylaimus ANDRÁSSY, 1986

This genus was proposed in a paper discussing the taxonomy of the genus *Mesodorylaimus* ANDRÁSSY, 1959. I found then that some groups of *Mesodorylaimus*-like species did not fit completely to the picture as generally known for the genus. One of these groups was then called *Miodorylaimus*. It is a small genus containing two species merely. Undoubtedly, it is a close relative of *Mesodorylaimus*, shows however some different characteristics like a slender body, thin cuticle, completely unsclerotized vulva, and more elongate, more or less semilunar male tail.

Two species, both collected in Peru, have been described: *Miodorylaimus decens* ANDRÁSSY, 1986 and M. *iucundus* ANDRÁSSY, 1986. In the recent material from Ecuador I found some specimens of the type species, M. *decens*. Although they agreed with the original description very well, I think to be worth describing them below to get a more definite picture on morphology of this remarkable genus/species.

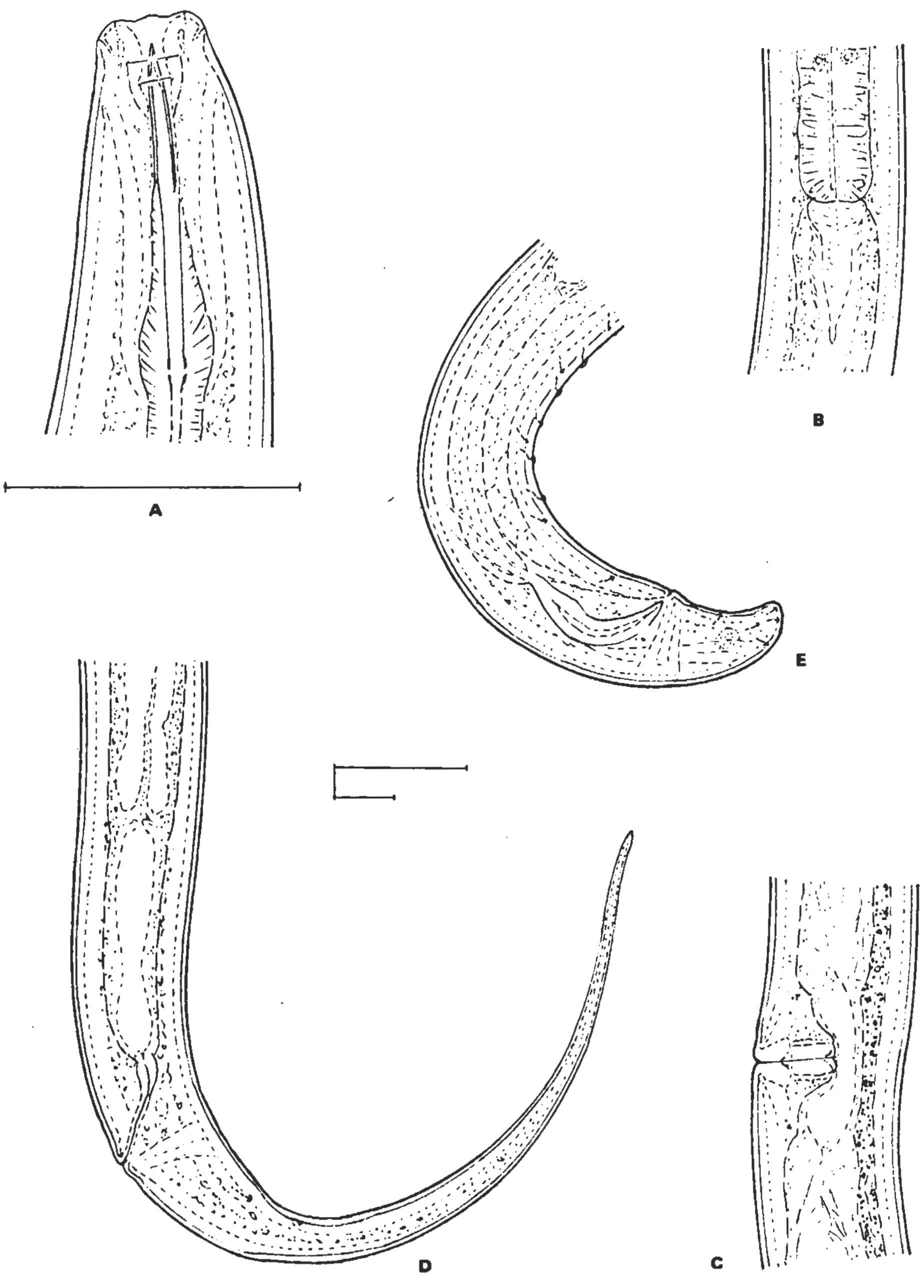

Fig. 8. *Miodorylaimus decens* ANDRÁSSY, 1986. A: anterior region, and body width at posterior end of oesophagus; B: cardial region: C: vulval region; D: posterior end of female; E: posterior end of male. (Bars = 10 μm each; upper: A, lower: B–E)

Miodorylaimus decens ANDRÁSSY, 1986

(Fig. 8 A–E)

Female: L = 1.19 mm; a = 45; b = 4.4; c = 8.8; V = 50 %; c' = 8.
Male: L = 0.85 mm; a = 36; b = 4.0; c = 40; c' = 1.2.

Body very slender, 26 μm in mid-region. Cuticle thin, 0.7–0.8 μm, smooth. Labial region not set off from body, 9.5 (female) or 8 (male) μm wide. Body at posterior end of oesophagus 2.6–2.9 times as wide as head. Amphids occupying one half body width.

Spear 12 (female) or 11 (male) μm, 1.3–1.4 times as long as labial diameter, or 4–5 % of oesophagus length, considerably thicker than cuticle at the same level. Spear aperture more than 1/3. Oesophagus 276 (female) or 215 (male) μm long, at 57–59 % widened. Cylindrus 112 (female) or 95 (male) μm long. Since the anterior half of oesophagus is comparatively wide the widening at cylindrus is gradual. Oesophageal nuclei distinct; dorsal nucleus large, one cylindrus width from beginning of the widened region, subventral nuclei small, anterior pair in mid-zone of cylindrus, posterior pair at two cylindrus widths from oesophagus terminus. Cardia long, elongate-conoid. Distance between posterior end of oesophagus and vulva slightly longer than oesophagus. Prerectum 3.3 anal widths long, rectum equal with anal diameter.

Vulva transverse, inner lips not sclerotized. Vagina as long as half a body width (14 μm), consisting of an outer wider and an inner narrower portion. Amphidelphic. Each gonad 5.5–6 body diameters long.

Male tail short, 21 μm, 1.2 anal diameters, 2.5 % of body length, on the whole semilunar in shape, ventrally bent, rounded on tip. Testes two; spermatozoa large, 8 μm, 1/3 of corresponding body width, fusiform. Spicula dorylaimid, 25 μm. Ventromedial supplements 5 in number, equally spaced, all lying anterior to spicula; the anteriormost located at 60 μm from cloaca. Prerectum much longer than in female, prerectal junction with intestine located before the supplements.

The recent specimens completely agreed with the Peruvian ones, with a one exception: the male possessed five copulatory supplements instead of four.

Locality: Flavio Alfaro, Prov. Manabi, Ecuador; 300 m above sea-level, soil in a bamboo forest; collected in April 1990 by A. ZICSI and CS. CSUZDI.

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Opusc. Zool. Budapest, XXIX–XXX, 1997

New species of oribatids (Acari) from the neotropical region

By
P. BALOGH*

Abstract. Nine new oribatid species (Acari) are recorded from Brazil and Costa Rica. In the first part four species of the family Malaconothridae (*Malaconothrus rohri*, *Trimalaconothrus oppositus*, *T. itatiaiae* and *T. humeratus* spp. n.), in the second part five species of the family Galumnidae (*Galumna laselvae*, G. *irazu*, G. *agueroi*, *Pergalumna sura* and *P. horvathorum* spp. n.) are described.

I. Four new Malaconothridae species from Brazil

The *Malaconothridae* are zoogeografically twofold interesting oribatids: *1)* They are thelythokous, parthenogenetic oribatids. *2)* Some species have so called "Gondwanan" distribution, i.e. they occur only on the late Gondwana plates. One of the new species, *Trimalaconothrus oppositus*, belongs to this type.

Malaconothrus rohri sp. n.

(Figs. 1–2)

Measurements. Length: 410 μm, width: 189 μm.

Prodorsum. Lamellar setae slightly widened, narrowly blade-shaped; originating between the prodorsal ridges. Rostral setae almost parallel, originated on the tip of prodorsal ridges; basally connected with a translamellar line. Interlamellar setae longer and thinner than sensillus.

Notogaster. All notogastral setae smooth; slightly widened; except setae *h_2* which are setiform and longer than the remaining notogastral setae.

Notogastral ridges well developed.

Ventral side. Epimeral setal formula: 3-1-3-2. Setae *3b*, *3c* and *4c* much longer and stronger than the remaining epimeral setae. Five pairs of genital setae; the 1st to 4th pairs are short, the 5th extremely long, more than four times longer as the last pairs of genital setae. One pair of anal setae represented by alveoli. Three pairs of long, narrowly blade-shaped adanal setae.

Legs monodactyle.

Material examined..Brazil, Sao Paulo, Ilha de Sao Sebastiano, Parque Estadual de Ilhabela, tropical rain forest; moss on trees and rocks, approx. altitude 350 m, 8. May 1990. BR. 90 B. 16-17, 1 holotype, 16 paratypes. Collected by Dr. J. BALOGH.

Remarks: This new species belongs to the *Malaconothrus plumosus* species-group (species with 5 pairs of genital setae and with well-developed notogastral ridges); near to *Malaconothrus hauseri* MAHUNKA, 1983; but the lamellar setae of. M. *hauseri* originate on

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the end of the prodorsal ridges, and the margo of notogastral setae ciliate. (*M. rohri*: notogastral setae smooth).

Derivatio nominis. Dr. RODOLFO ROHR (Campinas, Sao Paulo State, Brazil), engineer of Hungarian descent, called our attention to the remnant patches of indisturbed rainforests near Sao Paulo and offered his fazenda to serve as a research base for our studies.

Trimalaconothrus oppositus sp. n.

(Figs. 3–4)

Measurements. Length: 488 μm, width: 230 μm. Prodorsum rostral and lamellar setae medium long, of the same length. Interlamellar setae very long: longer than distance between interlamellar and lamellar setae. Sensillus very short. Interlamellar region with evanescent, irregular large foveolae.

Notogaster. All notogastral setae of the same length, very thin, flagellate, smooth. Setae p_1 somewhat shorter. Notogaster: without sclerotized ridges.

Ventral side. Epimeral setal formula: 2-1-3-2. Setae *3b*, *3c* and *4b* much longer than the remaining epimeral setae. Five or six pairs of genital setae: posterior one originated close to the posterior border and directed forwards as in *Tr. opisthosetosa*, *platyrhinchus*, *oxyrhinus*, *angustirostrum*; the remaining 4-5 setae originated on the anterior half of genital plates and directed backwards. Anal plates with 2 setal setal alveoli; adanal plates with 3 pairs of long and thin setae.

Legs tridactyle.

Material examined. Serra do Mantiguera, Parc National "Itatiaia", Itaporani path, near to Itaporani waterfall, cca 1500 m, very wet mosses on trees and rocks, 27. May 1992, BR-92, B.8-B.11, 1 holotype, 5 paratypes. Collected by Dr. J. BALOGH.

Remarks. The genital setation is reminiscent of *Trimalaconothrus opisthoseta* group.

Derivatio nominis. Named after the opposite position of posterior genital setae.

Trimalaconothrus itatiaiae sp. n.

(Figs. 5–6)

Measurements. Length: 531 μm, width: 324 μm.

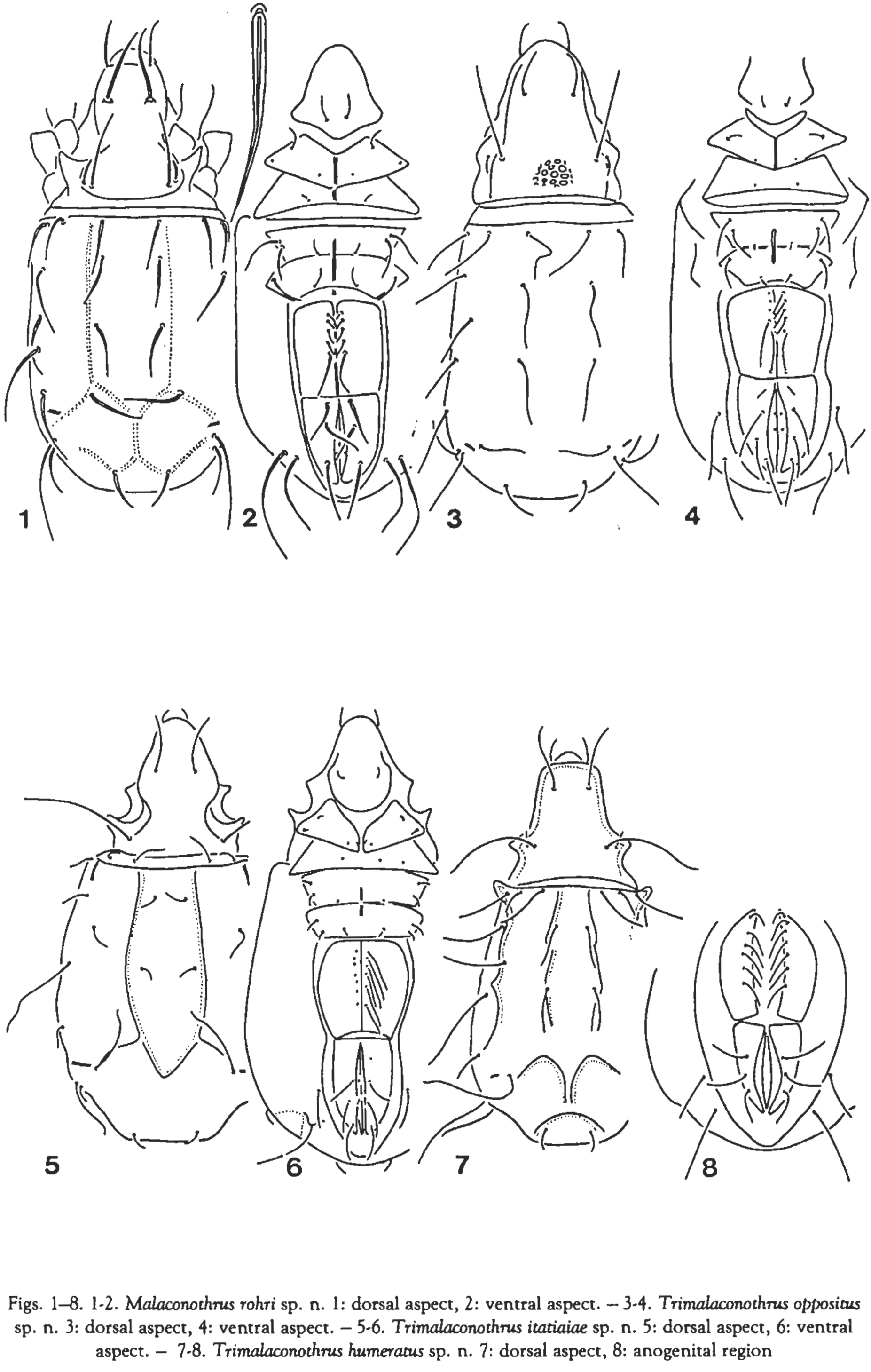
Prodorsum..Rostral setae short: shorter than the distance between their alveoli. Lamellar setae medium long: longer than distance between the lamellar and rostral alveoli. Interlamellar setae extremely long: almost as long as the length of prodorsum. Sensillus extremely short. All prodorsal setae fine smooth. Prodorsal ridgers S-shaped.

Notogaster. Strong notogastral heterotrichy: setae e_2, h_1, h_2 and ps_2 flagellate, the remaining fine and short (excepting ps_3 and c_1, wich are a little longer). Notogaster with sclerotized ridges.

Ventral side. Epimeral setal formula: 3-1/2/-3-3. All epimeral setae short. Genital plates with 6-7 pairs of long setae. Anal plates with 2, adanal plates with 3 pairs of setae.

Legs tridactyle.

Material examined. Serra do Manitguera, Parc National "Itatiaia", Itaporani path, near to Itaporani waterfall, cca 1500 m, very wet mosses on trees and rocks, 27. May 1992, BR-92,B. 8-11, 1 holotype, 3 paratypes. Collected by Dr. J. BALOGH.



Figs. 1–8. 1-2. *Malaconothrus rohri* sp. n. 1: dorsal aspect, 2: ventral aspect. – 3-4. *Trimalaconothrus oppositus* sp. n. 3: dorsal aspect, 4: ventral aspect. – 5-6. *Trimalaconothrus itatiaiae* sp. n. 5: dorsal aspect, 6: ventral aspect. – 7-8. *Trimalaconothrus humeratus* sp. n. 7: dorsal aspect, 8: anogenital region

Remarks. The new species belongs to the *Trimalaconothrus novus* (SELLNICK, 1931) species-group. The species of this group have sclerotized notogastral ridges and 7-11 pairs of genital setae.

Derivatio nominis. Named after the Parc National "Itatiaia".

Trimalaconothrus humeratus sp. n.

(Figs. 7–8)

Measurements. Length: 488 µm; width: 246 µm.

Prodorsum. Rostral setae short; lamellar setae more than twice longer than rostral setae. Interlamellar setae the longest: longer than the distance between interlamellar and lamellar setal alveoli. Sensillus very short: much shorter than rostral setae. Interlamellar area in two groups with 3-4 evanescent foveolae.

Notogaster. Well developed sclerotized ridges; the sublateral ones bearing each a protruding humeral process. Notogastral setae c_3 originate at the basis of this process. Weak noto-gastral heterotrichy: setae e_2, h_1, h_2 and ps_2 long, flagellate; setae ps_2 and c_2 short, the remaining notogastral setae long and short.

Ventral side. Genital plates with 6-7 pairs of setae. Anal plates with one short, adanal plates possessing three long setae.

Material examined. Serra do Mar, Parc National "Caraugatatuba", mosses on trees, 9. May 1990, BR-90, B.27, 1 holotype. Collected by Dr. J. BALOGH.

Key to these three *Trimalaconothrus* species

1 (2) Notogaster without sclerotized ridges. Five or six pairs of genital setae present; posterior ones originated close to the posterior border and directed forward: *oppositus* sp. n.

2 (1) Notogaster with sclerotized ridges. Six or seven pairs of genital setae present; all directed backwards.

3 (4) Setae d_1 and e_1 very short: interlamellar setae about four or five times longer than setae d_1 and e_1. Sublateral sclerotized ridges weakly developed; without protruding humeral process: *humeratus* sp. n.

4 (3) Setae d_1 and e_1 medium long: interlamellar setae about two times longer than setae d_1 and e_1. Sublateral sclerotized ridges well developed bearing each a protruding humeral process: *itatiaiae* sp. n.

II. New species of Galumnidae from Costa Rica

Alltough the Neotropical Region is relatively well-known in comparison with other tropical regions, there are areas where hardly anything is known of their oribatid mites. One of these is Costa Rica. So far only two publications have appeared on the oribatid fauna of this country. MAHUNKA (1982) metioned 10 species from Turritalba, of wich 7 were new to science. In my first publication from Costa Rica a new genus, *Bornemiszaella* P. BALOGH, 1994 was established, and three new species were described. The genus *Bornemiszaella*, together with *Varioppia* MAHUNKA, substitute in the Neotropical Region the genera *Granuloppia* J. BALOGH,1958 and *Pocsoppia* MAHUNKA, 1984 living in the

Aethopian Region and *Senectoppia* (=*Macrosoma* HAMMER, 1979) living in the Oriental Region.

This contribution presents the description of five new species of the family Galumnidae.

Galumna laselvae sp. n.

(Figs. 9–12)

Measurements. Length: 381-385 µm, width: 274 µm.

Prodorsum. Lamellar and sublamellar lines almost parallel. All prodorsal setae smooth, their ratio: *ro* >*le*> *in*. Setae in extremely short hardly visible. Lamellar setae originate nearer to lamellar line. Sensillus asymmetrically incrassate, with 8-10 short ciliae unilaterally.

Notogaster. Median part of dorsosejugal suture reduced. Area porosa dorsosejugalis narrow. Ten pairs of small alveoli; four pairs of areae porosae; *Aa* the largest, slightly obliquely elongate. A_1 smaller, A_2 and A_3 the smallest, about twice longer than wide.

Epimeral region. Epimeral setal formula: 1-0-2-1.

Ventral side. All setae very short or only with their alveoli represented. Two pairs of genital setae arising at the anterior margin of genital plates. Area porosa postanalis band-shaped, almost linear, as long as the width of genital plates.

All legs tridactyle, heterodactyle.

Material examined. Costa Rica, Parc National "La Selva", tropical rainforest, composing litter and soil, 12. January 1992: NC-B.13, 1 holotype, 16 paratypes. Collected by Dr. J. BALOGH.

Remarks. The new species belongs to the "*integrae–curtipili*" group, i.e. to the species with medially interrupted dorsosejugal suture and with extremely short interlamellar setae. Farther remarks can be found following the description of *Galumna agueroi* sp n.

Derivatio nominis: Named after Parc National "La Selva".

Galumna irazu n. sp.

(Figs. 13–16)

Measurements. Length: 795 µm, width: 615-672 µm.

Prodorsum. Lamellar and sublamellar lines almost parallel, their ratio: *le*> *ro*> *in*. Setae *in* extremely short, hardly visible. Lamellar setae originate nearer to lamellar line. All prodorsal setae smooth. Sensillus apically gradually incrassate, without cilia.

Notogaster. Median part of dorsosejugal suture reduced. Area porosa dorsosejugalis small, about twice longer than wide, rounded. Ten pairs of small alveoli. Three or four pairs of areae porosae. Area porosa *Aa* the largest, about twice longer than A_1 to A_3. Areae porosae A_1 and A_2 very near to each other, mostly fused. (Bilaterally fused, i.e. altogether 3 pairs of areae porosae: 6 exemplars; unilaterally fused: 4 exemplars; 4 pairs of areae porosae: i.e. A_1 and A_2 near to each other but well separated: 1 exemplar.) Median porus present.

Epimeral region. Epimeral setal formula:1-0-2-0 (?).

Ventral side. Three pairs of genital setae arising at the anterior margin of genital plates. Area porosa postanalis not visible.

All legs tridactyle, heterodactyle.

Material examined. Costa Rica, vulcano Irazu, ca 3000 m, rest of an oak forest, moss on the barks, 1 holotype, 10 paratypes. Collected by Dr. J. BALOGH.

Remarks. The new species belongs to the "*integrae–curtipili*"-group. Farther remarks are found following the description of *Galumna agueroi* sp. n.

Derivatio nominis. Named after vulcano Irazu.

Galumna agueroi sp. n.

(Figs. 17–22)

Measurements. Length: 435 μm, width: 318 μm.

Prodorsum. Lamellar and sublamellar lines parallel. All prodorsal setae smooth; their ratio: *ro*> *le*> in. Setae in very short, hardly visible. Lamellar setae originate near to lamellar line. Sensillus long, smooth, apically very slightly dilated, with acuminate tip.

Notogaster. Median part of dorsosejugal suture reduced. Area porosa dorsosejugalis narrow. Ten pairs of alveoli in normal position. Four pairs of areae porosae. *Aa* obliquely el-ongate, at least thrice longer than wide. Areae porosae A_1-A_3 much smaller: A_1 small, circu-lar, A_2 and A_3 very small, almost punctiform, hardly visible.

Epimeral region. Epimeral setal formula: 1-0-2-1.

Ventral side. Two pairs of genital setae arising at the anterior margin of genital plates. Ventral setae very short but well observable. Area porosa postanalis band-shaped, transversal, shorter than the width of genital plates.

All legs tridactyle, heterodactyle.

Material examined. Costa Rica, Cerro la Muerty, 3400 m, montane rainforest, edaphic-atmospheric assotiation, very low soil pH, *Garrya laurifolia-Hesperomeles heterophylla-Vaccinium consanguineum-Pernottia coriacaea-Ugni montana-Clethra gelica-Escallonia poosana* assotiation, moss on barks. 24. January 1992. Collected by Dr. J. BALOGH.

Derivatio nominis.Named after Dr. RENAN AGUERO, Director CIPROC, Escuela de Fitotecnia, Universidad de Costa Rica, San José, Costa Rica.

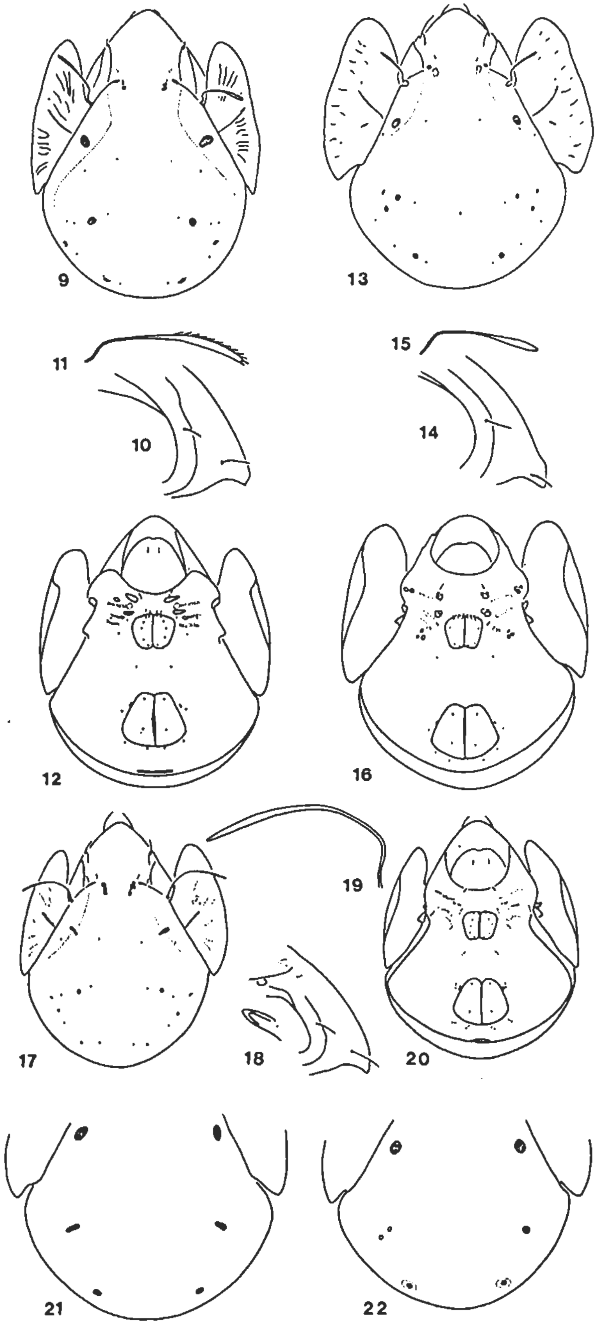
Key to these three species of the genus Galumna

1 (2) Sensillus slightly incrassate; unilaterally with 8-10 short ciliate. Two pairs of genital setae arising at the anterior margin of genital plates. Length: 381-385 μm.– Costa Rica, tropical rainforest: *laselvae* sp. n.

2 (1) Sensillus slightly incrassate, smooth, without setae.

3 (4) Three pairs of genital setae arising at the anterior margin of genital plates. A_1 and A_2 mostly fused: therefore 3 pairs of areae porosae present. Areae porosae A_3 well observable. Median pore present. Length: 795-887 μm. – Costa Rica, Vulcano Irazu 3000 m, paramo: *irazu* sp. n.

4 (3) Two pairs of genital setae arising at the anterior margin of genital plates. A_1 and A_2 always separated; A_2 and A_3 very small, punctiform. Median pore absent. Length: 435 μm. – Costa Rica, Serra do Muerte, 3400 m, paramo: *agueroi* sp. n.



Figs. 9–22. 9-12. *Galumna laselvae* sp. n. 9: dorsal aspect, 10: podosoma, lateral aspect, 11: sensillus, 12: ventral aspect. – 13-16. *Galumna irazu* sp. n. 13: dorsal aspect, 14: podosoma, lateral aspect, 15: sensillus, 16: ventral aspect. – 17-22. *Galumna agueroi* sp. n. 17: dorsal aspect, 18: lateral aspect, 19: sensillus, 20: ventral aspect, 21: notogaster with the area porosae (variant), 22: notogaster with the area porosae (variant)

Pergalumna sura sp. n.

(Figs. 19–21)

Measurements. Length: 443–463 μm, width: 336-377 μm.

Prodorsum. Lamellar and sublamellar lines almost parallel. Interlamellar setae on the apical half with some short ciliae. Lamellar and rostral setae smooth. Ratio of the prodorsal setae: *ro*> *le* = *ro*. Lamellar setae originate near to lamellar line. Sensillus very long, densely ciliate; with 25-30 very short ciliate.

Notogaster. Dorsosejugal suture absent. Areae porosae dorsosejugalis obliquely elongate, almost band-shaped. Ten pairs of alveoli; 3 pairs of areae porosae. Areae porosae *Aa* trans-versal, much longer than wide; inner (=paraxial) part boradly rounded, outer (=antaxial) part pointed. Areae porosae A_1 rounded with an obscure parabolic elongation posteriorly; A_2 absent, A_3 almost rounded.

Ventral side. Epimeral setal alveoli evanescent, hardly visible. Genital setae very short; at the anterior margin 2 pairs of genital seate. Aggenital adanal and anal setae only with their alveoli represented.

All legs tridactyle, heterodactyle.

Material examined. Costa Rica, Parc National "La Selva", tropical rainforest, composing litter and soil, 12 January 1992: NC-B. !3, 1 holotype, 13 paratypes. Collected by: Dr. J. BALOGH.

Remarks. The new species belongs to the *"integrae–longipili"* group, i.e. *Pergalumna* without dorsosejugal suture and with long interlamellar setae. In this group there is a subgroup: species with transversal, band-shaped *Aa* and with 3 pairs of areae porosae. In this subgroup only *Pergalumna sura* sp. n. has peculiar A_1 with an obscure parabolic elongation.

Derivation nominis. "Sura" is the name of a path in the Parc National "La Selva".

Pergalumna horvathorum sp. n.

(Figs. 23–26)

Measurements. Length: 394–410 μm, width: 295 μm.

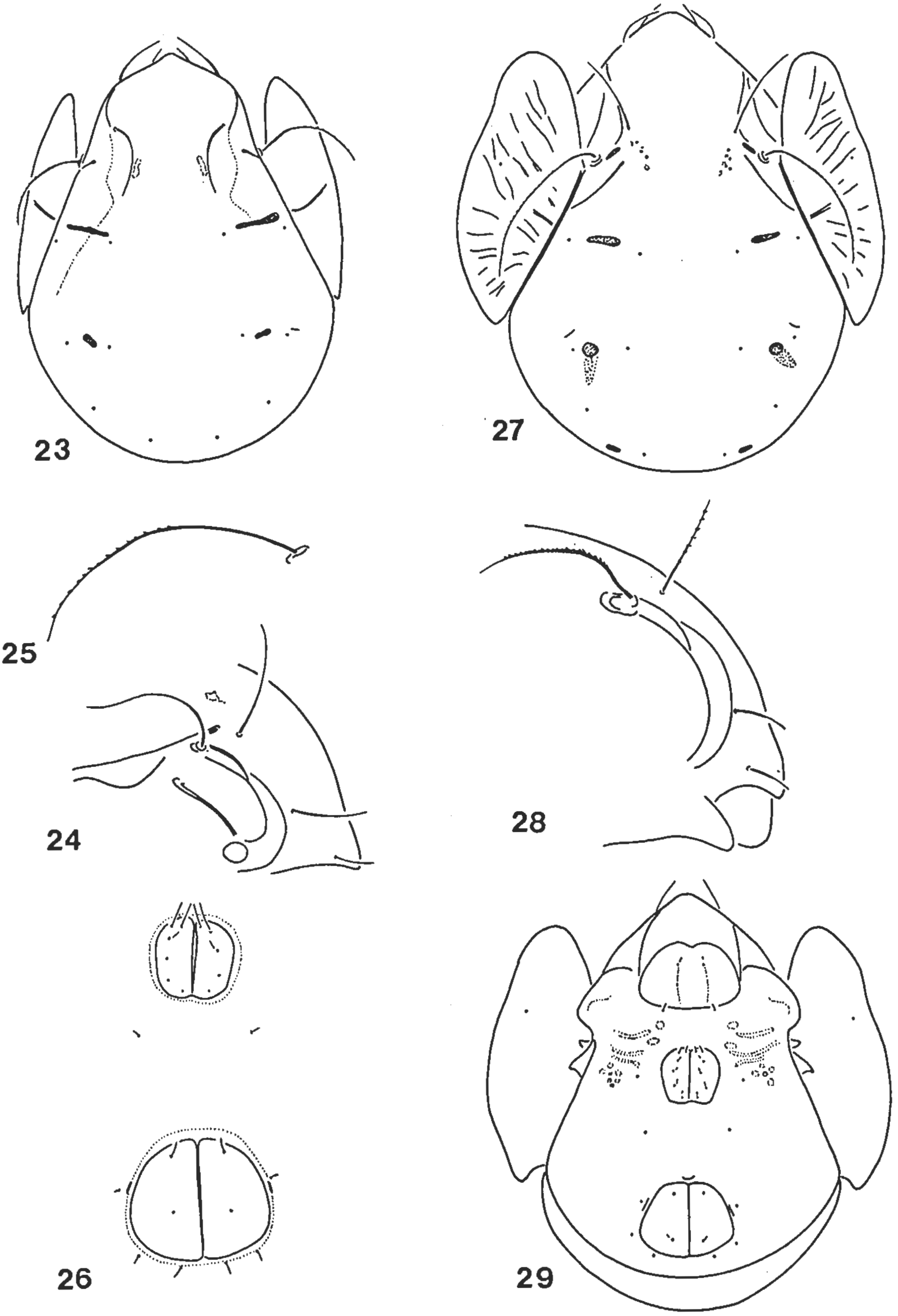
Prodorsum. Lamellar and sublamellar lines divergent. Prodorsal setae smooth. Ratio of prodorsal set.e: *in*> *le*> *ro*. Lamellar setae originate near to lamellar line. Sensillus medium long, setiform, sparsely ciliate, with 14-15 short ciliae.

Notogaster. Dorsosejugal suture absent. Only 2 pairs of areae porosae observable: *Aa* and A_1. Areae porosae *Aa* band-shaped, long, transversal, between the alveoli *te* and *ti*; areae porosae A_1 small, irregularly kidney-shaped; margins of areae porosae irregularly undulated.

Ventral side. Ventral setae short but well discernible. At the anterior margin of genital plates 2 pairs of genital setae.

All legs tridactyle, heterodactyle.

Material examined. Costa Rica, Cerro la Muerty, 3400 m, montane rainforest; edaphic-at-mospehric assotiation, very low soil pH, *Garrya laurifolia-Hesperomeles heterophylla-Vaccinium consanguineum-Pernottia coriacea-Ugni montana-Clethra gelica-Escallonia poasana*



Figs. 23–29. 23-26. *Pergalumna horvathorum* sp. n. 23: dorsal aspect, 24: podosoma, lateral aspect, 25: sensillus, 26: genital and anal plates. – 27-29. *Pergalumna sura* sp. n.: 27: dorsal aspect, 28: podosoma, lateral aspect, 29: ventral aspect

assotiation, moss on barks, 24. January 1992. CR. 92, B.67,1 holotype, 1 paratype. Collected by Dr. J. BALOGH.

Remarks. The new species belongs to the "*integrae–longipili*" group. Only *Pergalumna sura* sp. n. and *Pergalumna horvathorum* sp. n. have band-shaped, transversal *Aa*, but *horvathorum* sp. n. has no third pair of areae porosae and A_1 without obscure parabolic elongation.

Derivatio nominis. We wish to express our gratitude to His Excellency Dr. ZSOLT HORVÁTH for his labours in establishing scientific cooperation between Hungary and Costa Rica, and for personally providing assistance during the expeditions. This new species is named in honour of him and his family.

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Opusc. Zool. Budapest, XXIX–XXX, 1997

Three new Cavernocepheus species (Acari, Ortibatei: Otocepheidae) from Mexico

By
P. BALOGH* and J. G. PALACIOS-VARGAS**

Abstract. Three new oribatid species of the genus *Cavernocepheus* are described from Mexico: C. *acutus*, C. *fusifer* and C. *furcatus* spp. n.

J. BALOGH, A. BORHIDI, S. MAHUNKA and J. G. PALACIOS-VARGAS have proposed a project with the title: „The exploration of the oribatid fauna of Mexico". This project was accepted by both the Mexican CONAYT and the Hungarian OMFB, and was documented in a bilateral agreement. The Mexican leader of the theme is Dr. PALACIOS-VARGAS, university lecturer, the leader of UNAM Laboratory of Microarthropods, and the participants are the researchers and postgraduate students of the laboratory. The Hungarian leader of the project is Dr. BORHIDI, university lecturer (JPTE, Department of Botany, Pécs), DR. J. BALOGH, professor emeritus (ELTE, Budapest), Dr. P. BALOGH (Animal Ecology Research Group of the Hungarian Academy of Sciences, Budapest) and Dr. S. MAHUNKA, vice director (Hungarian Natural History Museum, Budapest).

In a very rich material collected by PALACIOS-VARGAS in Mexico three new species belonging to the genus *Cavernocepheus* J. BALOGH & MAHUNKA, 1969 were discovered. The genus is known from Manaus, Brazil, the single specimen of the type species, C. *monstruosus* J. BALOGH & MAHUNKA, 1969 was collected from litter of a tropical rain forest. Two further specimens of the same species were then found in Costa Rica (MAHUNKA, 1982).

Cavernocepheus acutus sp. n.

(Figs. 1–3)

Measurements. Length 476–586 μm, width 230–303 μm.

Prodorsum. Rostral and lamellar setae short, of the same length, originated near each other. Interlamellar setae longer, their apical half sparsely ciliate. Sensillus setiform, smooth, pointed, directed first outwards then inwards (Fig. 2). Lamellae slightly convergent with short prelamella. Bothrydia connected with an irregularly undulating line.

Notogaster. Dorsosejugal region with a deep hollow occupying anterior part of notogaster, and with two broad humeral protuberances. There are median lines, originating at the irregularly undulating transversal line, disappearing at the half length of

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notogaster. Ten pairs of medium long, smooth and setiform notogastral setae. Setae *ta* originating near anterior margin of humeral protuberance (Fig. 1).

Ventral side. Epimeral setal formula: 3–1–3–3. Epimeral setae short, of the same length. Three pairs of genital setal alveoli. One pair of aggenital, two pairs of anal, three pairs of adanal setae (Fig. 3).

Legs monodactyle.

Material examined. Colotlipa, Guerrero State, Mexico, 16. October 1983, ex litter; coll. PALACIOS.

Remarks. See after the descriptions.

Derivatio nominis. Named after the pointed sensillus.

Cavernocepheus fusifer sp. n.

(Figs. 4–5)

Measurements. Length 476–480 μm, width 189 μm.

Prodorsum. Rostral lamellar and interlamellar setae short, about of the same length, smooth. Lamella long, almost parallel, with very short prelamella. Sensillus with slightly dilatate head, smooth.

Notogaster. Dorsosejugal hollow short with divergent sides. Humeral protuberances almost triangular. Median lines of notogaster originating at the anterior margin of humeral protuberances, joint and disappear at the half length of notogaster. Ten pairs of smooth, pointed notogastral setae. Setae *ta* originated far from anterior margin of humeral protuberance (Fig. 4).

Ventral side. Epimeral setal formula: 3–1–3–3. Epimeral setae short. Three pairs of genital, one pair of aggenital, two pairs of anal, three pairs of adanal setae (Fig. 5).

Legs monodactyle.

Material examined. Coestalostoc, Puebla State, Mexico, 13. February 1991, ex litter; coll. PALACIOS.

Remarks. See after the descriptions.

Derivatio nominis. Named after the dilated sensillus.

Cavernocepheus furcatus sp. n.

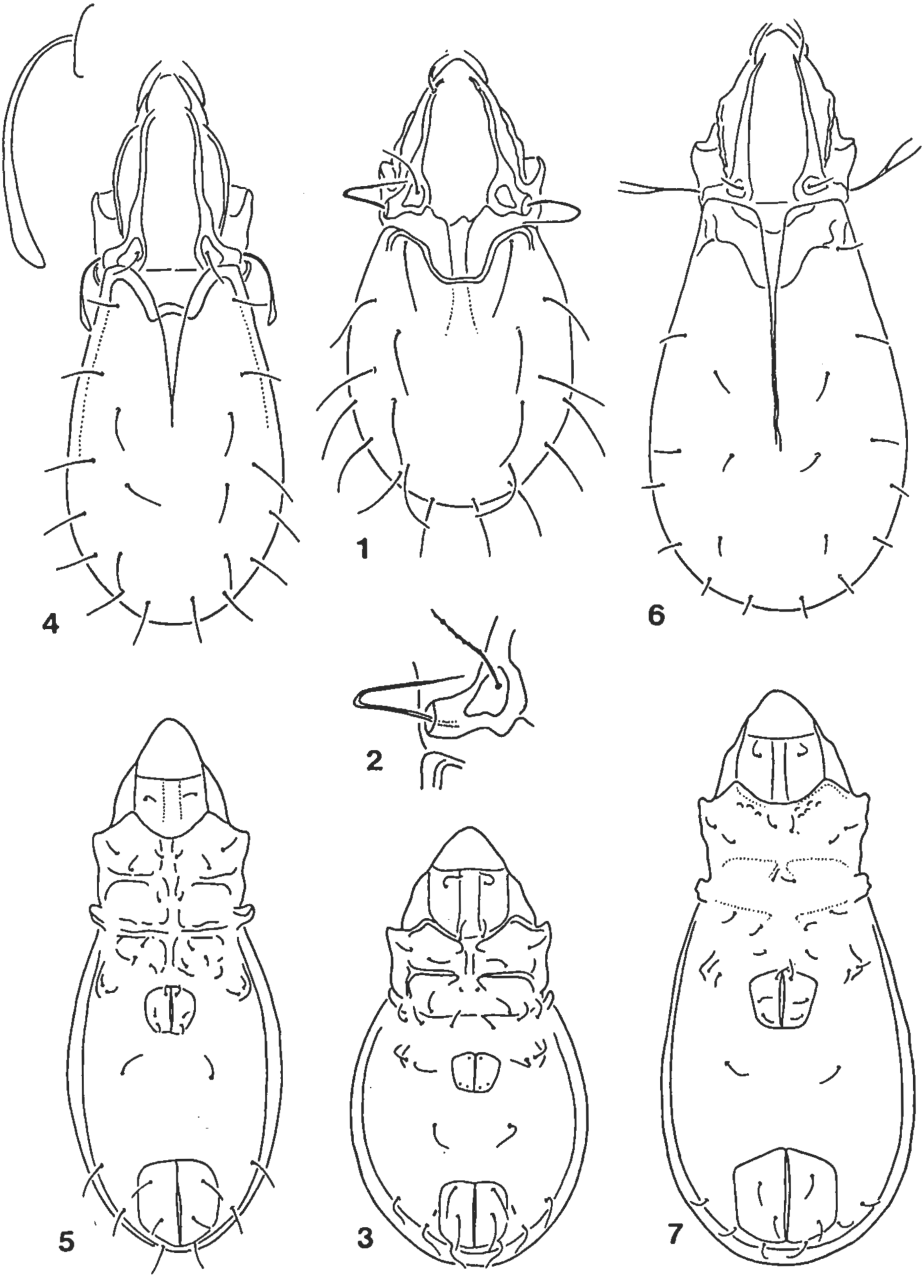
(Figs. 6–7)

Measurements. Length 623 μm, width 271 μm.

Prodorsum. Prodorsal setae short and smooth. Lamellae long, parallel, with short converging prelamellae. Sensillus setiform, medium long, about at the half length bifurcate with two long branches.

Notogaster. Dorsosejugal hollow covered by the humeral protuberances. Humeral protuberances almost squared; anterior margin straight with long, straight parallel sides; disappearing at the niveau of notogastral setae *ms*. Notogaster elongated; at the anterior margin the narrowest, then gradually dilated and at niveau of the notogastral setae *ms* the broadest. Notogastral setae short, fine, smooth. Setae *ta* far from anterior margin of humeral protuberance but close to its lateral margin. Setae *ta* far anterior: distance *ta–te* twice as long as distance *te–ti* (Fig. 7).

Ventral side. Epimeral setal formula: 3–1–3–3. Epimeral setae short. There are each 3 to 5 evanescent foveolae at the anterior margin of epimeral. Three pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae (Fig. 7).



Figs. 1–7. 1-3. *Cavernocepheus acutus* sp. n. 1: dorsal view, 2: sensillus, 3: ventral view. – 4–5. *Cavernocepheus fusifer* sp. n. 4: dorsal view, 5: ventral view. – 6-7. *Cavernocepheus furcatus* sp. n. 6: dorsal view, 7: ventral view

Legs monodactyle.

Material examined. Catemaco, Veracruz State, Mexico, 28. August, 1983, ex litter; coll. PALACIOS.

Key to the species of the genus Cavernocepheus

1 (2) 12–13 pairs of notogastral setae present; notogastral setae flagellate. – Brazil, Amazonia: *monstruosus* J. BALOGH & MAHUNKA, 1969

2 (1) 10 pairs of setiform notogastral setae.

3 (4) Sensillus bifurcate; dorsosejugal hollow covered by the humeral protuberances. – Mexico: *furcatus* sp. n.

4 (3) Sensillus not furcate: the median third of dorsosejugal hollow non covered by the humeral protuberances.

5 (6) Median lines of notogaster originating at the irregularly parallel, undulating transversal line between the bothrydia: sensillus setiform, pointed; notogastral setae long, setae *ti* as long as distance *ta–ti*. – Mexico: *acutus* sp. n.

6 (5) Median lines of notogaster originating at the inner margin of humeral protuberance, convergent and fused at the niveau of setae *ti*; sensillus with slightly dilated end; notogastral setae short, distance *ta–ti* more than twice as long as setae *ta*. – Mexico: *fusiger* sp. n.

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Opusc. Zool. Budapest, XXIX–XXX, 1997

Neue und bekannte Regenwürmer aus dem Naturhistorischen Museum, London (Oligochaeta: Acanthodrilidae)

Von
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Abstract. New and known earthworms in the collection of The Natural History Museum, London (Oligochaeta: Acanthodrilidae). Two new species, *Dichogaster (Diplothecodrilus) jamiesoni* and *Dichogaster (Diplothecodrilus) gatesi* spp. nov. in the collection of The Natural History Museum, London are described. Furthermore, data to the descriptions of *D. (Dt.) amphibiotica* DAHL, 1957; *D. (Dt.) proboscidea* MICHAELSEN, 1897 and *Dichogaster (Dichogaster) arcifera* OMODEO, 1958 are added.

Während eines Studienaufenthaltes im Naturhistorischen Museum von London hatte ich die Gelegenheit das dort aufbewahrte reiche Material der Unterfamilie Benhamiinae CSUZDI (im Druck), zu überprüfen.

Neben zahlreichen Typen und anderen bestimmten Tieren lagen auch viele unbestimmte Regenwürmer vor. Ein Teil dieser wurde von mir bereits veröffentlicht (CSUZDI, 1995). An dieser Stelle werden die Vertreter der Familie Acanthodrilidae aus kleineren Aufsammlungen bekannt gegeben.

Benhamiinae MICHAELSEN, 1897 emend. CSUZDI, 1996

Benhamia MICHAELSEN, 1889 emend. CSUZDI & ZICSI, 1994

Diagnose: Borsten eng gepaart, sämtliche ventral gelegen. Weibliche Poren auf dem 14. Segment, paarig oder unpaarig. Männliche Poren auf dem 18. Segment von den Prostataporen getrennt. 2 Paar Prostataporen auf dem 17. und 19. Segment. 2 Paar Samentaschenporen auf Intersegmentalfurche 7/8, 8/9. Zwei kräftig etwickelte Muskelmagen im 5.–6. Segment oder etwas weiter nach hinten gelegen. Kalkdrüsen mit paarigen Ausbuchtungen im 15.–17. Segment. Exkretionssystem meronephridisch mit vielen miteinander verbundenen Plectonephridien, denen sich im hinteren Teil des Körpers in jedem Segment ein Paar medioventrale Megameronephridien anschließen. Intestinale Blindsäcke fehlen.

Typus-Art: *Benhamia rosea* MICHAELSEN, 1889.

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Benhamia itoliensis MICHAELSEN, 1892

Fundorte: Uganda Camp 1, oberhalb Kilembe, Ruwenzori, 3000 m; leg. B. JAMIESON, 1. 1956; Inv. Nr. BM(NH) 1995.05.12.94. Uganda, zwischen Kabale-Kunungu, 1200 Ft. (1° 3' S. 29° 54' E.); leg. M. HARTLAND 9.1955;. Zaire, Kivu, Lubero, leg. VAN DE VELDE, 8. 1957; Inv. Nr. BM(NH) 1995.05.12.99.

Dichogaster BEDDARD, 1888 emend. CSUZDI, 1996

Diagnose. Borsten eng gepaart, sämtliche ventral gelegen. Weibliche Poren auf dem 14. Segment, paarig oder unpaarig. Männlicher Geschlechtsapparat acanthodrilin z. T. mit microscoleciner oder balantiner Reduktion. Zwei kräftig entwickelte Muskelmagen im 5.–6. Segment (können auch etwas weiter nach hinten verschoben sein). Kalkdrüsen mit stieligen, extramuralen Divertikeln im 15.–17. Segment. Exkretionssystem meronephridisch mit sackförmigen Meronephridien, denen sich im Hinterteil des Körpers segmentweise 1 Paar medioventrale Megameronephridien anschließen. Intestinale Blindsäcke fehlen.

Typus-Art: *Dichogaster damonis* BEDDARD, 1888.

Untergattung ***Dichogaster*** BEDDARD, 1888

Diagnose: Erster Rückenporus im Bereich der Gürtelorgane. Ampulle der Samentasche einfach.

Dichogaster (Dichogaster) arcifera OMODEO, 1958

OMODEO (1958) beschrieb diese Art auf Grund zwei preadulter Exemplare. Da unsere Tiere adult sind können wir die Originalbeschreibung an einigen Stellen ergänzen.

Länge 85–110 mm, Dicke 3–4,5 mm, Segmentzahl 145–179. Farbe gelblichbraun. Kopf mit einem kleinen Rüssel, manchmal ausgstülpt. Erster Rückenporus auf Intersegmentalfurche 12/13.

Zwei Paar Samentaschenporen auf Intersegmentalfurche 7/8 und 8/9 in Höhe der Borstenlinie ab. Gürtel vom 1/2 13.–19. Segment ringförmig, ventral schwach entwickelt. Unpaariger weiblicher Porus auf dem 14. Segment, liegt zwischen den a-a Borsten.

2 Paar Prostataporen auf dem 17. und 19. Segment. Die Poren einer Seite werden durch etwas gebogene Geschlechtsfurchen miteinander verbunden (Abb. 1).

Unpaarige ventralmediane akzessorische Pubertätsorgane befinden sich im 8/9, 16/17., 17/18. und 18/19. Segment, sowie drüsige Verdickungen auf dem 20.–25. Segment zwischen der Borstenlinie aa. Die Anordung der Papillen variieren von Tier zu Tier.

Innere Organisation. Erstes sichtbares Dissepiment in 7/8. Dissepimente 11/12–13/14 etwas verdickt. Zwei gut entwickelte Muskelmagen im 5.–6. Segment, 3 Paar bohnenförmige Kalkdrüsen im 15.–17. Segment, erstes Paar etwas kleiner als die hinteren. Exkretionsorgane meronephridisch, beiderseits mit 5-6 sackförmigen Meronephridien, denen sich hinter dem Gürtel je 1 Paar Megameronephridien anschließen. Letzte Paar Herzen im 13. Segment.

Geschlechtsorgane. Hoden und Samentrichter im 10. und 11. Segment, die im 11. Segment in perioesophageale, die im 10. in suboesophageale Testikelblasen eingeschlossen, die nach vorne bis unter den Muskelmagen reichen. 2 Paar Samensäcke im 11. und 12.

Segment. Ein Paar traubenförmige Ovarien im 13. Segment, Ovarialsacke fehlen. Samenleiter gut zu erkennen. Sie sind vom 15. Segment verdickt und bilden einen muskulösen Ductus ejaculatorius, der im 18. Segment ausmündet. Penialborsten stimmen mit denen von Omodeo erwähnten (1958, p. 68, fig. 26 D, E) überein. Samentaschen groß pilzförmig. Entaler Teil des Ausführungsganges verbreitet, hier mündet ein fingerförmiges Divertikel ein (Abb. 2).

Fundorte: Ghana, Kumasi UST Campus, in schwarzer Erde; leg. J.J. NILES. Inv. Nr. BM(NH) 1995.05.12.17-21., AF 3448 3 Ex.; Ghana, Ayeduasi nahe des UST Campus, unter faulenden Pflanzenresten; leg. J.J. NILES, 11.4.1968. Inv. Nr. BM(NH) 1995.05.12.22-33, AF 3447 6 Ex.; Ghana, Hügel von Kenyasi, Kenyasi cca 4 Meilen von der Kumasi, Savanne entfernt; leg. J.J. NILES, 22.3.1968. Inv. Nr. BM(NH) 1995.05.12.34-35.

Untergattung ***Diplothecodrilus*** CSUZDI, 1996

Diagnose: Erster Rückenporus in Intersegmentalfurche 5/6. Ampulle der Samentasche durch eine Verengung zweigeteilt. Divertikel entspringt an der Basis der Ampulle.

Typus-Art: *Dichogaster (Dt.) annae* (HORST, 1893).

Dichogaster (Diplothecodrilus) affinis (MICHAELSEN, 1890)

Fundorte: Florida, Dade Co. North Hamested; leg. W.W. BAKER & P. JINRIGHT, 3.7.1968. Inv. Nr. BM(NH) 1995.05.12.98-104.

Dichogaster (Diplothecodrilus) aloysiisabaudiae COGNETTI, 1906

Fundort: Uganda, Kilembe, Ruwenzori, Bambus-Wald, 9600 Ft; leg. B. JAMIESON, 1956; BM(NH) 1995.05.12.105-118.

Dichogaster (Diplothecodrilus) amphibiotica DAHL, 1957

Es liegen zwei gut erhaltene Exemplare dieser Art vor, diese ermöglichen die etwas spärliche Beschreibung zu ergänzen.

Länge 22—25 mm, Dicke 1,5 mm, Segmentzahl 90—95. Farbe gelblichbraun. Kopf prolobisch. Erster Rückenporus auf Intersegmentalfurche 5—6. Sämtliche Borsten ventral gelegen, eng gepaart, Borstendistanz hinter dem Gürtel aa:ab:bc:cd:dd = 4:1:8:2:70.

Zwei Paar Samentaschenporen auf Intersegmentalfurche 7/8 und 8/9 in Höhe der Borstenlinie b. Gürtel vom 14.—19. Segment ringförmig, ventral nicht so stark entwickelt. Unpaariger Weiblicher Porus auf dem 14. Segment, liegt zwischen den a-a Borsten.

2 Paar Prostataporen auf dem 17. und 19. Segment. Die Poren einer Seite werden durch ziemlich gerade Geschlechtsfurchen miteinander verbunden (Abb. 3).

Unpaarige, ventralmediane akzessorische Pubertätsorgane befinden sich im 8/9. Segment sowie drüsige Verdickungen auf dem 20.—25. Segment zwischen der Borstenlinie aa.

Innere Organisation. Erstes sichtbares Dissepiment in 7/8. Dissepimente 12/13—13/14 etwas verdickt. Zwei Muskelmagen im 5.—6. Segment, 3 Paar gleichgroße Kalkdrüsen im 15.—17. Segment. Exkretionsorgane meronephridisch, beiderseits mit 4 sackförmigen Meronephridien, enen sich hinter dem Gürtel je 1 Paar Megameronephridien anschließen. Typhlosolis klein, im 23. Segment beginnend, letzte Paar Herzen im 12. Segment.

Geschlechtsorgane. Hoden und Samentrichter im 10. und 11. Segment, die im 11. Segment in perioesophageale, die im 10. in suboesophageale Testikelblasen eingeschlossen. 2 Paar Samensäcke im 11. und 12. Segment. Ein Paar traubenförmige Ovarien im 13. Segment. Samenleiter gut zu erkennen, im 15. Segment eine große Schlinge bildend und im 18. Segment ausmündend.

Zwei Paar kleine Prostata im 17. und 19. Segment, sie bestehen aus einem kurzen muskulösen Ausführungsgang und einem etwas dickeren drüsigen Teil. Jede Prostata mit einem Penialborstensack versehen, in dem zwei adulte Borsten stecken. Größere Borste ist ungefähr 0,7 mm lang und ungefähr 0,015 mm breit. Ektales Ende der Borsten zugespitzt am Rand etwas gebogen. Im äußeren Drittel der Borste mit kräftigen Zähnchen ornamentiert. Kleinere Borste ist cca. 0,35 mm lang und 0,007 mm breit. Ektales Ende spatelförmig verbreitet, Skulpturen fehlen (Abb. 4—5).

Samentaschen im 8. und 9. Segment. Form einfach, kurzer Ausführungsgang mit einer zweigeteilten sackförmigen Ampulle. Zwischen Ampulle und Ausführungsgang ein kleines rundes Divertikel vorhanden (Abb. 6).

Fundorte: Ghana, Kumasi UST Campus.; leg. J.J. Niles, 10.4.1968; Inv. Nr. BM(NH) 1995.05.12.16.; Ghana, Kenyasi-Berg, Kenyasi cca. 4 Meilen von der Kumasi, Savanne entfernt; leg. J.J. NILES, 22.3.1968; AF 3449 1 Ex.

Dichogaster (Diplothecodrilus) bolaui (MICHAELSEN, 1891)

Fundorte: Uganda, Mt. Elgon, Buwalasi; leg. B. JAMIESON, 1956; Inv. Nr. BM(NH) 1995.05.12.14.; Uganda, Kabanyala-Universität, Bananen Plantage, Umgebung Kampala; leg. W. BLOCK, 27.4.1965, 28.5.1965; Inv. Nr. BM(NH) 1995.05.12.119-135.; Uganda, Kabanyala-Universität Umgebung Kampala; leg. W. BLOCK, 27.4.1965, 28.5.1965; Inv. Nr. BM(NH) 1995.05.12.136-145.; Neuguinea, Safaiyufa Dorf, Goroka; leg. ?; Inv. Nr. BM(NH) 1995.05.12.146-157.; USA, Florida, Dade Co. North Hamested; leg. W.W. BAKER, P. JINRIGHT, 3.7.1968; Inv. Nr. 1995.05.12.160.; USA, Florida, Palm Beach Co., leg. W.W. BAKER, P. JINRIGHT, 4.7.1968; Inv. Nr. BM(NH) 1995.05.12.161-163.; USA, Florida, Collier Co.; leg. W.W. BAKER, P. JINRIGHT, 4.7.1968; Inv. Nr. BM(NH) 1995.05.12.164.; USA, Florida, Broward Co. South Andytown, leg. W.W. BAKER, P. JINRIGHT, 4.7.1968; Inv. Nr. BM(NH) 1995.05.12.165.; USA, Georgia, Komitat Harris, Pine-Gebirge, Callaway-Garten; leg. E. und B. KOMAREK SR., 4.8.1967; Inv. Nr. 1995.05.12.166-175.

Dichogaster (Diplothecodrilus) elgonensis MICHAELSEN, 1937

Fundort: Uganda, Mt. Elgon, Jackson-See, 13020 Ft; leg. ?B. JAMIESON; Inv. Nr. BM(NH) 1995.05.12.176.

Dichogaster (Diplothecodrilus) equatorialis (MICHAELSEN, 1896)

Fundort: Uganda, Mt. Ruwenzori, Watamagufu, Beadle's camp, 1300 Ft, unter Moss auf Schwarzerd und unter Steinen; leg. B. Jamieson 20.1.1956. 1995.05.12.2-4., AF 3450 2 Ex.

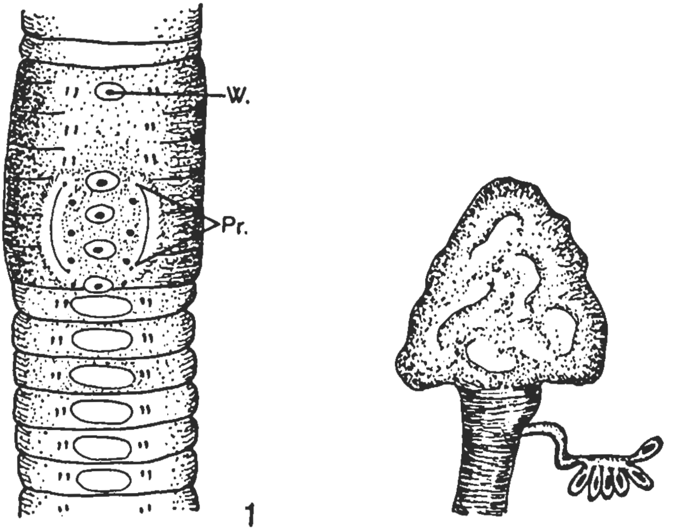

Abb. 1–2. *Dichogaster (Dichogaster) arcifera* OMODEO, 1958. 1: Ventralansicht (W: weiblicher Porus, Pr: Prostataporen). 2: Samentasche

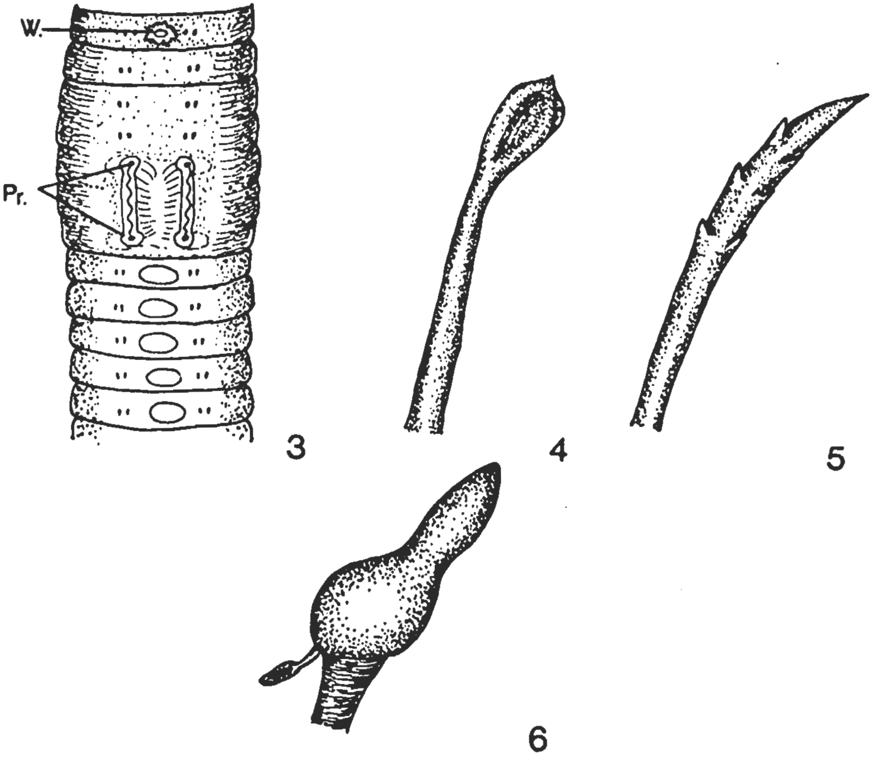

Abb. 3–6. *Dichogaster (Diplothecodrilus) amphibiotica* DAHL, 1957. 3: Ventralansicht (W: weiblicher Porus, Pr: Prostataporen). 4: Kleinere Penialborste. 5: Größere Penialborste. 6: Samentasche

Dichogaster (Diplothecodrilus) karagoensis MICHAELSEN, 1910

Fundort: Uganda, Kisoro, Schandl's Camp.; leg. ?B. JAMIESON, 29.1.1953; Inv. Nr. BM(NH) 1995.05.12.5-6., AF xxxx 1 Ex.

Dichogaster (Diplothecodrilus) modigliani (ROSA, 1896)

Fundorte: Ghana, Kumasi UST Campus; leg. J.J. NILES, 10.4.1968; Inv. Nr. BM(NH) 1995.05.12.84, 177; Uganda, Kabanyala-Universität Umgebung Kampala, Bananen Plantage; leg. W. BLOCK, 27.4.1965 und 28.5.1965; Inv. Nr. BM(NH) 1995.05.12.178-181.; Uganda, Kabanyala-Universität, Virgin Bush, Umgebung Kampala; leg. W. BLOCK, 27.4.1965 und 28.5.1965; Inv. Nr. 1995.05.12.182-186.; Neuguinea, Safaiyufa Dorf, Goroka; leg. ?? Inv. Nr. 1995.05.12.187.; USA Florida, Dade Co. North Hamested.; leg. W.W. BAKER, P. JINRIGHT, 3.7.1968; Inv. Nr. 1995.05.12.188.

Dichogaster (Diplothecodrilus) neumanni (MICHAELSEN, 1897)

Fundort: Uganda, Makerere, Umgebung Kampala, Wald.; leg. W. BLOCK , 25.2.1965; Inv. Nr. BM(NH) 1995.05.12.7-13., AF 4 Ex.

Dichogaster (Diplothecodrilus) proboscidea MICHAELSEN, 1897

Diese Art wurde von MICHAELSEN (1897) an Hand eines sehr schlecht erhaltenen Exemplares beschrieben. Die zahlreichen gut erhaltenen Tiere ermöglichen es jetzt die Originalbeschreibung zu ergänzen.

Länge 32–40 mm, Dicke 2 mm, Segmentzahl 87–96. Farbe in Alkohol konservierter Tiere unpigmentiert. Kopf V-förmig mit langem Rüssel, der bei einigen Exemplaren eingezogen ist. Erster Rückenporus auf Intersegmentalfurche 5/6. Sämtliche Borsten ventral gelegen, eng gepaart, Borstendistanz hinter dem Gürtel aa:ab:bc:cd:dd = 8:2:9:2:70.

Samentaschenporen auf Intersegmentalfurche 7/8 in Höhe der Borstenlinie b. Gürtel vom 1/2 13.–18. Segment sattelförmig. Weibliche Poren auf dem 14. Segment, liegen zwischen den a-a Borsten.

Prostataporen auf dem 17. Segment auf einer ovalen Papille (Abb.7). Unpaarige ventralmediane akzessorische Pubertätsorgane befinden sich im 7/8. Segment.

Innere Organisation. Erstes sichtbares Dissepiment in 6/7. Dissepimente 10/11–13/14 etwas verdickt. Zwei Muskelmagen im 5.–6. Segment, 3 Paar Kalkdrüsen im 15.–17. Segment, die Größe dieser von vorne nach hinten zunehmend. Exkretionsorgane meronephridisch, beiderseits mit 4 sackförmigen Meronephridien, denen sich hinter dem Gürtel je 1 Paar Megameronephridien anschließen. Typhlosolis wellige Lamelle, im 22. Segment beginnend, letzte Paar Herzen im 13. Segment.

Geschlechtsorgane. Hoden und Samentrichter im 10. und 11. Segment, die im 11. Segment in perioesophageale, die im 10. in suboesophageale Testikelblasen eingeschlossen sind und nach vorne bis zum Magen reichen. 2 Paar Samensäcke im 11. und 12. Segment. Ein Paar traubenförmige Ovarien im 13. Segment. Samenleiter gut zu erkennen, am Ende stark muskulös, im 17. Segment ausmündend.

Ein Paar Prostata im 17. Segment, sie bestehen aus einem kurzen muskulösen Ausführungsgang und einem zusammengerolten dickeren drüsigen Teil, der auf 3 Segmente beschränkt ist. Penialorste ungefähr 1,8 mm lang und 0,008 mm breit, ektales Ende hackenförmig gebogen. Äußeres Drittel der Borste mit kräftigen Zähnchen ornamentiert (Abb. 8).

Samentaschen bestehen aus einem langen Ausführungsgang und einer zweigeteilten pilzförmigen Ampulle. Zwischen Ampulle und Ausführungsgang ein kleines Divertikel vorhanden, das 4-5 Samenbälle enthält (Abb. 9).

Fundorte: Ghana, Kumasi, UST Campus, aus einem unzementierten Teil eines Kanales; leg. J.J. NILES, 10.1967; Inv. Nr. BM(NH) 1995.05.12.36-58., AF 3452 10 Ex.; Ghana, Kumasi UST Campus, aus Schwarzerde; leg. J.J. NILES, 10.4.1968; Inv. Nr. BM(NH) 1995.05.12. 59-83., AF 3453 15 Ex.

Dichogaster (Diplothecodrilus) saliensis (BEDDARD, 1893)

Fundorte: Uganda, Kabanyala-Universität, Graßland, Umgebung Kampala; leg. W. BLOCK, 27.4.1965 und 28.5.196; Inv. Nr. BM(NH) 1995.05.12.189-260.; Uganda, Kabanyala-Universität, Virgin Bush, Umgebung Kampala; leg. W. BLOCK, 27.4.1965 und 28.5.1965; Inv. Nr. BM(NH) 1995.05.12261-271.; Uganda, Kabanyala-Universität, Bananen Plantage, Umgebung Kampala; leg. W. BLOCK, 27.4.1965 und 28.5.1965; Inv. Nr. BM(NH) 1995.05.12.272-500.; Uganda, Kabanyala Universität, Graßland, Umgebung Kampala; leg. W. BLOCK, 27.4.1965 und 28.5.1965; Inv. Nr. BM(NH) 1995.05.12.501-521.; USA, Florida, Glades Co. South Lakeport; leg. W.W. BAKER, P. JINRIGHT, 4.7.1968; Inv. Nr. BM(NH) 1995.0 5.12.58-59.; USA, Florida, Dade Co. North Hamested; leg. W.W. BAKER, P. JINRIGHT, 3.7.1968; Inv. Nr. BM(NH) 1995.05.12.521-526.; USA, Florida, Collier Co.; leg. W.W. BAKER, P. JINRIGHT, 4.7.1968; Inv. Nr. BM(NH) 1995.05.12.527-530.

Dichogaster (Diplothecodrilus) jamiesoni sp. nov.

Holotypus. Unvollständig, Länge 85 mm, Dicke 4 mm, Segmentzahl 103. Paratypus praeadult, Länge 120 mm, Dicke 4 mm, Segmentzahl 156. Farbe im Alkohol konservierter Tiere unpigmentiert. Prostomium dreieckförmig, erster Rückenporus auf Intersegmentalfurche 5/6. Borsten entlang des Körpers hervorstehend, sämtliche ventral gelegen, eng gepaart. Borstendistanz hinter dem Gürtel aa:ab:bc:cd:dd = 8:3,5:8,5:2:70.

Samentaschenporen klein, auf Intersegmentalfurche 7/8—8/9, in Höhe der Bor stenlinie a. Gürtel vom 1/2 12.—20. Segment ringförmig, am 12. Segment schwach entwickelt. Weibliche Poren auf dem 14. Segment, liegen vor den a-a Borsten.

Zwei Paar Prostataporen auf dem 17. und 19. Segment. Die Poren einer Seite werden durch ziemlich gerade Geschlechtsfurchen miteinander verbunden, die vorne bis ins 16. Segment reichen (Abb. 10). Akzessorische Pubertätsorgane fehlen.

Innere Organisation. Erstes sichtbares Dissepiment 6/7. Dissepimente 8/9—12/13 etwas verdickt. Zwei große Muskelmagen im 5.—6. Segment, 3 Paar Kalkdrüsen im 15.—17. Segment, die Größe dieser von vorne hach hinten abnehmend. Exkretionsorgane meronephridisch, beiderseits mit 5 sackförmigen Meronephridien, denen sich hinter dem Gürtel je 1 Paar Megameronephridien anschließen. Typhlosolis klein, wellige Lamelle. Letzte Paar Herzen im 12. Segment.

Geschlechtsorgane. Hoden und Samentrichter im 10. und 11. Segment, in perioesophageale Testikelblasen eingeschlossen. 2 Paar Samensäcke im 11. und 12. Segment. Ein Paar traubenförmige Ovarien im 13. Segment. Samenleiter gut zu erkennen, vom 15. Segment muskulös, treten im 18. Segment aus.

Zwei Paar Prostata im 17. und 19. Segment, sie bestehen aus einem kurzen muskulösen Ausführungsgang und einem zusammengerollten dickeren drüsigen Teil. Jede Prostata mit einem Penialborstensack versehen, in dem eine adulte und eine juvenile Borste steckt. Die adulte Borste ist ungefähr 2,8 mm lang und 0,06 mm breit, ektales Ende zugespitzt. In der Mitte sägezähnförmig ornamentiert und am äußeren Ende mit kräftigen Zähnchen versehen (Abb. 11).

Samentaschen bestehen aus einem langen Ausführungsgang und einer zweigeteilten länglichen Ampulle. Zwischen Ampulle und Ausführungsgang ein kleines Divertikel vorhanden (Abb. 12).

Die neue Art steht *D. (Dt.) jordani* MICHAELSEN, 1937 am nächsten, unterscheidet sich von dieser durch die Lage des Gürtels, die Form der Samentaschen sowie durch die Form und ornamentierung der Penialborste.

Die neue Art wird zu Ehren vom bekannten Oligochaeten-Fachmann B. JAMIESON, Sammler dieses Materials benannt.

Fundort: Holotypus, Uganda, 44 Meilen von Masaka nach Kampala; leg. B. JAMIESON, 23.12.1955; Inv. Nr. BM(NH) 1995.05.12.1.; Paratypus, Fundort wie beim Holotypus, Inv. Nr. AF 3454 1 Ex.

Dichogaster (Diplothecodrilus) gatesi sp. nov.

Syn. *Dichogaster* sp. GATES (1977, p. 486).

Holotypus. Länge 65 mm, Dicke 3 mm, Segmentzahl 117. Paratypen. Länge 37–66 mm, Dicke 2,5–3,5 mm, Segmentzahl 102–125. Farbe im Alkohol konservierter Tiere rötlichbraun. Prostomium V-förmig eingezogen, erster Rückenporus auf Intersegmentalfurche 5/6. Sämtliche Borsten ventral gelegen, eng gepaart. Borstendistanz hinter dem Gürtel aa:ab:bc:cd:dd = 14:4:13:3:90.

Samentaschenporen auf weißen Papillen in der Intersegmentalfurche 7/8 zwischen der Borstenlinie ab.

Gürtel vom 13.-18. Segment ringförmig. Ventral etwas weniger entwickelt. Weibliche Poren auf dem 14. Segment, liegen etwas medial von den a-a Borsten.

Ein Paar Prostataporen auf dem 17. Segment. Die Poren liegen dicht neben der Intersegmentalfurche 17/18 auf einem rechteck- oder trapezförmigen Geschlechtsfeld. Zwei unpaarige akzessorische Pubertätsorgane auf dem 19. u. 20. Segment zwischen den Borsten a-a (Abb. 13). Männliche Poren liegen im 18. Segment, am Ende der Geschlechtsfurchen.

Innere Organisation. Erstes sichtbares Dissepiment 5/6. Dissepimente 8/9–11/12 schwach verdickt. Zwei große Muskelmagen im 5.–6. Segment, 3 Paar Kalkdrüsen im 15.-17. Segment, die letzten etwas kleiner als die vorausgehenden. Exkretionsorgane meronephridisch, beiderseits mit 4–5 sackförmigen Meronephridien, denen sich hinter dem Gürtel je 1 Paar Megameronephridien anschließen. Typhlosolis kleine wellige Lamelle im 22 Segment beginnend, vom 24.–29. Segment von Faltenbildungen begleitet. Letzte Paar Herzen im 12. Segment.

Geschlechtsorgane. Hoden und Samentrichter im 10. und 11. Segment, in perioesophageale Testikelblasen eingeschlossen. 2 Paar kleine Samensäcke im 11. und 12. Segment. Ein Paar traubenförmige Ovarien im 13. Segment. Samenleiter gut zu erkennen, vom 15. Segment muskulös, treten im 18. Segment aus.

Ein Paar Prostata im 17. Segment, sie bestehen aus einem kurzen muskulösen Ausführungsgang und einem großen zusammengerollten drüsigen Teil, der den Mitteldarm im 17–20. Segment überdeckt. Jede Prostata mit einem Penialborstensack versehen, in der zwei adulte und mehrere juvenile Borsten stecken. Die adulten Borsten ungefähr 1,3 mm

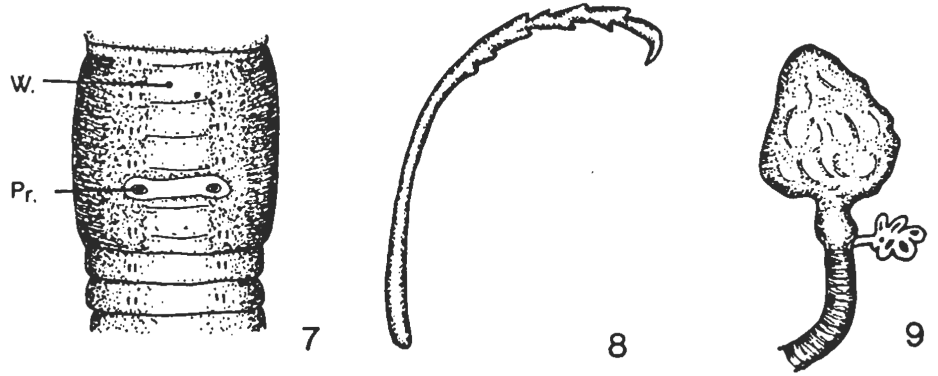

Abb 7–9. *Dichogaster (Diplothecodrilus) proboscidea* MICHAELSEN, 1897. 7: Ventralansicht (W: weibliche Poren, Pr: Prostataporen). 8: Penialborste. 9: Samentasche

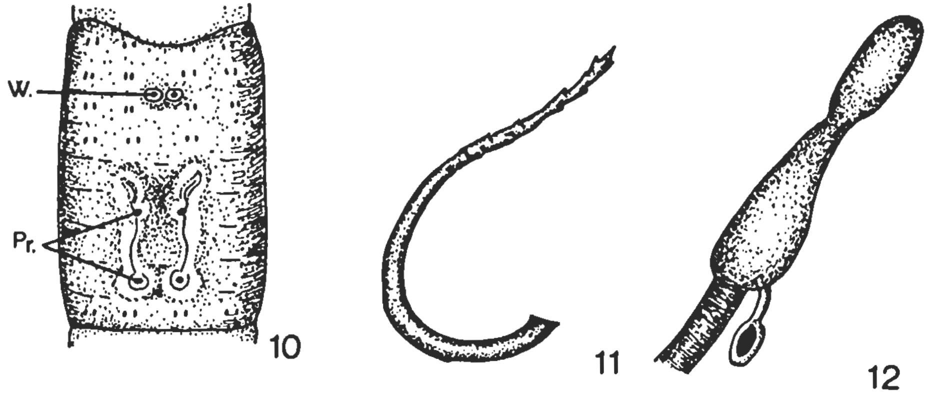

Abb. 10–12. *Dichogaster (Diplothecodrilus) jamiesoni* sp. nov. 10: Ventralansicht (W: weibliche Poren, Pr: Prostataporen). 11: Penialborste. 12: Samentasche

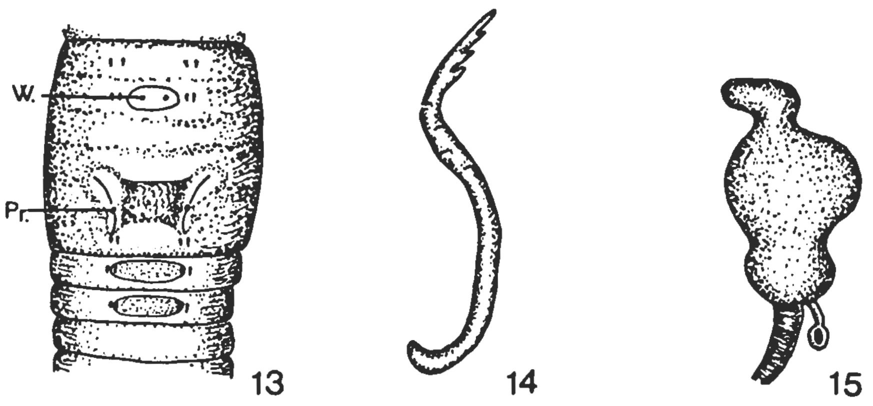

Abb. 13–15. *Dichogaster (Diplothecodrilus) gatesi* sp. nov. 13: Ventralansicht (W: weibliche Poren, Pr: Prostataporen). 14: Penialborste. 15: Samentasche

lang und 0,025 mm breit. Ektales Ende zugespitzt, von der Mitte sägezähnförmig ornamentiert und am äußeren Ende mit hervorstehenden kräftigen Zähnchen versehen (Abb. 14).

Samentaschen bestehen aus einem kurzen muskulösen Ausführungsgang und einer zweigeteilten, am Ende eingeschnürten sackförmigen Ampulle. Zwischen der Ampulle und dem Ausführungsgang ein kleines Divertikel vorhanden (Abb. 15).

Die neue Art steht *D. (Dt.) kunguluensis* MICHAELSEN (1915) am nächsten, unterscheidet sich von dieser durch die Form und Ornamentierung der Penialborste, die Lage des Gürtels, sowie durch die Form der Samentaschen.

Die neue Art wird zu Ehren des bekannten Oligochaeten-Forschers G. E. GATES benannt.

Bemerkung: Bei einigen Exemplaren waren Prostata auf einer Seite auch in 17. u. 18. Segment vorhanden, bei einem Tiere aus Putty Hill auf der einem Seite sogar 3 im 17.–19. Segment. Bei den Exemplaren aus Scotland sind die Prostata-Öffnungen ganz auf dem 18. Segment. Hier fehlen die ab Borsten nicht am 17. sondern am 18. Segment.

Fundorte: Holotypus, Insel St. Helena, 16. 07. 1959; leg. A. LOVERIDGE, Inv. Nr. BM(NH) 1995.05.12.543.; Paratypen: BM(NH) 1995.05.12.544., Fundort wie beim Holotypus; Insel St. Helena, Scotland, 27. 07. 1965 leg. A LOVERIDGE, Inv. Nr. BM(NH) 1995.05.12.545-558. 14 Ex., AF 3455 6 Ex.; Insel St. Helena, Putty Hill, 29. 07. 1959 leg. A. LOVERIDGE, Inv. Nr. BM(NH) 1995.05.12.559-577. 19 Ex., AF 3456 10 Ex.; Insel St. Helena, leg. A. LOVERIDGE BM(NH) 1995.05.12.578-582. 5 Ex., AF 3457 3 Ex.

Eutrigaster COGNETTI, 1904 emend. CSUZDI & ZICSI, 1991

Diagnose: Borsten eng gepaart, sämtliche ventral gelegen. Weibliche Poren auf dem 14. Segment, paarig oder unpaarig. Männlicher Geschlechtsapparat acanthodrilin z. T. mit microscoleciner bzw. balantiner Reduktion. Schwach muskulöser Vormagen im 5. Segment, und 2 große Muskelmagen im 6.–7. Segment. Kalkdrüsen mit stieligen extramuralen Divertikeln im 15.–17. Segment. Exkretionssystem meronephridisch mit sackförmigen Meronephridien, denen sich am Ende des Körpers in jedem Segment medioventral 1 Paar Megameronephridien anschließen. Intestinale Blindsäcke fehlen. Samentaschenampulle einfach. Ausführungsgang der Samentasche mit mehreren einkämmrigen oder einem mit Stiel und mehrkämmrigen Divertikel versehen. Erster Rückenporus in der Nähe des Gürtels, hinter Intersegmentalfurche 9/10 beginnend.

Typus-Art: *Eutrigaster oraedivitis* COGNETTI, 1904.

Untergattung ***Graffia*** CSUZDI & ZICSI, 1991

Diagnose: Penialborsten vorhanden.

Eutrigaster (Graffia) gagzoi (MICHAELSEN, 1908)

Fundort: Haiti, zwischen Belladere und Janvier; Leg ?. 19.7.1930. Inv. Nr. BM(NH) 1995.05.12.531.; Dominikanische Republik, Loma Rucilla, Zentrale Kordillera, 8000-10000 Ft., leg. P.J. DARLINGTON Jr., 7. 1938; Inv. Nr. BM(NH) 1995.05.12.86-89., AF 3458 2 Ex.

Eutrigaster (Graffia) godeffroyi (MICHAELSEN, 1890)

Fundort: Dominikanische Republik, Prov. La Vega, Municipio Jarabacoe Seccia Monaboo Paraje la Cienaga; leg. C. E. ROY + R. R. ALLEN, 22.2.1963; Inv. Nr. BM(NH) 1995.05.12.90-93. AF 3460 2 Ex.; Dominikanische Republik, Espuela, 2000 F; leg. P. J. DARLINGTON, 8.1938; Inv. Nr. BM(NH) 1995.05.12. 85., AF 3459, 1 Ex.

Eutrigaster (Graffia) guatemalae (EISEN, 1900)

Fundort: Guatemala, Totenicapan; aus EISEN's Kollektion; Inv. Nr. BM(NH) 1995.05.12.583-589., AF 3461, 4 Ex.

Eutrigaster (Graffia) montana CSUZDI & ZICSI, 1991

Fundort: Jamaica, Montengo Bay, unter der Laubstreu von Kokosbäumen; leg. J. A. GRASBECK, 14.3.1911; Inv. Nr. BM(NH) 1995.05.12.532.

Eutrigaster (Graffia) sporadonephra (COGNETTI, 1905)

Fundort: Aus EISEN's Kollektion. Inv. Nr. BM(NH) 1995.05.12.532.

Acanthodrilinae CLAUS, 1880 emend. CSUZDI, 1996

Eodrilus MICHAELSEN, 1907

Da die besonders komplizierte Vergangenheit der Gattung *Eodrilus* von JAMIESON & DYNE (1976), JAMES (1990) und REYNOLDS & RIGHI (1994) zusammengefaßt wurde, halten wir uns an den Vorschlag von REYNOLDS & RIGHI (1994), demnach die Gattungen *Diplotrema* SPENCER, 1900 und *Eodrilus* solange weitergeführt werden müssen, bis deren Typusarten nicht revidiert werden.

Diagnose: Zwei Paar Hoden und Samentrichter im 10. und 11. Segment. Weibliche Poren auf dem14. Segment, paarig oder unpaarig. Männlicher Geschlechtsapparat acanthodrilin, z. T. mit microscoleciner Reduktion. Ein Muskelmagen vor dem Hodensegment oder fehlend. Kalkdrüsen fehlen. Exkretionssystem holonephridisch, Nephridialblasen fehlen.

Typus-Art: *Eodrilus cornigravei* MICHAELSEN, 1907.

Eodrilus hamiger MICHAELSEN, 1911

Fundort: Guatemala, Totenicapan; aus EISEN's Kollektion; Inv. Nr. BM(NH) 1995.05.12.534-538., AF 3462 3 Ex.

Eodrilus whitmani (EISEN, 1900)

Fundort: Guatemala, Totenicapan; aus EISEN's Kollektion; Inv. Nr. BM(NH) 1995.05.12.539-541., AF 3463 2 Ex.

Octochaetinae MICHAELSEN, 1900 emend. CSUZDI, 1996

Ramiellona MICHAELSEN, 1935

Diagnose: Ein Muskelmagen vor dem Hodensegment. Kalkdrüsen mit oesophagealen Ausbuchtungen zwischen den Segmenten 8–12. Weibliche Poren auf dem 14. Segment, paarig oder unpaarig. Männlicher Geschlechtsapparat acanthodrilin, z. T. mit balantiner Reduktion. Exkretionssystem meronephridisch mit sackförmigen Meronephridien; medioventrale Megameronephridien fehlen.

Typus-Art: *Ramiellona stadelmanni* MICHAELSEN, 1935.

Ramionella strigosa GATES, 1962

Bemerkung: Die von mir bestimmten Tiere stammen warscheinlich aus den Aufsammlungen, die EISEN im Mai und November 1902 in Guatemala erbeutet hatte und die von MICHAELSEN (1911) und GATES (1962) zum Teil bearbeitet wurden.

Fundort: Guatemala, Totenicapan; aus EISEN's Kollektion; Inv. Nr. BM(NH) 1995.0 5.12.542., AF 3464 1 Ex.

*

Danksagung. Für die Überlassung des Materials, ferner für einen Arbeitsplatz im Museum spreche ich Herrn PAUL CLARK und Frau MIRANDA LOWE (The Natural History Museum, London) meinen besten Dank aus.

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Opusc. Zool. Budapest, XXIX–XXX, 1997

Timmodrilus gen. n., a new genus from the family Enchytraeidae (Oligochaeta)

By

K. DÓZSA-FARKAS*

Abstract. *Timmodrilus* gen. nov. and its type species, *T. oligoseta* sp. nov. are described from Estonia. The species *Enchytraeus christofferseni* RIGHI, 1975 is also placed in the new genus *Timmodrilus*, the main characteristics of wich are: dorsal pores absent, brain convex anteriorly and slightly incised posteriorly. Setae and peptonephridia are of *Fridericia*-type. Anteseptale of nephridia consisting of funnel and a few canals, efferent duct arising ventrally, posteroventrally or terminally. Lymphocytes of two types. Spermatheca entally connecting with the oesophagus. The main characteristics of the new species are: the absence of the dorsal setae still the last 18-19 segments; the spermatheca has two sessile diverticulae.

In the year 1996 I got some soil samples from Estonia from Professor T. TIMM. During the study of the material a new species was found which belonged to an unknown genusnamed here *Timmodrilus*. The species *Enchytraeus christoffersenі* RIGHI, 1975 is transferred to this genus. In the present paper the new genus and the new species are described.

Material and methods

Enchytraeid worms were collected from Estonia, Tartu County (Tartumaa), near the Vortsjarv Limnological Station, narrow flood-forest strip of *Alnus glutinosa* on the lowest lake terrace.

Two specimens have been examined, the description is based on the examination of live material and the living animals were recorded on videotape too (Sony CCD-IRIS,DXC 107 p colour video camera with Zeiss microscope). The worms were fixed in bouin and stored in 70 % ethanol. Measurements were taken on living worms.

Timmodrilus gen. nov.

Setae straight with ental hook, without nodulus. If the number of setae more than 2, the innermost setae of the bundles pairwise shorter than the outer ones. Headpore at 0/I, dorsal pores absent. Gradual transition between oesophagus and intestine. Oesophageal appendages and intestinal diverticula absent. Peptonephridia present. Blood colourless, dorsal vessel arising in the postclitellar region. Two types of lymphocytes present: oval large, nucleate cells and smaller, hyaline, anucleate ones. Anteseptal part of nephridia consists of funnel and coils of nephridial canal, postseptale oval, the efferent duct arising mid- and posteroventrally or terminally. Interstitial tissue of nephridia well-developed.

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Seminal vesicle may be present. Sperm funnel cylindrical. Penial bulb present. The spermatecae with or without diverticulae. The ectal duct long and well demarcated. Ental ducts communicate with the oesophagus.

The new genus shows similarities to *Fridericia* in type of peptonephridia, setae, lymphocytes and spermatheca, but differs from it in the absence of dorsal pores. *Timmodrilus* resembles *Enchytraeus*, too, but differs from it in the type of peptonephridia, the disposition of setae, the two types of lymphocytes and the form of spermatheca.

Type species. *Timmodrilus oligoseta* sp. n.

Two species belong to the genus:

T. christofferseni (RIGHI, 1975) comb. nov.
Syn. *Enchytraeus christofferseni* RIGHI, 1975
T. oligoseta sp. n.

Timmodrilus oligoseta sp. n.

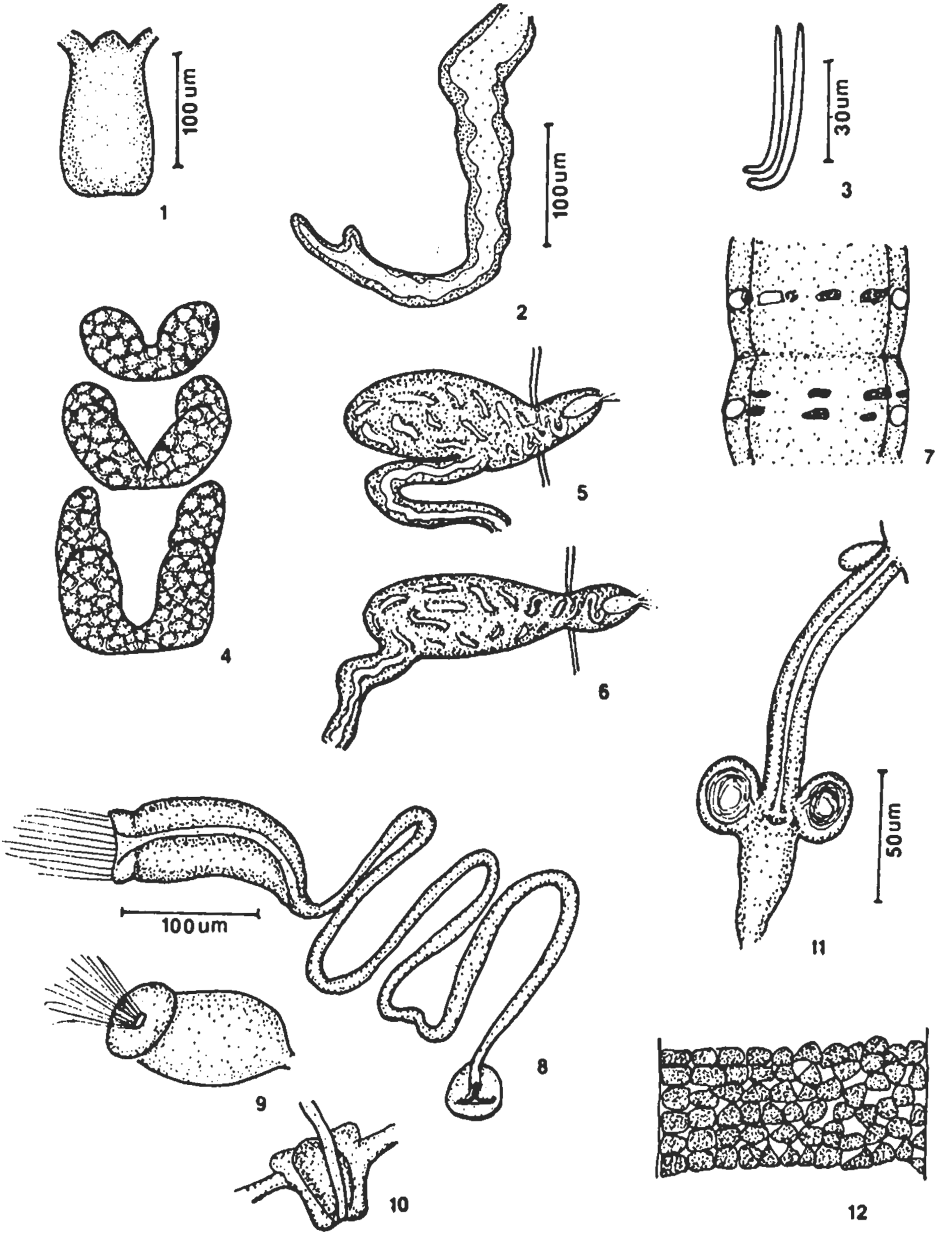
(Figs. 1–12)

External characters. Medium-sized species. Holotype: segments 39, length 10.1 mm, the diameter at segment VIII is 0.29 mm, and at the clitellum 0.35. Paratype: segments 36, length 7.8 mm and 0.25/0.28 mm in width. Colour whitish. The worms are rather stiff and tolerate even the pressure of a larger cover slip well. Setae straight with ental hook (Fig 3). All setal bundles contain 2 setae, but the dorsal bundles absent in II - XX or XXV. Both dorsal and ventral bundles absent on XII. Setal formula: 0 - 0, 2 : 2 - 2. Length of praeclitellar setae 28-36 μm, on the posterior segments 45-49 μm. Head pore at 0/I , dorsal pores absent. Cutaneous glands arranged in 1-2 transverse rows of big (14 μm) transparent and brown cells (Fig. 7). Clitellum on segments XII-1/2 XIII, well developed, with large gland cells close together ventrally but irregularly arranged dorsally (Fig. 12).

Internal characters. Brain (Fig. 1) twice as long as wide, the posterior end slightly incised and anteriorly convex. Peptonephridia (Fig. 2) long, extending backwards to VI, unbranched or with 1-2 short terminal branches. Gradual transition between oesophagus and intestine. Chloragogen cells present from VI, their size 16-40 μm, with refractive globules, forming a thin layer on gut. Three pairs of primary septal glands all of them united dorsally, on septa IV/V-VI/VII and the second and third pairs have ventral lobes (Fig. 4). Secunder septal glands absent.

The blood is colourless, the dorsal vessel arises in segment XVII. The first nephridia in VI/VII. The anteseptal section of nephridia consists of a funnel and some nephridial canals, the postseptale section is about 2 times longer than the preseptale, the efferent duct arising mid-ventrally (Fig. 5) and in the posterior segments of body postero-ventrally (Fig 6). Lymphocytes are nucleated, transparent, elongate oval and granulated (16-32 μm long), 1-2 very small (3-6 μm) anucleated hyalin corpuscles can be found in coelom too. The low number of these small corpuscles makes it uncertain to consider them as lymphocytes. In future the study of a greater material could solve this problem.

Seminal vesicle small. Sperm funnel (Fig. 8, 9) cylindrical, about 2 times longer than wide (120-150 μm long and 52-88 μm wide), the distinct collar slightly narrower than the funnel itself. The duct is not too long, irregularly coiled in XII, diameter 5-7 μm (Fig. 8). Penial bulb small, poorly developed (Fig. 10). Two mature eggs present at a time. The ampulla of spermatheca small, with two distinct globular sessile diverticula. Ental duct opening separatelly, but near together into the oesophagus. Ectal duct long (125-160 μm



Figs. 1–12. *Timmodrilus oligoseta* sp. n. 1: brain, 2: peptonephridia, 3: setae, 4: septal glands, 5: nephridium in preclitellar segments, 6: nephridium in postclitellar segments, 7: cutaneous glands, 8: sperm funnel with the sperm duct, 9: sperm funnel, 10: penial bulb, 11: spermatheca, 12: gland cells of clitellum, lateral view (d: dorsal side, v: ventral side)

long and about 20 μm wide), well demarcated. One sessile ectal gland (24 μm long) present at the orifice (Fig. 11).

Discussion. The new species is similar to *T. christofferseni* (RIGHI, 1975) in the long tubular peptonephridia (but the latest forms a coil), in the spermatheca: both have a long, demarcated ectal duct (but the spermatheca of *T. christofferseni* has not diverticula, and the ental ducts merging before the connection with oesophagus). In addition, *T. oligoseta* differs from *T. christofferseni* in the number of setae, and in the types of lymphocytes. The new species has very few anucleated hyalin corpuscles.

Type-locality. Estonia, Tartu County (Tartumaa), the former Petseri Farm near the Vortsjarv Limnological Station, eastern shore of Lake Vortsjarv, narrow flood-forest strip of *Alnus glutinosa* on the lowest lake terrace, with scarce *Filipendula*, *Urtica* and *Lysimachia*.

Holotype. T.1, in ethanol, leg.: 21.06.1996. Dr. T. TIMM. Det. 2.03.1997. Paratype: P. 37, one specimen in ethanol, leg.: 21.06.1996. Dr. T. TIMM. Det. 16.10.1996. Type material is deposited in the collection of the author, Department of Systematic Zoology and Ecology, Loránd Eötvös University, Budapest.

Derivatio nominis. The genus is named in honour of Professor TARMO TIMM, who collected the material. The specific name "*oligoseta*" refers to the absence resp. lower number of setae; *oligoseta* (Latin) = a few setae.

*

Acknowledgement: I wish to thank Prof. Dr. TARMO TIMM (Estonia, Tartu) for collecting the valuable material, and Dr. MARIA POBOZSNY for helping in English.

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Opusc. Zool. Budapest, XXIX–XXX, 1997

Comparison of Collembola communities in different habitats on some drainage area of Lake Balaton

By
J. FARKAS*

Abstract. Collembola fauna was investigated in different habitats of drainage area of Lake Balaton. Three large areas (shore of the Lake, inflows of the Lake, Kis-Balaton Nature Conservation Area) were divided into smaller study areas, which differ from each other in vegetation and the degree of wetness. I collected samples from suitable places using mainly 3 different methods: (1) Berlese funnel, (2) Pitfall traps, (3) Vacuum hoover.

Investigation of collembolan communities was carried out by comparing the species composition of different habitats. The species compositions reflect the microclimatic characters of the different habitats. Both diversity and abundance were highest in the large reeds where collembolans found large number of microhabitats. Diversity and abundance were lowest in dry and warm areas. The composition of the Collembola fauna collected from sites of similar humidity and vegetation were similar. Finally I conclude that some of the study areas proved to be valuable places. The most diverse places are mosaic-like habitats. It is especially important to conserve these mosaic-like habitats for their high biodiversity.

Springtails are one of the most important animal groups of the soil fauna. Not only because they take part in decomposition of the organic matter of the soil but sometimes they could be so abundant that they become very important members of the food-chain. On the other hand, in consequence of their small size, they are very sensitive of the environmental circumstances (humidity, texture of soil, vegetation) so they are suitable for characterization of different habitats. The species composition, diversity and density of species could be changed in larger habitats. These parameters show the natural value of a place and indicate the human influences.

Protection of water quality and natural values of Lake Balaton is impossible without the protection of streams and other inflows running into the Lake, since most of the pollutants reach the Lake by this way. For this reason investigation of these streams is of great importance.

Some members of the Collembola fauna, mainly the smaller ones could drift by heavy rainfalls into the large reeds surrounding the shore, or drift directly into the Lake. Sometimes drift processes play significant role in inhabitation of the Lake area. On the other hand, the change of the fauna could indicate the changes in the Lakes characteristics which occur only later.

Pollutants carried in by Zala River cause one of the most serious problems of Lake Balaton. Therefore scientists attach great hope to the recreation of the original Kis-Balaton area comprising large swamp and reeds. The recreation of the Kis-Balaton area is being realized in two periods. The first one resulted in a shallow lake with a large extension (Reservoir I). The second step just now occurs (Reservoir II). Recently habitats of Kis-Balaton Nature Conservation Areas are in continuous change.

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The aim of the present study was to make a comparison among Collembola fauna of different habitats of Lake Balaton, Kis-Balaton Nature Conservation Area and some inflows of Balaton. Previously I gave an account of Collembola fauna of Lake Balaton's shore (FARKAS, 1995).

Materials and Methods

Site description

Shore of Lake Balaton

I investigated 3 large areas. Each of them was divided into smaller habitats. These smaller habitats are as follows:

Close to Balatonkenese. Large reeds bordereding a stone dam

1. The 2 or 3 year old debris of reeds on top of the dam. This area is moderately wet and dry during most of the summer.
2. The fresh reed debris on lake side of the dam where it is always wet.
3. Moss on the dam where it is dry during the summer.
4. Among the reeds where it is always wet.
5. Shore of a small swamp where it is always wet and rich in organic matter.
6. Large reedy area close to Alsóörs.

Area of large reeds and a patch of willow trees between Alsóörs and Palóznak

7. Area with horsetails and sedges. A warm and dry place where bushes grow.
8. An area of reeds and willow tree where with the exception of summer it is always wet.
9. Areas comparison. I collected samples from other parts of the lake, for example from Ábrahámhegy, Szigliget, Keszthely, Siófok, etc.

Inflows of Lake Balaton

To characterize every each stream in whole length is impossible because they flow through different types of areas, so their faunas are under different influences. According to this, the investigated streams and canals were divided into smaller but characteristic habitats.

Lovasi Stream

Two localities were monitored along the stream, where not only current velocity and water discharge but the vegetation was also different.

II. 1. Damned stream section at Lovas: lake with an extensive reed belt.

II. 2. Section between the railway lines and Lake Balaton: reed and sedge dominated area with a fluctuating water cover.

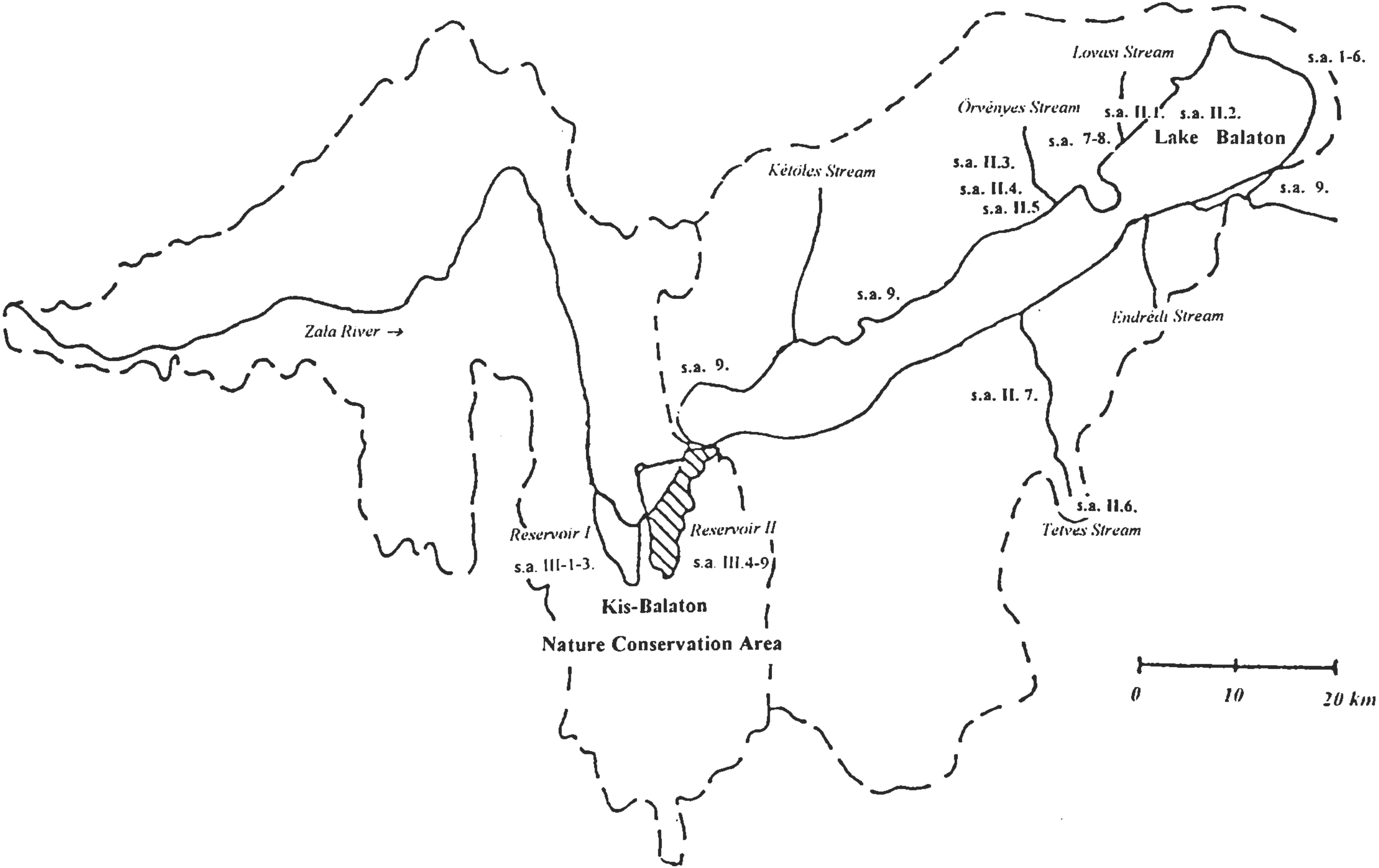
Örvényesi Stream

The Örvényesi Stream is permanent running water connecting areas with different vegetation types. Three areas were selected for investigation.

II. 3. Section above the mill: dense bush and wood.

II. 4. Section at the railway: concrete stream channel surrounded with an open meadow.

II. 5. Mouth area: reed-covered wetland directly at Lake Balaton.



DRAINAGE AREA OF LAKE BALATON

Table 1. The list of Collembola species which are abundant in at least one habitat of shore of Lake Balaton

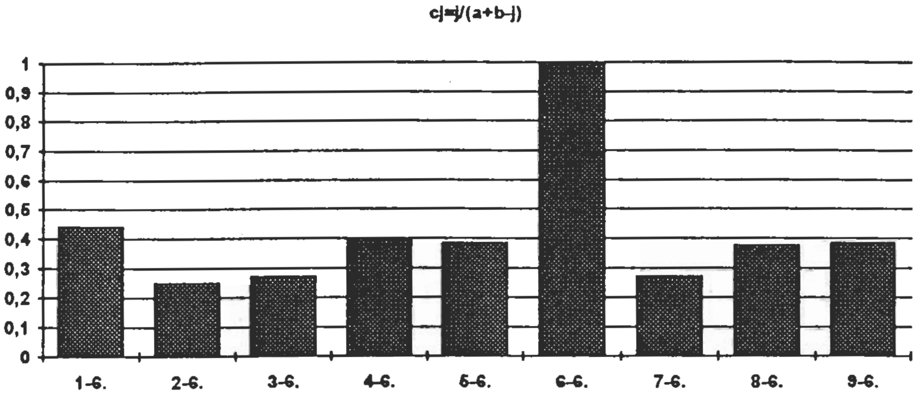
Species	Study area								
	1	2	3	4	5	6	7	8	9
Poduridae									
Podura aquatica Linné	-	*	-	*	*	*	-	+	-
Hypogastruridae									
Pseudachorutes corticicola (Schaff.)	+	-	+	+	*	+	+	-	+
Hypogastrura denticulata (Bagn.)	-	+	*	*	*	*	-	+	-
Friesea mirabilis (Tull.)	+	-	+	+	+	+	-	-	+
Neanura conjuncta Stach	+	-	-	-	-	+	-	+	+
Isotomidae									
Folsomia nana Gisin	*	+	+	+	+	*	*	*	*
Folsomia candida (Wilem)	+	-	-	-	-	+	+	-	+
Folsomia multiseta Stach	-	-	-	-	+	-	-	-	-
Proisotoma minuta (Tullb.)	*	-	+	*	*	*	+	*	*
Isotoma notabilis Scaff.	+	-	-	-	-	*	-	-	*
Isotomurus palustris (Müll.)	+	+	-	*	*	+	-	*	*
Entomobryidae									
Entomobrya marginata (Tullb.)	-	-	-	-	-	-	+	-	-
Orchesella flavescens (Bourl.)	-	-	-	+	+	*	-	+	-
Lepidocyrtus lanuginosus (Gmelin)	*	+	+	*	*	*	+	*	*
Lepidocyrtus paradoxus Uzel	*	-	-	+	+	*	*	*	*
Tomocerus longicornis (Müller)	-	-	+	-	-	-	+	-	+
Sminthuridae									
Sminthurides aquaticus (Bourl.)	-	*	+	*	*	-	-	*	*
Dicyrtoma ornata (Nic.)	+	-	-	-	-	*	-	-	-

Explanation: - non-existing species, + existing but not abundant, * abundant, dominant species, 1–9 habitats as mentioned in the text

Table 2. The list of Collembola species which are abundant in at least one habitat of inflows of Lake Balaton

Species	Study area						
	1	2	3	4	5	6	7
Poduridae							
Podura aquatica Linné	*	*	-	-	*	+	-
Hypogastruridae							
Pseudachorutes corticicola (Schaff.)	+	-	-	-	*	+	-
Hypogastrura armata Nicolet	*	+	+	+	+	+	-
Friesea mirabilis (Tullberg)	+	+	*	-	+	-	+
Onychiuridae							
Onychiurus armatus (Tullberg)	*	-	-	-	+	-	-
Isotomidae							
Folsomia nana Gisin	*	*	+	+	*	*	-
Folsomia candida (Willem)	*	+	+	-	-	+	-
Isotomurus palustris (Müller)	+	*	-	-	+	+	-
Entomobryidae							
Orchesella flavescens (Bourlet)	+	*	-	-	*	+	-
Lepidocyrtus curvicollis Bourlet	*	*	+	+	*	*	+
Lepidocyrtus lanuginosus (Gmelin)	*	*	+	+	*	*	-
Tomoceridae							
Tomocerus longicornis (Müller)	*	*	+	-	*	+	+
Tomocerus vulgaris (Tullberg)	*	+	+	-	+	*	+
Sminthuridae							
Sminthurides aquaticus (Bourlet)	+	-	-	-	+	+	-
Sminthurides pumilis (Krausbauer)	+	*	-	-	+	-	-
Sminthurus viridis Linné	-	+	+	+	-	-	-
Dicyrtoma fusca (Lucas)	-	+	*	-	-	-	-

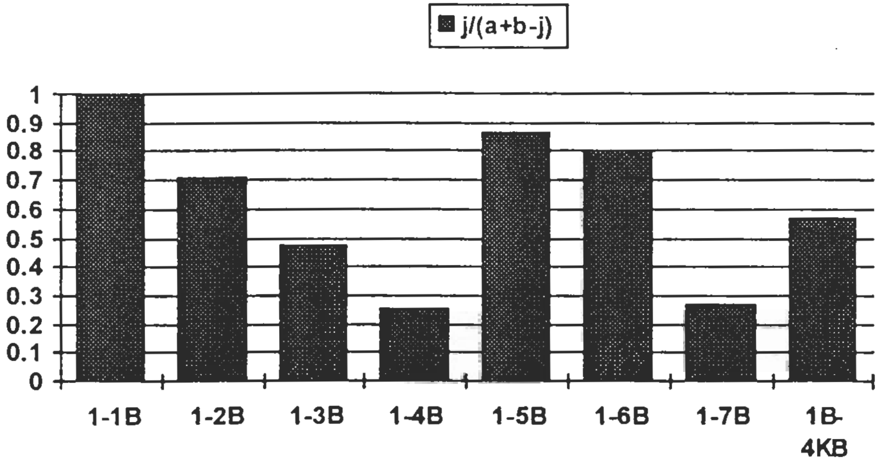
Explanation: - non-existing species, + existing but not abundant, * abundant, dominant species, 1-7 habitats as mentioned in the text



Explanation:
1. Study area I.1.
2. Study area I.2.
3. Study area I.3.
4. Study area I.4.
5. Study area I.5.
6. Study area I.6.
7. Study area I.7.
8. Study area I.8.
9. Study area I.9.

Study areas see those mentioned above

Fig. 1. Similarities of species (Jaccard Index) in different habitats of Lake Balaton



1B. Study area II.1.
2B. Study area II.2.
3B. Study area II.3.
4B. Study area II.4.
5B. Study area II.5.
6B. Study area II.6.
7B. Study area II.7.
4KB Study area III.4.

Fig. 2. Similarities of species (Jaccard Index) in different habitats along the inflows of Lake Balaton

Table 3. The list of Collembola species which are abundant in at least one habitat of Kis-Balaton Nature Conservation Area

Species	Study area								
	1.	2.	3.	4.	5.	6.	7.	8.	9.
Poduridae									
Podura aquatica Linné	*	-	*	*	+	-	-	*	+
Hypogastruridae									
Pseudachorutes corticola (Scaff.)	-	-	+	*	-	-	-	+	-
Hypogastrura denticulata (Bagnall)	*	-	*	*	*	-	-	+	+
Friesea mirabilis (Tullberg)	-	-	-	+	-	-	+	*	-
Proisotoma crassicauda (Tullberg)	-	-	+	*	-	-	-	-	-
Proisotoma minuta (Tullberg)	+	+	*	*	*	-	*	*	+
Onychiuridae									
Onychiurus armatus (Tullberg)	-	-	*	+	+	-	-	-	-
Folsomia candida (Willem)	+	*	+	+	-	*	*	+	-
Folsomia nana Gisin	-	*	+	+	+	*	*	*	+
Isotomidae									
Isotomurus palustris (Müller)	-	-	+	+	-	-	+	*	+
Entomobrya lanuginosa (Nic.)	-	-	+	-	*	-	+	+	+
Entomobryidae									
Orchesella flavescens (Bourlet)	+	-	*	*	*	-	-	-	-
Lepidocyrtus lanuginosus (Gmelin)	*	-	+	+	+	-	-	*	*
Lepidocyrtus curvicollis Bourlet	-	-	+	*	-	-	-	-	*
Heteromurus nitidus (Templ.)	-	-	-	*	-	-	*	+	-
Tomoceridae									
Tomocerus longicornis (Müller)	-	+	-	-	*	-	-	-	*
Tomocerus vulgaris (Tullberg)	-	+	-	-	*	+	-	*	+
Sminthuridae									
Sminthurides aquaticus (Bourlet)	*	-	+	+	-	-	-	*	-
Sminthurides pumilis (Krausbauer)	+	-	*	*	+	-	-	*	+
Dicyrtoma ornata (Nic.)	-	-	+	*	-	-	-	-	-
Dicyrtoma fusca (Lucas)	-	-	*	+	-	+	-	+	-

Explanation: - non-existing species, + existing but not abundant, * abundant, dominant species, 1–9 habitats as mentioned in the text

Balatonendréd

The Endrédi Stream is damned above Balatonendréd near the source creating a siltated pond. The water flows through a meadow before reaching the village. Upstream the village two artificial ponds are in the floodplain near the stream. The stream bed has been deepened downstream the village resulting in a canal like appearance of the stream.

II. 6. Source area: meadow with two ponds.

II. 7. Canal-like section downstream the village: ruderal, open area.

Kis-Balaton Nature Conservation Area

Collembola fauna was investigated in some characteristic habitats in areas of reservoir I and II of Kis-Balaton Nature Conservation Area. Habitats differ from each other in the composition of the vegetation and the water regime of the soil. The selected three large areas were divided into smaller habitats. These smaller habitats are as follows:

Reservoir I

III. 1. Shore of damned lake

There are only a few plants. Vegetation is composed of herbosa mainly of sedge and grass. It is always wet.

III. 2. Steppe close to the shore

Area with horsetails, sedges and grasses. It is always dry.

III. 3. Large reeds and swamp

It is always wet and rich in organic matter.

Reservoir II

III. 4. Large reedy area

Similar to study area III.3. Always wet and rich in organic matter.

III. 5. Reedy area along the shore of Zala River

Narrow reeds with willow trees and bushes. It is moderately wet during most of the year.

III. 6. Steppe between a forest and a large reeds

Similar to study area III.2. This area a warm and dry place during most of the year.

Diás Island (Reservoir II)

III. 7. Clearing area in Diás Island

This grassy area is very wet during spring and moderately dry during summer.

III. 8. Small swamp in the edge of a forest in Diás Island

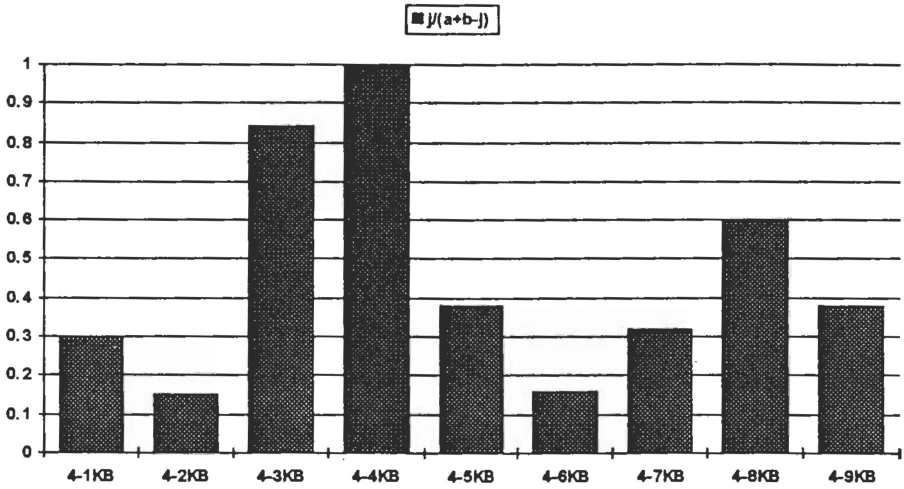
Always very wet area with open water surface and with diverse vegetation.

III. 9. Shore of Zala River close to Diás Island

Similar to study area III.6. Narrow reeds with bushes and trees. It is moderately wet.

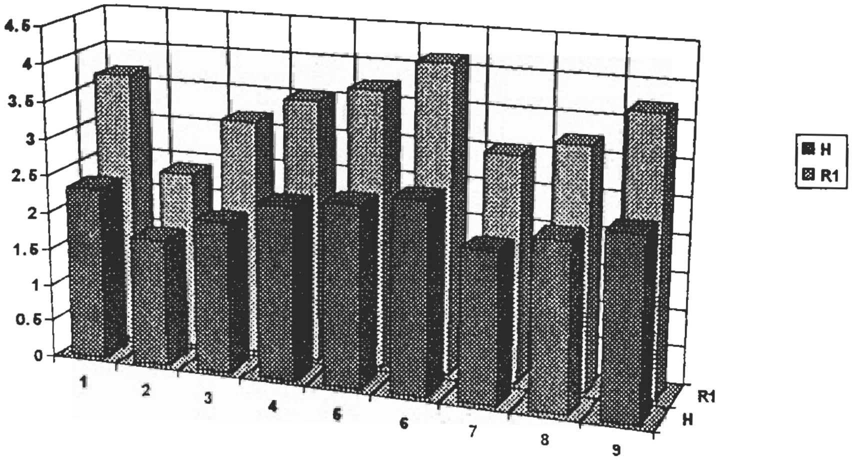
Collection of specimens

Springtails were collected from suitable places using mainly 3 different methods: (1) The majority of the animals was collected using pitfall traps. 2 dl plastic glasses were placed in five meter distance from each other. The glasses were filled up with ethylene glycol. The traps were emptied generally monthly. If it was necessary we used the isolation method of salting. The collected material was stored in 70% methanol until examination. (2) We collected samples of soil and leaf litter from which the animals were isolated using the Berlese method. (3) Samples mainly from Kis-Balaton and along of inflows were collected by vacuum hoower frequently. Sometimes I used singling and sweeping techniques.



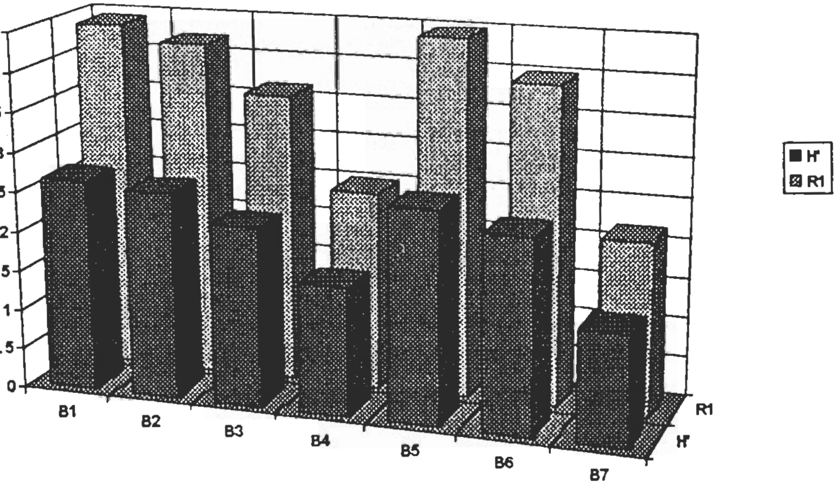
1KB. Study area III.1. 2KB. Study area III.2. 3KB. Study area III.3.
4KB. Study area III.4. 5KB. Study area III.5. 6KB. Study area III. 6.
7KB. Study area III.7. 8KB. Study area III.8. 9KB. Study area III.9.

Fig. 3. Similarities of species (Jaccard Index) in different habitats of Kis-Balaton Nature Conservation Area



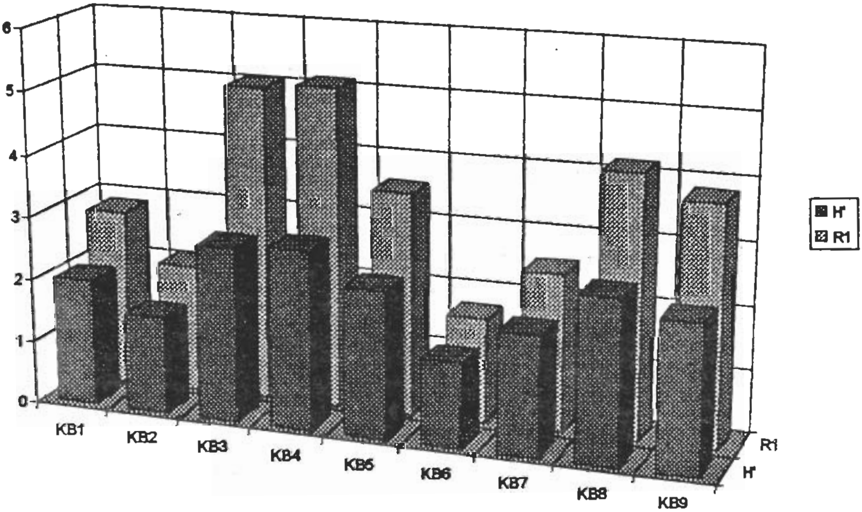
Explanation:
1. Study area I.1.
2. Study area I.2.
3. Study area I.3.
4. Study area I.4.
5. Study area I.5.
6. Study area I.6.
7. Study area I.7.
8. Study area I.8.
9. Study area I.9.
Study areas see those mentioned above

Fig. 4. Richness és Shannon Index Shore of Lake Balaton



B1. Study area II.1.
B2. Study area II.2.
B3. Study area II.3.
B4. Study area II.4
B5. Study area II.5.
B6. Study area II.6.
B7. Study area II.7.
4KB. Study area III.4.

Fig. 5. Richness és Shannon Index Inflows of Lake Balaton



1KB. Study area III.1.
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5KB. Study area III.5.
6KB. Study area III. 6.
7KB. Study area III.7.
8KB. Study area III.8.
9KB. Study area III.9.

Fig. 6. Richness és Shannon Index Kis-Balaton Naturel Conservation Area

Results

Works of GISIN (1960), FJELLBERG (1980) and DUNGER (1994) were used to identify species.

Generally, making comparison between Collembola fauna of large areas, such as Lake Balaton (shore and inflows) and Kis-Balaton Nature Conservation Area is very difficult. Actually, we can compare only the smaller habitats because of the fragmentation of the larger areas.

The species composition reflected the microclimatic characters of the individual habitats. Collembolans are the most sensitive to temperature and the degree of moisture because of theirs small size. Species detected in different habitats are many kind of and their claims are also different.

Both species diversity and the frequency of occurrence were highest in the large reedy areas (study areas I 6, II. 1, III. 3, III. 4) which consisted of more smaller habitats. Study areas I. 2, II. 4, II. 7, III. 2, III. 6 proved to be the least diverse ones because of their dry nature. The largest differences were found between the permanently wet reedy areas (study areas I. 6, II. 1, III. 3, III. 4) and the steppe like habitats (study areas I. 7, II. 4, III. 2, III. 6).

Sometimes human influence (e.g. creation of new habitats by impounding a stream) results in an increase diversity. Poorer composition of vegetation and most kind of human influences (e.g. concretion of stream-bed) decrease both species and individuals numbers.

Large reeds in all three investigated large areas (shore of Lake Balaton, along inflows, Kis-Balaton Nature Conservation Area) were very similar regarding the Collembola abundances and diversity values. Results from the comparison of smaller areas show that species composition is a function of humidity of the area.

The rate the species diversity was a little higher in Kis-Balaton Nature Conservation Area (study areas III. 4, III. 3) than in the other places (study areas I. 6, II. 1).

Finally, I concluded that large areas without human influences have a diverse Collembola fauna. The similarity of species composition in different habitats reflected the microclimatic characters of each habitat.

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Opusc. Zool. Budapest, XXIX–XXX, 1997

The Amphibia, Insectivora and Rodentia fauna along some inflows of Lake Balaton

By
J. FARKAS* and M. PUKY**

Abstract. The aim of the present study was the compilation of species lists and the description of demographic parameters of Amphibia, Insectivora and Rodentia species along some inflows of Lake Balaton. Migration opportunities between stream and lake populations were also to be investigated. Surveys were carried out along five streams. Seven amphibian taxa, nine rodent and three insectivora species were found. Besides water quality requirements, the highest possible diversity of the neighbouring areas is also an important factor in maintaining species rich communities.

While the fauna of Lake Balaton is extensively studied, only scarce information is available on the animal communities of its inflowing streams and their floodplains. They are situated in the contact zone of three zoogeographical regions, Eupannonicum, Praeillyricum and Pilisicum. The Department of Systematic Zoology and Ecology of the Loránd Eötvös University has launched a complex research programme to fill this information gap. One aspect of the study is the investigation of vertebrate groups. Amphibians and small mammals were selected to study. Amphibians are sensitive bioindicators, their decline can be proved worldwide (WADE, 1991). Still, their present distribution has not been thoroughly studied not even in Europe, which is the best known continent from this viewpoint (CRESPO, E. G. et al., 1995). Small mammals are not only important elements of the food chain but their gradation can lead to the complete degradation of certain areas.

The aim of the present study was the compilation of species lists and the description of demographic parameters of Amphibia, Insectivora and Rodentia species. Migration opportunities between stream and lake amphibian populations were also to be investigate

Sampling sites and method

Figure 1 shows the five surveyed inflows of Lake Balaton (Lovasi Stream, Örvényesi Stream, Endrédi Stream, Ķétöles Stream, Tetves Stream). The first three streams are described according to the small mammal sampling sites.

I. Lovasi Stream:

Three localities were monitored along the stream, where not only current velocity and water discharge but the vegation was also different.

I/1. Source: ruderal area with some trees at Felsőörs.

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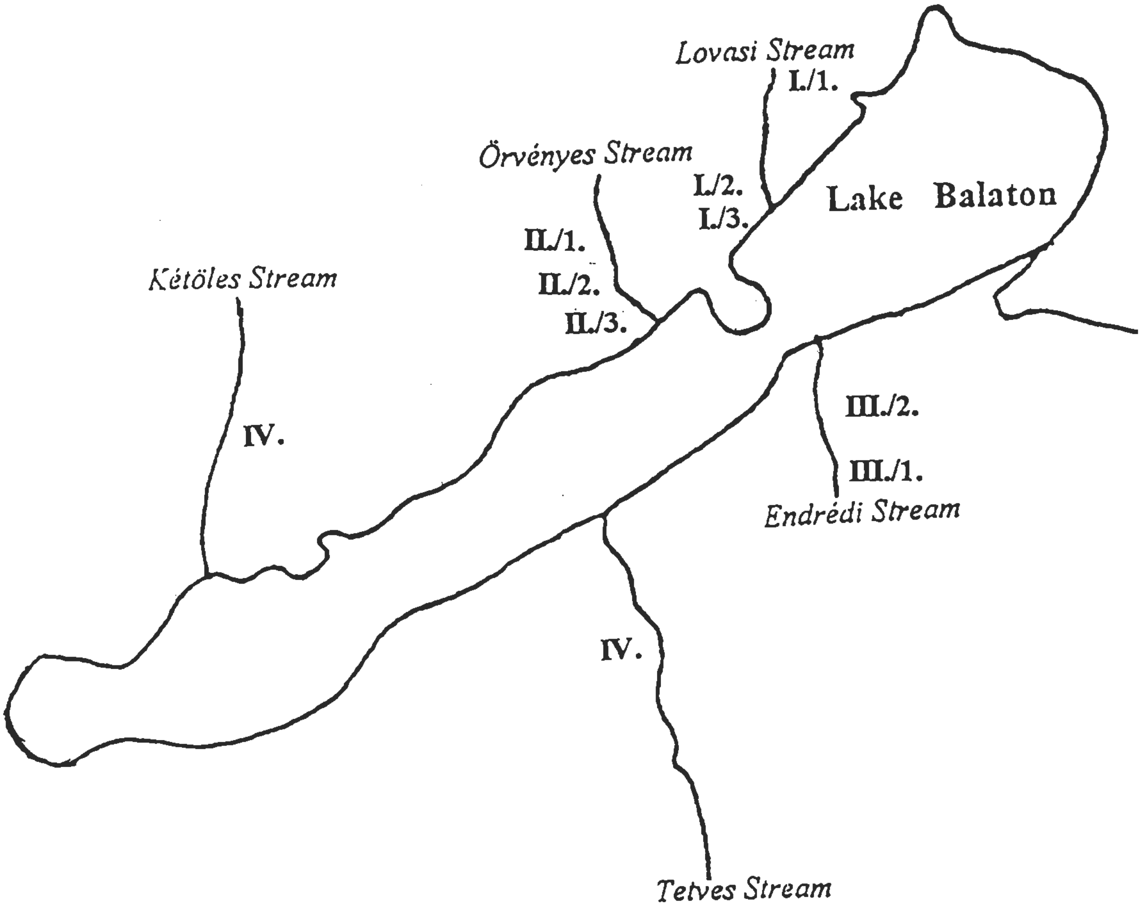
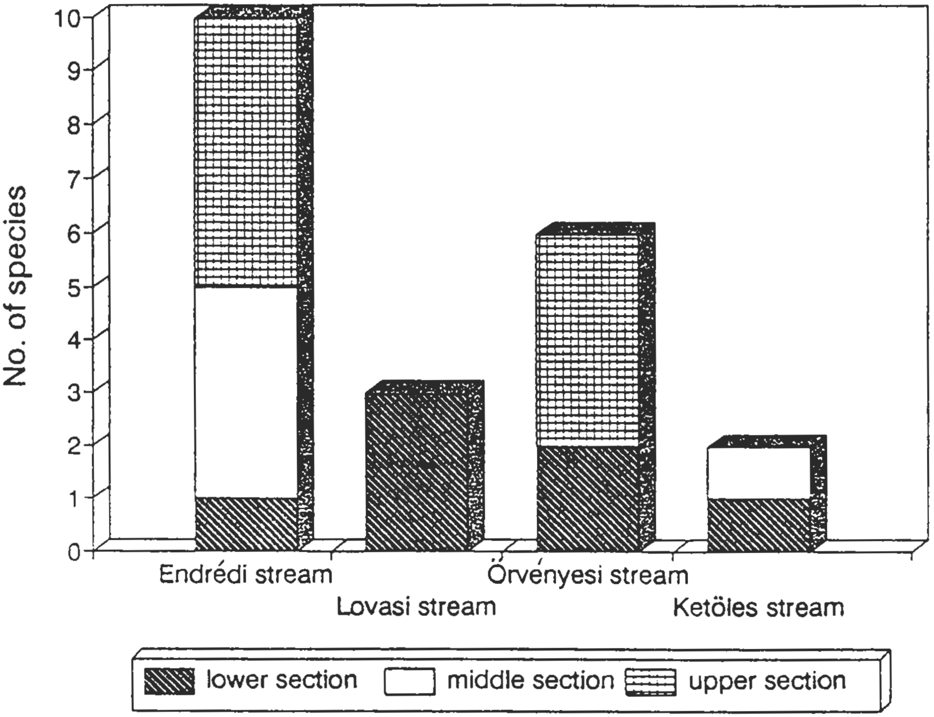

Lovasi Stream
I./1.
Örvényes Stream
I./2.
I./3.
Lake Balaton
II./1.
II./2.
II./3.
Kétöles Stream
IV.
III./2.
III./1.
Endrédi Stream
IV.
Tetves Stream

Fig. 1.


No. of species
0
1
2
3
4
5
6
7
8
9
10
Endrédi stream
Lovasi stream
Örvényesi stream
Ketöles stream
lower section
middle section
upper section

I/2. Damned Stream section at Lovas: lake with an extensive reed belt.

I/3. Section between the railway lines and Lake Balaton: reed and sedge dominated area with a fluctuating water cover.

II. Örvényesi Stream:

The Örvényesi Stream is permanent running water connecting areas with different vegetation types. Three areas were selected for investigation.

II/1. Section above the mill: dense bush and wood.

II/2. Section at the railway: concrete stream channel surrounded with an open meadow.

II/3. Mouth area: reed-covered wetland directly at Lake Balaton.

III. Balatonendréd:

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

III/1. Source area: meadow with two ponds.

III/2. Canal-like section downstream the village: ruderal, open area.

IV. Other areas:

Besides the above described streams amphibians were also monitored at Kétöles and Tetves streams, too. The former is a northern inflow with a highly canalised lower section, the latter flows into Lake Balaton from the south, and is in connection with a sophisticated fish pond system.

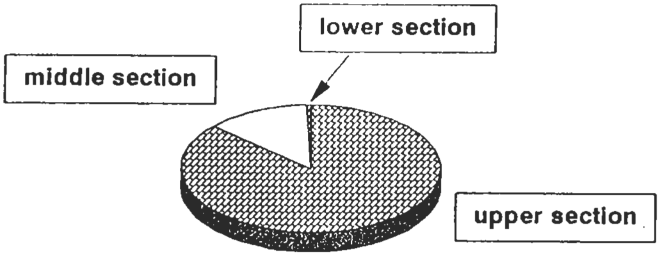
The amphibian fauna of the sampling sites were investigated in all developmental stages (eggs, tadpoles, adults). During the breeding period egg clutches and adults were counted. In late spring tadpoles and adults were determined according to DELY (1967), ARNOLD & BURTON (1980) and NÖLLERT & NÖLLERT (1992). Green frogs (*Rana esculenta*, *Rana ridibunda*, *Rana lessonae*) were regarded as a species group here. One species (*Bombina bombina*) was also put in the species list on the basis of its mating call. At the upper section of Endrédi Stream, where there are two additional water bodies in the floodplain (wired pond, fenced pond), the metapopulation structure of *Rana dalmatina*, *Bufo bufo* and *Pelobates fuscus* was also studied (EDENHAMN, 1993).

The live-trap method was applied to catch small mammals. 15 traps were arranged into 3 rows parallel with the streams. The traps were suitable to catch both smaller insectivores and larger rodents. The bait was a small piece of toast spiced with onion. Sunflower seeds were put into the trap to reduce the mortality. Trapped animals were narcotized by diethil-ether during the treatment. Several parameters of animals, for example length of body, legs and tail length, weight, state of sex etc were recorded. Animals were marked by cut fingers and the Capture-Mark-Recapture Method was applied. Seen animals were also used in the compilation of the species list.

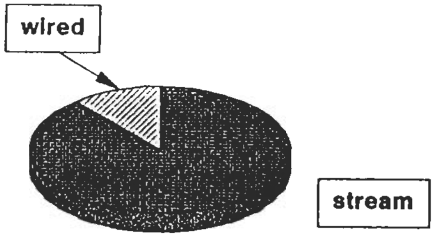
Results and discussion

Considerable differences were recorded both in species and individual number among the sampling localities at both animal groups (Table 1 and 2).

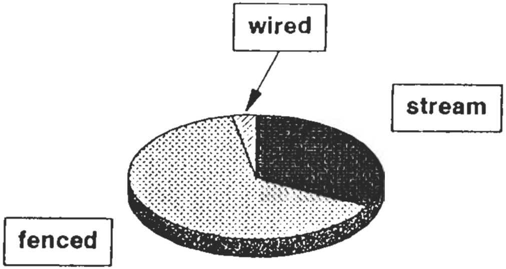
Altogether, seven amphibian taxa, half of the Hungarian fauna were found. The amphibian faunal composition of the northern inflows of Lake Balaton was similar to communities in the Bakony Mountains (MARIÁN, 1988). The presence of *Bombina bombina* at three streams, *Hyla arborea* at Tetves Stream and *Pelobates fuscus* at Endrédi Stream was of interest. *Rana esculenta* complex was the commonest at all streams, *Bufo bufo* and *Rana dalmatina* was also quite common. The latter had a highly oppurtunistic breeding strategy, Total individual number of amphibians at different sections of Endredi stream



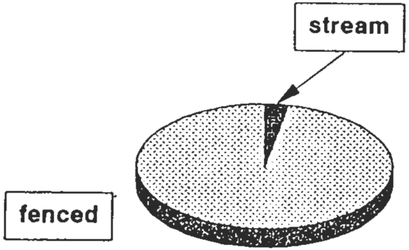
Relative individual number of **Bufo bufo**



Relative egg clutch number of **Rana dalmatina**

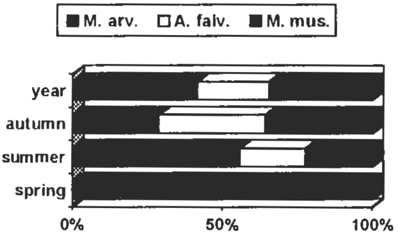


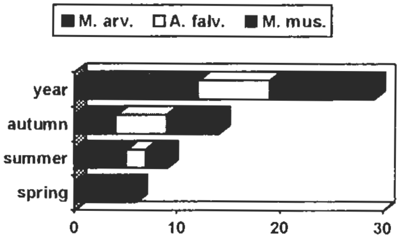
Relative individual number of **Pelobates fuscus**



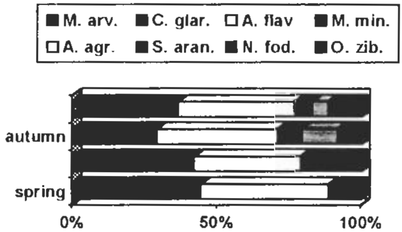
Number of small mammal individuals and rate of the species in different study areas

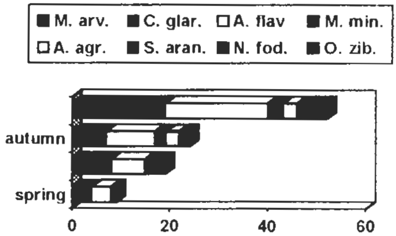
I./1. study area



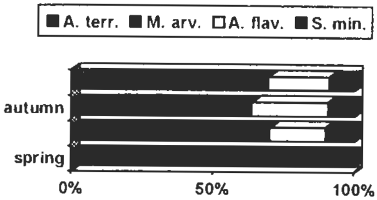


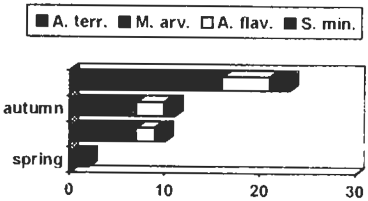
I./2. study area



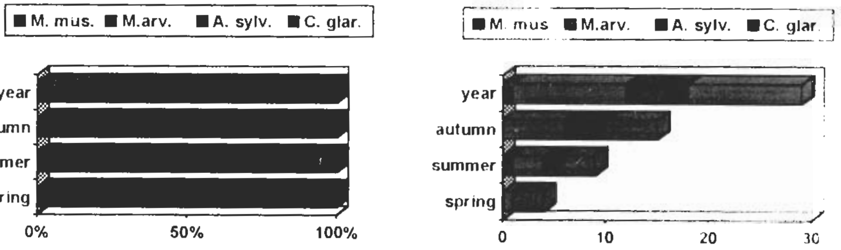


I./3. study area

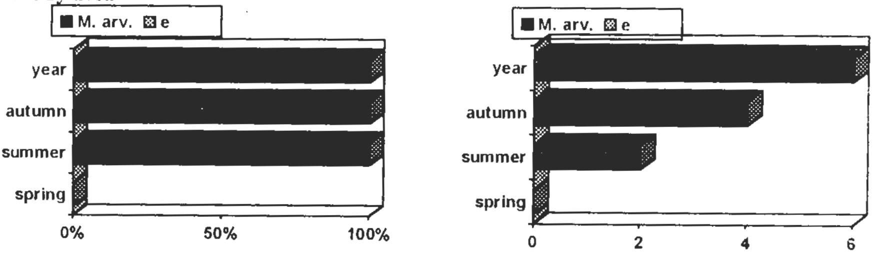




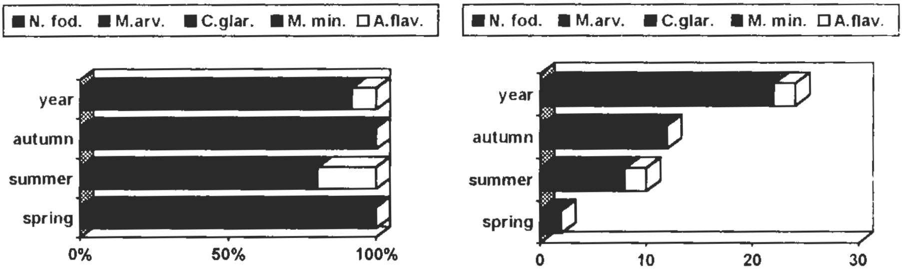
II./1. study area



II./2. sudy area



II./3. study area



at one locality along the northern shore (the mouth of Örvényesi Stream) it also fixed egg clumps on reed tussocks in Lake Balaton.

Table 1. Amphibian fauna of five inflows of Lake Balaton

	Triturus vulgaris	Bombina bombina	Bufo bufo	Hyla arborea	Pelobates fuscus	Rana dalmatina	Rana esculenta complex
Endrédi Stream	×		×		×	×	×
Lovasi Stream		×	×			×	×
Örvényesi Stream		×	×	×		×	×
Kétöles Stream						×	×
Tetves Stream		×	×	×		×	×

No correlation between amphibian species composition and stream sections (upper, middle, lower) could be found in a comparison of four streams (Figure 2). The presence of amphibians rather depended on the intensity of different human activities (stream bed modification, agriculture, etc.). Bottleneck areas, where there seems to be barriers for at least some of the species because of inadequate terrestrial or aquatic habitats, were present along all studied streams.

Different breeding habitat preferences of the three predominant species were recognised at the uppper section of Endrédi Stream, which was the most species-rich area (see the top left diagram in Figure 3). The investigation of three separate water bodies (Endrédi Stream, fenced pond, wired pond), with a functional relationship provided an opportunity for metapopulation studies. The other three diagrams (Figure 3) show the distribution of the three commonest amphibians among the water bodies. Surprisingly, the stream was the most important breeding site for *Bufo bufo*. In general, this species selects its breeding sites conservatively. The stream might be a good breeding site due to a moderate current velocity and a stable oxygen supply. There was no special area of *Bufo bufo* reproduction, egg strings were distributed quite equally along a 350 m stretch of the stream upstream the village. Only male common toads were found within the village.

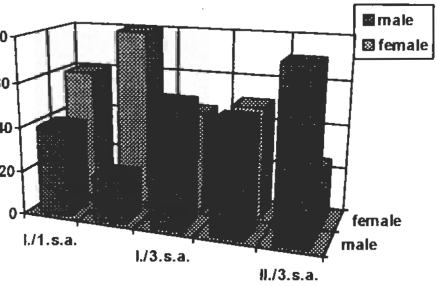
The fenced pond was the most important breeding site for the two other species, *Rana dalmatina* and *Pelobates fuscus*. The third separate water body seemed to be the least important breeding site, still, it is the only remaining breeding locality for common toads in the area in case the stream dries out temporarily or it is polluted.

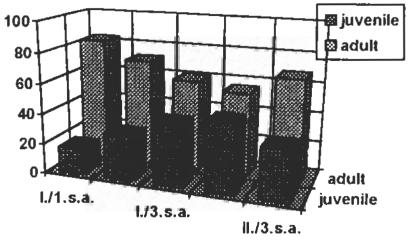
During the breeding season several *Pelobates fuscus* males died in the stream with no obvious reason. The unknown factor is suspected to be originated from a non-point source, but no evidence could be detected for this hypothesis. No female corpses were found, which is probably because of the general phenomenon of females staying less time in the water than males. No harm was observed on *Bufo bufo* and *Rana dalmatina*, which might be due to their higher tolerance and earlier breeding season, respectively.

Nine rodents and three insectivorous species were trapped in the investigated areas. Most of them lived in very low numbers in these areas, these animals were probably migrant individuals. This concept is supported by the fact that the rate of juveniles and males were higher at less favourable sites (e.g. study areas II./2 and I./1) than in more complex areas (e.g. study areas I./3 and II./3). Degree of diversity was the highest in areas with limited human impact, though most species were reported from an artificial habitat (I./2 study area). The explanation of this fact may be the complexity of this study area.

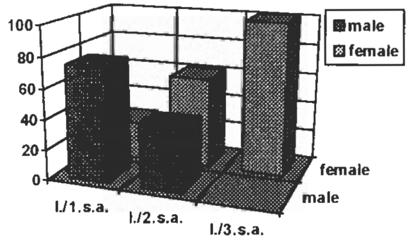
Rate of sexes and rate of juveniles and adults

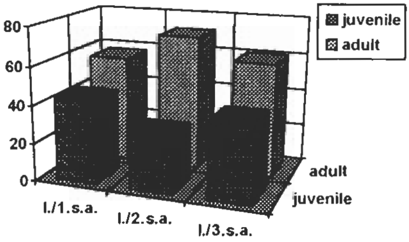
Microtus arvalis



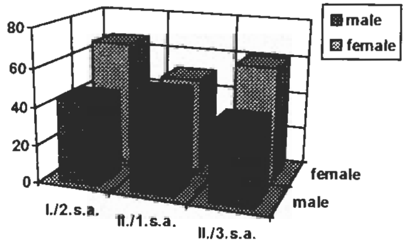


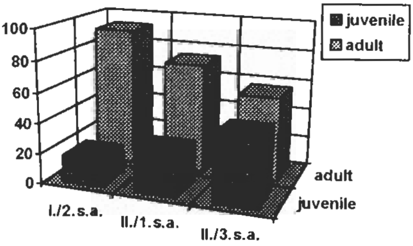
Apodemus flavicollis





Clethrionomys glareolus





Study area I./2 was surrounded by a lot of different habitats which serve as refuge for small mammals during unfavourable conditions.

Table 2. Rodentia and Insectivora fauna in the sudy areas

Species	Number of individuals			
	spring	summer	autumn	total
I/1. study area: 28 trapped individuals				
Microtus arvalis	3	5	4	12
Apodemus flavicollis	-	2	5	7
Mus musculus	2	2	5	9
I/2. study area: 50 trapped individuals				
Microtus arvalis	2	3	3	8
Clethrionomys glareolus	2	5	4	11
Apodemus flavicollis	4	7	10	21
Micromys minutus	-	1	2	3
Apodemus agrarius	-	-	3	3
Sorex araneus	1	-	1	2
Neomys fodiens	-	2	-	2
Ondatra zibethicus	-	detected	detected	-
I/3. study area: 23 trapped individuals				
Arvicola terrestris	-	1	-	1
Microtus arvalis	2	6	7	15
Apodemus flavicollis	-	2	3	5
Sorex minutus	-	1	1	2
II/1. study area: 29 trapped individuals				
Clethrionomys glareolus	3	3	5	11
Microtus arvalis	1	3	6	11
Apodemus sylvaticus	-	2	4	6
Mus musculus	-	1	-	1
II/2. study area: 6 trapped individuals				
Microtus arvalis	-	2	4	6
II/3. study area: 24 trapped individuals				
Neomys fodiens	-	2	1	3
Microtus arvalis	1	2	3	6
Clethrionomys glareolus	1	3	5	9
Micromys minutus	-	1	3	4
Apodemus flavicollis	-	2	-	2

It is interesting that house mouse lived along the section of the stream which flows through the village if the circumstances were favourable for them.

Summary

While the fauna of Lake Balaton is extensively studied, only scarce information is available on its inflowing streams. The aim of the present study was the compilation of species lists and the description of demographic parameters of Amphibia, Insectivora and Rodentia species. Migration opportunities between stream and lake populations were also to be investigated.

Surveys were carried out along five streams. All developmental stages of amphibians were investigated. Mating calls were also considered when the species lists were summarised. Rodents and insectivores were trapped alive. They were marked, and the parameters of the population were estimated by the capture - recapture method.

Altogether, seven amphibian taxa were found. The presence of *Bombina bombina* at three streams, *Hyla arborea* at Tetves Stream and *Pelobates fuscus* at Endrédi Stream was of interest. Different breeding habitat preferences of the three predominant species were recognised at Endrédi Stream, where several *Pelobates fuscus* males died due to an unknown factor probably non-point pollution.

Nine rodent and three insectivore species were trapped along the streams. They seemed to serve as migration corridors as few individuals were trapped from most species and mainly males and juveniles occurred at less favourable sites.

Besides water quality requirements, the highest possible diversity of the neighbouring areas is also an important factor in maintaining species rich communities. Semi-natural sections, wide riparian zones and certain man-made changes can help the migration and spatial distribution of the investigated species and the development of their stable populations.

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Opusc. Zool. Budapest, XXIX–XXX, 1997

The effects of caterpillars and Lepidoptera imagos on water-quality at Lake Kis-Balaton

By
G. GERE* and S. ANDRIKOVICS**

Abstract. Since 1989 we have identified 14 moth and 1 butterfly species whose caterpillars feed on water plants at the Kis-Balaton area (Table 1). In Table 2 we record the live and the abs. dry body weights of these Lepidoptera, as well as their nitrogen contents. These individuals decrease the organic content of the water by the given amounts because their dead carcasses generally do not get back into the water. This process decreases eutrofication. Table 3 presents a compilation - according to our calculations - of the amount of food consumed, the amount of excrement produced, and the nitrogen content of the excrement for the caterpillar of each species discussed. The food consumption, of course, directly decreases the assimilation capacity of plants, but this effect is increased significantly by the damage caused to plants. About 3/4 of the food taken is returned to the water in the form of excrement which decomposes more quickly than dead pieces of plants. In this way, the significant amount of nitrogen contained in excrement increases eutrofication. In our opinion, Lepidoptera - and animals in general - shape the quality of water through such contradictory and complex effects.

In shaping the quality and trophity of waters, animals - beside plants - naturally play a significant role. This role, however, is only understood in certain of its aspects, and is known and studied primarily with respect to birds. This is shown, for example, by the great interest expressed in 1991 at an international conference dealing with similar issues, in Sackville, Canada. Much less is known in the given topic about insects, even though insects, because of the extra large number of their species and the significant size of their biomass, play a key role in shaping the productional aspects of aquatic life systems. Therefore, we think there is great need for research in this direction, and if we desire to understand and shape the aquatic interrelations of the Kis-Balaton, we cannot ignore the role of insects in this respect.

Previously, we have studied the role of dragonflies, as well as various birds, in the Kis-Balaton area (ANDRIKOVICS and GERE, 1992). In this study, we describe some of our findings of research conducted on lepidoptera. This populous order of animals has many members in close connection with water because their caterpillars (larvae) feed on water plants.

We can analyze the role of Lepidoptera and caterpillars in an aquatic ecosystem from a production-biological - as well as theoretical - viewpoint by a double approach.

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On the one hand, we have to understand the qualitative and quantitative aspects of the courses of matter (and energy) that develop through the metabolism of animals. This way, we can acquaint ourselves with the amount of food consumed by the animals, which in the given case tells us how much assimilating biomass they extract directly from the system, with the amount and destination of the excrement produced, and with their nitrogen treatment, which is of special interest from the standpoint of eutrofication. On the other hand, we have to keep in mind that these and other similar questions only partially explain the functioning of animals. Because of the extra damage inflicted by the ways of feeding, chewing, and finding suitable abodes, most animals that feed on live plants take a much higher toll on the vegetation than what they directly consume. This is especially true for caterpillars feeding on water plants because most of them live inside the plants they eat, sometimes close to the root, making the effects of their chewing felt throughout the plant. Sometimes this causes the death of the plant. The magnitude of these effects can only be estimated by repeated observations of the affected plants. Much valuable information on this topic can be found in the volume edited by VÁSÁRHELYI (1995). Our own examinations and the topic of this paper are concentrated not on this second, but on the first problem mentioned.

Methods

Since 1989 we have systematically studied the Lepidoptera fauna of the Kis-Balaton, especially around Hévizi Channel and Diás Island, by collections during daytime and at nighttime (with the help of lights). We have determined the average live body weight of the various species feeding on water plants by measuring 10 individuals of each species (except in the case of two species that occurred in very scarce numbers). In some cases, especially for species showing high sexual dimorphism, we have made separate measurements for the màle and the female. In the case of six individuals of different species (in some cases separately for the two sexes), we have determined the water content and the dry matter content, by the method of drying the specimen at 104 C° until a constant weight was reached. We have considered the water content of the other species to be the same as the species closest to them, because experience shows that it is possible to determine types in this case (GERE, 1979). We have estimated the total quantity of food produced and the food-excrement ratio based on examinations on *Hyphantria cunea* (BALOGH and GERE, 1953; GERE, 1954-56, 1957; NAGY, 1952; JASIČ and MACKO, 1961), on *Phytometra gamma* (SYLVÉN, 1947), on *Lymantria dispar* (LEONARD, 1974; GERE, manuscript), and on *Inachis io* (GERE, manuscript). The nitrogen content of the excrement of Lepidoptera and caterpillars was estimated based on examinations using the halfmicro method of KJELDAHL (BALOGH and GERE, 1953; GERE, 1993) by making use of tipifying.

Results

We have collected 15 species of Lepidoptera in the Kis-Balaton area whose caterpillars feed on water plants or similar food most of the time (Table 1). We note that

Table 1. The species found and their feeding habits

Species and family	The feeding habit of the caterpillar
Phragmataecia castaneae HÜBNER (Cossidae)	1.2.5. In the stem of reed (*Phragmites communis*)
Chilo phragmitella HÜBNER (Pyralidae or Crambidae)	4.5 In the stem of reed (*Phragmites communis*) and water mannagrass (*Glyceria maxima*)
Calamotropha paludella HÜBNER (Pyralidae or Crambidae)	4. On the leaves of bulrush (*Typha angustifolia* and *latifolia*)
Scirpophaga praelata SCOPOLI (Pyralidae or Crambidae)	4. On various species of rush (*Schoenoplectus species*)
Schoenobius gigantellus DENIS & SCHIFFERMÜLLER (Pyralidae or Crambidae)	4. In the stem of reed (*Phragmites communis*) 5. In the stem of reed (*Phragmites communis*) and on water mannagrass (*Glyceria maxima*)
Lycaena dispar HAWORTH (Lycaenidae)	2. On the leaves of various dock species (*Rumex hydrolapathum* and other species)
Philudoria potatoria L. (Lasiocampidae)	2. Among others, on reed (*Phragmites communis*) and sedge species (*Carex*) 5. In autumn: on grass, in spring: on sedge (*Carex*), later on the leaves of reed (*Phragmites communis*)
Laelia coenosa Hübner (Lymantriidae)	2. Among others, on reed (*Phragmites communis*) and on the leaves of a sedge species (*Cladium mariscus*), great bulrush (*Schoenoplectus lacustris*), water mannagrass (*Glyceria maxima*) 5. On the leaves of reed (*Phragmites communis*)
Senta stenoptera STGR. (*or flammea* CURT.) (Noctuidae)	2. S.flammea: on reed (*Phragmites communis*) 3. The living style of S. stenoptera's caterpillar is not yet described 5. Feeds only on reed (*Phragmites communis*), in the stem or among closed up leaves
Mythimna straminea TREITSCHKE (Noctuidae)	2. On the leaves of reed (*Phragmites communis*) 5. In spring: on the young shoots, later in the stem
Mythimna pudorina DENIS & SCHIFFERMÜLLER (Noctuidae)	2.3. In autumn: on the leaves of reed (*Phragmites communis*), after living through the winter: among marsh grasses. 5. After living through the winter, also feeds on the leaves of of reed (*Phragmites communis*)
Sedina buettneri HERING (Noctuidae)	2. First, mining in the leaves of sedge (*Carex acutiformis*) and water mannagrass (*Glyceria maxima*), later in thier stem 3. In the ground, close to the root
Nonagria typhae THUNBERG (Noctuidae)	1. In the stem of bulrush (*Typha*) 2. On bulrush (*Typha angustifolia* and *latifolia*) and on great bulrush (*Schoenoplectus lacustris*) 3. In the stem and on the fruit of the above
Rhizedra lutosa HÜBNER (Noctuidae)	2.3. In the stem of reed (*Phragmites communis*) and close to its root
Chilodes maritinus TAUSCHER (Noctuidae)	2. In the stem of reed (*Phragmites communis*) 3. In its last phase of larva, it feeds on other larvae living in the stem of reed (*Phragmites communis*)

1. ABAFI-AIGNER, 1907; 2. KOCH, 1988; FORSTER, 1980; 4. GOZMÁNY, 1963; 5. VÁSÁRHELYI, 1995.

Table 2. The body weight and nitrogen content of the moths and butterflies

Species	Sex	The live weight of one imago (mg)	The abs. dry weight of one imago (mg)	The total nitrogen content of one imago (mg)
Phragmataecia castaneae	male	187.6	69.4	7.9
	female	455.2	141.1	16.1
Chilo phragmitella	mixed	73.9	28.1	3.2
Calamotropha paludella	mixed	70.5	26.8	3.1
Scirpophaga praelata	mixed	60.5	23.0	2.6
Schoenobius gigantellus	male	148.7	58.0	6.6
	female	138.9	48.6	5.5
Lycaena dispar	mixed	76.2	28.9	3.0
Philudoria potatoria	male	348.1	132.3	15.1
	female	797.6	271.2	30.9
Laelia cooenosa	male	149.2	55.2	6.3
	female	367.3	110.2	12.6
Senta stenoptera (flammea)	mixed	33.9	12.9	1.4
Mythimna straminea	mixed	97.1	36.9	3.9
Mythimna pudorina	mixed	116.3	44.2	4.6
Sedina buettneri	mixed	130.8	49.7	5.2
Nonagria typhae	mixed	365.5	138.9	14.6
Rhizedra lutosa	mixed	435.8	165.6	17.4
Chilodes maritinus	mixed	38.7	14.7	1.5

Table 3. The production biological parameters of the caterpillars

Species	Sex	The amount of food consumed by one caterpillar	The total excrement of one caterpillar	The total nitrogen content in the excrement of one caterpillar (mg)
		Given as abs. dry weight (mg)		
Phragmataecia castaneae	male	1617	1208	20,5
	female	3262	2455	41,7
Chilo phragmitella	mixed	654	489	8,3
Calamotropha paludella	mixed	624	466	7,9
Scirpophaga praelata	mixed	536	400	6,8
Schoenobius gigantellus	male	1351	1009	17,2
	female	846	846	14,4
Lycaena dispar	mixed	673	503	8,5
Philudoria potatoria	male	3083	2302	39,1
	female	6319	4719	80,2
Laelia coenosa	male	1286	961	16,3
	female	2568	1918	32,6
Senta stenoptera (flammea)	mixed	301	225	3,8
Mythimna straminea	mixed	860	642	10,9
Mythimna pudorina	mixed	1030	769	13,1
Sedina buettneri	mixed	1158	865	14,7
Nonagria typhae	mixed	3236	2417	41,1
Rhizedra lutosa	mixed	3858	2881	49,0
Chilodes maritinus	mixed	342	256	4,3

we use LERAUT's (1980) nomenclature. *Lycaena dispar* occurred only once or twice. *Senta stenoptera* is arguably not an independent species; according to some researchers, it is the second generation of the morphologically similar *S. flammea* (VÁSÁRHELYI, 1995). In Table 1 we report the feeding habits and plants consumed by the caterpillars according to the literature.

Most of the species occurred regularly in the area every year, with the most frequent species being *Ph. castaneae*, *Ch. phragmitella*, *Sch. gigantellus*, *Ph. potatoria*, *L. coenosa*, *M. straminea*, *N. typhae*, and *Rh. lutosa*. FISCHL has noticed damage caused by *Ch. phragmitella* on reed (*Phragmites communis*), bulrush (especially *T. latifolia*), and on horsetail (*Equisetum*). The caterpillars primarily chewed these plants at the water level (oral communication).

Table 2 reports the live and the abs. dry body weight of the moths and the butterflies. The individual animals take at least this much matter out of the water. Moreover, since most of them do not die above the water, and since the non-feeding species live up most of this matter (GERE, 1964), the matter taken out of the water generally does not get back into it. The table also gives information about the nitrogen contents of the Lepidoptera. It can be observed that, for example, 1253 (young) female *Ph. potatoria* amount to one kilogram of biomass. (With regard to the number of individual Lepidoptera, this is not a large number.) Further, 32362 female *Ph. potatoria* contain one kilogram of nitrogen, which is also derived from the water.

With respect to these observations, the effect of Lepidoptera can be said to work definitely against eutrofication. And, considering all the various species given in the table, and other species that might be found later on, this effect is not at all negligible.

The effects of the caterpillars, by their feeding and metabolism, are more complex. Table 3 shows the amount of food consumed by the larvae and the amount of excrement produced.

Continuing with the example of *Ph. potatoria*, it can be calculated that 396 individual caterpillars consume a total of one kilogram plant matter (assuming 75% water content for the plants). Therefore, they decrease the amount of the vegetation biomass by at least this much. But it must be emphasized once again that because of other damage caused to the plants, the total effects of obstructing the development of vegetation are much larger. The interrelations between the quality of water and the aquatic vegetation are much researched and evaluated; therefore, we will not deal with the question in its details.

The amount of excrement produced by caterpillars feeding on green plants usually adds up to about 74-75% (of the abs. dry matter) of the total weight of food consumed. The excrement of the caterpillars feeding on water plants generally gets back into the water, not far from the place of feeding. In this way, these individuals generally decrease the amount of organic matter in the water by about 1/4 of the total amount of plant consumed. The large amount of excrement getting into the water; however, has very different effects from the same amount of dead plant parts. First of all, it must be known that the excrement is a biologically important source of nutriment. The energy content of the food of *Hyphantria cunea* caterpillars is 4380 cal/g (of the abs. dry weight), and the same figure for their excrement is not much lower, 4000-4200 cal, depending on the age of the individual (GERE, 1957).

Table 3 also provides information about the significant nitrogen content of the excrement. Since caterpillars do not digest their food very much, the nitrogen present in their excrement is largely in the form of macromolecules that are not directly accessible to plants. Our experimental millet plants (*Panicum miliaceum*) grown in fresh caterpillar waste suffered from slight nitrogen deficiency. However, the fragments of plants getting into the excrement are broken into tiny pieces as a result of the chewing process, thus ending up with a very large surface area. And because of its huge surface area, this matter becomes very much accessible to bacteria and fungi, facilitating very intense processes of decomposition. The excrement is thus recycled much quicker than pieces of dead plants.

This process means that the excrement speeds up eutrofication. This effect is opposite to that of the metabolism of the lepidoptera. Therefore, if we wish to evaluate the effects of Lepidoptera, or in general other living organisms, on water, we have to reckon with such complex and contradictory effects.

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Dynamics of juvenile fish assemblages in the Szigetköz section of the Danube since the operation of an artificial water replenishment system in the floodplain

By

G. GUTI*

Astract. At the end of 1992, the Szigetköz section of the Danube was diverted to the by-pass canal of the Gabcikovo Hydroelectric Power Plant and side arms became dry in the floodplain. Since 1995, an effective water replenishment system has been put into operation. The study was implemented in 6 sampling sites in the main channel of the Danube, in side arms of the active floodplain and in the water bodies of the protected floodplain. Fish assemblages were sampled by electric fishing. Evaluation of the data was based on the frequency distribution of juvenile fish species to monitor the investigated biotopes.

The Szigetköz section of the Danube runs on the Hungarian-Slovak border, deposting the largest stream alluvial cone in Europe. The Hungarian side of this braided hydrosystem is known as the Szigetköz floodplain, which is the area between the main channel of the Danube (r. km 1850-1794) and the meandering Mosoni-Danube arm. Its length is 52 km and its average width is 7-8 km. The Szigetköz floodplain played a prominent part in the recruitment of fish populations along the Middle Danube. In the spawning season numerous fishes of the main stream migrated instictively against the current, sometimes covering a distance of 100-200 km, before they found suitable biotopes for reproduction (GUTI, 1993). Since the second half of the 19th century, river regulation and flood control measures have altered the original floodplains. The inundated floodplains have been reduced to 4 % of their former area and the alluvial sediment accumulated on the narrow inundated part. This process accelerated the aggradation of the main channel and the silting up of the active branches in the 20th century.

At the end of 1992, the Szigetköz section of the Danube was diverted to the by pass canal of the Gabcikovo Hydroelectric Power Plant and 80 % of the side arms became dry in the floodplain for a long period, only the deeper beds remained watered. In 1993 and 1994 the missing connections between the main channel of the Danube and the branch systems, as well as the extremely low water level moderated and restricted the aquatic biotopes. In 1993 a mitigation plan was prepared and from August the branch systems in the floodplain and the canals in the flood protected area got a small amount of water, 5-15 $m^3.s^{-1}$ and 3-6 $m^3.s^{-1}$ respectively. In 1994 the artificial water supply was increased to 15-30 $m^3.s^{-1}$ in the floodplain. From June 1995, a more effective water replenishment system has been put into operation, with the capacity of 40-130 $m^3.s^{-1}$. The water supply is provided by gravitation from the dammed section of the main river bed, upstream of a bottom sill have been contsructed in the bypassed section of the Danube (at 1843 r. km), in this way the inlet of the water replenishment system created a limited connection between the main channel and the floodplain branches.

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The biological monitoring of the Szigetköz floodplain has been one of the principal work of the Hungarian Danube Research Station since the operation of the Gabcikovo hydroelectric power plant. The application of juvenile (0+) fish assemblages to define the ecological condition of the floodplain biotopes offers a number of advantages: 1) The movement of fish between the biotopes is more dynamical than the movement of aquatic invertebrates. 2) Juvenile fish can tolerate a narrower range of environmental variables than adult fish, so their distribution indicates the ecological conditions of the biotopes more precisely. 3) The evaluation of juvenile fish assemblages species diversity provides a simple assessment of the reproduction potential of certain biotopes.

Sampling sites and methods

The presented study was carried out at 2-2 sampling sites in the main channel of the Danube, side arms of the active floodplain and in water bodies of the flood protected area:

1) Sampling site 1 was in the riparian zone of the main channel at 1834 r. km. It had a permanent flow with a depth of 0.3-1.2 m. Bottom was composed of stones and gravel. Turbidity was high, vertical stratification in temperature and oxygen was negligible. Macrophytes were missing.

2) Sampling site 2 was in the riparian zone of the Danube at 1843 r. km before the construction the bottom sill. The water depth was 0.2-1.5 m. Bottom was composed of stones and gravel. Since 1995, there is a special biotope on the downstream part of the bottom sill. The high gradient section had a permanent and turbulent flow. Depth was 0.2-0.5 m with a stony bottom. Turbidity was high, vertical stratification in temperature and oxygen was negligible. Macrophytes were missing, but there were some aquatic moss on the stones of the bottom sill.

3) Sampling site 3 was a lentic backwater connected permanently to the parapotamal type (AMOROS et al. 1987) Csákányi side arm in the Cikola branch system. It was dry in the first half of 1993. Its depth was 0.5-1.5 m and the bottom consisted of sand mixed with silt. Turbidity was high, vertical stratification in temperature and oxygen was detectable. Macrophytes grew in patches.

4) Sampling site 4 was in the Schiesler arm of the Cikola branch system. It was plesiopotamal permanent standing water. It had direct connection to other side arms for an average of 15 days per year during the period of 1961-1990. It became completely isolated after the Danube had been diverted in 1992. It was nearly dry in 1993, infiltered water gradually filled it up later. Its depth was 0.7-1.8 m, bottom consisted of silt. Turbidity was low and a vertical temperature and dissolved oxygen stratification was detected there. Macrophytes grew densely.

5) Sampling site 5 was a lentic section of the Gazfüi-Danube in the flood protected area. It was a paleopotamal type standing water before the operation of the Gabcikovo Hydroelectric Plant. It was dry in the first half of 1993 after the diversion of the Danube. Since its artificial replenishment there is a slow permanent flow at this site. In 1995 and 1996 the water level was raised according to the spawning period of fishes. The water depth was 0.5-1.5 m with a low turbidity. Vertical temperature and oxygen stratification was detected and the bottom consisted of silt. Macrophytes grew densely.

6) Sampling site 6 was a dredged section in the Lipót oxbow lake, a paleopotamal standing water before the diversion of the Danube. It was dry in 1993, but has a slow permanent flow since the operation of its water supply system. Its depth was 0.4-1.6 m and the bottom consisted of silt. Turbidity was moderate with a vertical temperature and oxygen stratification. Macrophytes grew densely.

Sampling was carried out at 20-40 sampling points per sites at a distance of approximately 10 m-s from each other in a random distribution. Fish were collected with a battery-powered electroshocker of a low output (80 W) and a 1 mm mesh size dipnet. A small boat was needed to reach the sampling points. The field works were accomplished at late summer and early autumn, when the composition of juvenile fish assemblages becomes stable. Data evaluation to monitor the investigated biotopes was based on the frequency distribution of fish species.

Results and discussions

The main channel of the Danube

1834 river km (Fig. 1)

In 1994, 1995 and 1996 3, 11 and 12 juvenile fish species were collected respectively in the sampling site. The diversity of fish species was great and assemblages were dominated by rheophilic species. The rheophilic character of the samples has become even more characteristic with the increasing species richness from 1994. There was no significant difference between the frequency distribution of fish in 1995 and 1996. In 1996 *Gobio albipinnatus* and *Rhodeus sericeus* were not found, but *Vimba vimba*, *Perca fluviatilis* and *Esox lucius* were new for this site, as well as 4 other species were identified among the adult (1+ or older) fishes: *Abramis brama*, *Cyprinus carpio*, *Carassius auratus* and *Pelecus cultratus*.

1843 river km (Fig. 2)

In 1994, 1995 and 1996 5, 2 and 5 juvenile fish species were found, respectively. Since the construction of the bottom sill, the assemblages has been dominated by rheophilic species. The juveniles of 3 new species for the site *Cottus gobio*, *Leuciscus leuciscus* and *Chondrostoma nasus* were found in 1996. *Proterorhinus marmoratus* was common every year. Among the adult fishes 13 other species were collected in 1995 (GUTI, 1996) and many of them are endangered in the Middle Danubian Basin (*Vimba vimba*, *Barbatula barbatula*, *Lota lota*, *Gymnocephalus baloni*, *Gymnocephalus schreatzer*, *Zingel streber*). In 1996, 2 other rare species were detected: *Salmo trutta* and *Neogobius kessleri*. The occurrence of the *N. kessleri* was proved for the first time in the Szigetköz section of the Danube (GUTI, 1997).

The side arms of the floodplain

Csákányi arm in the Cikola branch system (Fig. 3)

In 1992, 14 juvenile fish species were collected from this sampling site. The occurrence of the rheophilic species indicated a direct connection between the side arm and the Danube. In 1994, 9 juvenile fish species were found. Rheophilic species diminished and some phytophilic spawner limnophilic species (*C. auratus*, *Lepomis gibbosus*) appeared with the expansion of the aquatic macro vegetation. The artificial water supply has become more effective since 1995. Due to the lessening of the aquatic vegetation the juveniles of phytophilic fishes declined, and the number of detected species was 6. In 1996, juveniles of 8 species were identified. Some rheophilic species (*L. leuciscus*, *Abramis ballerus*) reappeared, which reflected to the limited connection of the branch system with the main channel. In 1996, *Tinca tinca* was caught among the adult fishes, which was its first record in the floodplain after the diversion of the Danube. Close to the sampling site, the presence of the *Gasterosteus aculeatus* was established in the Csákányi arm. The occurrence of the *G. aculeatus* had only been known from the Mosoni-Danube in the Szigetköz area, therefore its appearance in the floodplain branch system probably indicated the fish movement from the Mosoni-Danube through the water supply system.

Schiesler arm in the Cikola branch system (Fig. 4)

In 1992, juveniles of 8 fish species were collected from the sampling site. Probably some fish could survive the dry period in 1993 in the wet mud of the isolated arm. After the bed had been filled up with ground water, the aquatic vegetation grew densely in 1994 and the presence of 4 juvenile fish species (C. *auratus*, R. *sericeus*, *Scardinius erythrophthalmus*, *Leucaspius delineatus*) was proved here. The frequency of L. *delineatus* was relatively high regarding that it had only been recorded once in the area during the previous six years. In 1995, it greatly declined, only an adult specimen was caught and it disappeared in the samples in 1996. R. *sericeus* was a common species in 1992 and 1994, but it became rare in 1995 and its juveniles could not been collected in 1996. The juveniles of C. *auratus* have occurred in extreme abundance since 1994 and it became dominant in 1995. The diversity of fish assemblages have decreased with the complete separation of the biotope and in 1996 only C. *auratus* could be collected.

Water bodies in the flood protected area

Gazfüi Danube (Fig. 5)

In 1994, 1995 and 1996 6, 9 and 10 juvenile fish species were found respectively in the sampling site. In 1994, most of the species of the previous limnophilic fauna was collected and the scarce occurrence of the adult *Umbra krameri* and *Misgurnus fossilis* was documented. In 1995, the composition of juvenile fish assemblages changed because of the permanent flow. Limnophilic species became rare and some new neutrophilic species appeared. The endangered U. *krameri* has not been found in the samples since 1995. In 1996 limnophilic species became dominat in the assemblages.

Lipót oxbow lake (Fig. 6)

Most probably the former fish fauna could not survive the dry period of the oxbow lake in 1993 and the new water body was repopulated by fishes mainly from the floodplain side arms through the water replenishment system. In 1994, 1995 and 1996 4, 6 and 10 juvenile fish species were found respectively. Their compositions were similar to the juvenile fish assemblages of the branch systems in the floodplain. In 1996 rheofilic species (juvenile V. *vimba*, adult L. *leuciscus*) appeared in the sampling site, which indicated an indirect connection between the oxbow lake and the main channel of the Danube. The occurrence of the endangered fishes of the previous limnophilic fauna (U. *krameri* and M. *fossilis*) was not proved, but adult specimens of some characteristic species (E. *lucius*, T. *tinca*, S. *erythrophthalmus*) were found in the inside part of the oxbow lake.

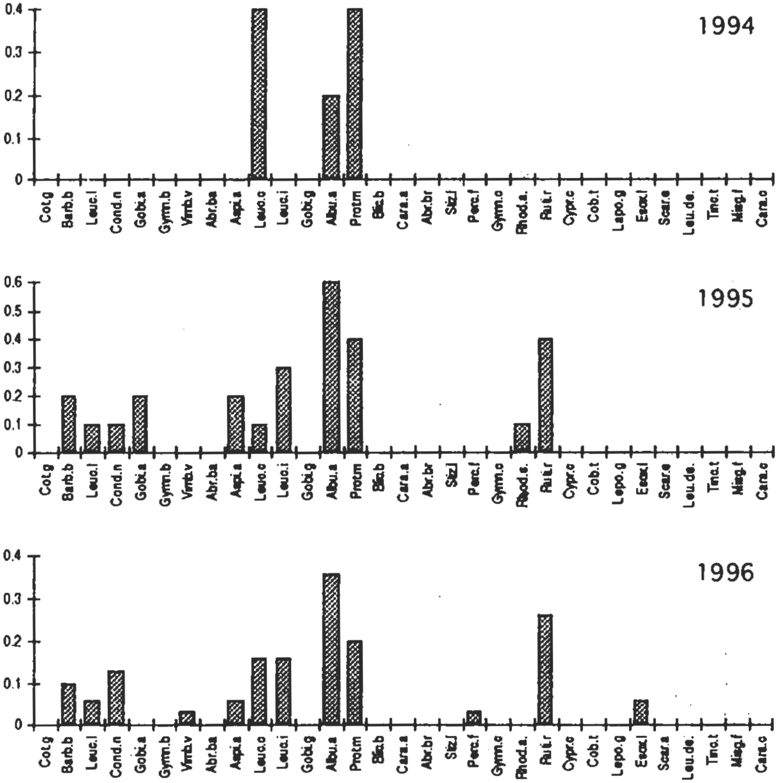

Fig. 1. Frequency distribution of juvenile fish species at sampling site 1 (main channel of the Danube at 1834 river km) in 1994, 1995 and 1996. The order of the species is determined by the velocity tolerance (rheophilic species are on left, limnophilic on right). – Abbreviations: Cot.g. = *Cottus gobio*; Barb.b. = *Barbus barbus*; Leuc.l. = *Leuciscus leuciscus*; Cond.n. = *Condrostoma nasus*; Gobi.a. = *Gobio albipinnatus*; Gymn.b. = *Gymnocephalous baloni*, Vimb.v = *Vimba vimba*; Abr.ba. = *Abramis ballerus*; Aspi.a. = *Aspius aspius*; Leuc.c. = *Leuciscus cephalus*, Gobi.g. = *Gobio gobio*; Albu.a. = *Alburnus alburnus*; Prot.m. = *Proterorhinus marmoratus*; Blic.b. = *Blicca bjoerkna*; Cara.a. = *Carassius auratus*; Abr.br. = *Abramis brama*; Stiz.l. = *Stizostedion lucioperca*; Perc.f. = *Perca fluviatilis*; Gymn.c. = *Gymnocephalus cernuus*; Rhod.c. = *Rhodeus sericeus*; Ruti.r. = *Rutilus rutilus*; Cypr.c. = *Cyprinus carpio*; Cob.t. = *Cobitis taenia*; Lepo.g. = *Lepomis gibbosus*; Esox.l. = *Esox lucius*; Scar.e. = *Scardinius erythrophthalmus*; Leu.de. = *Leucaspius delineatus*; Tinc.t. = *Tinca tinca*; Misg.f. = *Misgurnus fossilis*; Cara.c. = *Carassius carassius*

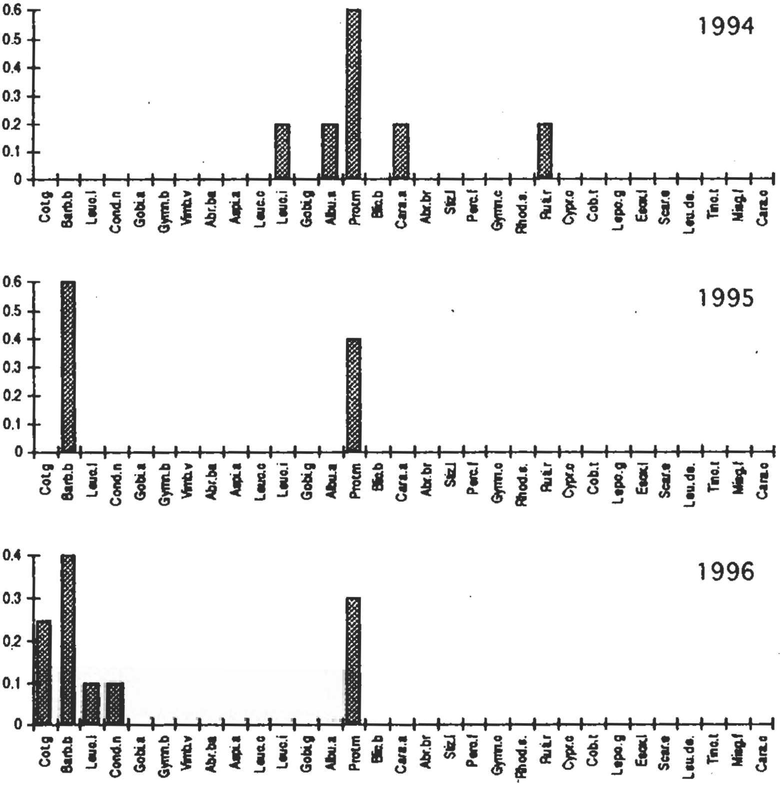

Fig. 2. Frequency distribution of juvenile fish species at sampling site 2 (main channel of the Danube at 1843 river km) in 1994, 1995 and 1996. (See other comments at Fig. 1)

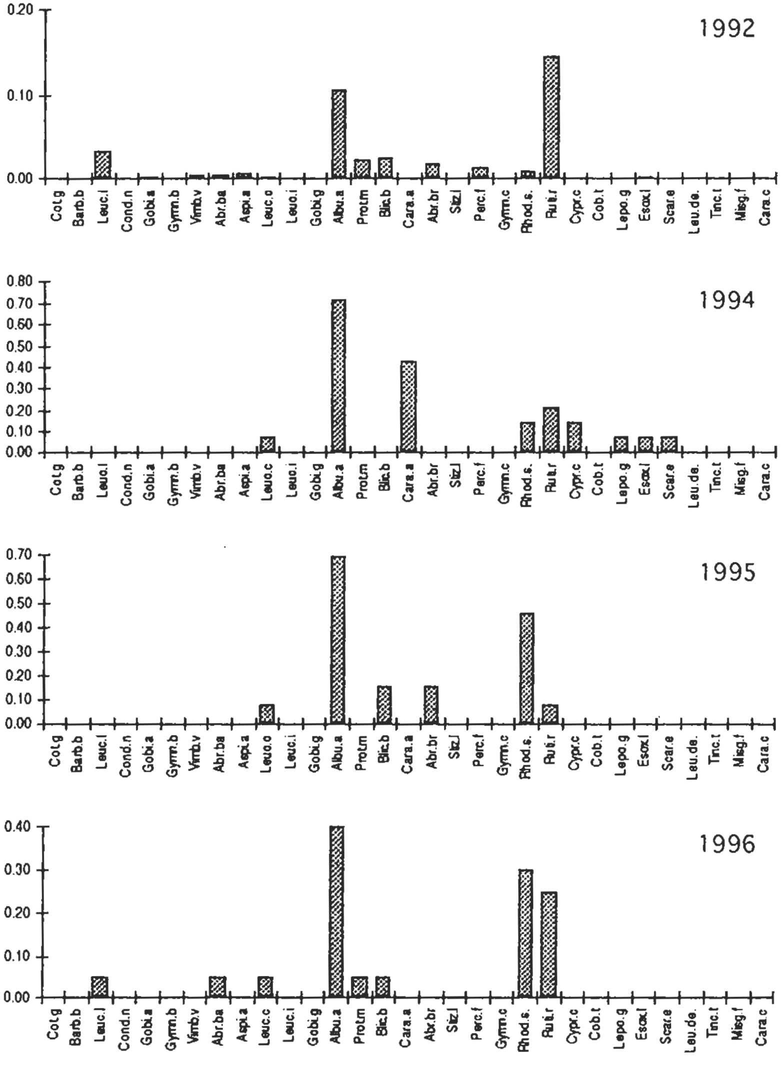

Fig. 3. Frequency distribution of juvenile fish species at sampling site 3 (Csákányi arm in the Cikola branch system) in 1992, 1994, 1995 and 1996. (See other comments at Fig. 1)

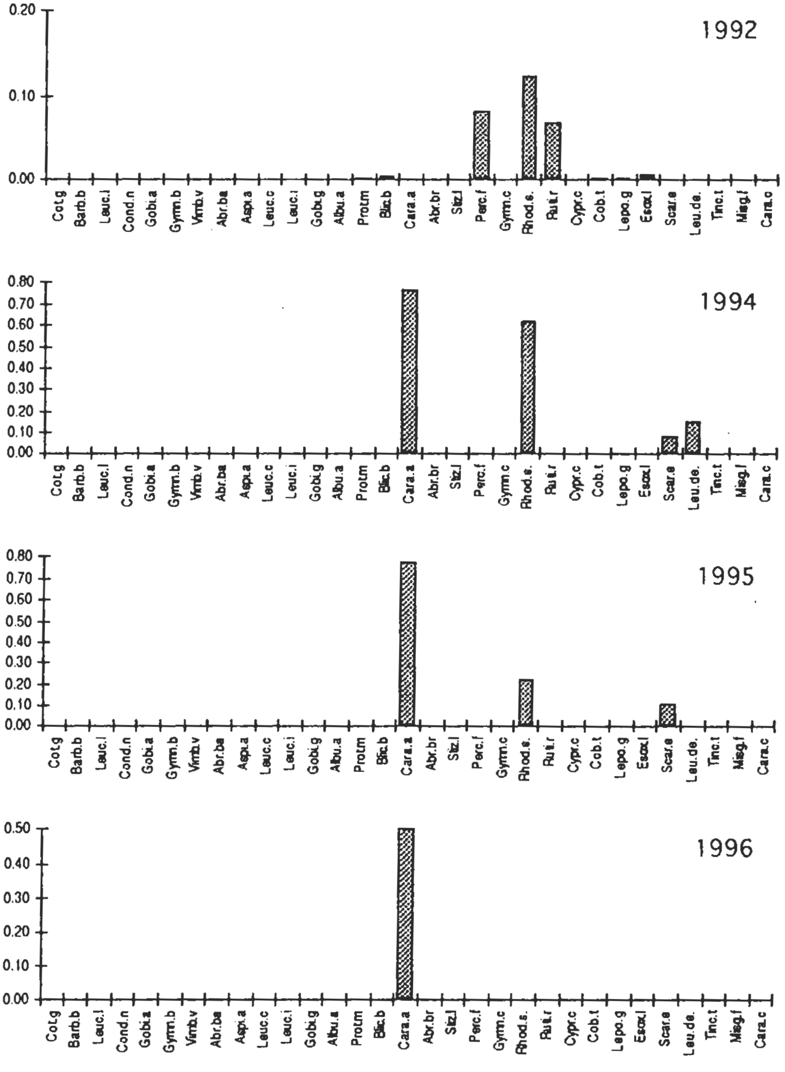

Fig. 4. Frequency distribution of juvenile fish species at sampling site 4 (Schiesler arm in the Cikola branch system) in 1992, 1994, 1995 and 1996. (See other comments at Fig. 1)

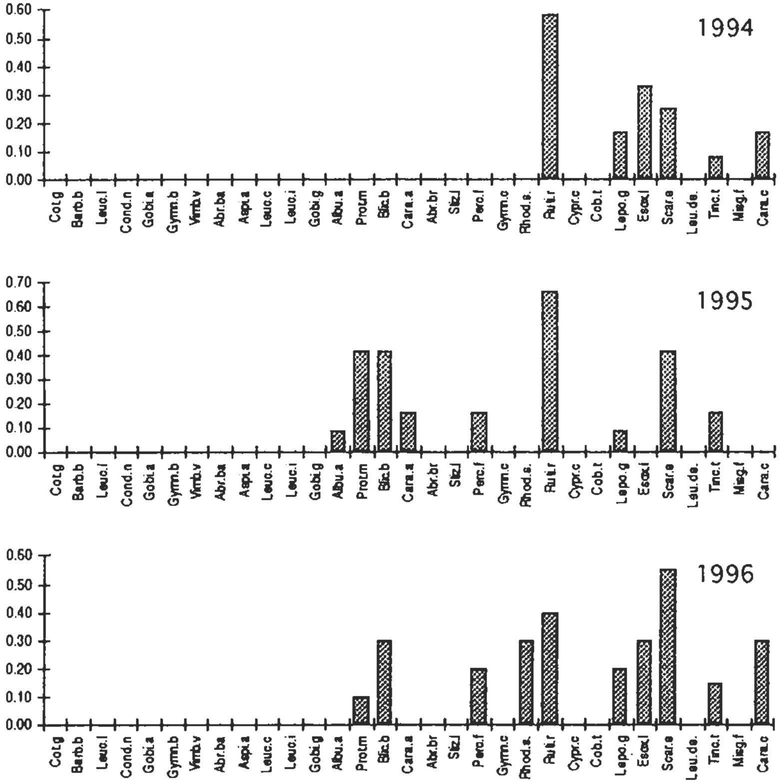

Fig. 5. Frequency distribution of juvenile fish species at sampling site 5 (Gazfüi Danube) in 1994, 1995 and 1996. (See other comments at Fig. 1)

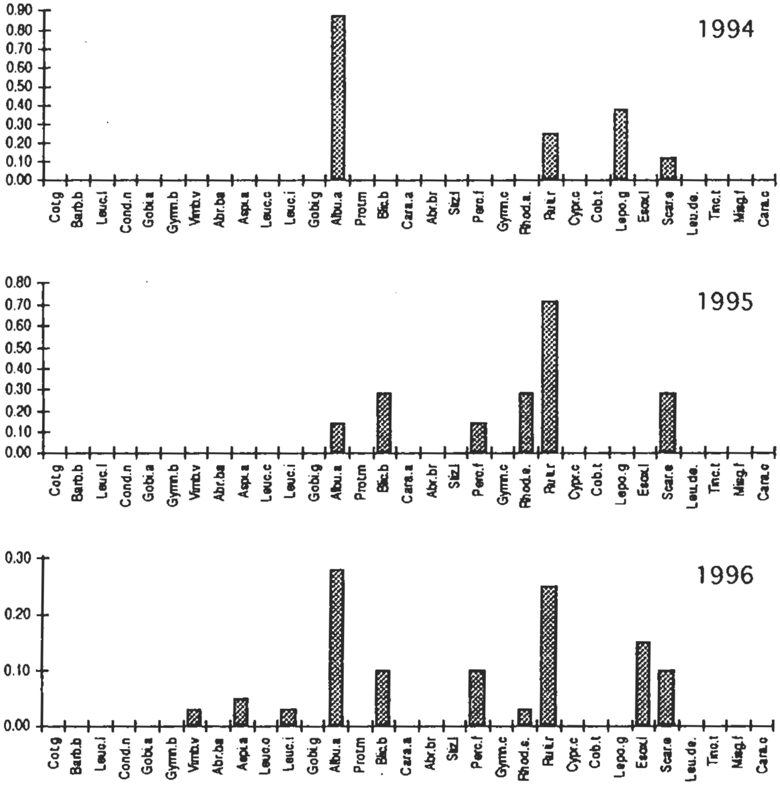

Fig. 6. Frequency distribution of juvenile fish species at sampling site 6 (Lipót oxbow) in 1994, 1995 and 1996. (See other comments at Fig. 1)

Conclusions

1) No fundamental changes in the fish fauna composition could be verified in the bypassed section of the Danube since the operation of the Gabcikovo Hydroelectric Power Plant.

2) The bottom sill was not an insurmountable barrier for most of the fish species in the main channel of the Danube.

3) The downstream slope of the bottom sill is an especially high gradient biotope of the Danube at 1843 r. km, where at least 20 fish species occurred in 1995 and 1996, many of them are endangered in the Middle Danubian basin.

4) The artificial water replenishment from the dammed upstream of the bottom sill created a limited connection between the main channel of the Danube and the floodplain side arm system. Some rheophilic species of the main channel appeared occasionally in the canal system of the flood protected area, too.

5) Fish movement is highly probable from the Mosoni-Danube to floodplain side arms.

6) A degradation process of the fish fauna was detected in the completely disconnected arms of the floodplain.

7) The regulated supply dynamics improved the spawning conditions of some phytophilic spawner fish species, but paleopotamal type of biotopes have become restricted in the canal system of the flood protected area.

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Feeding ecology of the Common Tree Frog (Hyla arborea) in a swampland, Western Hungary

By

T. KOVÁCS and J. TÖRÖK*

Abstract. We studied the food composition of 220 specimens of *Hyla arborea* in a swamp forest in Kis-Balaton Nature Reserve, Western Hungary, between 1993-1995. The diet of frogs basically consisted of insects, mainly Diptera, Coleoptera, Homoptera and Heteroptera. Araneidea was also found in high percentage in the sampled stomachs. By mass Gastropoda and Lepidoptera larvae made up a larger proportion of diet than by number. The diet of Common Tree Frog was more diverse in autumn than in spring or summer. Between years, similarity of food composition were around 50 %.

The Common Tree Frog (*Hyla arborea*) has wide geographical range in Europe. It distributes from the north-west part of the Iberian Peninsula to the western Ukraine and from southern Sweden to the Caucasus (GROSSE, 1994). *H. arborea* is a widely distributed but locally not abundant species of the Hungarian herpetofauna. It uses various microhabitats from the herb-layer to the canopy and changes them depending on seasons and ages of frogs. In our study area adults were found on the ground in early spring and in October. After mating they climb 5 or more meters up into the bushes and trees. Postmetamorphs and young juveniles forage on the ground or the lower bush-layer up to 2 m.

Similarly to other amphibian species, *H. arborea* is a generalist and opportunistic predator. As a consequence of this foraging strategy, the composition of its diet reflects the available food supply in the microhabitats where it forages. Although *H. arborea* is widely distributed in Europe few data have been published on its diet (BANNIKOV, 1985; CLAUSNITZER, 1986; JUSZCZYK; 1974). Some data has been published on the other species in *Hyla*, in other parts of Holarctic Region (JOHNSON and BURY, 1965; OPLINGER, 1967; FREED, 1988). It is, however, difficult to compare those findings with our results as the life history of those species, the used habitat, available food supply, and other variables differ from those in our Common Tree Frog population. Previous studies (LÖW et al., 1990; KOVÁCS and TÖRÖK, 1992, 1994, 1995, 1997; TÖRÖK and CSÖRGŐ, 1992; TÖRÖK and KOVÁCS, 1996) have shown a high level of consumption of coleopterans and dipterans in six studied non-hylid amphibian species in Kis-Balaton swampland area.

The predator-size/prey-size hypothesis predicts that larger predators usually forage for larger prey. This hypothesis has been tested in various type of predators including amphibians (GRIFFITHS, 1986; FLOWERS and GRAVES, 1995). This relationship usually

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exists in competitive communities where a range of sizes predator species occur. In the present study we tested whether size-related prey preference can be found within the population of H. *arborea*.

Materials and methods

Our study was conducted over three years, between 1993-1995. The study site was a swamp forest (Diás-Island) in the northern part of Kis-Balaton Nature Reserve. *H. arborea* occurred mostly on the trees in the edge zone of the forest and, with lower frequency, on the ground in open meadows. No specimens were found on the ground in the forest.

We collected frogs by hand. We used stomach-flushing (OPATRNY, 1980) to obtain stomach contents from the frogs. Prey items were preserved in 70% methanol, and then were identified to order or family level and their length (mm) was measured. We also measured the snout-vent length of frogs. Weight of prey items were estimated by three generalised weight-length indices (GOWING, 1984; ROGERS et al., 1976, 1977) and we calculated the percentage occurrence of prey groups by mass and by number. For comparing the diet in different years we used a proportional similarity index (RENKONEN, 1938). The diet diversity was computed using the Shannon diversity index (SHANNON and WEAVER, 1949). Seasonal changes in diet were compared only in 1995.

Results

We found large numbers of dipterans, coleopterans, spiders and aphids in the stomach of *H. arborea* (Table 1/a). Dipterans in the families of Culicidae and Chironomidae were extremely considerable in 1994.

There was seasonal change in diet composition (Table 1/b). In spring, frogs ate dipterans, coleopterans and spiders in high numbers, whereas in summer homopterans and dipterans dominated in the diet. In autumn the proportion of the dipterans decreased but gastropods, lepidopteran larvae and spiders appeared in higher numbers in *H. arborea*.

Considering the biomass of prey items asides from dipterans and coleopterans, gastropods and lepidopteran larvae also formed important parts of the diet (Table 1/a). The preferred prey goups by season were: spring, dipterans and coleopterans; summer, dipterans, lepidopteran larvae and gastropods; and autumn, lepidopteran larvae and gastropods. In spring of 1995 three dragonflies were eaten. They were extremely large ($x = 308$ mg) compared to other prey items and therefore dominated volume estimates of prey importance in the diet.

We found that, on average, smaller (juvenile) frogs fed on smaller prey and the larger frogs on larger prey (Fig.1). However, the minimum and maximum prey sizes were the same in the smallest and largest frogs. There was a significant, positive correlation ($r = 0.311$, $n = 209$, $p = 0.01$) between the size of frogs and the size of prey.

Diet diversity was the same in 1993 and 1995 ($H = 2.32$ for 1993, $H = 2.37$ for 1995) while in 1994, when dipterans formed more than 70 percent of the diet, diet diversity was quite low ($H = 1.52$). Diet diversity also showed seasonal variation. It was lower in spring and summer ($H = 1.85$ and $H = 1.86$ for the two seasons respectively) but higher in

Table 1/a. Percentage of different prey groups in the stomachs of Hyla arborea on Diás Island in three sampling years (N=by number, W=by weight, l=larvae)

Prey groups	1993		1994		1995	
	N	W	N	W	N	W
Gastropoda	1.8	**13.2**	0.7	6.7	5.7	**24.4**
Isopoda					0.4	0.0
Chilopoda					0.2	0.0
Collembola					0.2	0.0
Odonata					0.8	**24.7**
Orthoptera					0.2	1.4
Psocoptera					0.9	0.1
Physopoda					0.2	0.0
Heteroptera	8.9	3.4	4.7	3.0	3.8	1.0
Homoptera	1.8	0.7	0.2	0.2	5.5	1.7
Aphidina	**12.7**	1.4	0.7	0.2	0.8	0.1
Neuroptera			0.2	0.9	0.6	0.1
Coleoptera	**26.0**	**15.4**	7.7	6.3	**10.6**	4.2
Coleoptera l.	2.5	1.9	0.5	0.6	1.0	0.4
Trichoptera	1.3	**14.0**				
Lepidoptera			0.2	0.1	0.8	3.9
Lepidoptera l.	5.1	**16.4**	0.2	0.1	4.2	**11.8**
Diptera	**18.3**	**12.6**	**75.5**	**72.3**	**42.0**	**19.1**
Diptera l.	3.2	0.2	0.2	0.0	1.9	0.1
Hymenoptera	3.2	2.5	2.2	0.6	2.5	0.5
Formicidae	3.6	0.7	0.5	0.1	5.1	0.3
Pseudoscorpionidea	0.6	0.1	0.2	0.1	0.6	0.0
Opilionidea			0.2	0.5	0.4	0.2
Araneidea	**10.8**	**17.8**	4.2	8.4	**10.4**	5.9
Acaridea			1.2	0.0	0.6	0.0

Table 1/b. Percentage of different prey groups in the stomachs of Hyla arborea on Diás Island in three seasons of 1995 (N=by number, W=by weight, l=larvae)

	Spring		Summer		Autumn	
	N	W	N	W	N	W
Gastropoda			5.0	**27.7**	**14.7**	**49.8**
Isopoda			0.6	0.1	0.7	0.1
Chilopoda					0.7	0.1
Collembola	0.4	0.0				
Odonata	2.0	**65.3**				
Orthoptera					0.7	4.0
Psocoptera			0.6	0.1	2.8	0.1
Physopoda					0.7	0.1
Heteroptera	2.0	0.6	2.8	0.7	7.7	1.6
Homoptera			**15.0**	5.7	1.4	0.5
Aphidina	0.5	0.0	1.2	0.1	0.7	0.0
Neuroptera					2.1	0.2
Coleoptera	**17.6**	4.8	6.1	7.2	6.3	1.4
Coleoptera l.	0.5	0.3	0.6	0.1	2.1	0.7
Lepidoptera			1.2	**12.0**	1.4	2.1
Lepidoptera l.	1.5	3.6			**13.3**	**30.8**
Diptera	**48.3**	**18.5**	**58.3**	**41.3**	**12.6**	3.1
Diptera l.	2.4	0.1	1.8	0.3	1.4	0.1
Hymenoptera	2.4	0.7	0.6	0.3	4.9	0.4
Formicidae	5.9	0.3	0.6	0.0	9.8	0.6
Pseudoscorpionidea	1.5	0.1				
Opilionidea			1.2	0.8		
Araneidea	**11.7**	9.2	4.4	3.3	**16.1**	4.4
Acaridea	1.5	0.0				

autumn (H = 2.54) because of the moderate proportion of dipterans. The similarities between the diet of the study years were quite low (0.41, 0.56, 0.58 between 1993-1994, 1994-1995, 1993-1995, respectively).

Discussion

In our study, we found that *H. arborea* fed on prey which typically found off the ground in higher vegetation. Stomachs of frogs collected on the ground (at the beginning and the end of their active period) were usually empty. Also, prey number per stomach was low in these individuals. Some prey types, such as earthworms, isopods, collembolans, chilopods and diplopods, which typically move on the soil surface and are usually present in the diet of other amphibian species in the study area, were almost completely absent from the stomach of these tree frogs (KOVÁCS and TÖRÖK, 1992, 1994). There was no evidence that these tree frogs feed on aquatic groups, as neither amphipods nor aquatic insects were present in the stomachs. In Germany, CLAUSNITZER (1986) analysed faecal pellets of *H. arborea* and found that dipterans and coleopterans dominated in the diet in summer (47.2 and 34.2 %, respectively). In our study, these groups dominated in the diet, but only if spring, summer and autumn were combined; they did not dominate if only summer was examined. In summer, homopterans were more numerous than coleopterans in Diás-Island. In autumn, other groups, such as gastropods, lepidopteran larvae, ants and spiders also occurred in higher number than did coleopterans in the diet of frog diets.

Comparing the diet of *H. arborea* to the other anuran species living in Kis-Balaton we found notable differences (KOVÁCS and TÖRÖK, 1992). The highest similarity in diets (0.74) was between *H. arborea* and *Rana esculenta* complex (unpublished data of 1995) because the latter species also ate large numbers of dipterans and coleopterans. Edible Frog forages mainly during the daytime and very often in open sites where dipterans were common. Edible Frog uses several microhabitats, such as forest ground, meadows, river banks, reedbeds and open water. Because of it, many other prey groups were present in its diet, i.e. earthworms and aquatic isopods. We found the lowest similarity between *H. arborea* and *Bufo bufo* (0.28) in 1995. Common Toad is a nocturnal predator, and its diet consists of mostly apterous or weakly flying groups. Dipterans formed only 10.7 % of the diet. Diet composition of other anuran species (*Rana arvalis*, *Bombina bombina*, *Pelobates fuscus*) shown moderate similarity to Common Tree Frog's diet.

Seasonal changes in diet composition was probably correlated to variations in resource supply. When a prey group dominated in the habitat, it also formed a higher proportion of the diet. For example, dipterans were common in spring and summer and non-aphid homopterans were common in summer. The high diet diversity in autumn was the result of more generalised feeding, in which dipterans played a much smaller role. Our studies in 1992-93 on seasonal change of diet diversity in *R. esculenta* c. shown a different result from that found in the Common Tree Frog (KOVÁCS and TÖRÖK, 1994). In Edible Frog, diet diversity was almost the same in the three seasons (spring: 2.59, summer: 2.40, autumn: 2.50). There was no prey group which dominated as strongly as did dipterans in *H. arborea*. Because of its unspecialised microhabitat preference Edible Frog can change its forage sites easily following a change in prey supply. However, Comon Tree Frog are tree-climbing specialist and unwillingly leave the canopy.

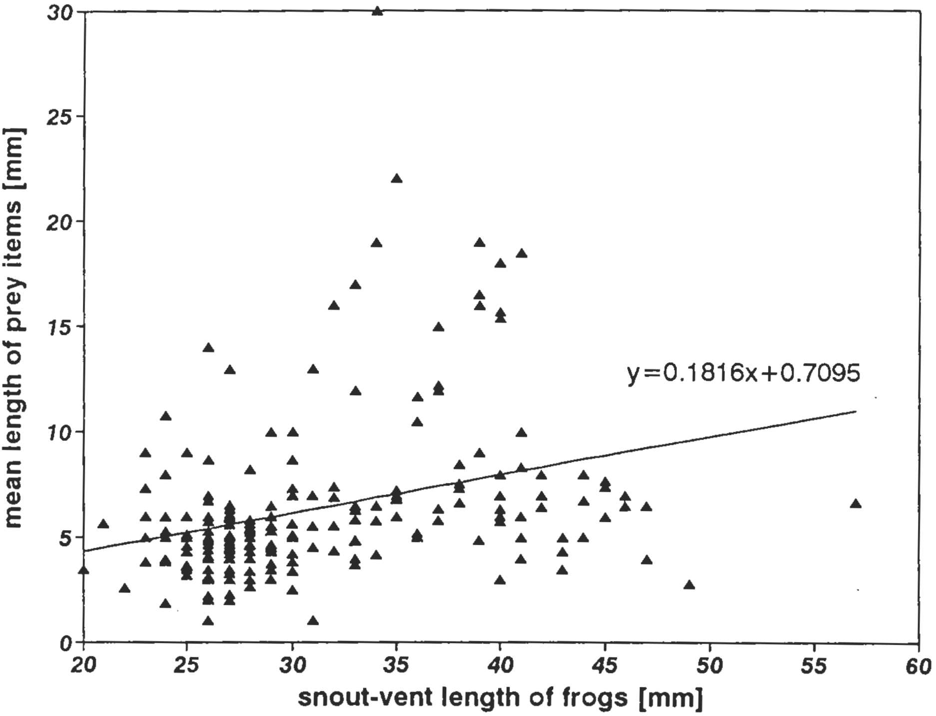

Fig. 1. Predator size dependent prey sizes in *Hyla arborea* in Diás Island, 1993-1995

There is only a moderate difference between the size of postmetamorph juveniles (20-25 mm) and adults (40-50 mm) of *H. arborea*. As a result, there are only slight differences in the prey utilised by these two size groups. LÖW (1990) found much larger prey sizes were eaten by larger specimens of *R. esculenta* and *R. arvalis* in which snout-vent length of postmetamorph juveniles is 20-25 mm whereas 4-years old adults grow up to 70 mm or more.

Summing up our results, although *Hyla arborea* eats a large variety of prey groups its diet consists of mainly dipterans and coleopterans. We observed seasonal changes in diet composition which connect not to differences in microhabitat use of Common Tree Frog but to the availability of prey supply. As the predator-prey size hypothesis predicts, there was a positive correlation between frog size and its prey size.

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Site fidelity of Great and Blue Tits in the Pilis-Visegrád Mountains

By

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Abstract. We present an analysis of natal and breeding site fidelity of the Blue and the Great Tit (*Parus caeruleus, P. maior*) based on the data collected between 1982-1995 in the Pilis-Visegrád Mountains. Site fidelity depended in both species on age: natal site fidelity (500 m, 1000 m) is much weaker than breeding site fidelity (median distance within year 39 m, 55 m; between years about 80 m in both species). Natal dispersal among Great Tits and between years breeding site fidelity among Blue Tits depended on sex (males had shorter dispersal distances). There was no difference in the spatial distribution within plots between yearling birds immigrated to or resident in the area. Proportion of birds changing nest box within one season if they reared no young from the first brood was higher comparing to pairs with successful first breeding especially in Great Tits, but also in Blue Tits. There was no difference in the distance moved to the site of replacement clutch by birds whose nest was failed before or after hatching. After the total failure, Great Tits with predated first brood moved further than birds lost their brood by other reasons (i.e. interspecific competition). Neither the failure of the first, nor of the replacement and second clutch affected site fidelity between years.

Passerines known to be resident rarely remain on the same territory throughout their life. However, they do return to a restricted area, which behaviour is called as site fidelity, and the distance moved is the dispersal distance. Site fidelity can be measured to natal, breeding, feeding, wintering or roosting areas. After the familiarity hypotheses, the benefit of site fidelity is the knowledge of the area (as birds are familiar with resources, competitors and dangers). Birds on a familiar area may have higher fitness than birds living on formerly unknown area (SLAGSVOLD & LIFJELD, 1990). Site fidelity decreases (dispersal distance increases) if birds are living among spatially or temporally heterogeneous, thus unpredictable environmental variables (JÄRVINEN, 1989); or if an area was proved to be unfavourable (e.g. individuals had bad reproduction).

Site fidelity may affect local survival estimations (BARROWCLOUGH, 1978). Natal and breeding site fidelity should be investigated in evolutionary and population biology and behavioral ecology studies because it usually affects the demographic parameters (LIDICKER, 1975; BREITWISCH, 1989), and also affects genetic variance (WRIGHT, 1946; ERHLICH & RAVEN, 1969; SHIELDS, 1983; PERRINS, 1990).

In this study we analysed some possible causes and consequences of natal and breeding site fidelity of two common tit species, the blue and the Great Tit. The main questions addressed were whether there are site fidelity differences between sexes, age groups, birds with different previous experiences (e.g. birds living on known or unknown area, MCCLEERY & CLOBERT, 1990; birds with failed or successful former breeding attempt, birds with surviving recruits, birds with clutch lost by predation or by other kind of disturbance, NUR, 1988; PÄRT & GUSTAFSSON, 1989; SLAGSVOLD & LIFJELD,1990;

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SHIELDS, 1984; NEWTON & MARQUISS, 1982; review in GAVIN & BOLLINGER, 1988). We also asked whether recruitment rate is affected by site fidelity.

Study area, species and methods

Study area lays in the eastern part of the Pilis-Visegrád Mountains, 50 km from Budapest to NW, in an oak-hornbeam forest managed by the Pilis Park Forestry. Average age of forest is between 60-70 years. More detailed descriptions and maps about the area, and the long-term population biology and behavioral ecology studies on the nine artificial nest-box plots may be found in TÖRÖK & TÓTH (1988a, 1988b), TÓTH (1985) and KÖNCZEY (1990). Human disturbance is significant in some plots owing to the paths and roads crossing them. Nest predation rate on average is 0.1 (fluctuating between 0-0.3 between plots and years). Most frequent nest predator is the dormouse, but woodpeckers, grass-snakes, mustelids (weasel, marten), cats are also observed or potential predators on the plots. Nest predation results in total failure in about 85% of cases. Other important causes of nesting failure are inter- or intraspecific competition for boxes, human disturbance (e.g. tits are highly intolerant to disturbance at nest during egg-laying and incubation; KANIA, 1989).

Most frequent breeding species (with descending frequency) on the plots are: Collared Flycatcher (*Ficedula albicollis*), Great Tit, Blue Tit, Nuthatch (*Sitta europaea*). The outcome of competition for boxes is strongly affected by body mass of birds and the time period of competition (see e.g. SLAGSVOLD, 1975; GUSTAFSSON, 1988). Both tit species are territorial and resident. Males take up territories in autumn (DRENT, 1983), and both sexes and species form flocks during winter. Breeding starts between end of March and middle of April. Egg-laying is synchronised with the peak period of caterpillars, the main food of tits during breeding (VAN BALEN, 1973; TÖRÖK & TÓTH, 1988b.). Incubation period is 2 weeks, the young fledge at day 18-20 after hatching. Breeding failure is usually followed by a repeated clutch. After fledging the first clutch, a second clutch can be laid in late May. Size of second clutch, as well as repeated clutch, and the success of second breeding is smaller than those of the first breeding.

We measured site fidelity by the distance in meters of the two boxes occupied by the same individual in consecutive breeding attempts within or between years (GREIG-SMITH, 1982; SHIELDS, 1984). Data of (young or breeding) birds dispersing from the closed plots were omitted. Reliability of distance measures is 1 m, of bearing is 5. Maps were digitalized to get the coordinates of boxes. When a box was moved to a nearby tree (e.g. after natural fell of a dead trunk) the new coordinates of it were determined.

Boxes were checked 1-3 times per week from the beginning of breeding season. The following breeding phenological data of tits were used in this study: place of breeding, onset of breeding (considering the date of first egg laid in the population as day 1), ring number of parents and young, age of parents (2Y=yearling, or older), adult survival to the next breeding season, number of eggs, hatched, fledged and recruited young (recaptured the next spring or later), factor determined as reason for nest failure. More than 80% of females, and more than 90% of young were ringed. Males captured only since 1987, and only in 40% of tit nests (mainly because failure during incubation makes males impossible to catch and identify). We used standardised breeding parameters to decrease year-to-year and site-to-site variances.

Site fidelity of tits were tested using Mann-Whitney U-test, Chi-square test and Spearman rank correlation (SPSS/PC+ software were used in all analyses, SPSS Inc. 1984-1985). Probabilities are two-tailed.

Results

Natal site fidelity

Yearling Great Tits showed sex-dependent site fidelity towards their natal site (male median = 899 m, n = 15, female median = 1144 m, n = 13; Mann-Whitney U-test, Z = -2.19, $p < 0.05$). In Blue Tit the difference was not significant (male median = 418 m, n = 10, female median = 555 m, n = 8; Z = -1.07, NS).

On plots smaller than 6 hectares tits prefer the marginal boxes (KÖNCZEY, 1990), and recruitment rate of young fledged from these boxes are better than those of fledged from "inside" boxes (our unpublished data). According to the familiarity hypothesis birds remaining on their natal area, thus knowing better their environment (resources, competitors, predators) are in favour comparing to birds immigrating to the area. As a consequence, more resident yearlings are expected to breed in the preferred marginal boxws. We examined the proportion of resident and immigrant 2Y tits breeding in marginal and inside boxes regarding the two species and both sexes. Individuals born on or immigrated onto their first breeding area occupied the two types of boxes with the same probability (^{2} in all cases < 1.74, df = 1).

Mate fidelity

Mate fidelity in tits could be analysed only in the very few cases where both parents were captured, and 1.) both were recaptured and formed a breeding pair again, or 2.) one of them was recaptured in the next breeding period and had different partner, or 3.) both were recaptured in different boxes in the next breeding period. The members of 5 Great Tit and 4 Blue Tit pairs of replacement or second broods remained the same as in the first brood, i.e. mate fidelity was characteristic to them within season. Recruitment rate of tits is considerably low, thus it was not surprising that 14 Great Tit females and 10 males ("widow" birds) recaptured in two consecutive years with different or unringed partner and only one with the same partner (faithful), and one with a male captured with another female in previous year ("divorced"). Among Blue Tits, two pairs were faithful, one pair divorced, and 5 females and 7 males were determined as widows. Faithful birds in every cases bred closer to their previous nest than divorced ones, although because of the small sample sizes we did not prove it by statistics.

Breeding site fidelity

Breeding site fidelity of birds between years was much stronger than natal site fidelity of young (Mann-Whitney U-tests, Great Tit female Z = -5.60, $p < 0.0001$, male Z = -3.85, $p = 0.0001$; Blue Tit female Z = -2.84, $p < 0.005$, male Z = -3.19, $p < 0.005$). On the base of site fidelity of females recaptured within season (within year site fidelity is the distance moved from the box of the first breeding to the second or repeated breeding), we can state that both species held their territories during a breeding season: median of distance between sites of first and replacement nests in Great Tit was 55 m, in Blue Tit was 42 m, while median of distance between sites of first and second nests was 52 m in Great Tit, and zero in Blue Tit (Great Tit Z = -2.0, $p < 0.05$; Blue Tit Z = -0.94, NS). We analysed the independence of shifting between boxes or holding a box vs. having a successful or failed first breeding. Significantly more birds laid the second clutch in the box of the first clutch after a successful breeding (8 Great Tit pairs of the 35, and 5 Blue Tit pairs of the 9) than after an unsuccessful one (0 Great Tit pairs of 59, and 3 Blue Tit pairs of 17; Great Tit $^2 = 14.74$, df = 1, $p < 0.0005$, Blue Tit $^2 = 3.97$, df = 1, $p < 0.05$).

Within year and between years breeding site fidelity of females differed in both species (Great Tit female: $Z = -2.76$, $p < 0.01$, male: $Z = -1.61$, $p = 0.107$; Blue Tit female: $Z = -4.13$, $p < 0.0001$, male: $Z = -1.89$, $p = 0.059$, *Fig. 1*): namely within year site fidelity was stronger than between year site fidelity. The difference in between years site fidelity of male and female Great Tits was found to be not significant ($Z = -0.69$, NS, *Fig. 1*). Site fidelity of male Blue Tits was stronger than that of the females ($Z = -2.16$, $p < 0.05$, *Fig. 1*).

The effect of females' age and breeding success on site fidelity were analysed in detail. We found no difference in within year site fidelity among 2Y and older birds of both Great and Blue Tits (Great Tit: older median = 54m, n = 59, 2Y median = 55m, n = 47; $Z = -0.71$, NS; Blue Tit: older median = 40m, n = 11, 2Y median = 33m, n = 11; $Z = -0.20$, NS). However between years breeding site fidelity of 2Y Great Tit males was found to be stronger than that of the older males (Table 1). No similar age effect was documented in Great Tit females and in any sexes of Blue Tits (Table 1). Omitting birds with unsuccessful breeding attempt in the first investigated season the similar analyses was carried out, and no age dependent differences were found in their site fidelity.

The date when first clutch failed (i.e. failed before or after hatching) did not affect the site fidelity, the distance between boxes of the unsuccessful first and the repeated clutch (Great Tit: clutch failed before hatching, median = 56 m, n = 44; clutch failed after hatching, median = 55 m, n = 14, $Z = -0.14$, NS; Blue Tit: clutch failed before hatching, median = 38 m, n = 16, the pair with the only clutch failed after hatching occupied a box 45 m far from the first for repeated clutch, $Z = -0.20$, NS). In Great Tit failures caused by nest predation resulted in greater avoidance (median of distances between first and repeated clutches = 87 m, n = 5), than those failed for another reason (e.g. competition for nestbox, human disturbance, median = 49 m, n = 25, $Z = -2.48$, $p < 0.05$). No similar effect was found in Blue Tits (predated: median = 79 m, n = 7, non predated: median = 53 m, n = 3, $Z = -0.57$, NS).

There was no difference in the between years site fidelity between birds with successful or unsuccessful breeding (Table 2, Mann-Whitney U-test NS for both species, for both sexes). We could not analyse the effect of total failure on the site fidelity of different age groups because unsuccessful yearlings were almost no recaptured after their unsuccessful breeding. Recruitment rate of 2Y Blue Tit females was lower for unsuccessful ones than for females rearing at least one fledgling in their first breeding season ($(^2 = 5.52$, df = 1, $p < 0.01$). Expected and observed local survival of 2Y Great Tits, 2Y male Blue Tits and all old tits were not different ($(^2$ in all cases < 0.95, df = 1).

Only a small fraction of fledged young survived to the first breeding season (recruitment rates were 0.5% and 0.8% for Blue and Great Tits respectively). Considering the 0.5-6 km distance of our study plots from each other, the above reported 1 km (Great Tits), or half km (Blue Tits) extent of natal site fidelity means the correct sampling of the population as well. We examined whether the site fidelity of parents having at least one, or have no survived offspring was the same. Although both species and sexes having no recaptured offspring showed weaker site fidelity, these differences were not significant (Z in all cases < -1.5). Sample sizes were extremely low in these analyses.

Table 1. Between years breeding site fidelity of yearling and older tits

Species	Sex	Yearling median (n)	Older median (n)	Z	p
Great Tit	female	85 m (36)	62 m (39)	−0.69	NS
	male	65 m (8)	120 m (10)	−2.05	< 0.05
Blue Tit	female	105 m (16)	95 m (23)	−0.63	NS
	male	75 m (8)	71 m (8)	−0.05	NS

Table 2. Between years breeding site fidelity of Great and Blue Tits with unsuccessful or successful breeding attempt

Species	Sex	Seaso started		Season finished	
		unsuccessfully	successfully	unsuccessfully	successfully
		median (n)	median (n)	median (n)	median (n)
Great Tit	female	43 m (3)	71 m (37)	91 m (12)	65 m (62)
	male	22 m (3)	86 m (12)	38 m (3)	94 m (14)
Blue Tit	female	126 m (4)	104 m (31)	119 m (5)	100 m (32)
	male	86 m (2)	76 m (13)	86 m (2)	72 m (14)

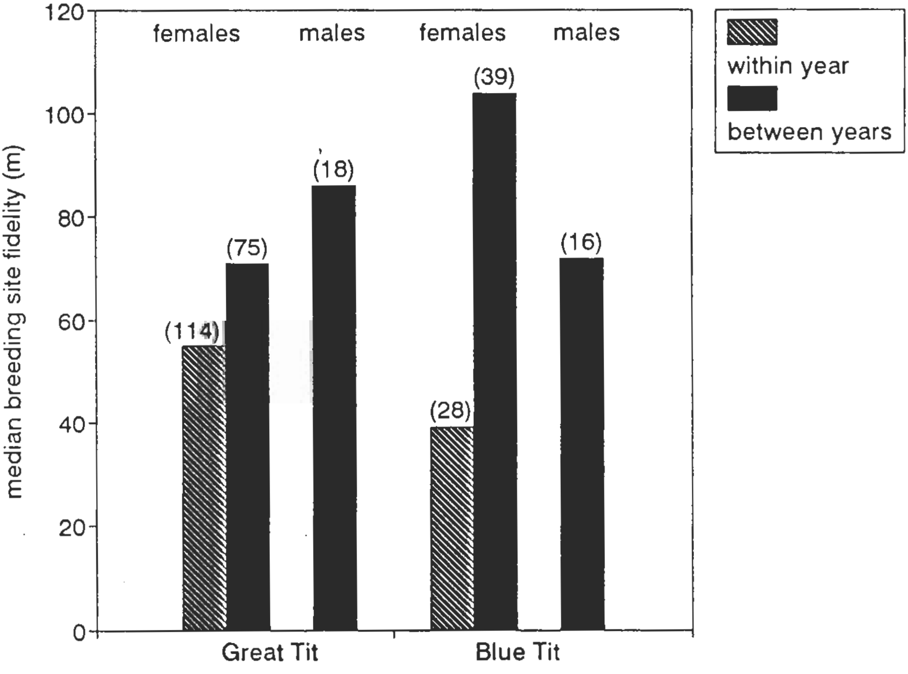

Fig. 1. Within and between years site fidelity of Great and Blue Tits. (Sample sizes are in parentheses)

Discussion

Although yearling tits choose breeding area much farther from their natal site than adults from their previous breeding site, even this distance is comparable with the sizes of territories (SHIELDS, 1982). Benefit of the weaker natal site fidelity is that it indirectly decreases inbreeding both among sisters and brothers (if natal dispersal is different for sexes) and moreover both among parents and offspring. Natal dispersal can be influenced by the time of fledging (PAYNE, 1991; DHONDT & HUBLÉ, 1978), brood size (PÄRT, 1990), density at the time of fledging (DRENT, 1983; NILSSON, 1989), sex (reviewed in GREENWOOD & HARVEY, 1982) and condition of fledglings, their dominance status (DHONDT, 1979), the quality of natal area (NEWTON & MARQUISS, 1983).

Studies provided evidences that breeding site fidelity can be affected by sex, age (PÄRT & GUSTAFSSON, 1989; HARVEY et al., 1984), previous breeding performance (VON HAARTMAN, 1949; FREER, 1979; PÄRT & GUSTAFSSON, 1989), wintering and migration, breeding density (PÄRT, 1990), parents condition which is affected by the food supply of the habitat (SHAW, 1990) and genetic factors (reviewed in GREENWOOD & HARVEY, 1982; SHIELDS, 1984).

Correspondingly to GREENWOOD et al. (1979) young Great Tit males in the Pilis-Visegrád Mountains chose breeding ground closer to their natal site than females. Natal site fidelity of Blue Tits was unrelated to sex. The extent of the observed natal dispersal distance in our area is in accordance with the data of other European population (Great Tit male: ranging from 354 m to 1017 m, female: ranging from 543 m to 1269 m, in GREENWOOD et al., 1979). Tits were faithful to their breeding area as it was shown by the median of between years site fidelity (less than 100 m, which data corresponds to the studied British population, HARVEY et al., 1979). GREENWOOD (1980) found that females have weaker site fidelity than males in species where males defend territory, while in species where males defend females, the pattern is opposite. Our results on Great Tits, of which male defends not only the territory, but guards the female as well, correspond to this theory because site fidelity of sexes is similar. However we found sex-dependent breeding site fidelity in Blue Tits where males had stronger site fidelity than females.

Mate fidelity is characteristic within season. Mate fidelity between years (of which benefit is considered to be the higher breeding success, which benefit could make reasonable the strong site fidelity, SCHIECK & HANNON, 1989) was extremely rare in these populations, where the survival rate is also very low. The higher between years mate fidelity found in Great Britain (HARVEY et al., 1979) can be partially owned to the mild winter climate: birds stay for almost whole year on the breeding ground, while in the Pilis-Visegrád Mountains the winter flocks move greater distances and spend more time in valleys to utilize the better feeding possibilities. In the above British population mate fidelity is more frequent than divorce, and divorced Great Tit females bred farther from their previous year box than faithful ones. Owing to the low data size we could not prove statistically that site fidelity of widow and divorced birds is weaker than of faith birds.

Birds were born on the area where they started to breed were not in favour comparing to yearling birds immigrated to the breeding ground.

Total failure increased the chance of finding a new box for replacement brood within season in both Great and Blue Tits. Brood status (before or after hatching) in the time of nest failure did not affected the distance moved to the site of replacement brood. After a total failure, Great Tit pairs with predated first brood moved further than birds lost their brood by other reasons. Neither the failure of the first, nor of the replacement or second clutch affected site fidelity between years, although fewer unsuccessful 2Y Blue Tit females returned to the breeding ground than expected. These result about the effect of breeding success on site fidelity only partly correspond with NUR (1988) who found stronger site fidelity after successful season. Although both species and sexes having no recruit showed weaker site fidelity than individuals with at least on survived offrspring, these differences were not significant.

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Opusc. Zool., Budapest, XXIX–XXX, 1997

The life-history and gut content of Potamophylax nigricornis (Trichoptera, Limnephilidae)

By

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Abstract. During our hidroecological survey we have observed the life-cycle and gut content of a common caddisfly species. We had found the egg-masses of the animal, and after LEPNYEVA (1971) we identified the five larval stages.

The investigated Trichoptera species is a univoltin organism. Larvae occur both in creeks with stone and among plant detritus. Despite the ubiquitous occurrence of *Potamophylax nigricornis*, many details of larval life history are unknown. We provide much of this missing information through both field and laboratory studies.

Investigations have been done in two creeks near the village Törökmező in the Mountains Börzsöny between 1986-1989. One of them contains shallow water, but never completely dries. The other one springs at Fehér-forráscsoport (White Spring Group), is permanent and also flows into the stream Malomvölgyi.

We have found detailed descriptions of the larval stages in several basic works (LEPNYEVA, 1971; MACAN, 1973; MALICKY, 1983; MORETTI, 1983; ROZKOSNY, 1980; STEIMANN, 1970; ULMER, 1909).

Material and methods

We had caught the larvae and the pupas with hand and water nets and we preserved some of them in 70 % alcohol. The mass of eggs and the live animals among wet fallen leaves were taken to the laboratory.

Original stream water and air-freshened running water was used for rearing the larvae. The individual larva population were kept in water of 15-16° C in plastic containers containing 8 liter. Water in conteners was changed daily.

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Results and discussion

Life-history

The adults emerge at the end of April or the beginning of May. The gelatinous egg masses (Fig. 1) can be found in the stream in the middle of May. The diameter of egg masses is 8 mm and each contains 116-120 eggs. They can mostly be found near the shore or on the under side of stones, or on decaying leaves. In some places, there are 3-4 of them right next to
each other.

The larvae in the first stage assemble on branches. In each aggregation, we often find over a hundred larvae. During the second and third stages, they scatter in the spring and afterwards rarely can be found more than 3-4 individuals in one place. The larvae derived from their amphibious life-style can be found mostly in the piles of leaves near the shore.

Five larval stages were demonstrated (Fig. 2) but because of the special case-building strategy, it is not possible to give definite case-forms for different stages.Before forming pupas, for the prevention of being swept away, they glue larger flat stones to the posterior side of cylindrical cases, and this makes them heavier. They seal the opening of the cases with limestone fragments and form pupas in these cases.

At the original living place, the pupas appear in the middle of February or at the beginning of March. Both of their ends are sealed with limestone fragments.

In opposition to LEPNYEVA (1971), we did not come across pupas fixed to the bedding at the living site studied by us. Under natural circumstances the animals do not form pupas in groups. However, under experimental circumctances, abscence of building materials, we observed phenomena opposing the preceeding, too.

In the laboratory, pupation lasts for 14-21 days, in nature the duration of it is 1-1.5 month, because the water temperature is usually cooler in the spring.

After the adults had emerged, the cast skin was mostly found in dry places on the side of the container in laboratory, which shows that the moult takes place on the land.

Gut content

In the stream bed oak and beech leaves had been found in large numbers. There was a difference in the proportion of leaves found in the water, there was by far less oak then beech leaves.

In the preference experiments, oak had disappeared completely in a day and there was little missing from beech leaves. If the larvae only come by beech leaves, then they first of all consume the younger, thinner leaves. In experimental circumstances the larvae feed during the whole year, and only in the spring shortly before becoming pupas stop consuming food.

These leaf fragments were defined from the intestines of larvae collected on field, and of those brought up in experiments.

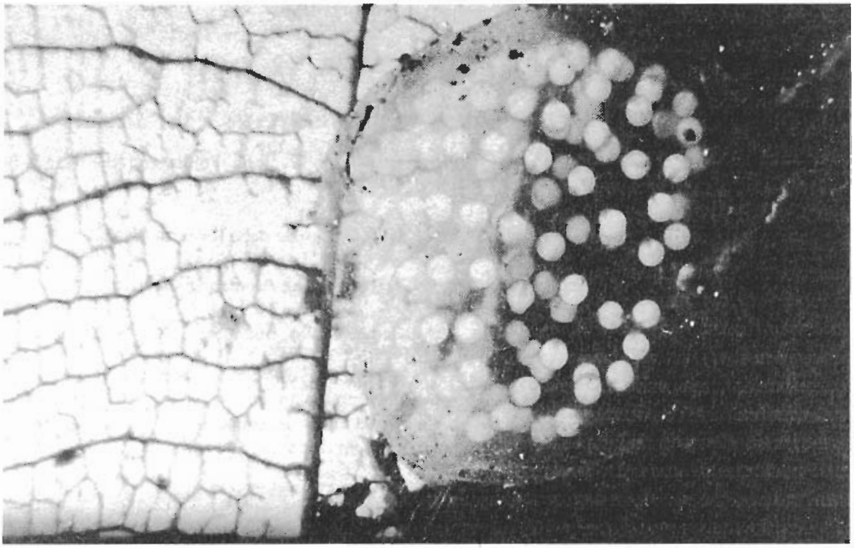

Fig. 1. The gelatinous egg masses of *Potamophylax nigricornis*

Fig. 2. *Potamophylax nigricornis*, larval stages

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Vergleichende Untersuchungen des Konsums bei Männchen und Weibchen von Diplopoden

Von
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Abstract. Feeding characters of male and female specimens of three diplopod species – *Unciger foetidus* (C. L. KOCH), *Cylindroiulus luridus* (C. L. KOCH) and *Megaphyllum projectum* (VERHOEFF) – were compared from data got in laboratory experiments. Significant differences were found in the consumption values of the males and females of M. *projectum* only. The body weights of the different sexes of all three species differed from each other significantly. All three species showed coprophagous behavior.

Die ernährungsbiologische Literatur der Diplopoden verfolgend konnte festgestellt werden, daß über die Unterschiede der Geschlechter beim Konsum bisher nur wenige Veröffentlichungen erschienen sind. Diese Arbeiten sowie Untersuchungen des Atmungsmetabolismus beim Männchen und Weibchen haben erwiesen, daß das Geschlecht der Tiere weder den Konsum noch den Sauerstoffverbrauch beeinflußt (DANGERFIELD, 1993; BYZOVA, 1967; PENTEADO, 1987; PENTEADO et al., 1991). Frühere Arbeiten haben zwischen der Größe, resp. der aktiven Körperoberfläche Zusammenhänge herausgefunden (VAN DER DRIFT, 1951; GERE, 1956). BLOWER (1974) fand, daß zunehmendes Körpergewicht einen höheren Konsum zur Folge hat.

Zwischen den oben angeführten Feststellungen sehe ich gewisse Widersprüche, daß bei den meisten Diplopoden-Arten ziemlich große Unterschiede in Größe und Gewicht, d. h. also auch in der Körperoberfläche, zwischen den verschiedenen Geschlechtern bestehen. Die bisherigen Aussagen berücksichtigend, wurden Untersuchungen über die Ernährungsweise der Geschlechter verschiedener Diplopoden-Arten ins Auge gefaßt, um durch den Vergleich der erzielten Ergebnisse Antwort auf die Probleme zu finden.

Material und Methode

Die jetzige Versuchsserie bildet einen Teil der mit verschiedenen Diplopoden-Arten durchgeführten Fütterungsversuche, denen die Koprophagie der einzelnen Arten zum Ziel gesetzt wurde (POBOZSNY, im Druck). Da die gleiche Methode zur Anwendung gelangte, wird ihre Beschreibung hier nur kurz zusammengefaßt.

Als Versuchstiere wurden drei Diplopoden-Arten eines Hainbuchen-Eichenbestandes, deren Vorkommen dort am häufigsten war, herangezogen. Diese sind *Unciger foetidus* (C.

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L. KOCH), *Cylindroiulus luridus* (C. L. KOCH) und *Megaphyllum projectum* (VERHOEFF). Die Tiere wurden im Vértes-Gebirge, im Vinyabükk-Tal (West-Ungarn) gesammelt.

Ebenfalls von dort stammte die als Futter verabreichte Streu der Esche (*Fraxinus excelsior*). Da es sich um Blätter aus dem Januar handelte, hatte sich ein gewisser Vorabbau in der Streu vollzogen.

Für die im Labor durchgeführten Fütterungsversuche wurden Plastikgefäße mit einem Durchmesser von 10 cm verwendet. Der Boden dieser Gefäße wurde entfernt und durch ein Nylonnetz ersetzt. Die Gefäße wurden auf eine kleine Tasse gestellt, diese wiederum auf ein größeres, mit Sand gefülltes und Wasser gesättigtes Gefäß. Um hohe Luftfeuchtigkeit zu sichern, wurden die Versuche abgedeckt (SZLÁVECZ and POBOZSNY, 1995). Die Temperatur im Labor schwankte zwischen 10-12° C.

Die Tiere erhielten zwei verschiedene Futter. *1)* Eschenblätter, die nach dem Einsammeln lufttrocken aufbewahrt wurden. Zum Konsum wurden Blattscheiben von 18 mm Durchmesser angeboten. *2)* Kot von C. *luridus*, die mit Eschenlaub gefüttert wurden. Dieser wurde im Trockenzustand zerrieben und in Form von Tabletten verabreicht. In jedes Gefäß wurden Scheiben und Tabletten untergebracht. Vor dem Versuch wurde das Gewicht der Blattscheiben und Tabletten, das absolute Trockengewicht (nach Austrocknung bei 105° C) bestimmt. Nach Befeuchtung der Nahrung wurde je ein gewogenes adultes Tier von jeder Gattung in 5-5, artenweise in 10-10 Wiederholungen eingesetzt.

Die im November durchgeführte Versuchsdauer betrug 17 Tage. Bei der Auswertung der Versuche wurden zum Vergleich die Werte eines Versuches mit M. *projectum* vom Mai (8 Tage), unter gleichen Bedingungen, herangezogen.

Gleiche Versuchsansätze ohne Tiere dienten in 10 Wiederholungen als Kontrolle, wobei die mikrobielle Zersetzung verfolgt werden sollte.

Nach Beendigung des Versuches wurden die Tiere, die Nahrungsreste (Streu und Tabletten) sowie die Menge der erzeugten Exkremente gemessen und die Trockenmasse bestimmt.

Bei der Berechnung des Nahrungsverbrauches wurde der Konsum C nach der Formel von REIMAN (ZICSI and POBOZSNY, 1977) $C = (M-m)SM^{-1}$ (wo S = Ausgangsmasse, M = Restmasse im Kontrollversuch, m = Restmasse der angebotenen Nahrung) errechnet.

Wertung der Ergebnisse

Da bei den Diplopoden die Männchen und Weibchen von verschiedener Größe sind, ist auch ihr Körpergewicht dementsprechend verschieden. Bei allen 3 untersuchten Arten haben wir hohe signifikante Unterschiede im Körpergewicht der Geschlechter gefunden (Tabelle 1). Das Körpergewicht der M. *projectum*-Individuen zeigte im Frühling und Herbst nur bei den Weibchen bedeutende Unterschiede, u. zw. zugunsten der im Frühjahr gemessenen Gewichte. Dies kann mit der Paarungszeit und Eiablage dieser Art, die sich auf Grund unserer Erfahrungen im Mai-Juni vollzieht, in Zusammenhang gebracht werden. Das höhere Körpergewicht kann eine Vorbereitung zur Vermehrung bedeuten. Es ist bedauerlich, daß wir bei den anderen Arten keinen jahreszeitlichen Vergleich besitzen.

Tabelle 1. Durchschnittsgewicht (mg ± SD) bei verschiedenen Geschlechtern von Diplopoden-Arten

Art		Männchn		Weibchen		t	P
Unciger foetidus		131,9	± 6,2	151,8	± 14,9	4,203	< 0,001
Cylindroiulus luridus		130,1	± 16,7	300,2	± 22,4	19,845	< 0,001
Megaphyllum projectum	Herbst	202,1	± 20,4	321,7	± 23,4	12,169	< 0,001
	Frühling	224,4	± 32,9	399,4	± 64,1	24,272	< 0,001

Die Ergebnisse der ernährungsbiologischen Versuche sind in Tabelle 2 zusammengefaßt. Obwohl bei allen drei Arten bedeutende Körpergewichtsunterschiede gemessen werden konnten, waren im Konsum nur bei M. *projectum* höhere signifikante Unterschiede nachzuweisen. Dies bezieht sich, wenn auch unterschiedlich, sowohl auf den Konsum der Streu und der Tabletten, sowie auf die Gesamtkonsummenge. Die höchsten Fraßmengen wurden bei den Männchen und Weibchen von C. *luridus* bestimmt. In Tabelle 3 werden die täglichen Konsumwerte der einzelnen Arten im Verhältnis zum Lebendgewicht zusammengefaßt. Auch aus diesem Gesichtspunkt sind die Werte von C. *luridus* hervorzuheben. Aus der Tabelle 3 geht weiter noch hervor, daß bei C. *luridus* und U. *foetidus* die Männchen im Verhältnis zum Körpergewicht mehr fressen, bei M. *projectum* ist es gerade umgekehrt.

Auch in der Assimilationseffizienz unterscheiden sich die Männchen und Weibchen einer Art nicht besonders; die A/C-Werte der Weibchen sind im allgemeinen etwas höher. Was die Körpergewichtsveränderungen betrifft, läßt sich eine Gewichtszunahme überall erkennen, die verhältnismäßig hohe Streuung der Werte ermöglichten keinen statistischen Vergleich. Es konnten bei allen Arten hohe Überlebenswerte erzielt werden, die sich sehr erfreulich für die Auswertung der Versuche erwiesen.

Die zu zwei verschiedenen Jahreszeiten durchgeführten Untersuchungen mit M. *projectum* ermöglichen es, die Konsumcharaktere miteinander zu vergleichen (Tab. 4). Während die Männchen nur beim Konsum der Tabletten Unterschiede aufwiesen, konnte ein signifikanter Unterschied bei den Weibchen beim Konsum der Laubstreu, im Gasamtkonsum, in der Exkrementproduktion und in der Assimilationseffizienz nachgewiesen werden.

DANGERFIELD et al. (1993) haben in Freilanduntersuchungen bei Diplopoden in Akazien-Savannen nie eine Koprophagie registriert. Wie dies vorausgehend bewiesen wurde, konnte bei allen drei Versuchsarten Koprophagie nachgewiesen werden, C. *luridus* fraß sogar auch ihre eigenen Exkremente (SZLÁVECZ and POBOZSNY, 1995; POBOZSNY, im Druck). Die jetzigen Angaben geben Aufschluß über die Koprophagie der verschiedenen Geschlechter. Ob die Tiere die Laubstreu oder die Exkrementtabletten preferieren, geht aus Abb. 1 eindeutig hervor. Da es sich um eine Untersuchungsreihe aus dem Herbst handelt, bestand der größte Teil der Nahrung aus Laubblättern (POBOZSNY, im Druck), welcher von den Männchen in höheren Prozenten konsumiert wurde als von den Weibchen. Eine Ausnahme bildeten nur die Weibchen von U. *foetidus*, die sich lieber von den Exkrementtabletten ernährten. Im Frühjahr fraßen die Männchen von M. *projectum*

Tabelle 2. Ernährungscharaktere von Diplopoden-Arten in Laborversuchen

	Konsum (mg/g/Tag) ± SD			Exkrement-produktion	Assimilations-effizienz	Gewichtsveränderung des Körpers	Überleben
	Fallaub	Exkrement-tabletten	Gesamt	(mg/g/Tag) ± SD	A/C % ± SD	% ± SD	%
U. foetidus							
Männchen	17,7 ± 5,5	7,0 ± 5,4	24,7 ± 8,6	16,8 ± 8,9	38,3 ± 20,9	5,1 ± 1,9	100
Weibchen	8,5 ± 5,7	10,4 ± 9,6	19,0 ± 10,7	15,0 ± 8,9	22,6 ± 8,3	6,9 ± 3,2	100
t	2,366	0,727	0,877	0,298	1,258		
P	<0,5	<0,2	<0,2	<0,02	<0,5		
C. luridus							
Männchen	60,2 ± 13,1	11,8 ± 14,8	72,0 ± 11,3	62,1 ± 9,3	13,6 ± 3,3	6,6 ± 1,5	100
Weibchen	45,2 ± 9,1	23,1 ± 7.8	68,3 ± 5,5	55,2 ± 4,7	19,2 ± 3,0	5,1 ± 0,8	90
t	2,091		0,651	1,470	2,765		
P	<0,1		>0,5	<0,2	<0,05		
M. *projectum*							
Herbst							
Männchen	29,9 ± 5,7	11,5 ± 5,5	41,4 ± 6,6	34,8 ± 6,4	16,2 ± 4,0	4,2 ± 3,5	100
Weibchen	39,6 ± 5,2	23,7 ± 8,1	63,3 ± 8,3	52,3 ± 7,6	17,4 ± 4,0	10,2 ± 1,3	100
t	2,817	2,772	4,603	3,917	0,462		
P	<0,05	<0,05	<0,002	<0,005	>0,5		
Frühling							
Männchen	16,2 ± 9,7	27,7 ± 5,1	43,9 ± 6,2	35,6 ± 5,4	19,0 ± 0,9	0,4 ± 8,5	100
Weibchen	24,8 ± 7,0	19,9 ± 11,0	44,7 ± 10,8	34,4 ± 9,1	23,7 ± 3,9	10,1 ± 1.8	100
t	2,219	4,225	0,540	0,194	1,439		
P	<0,1	<0,002	>0,5	>0,2	<0,2		

Tabelle 3. Konsum der Männchen und Weibchen verschiedener Diplopoden-Arten im Prozent des lebenden Körpergewichtes

Art	Männchen	Weibchen
Unciger foetidus	2,5 ± 0,8	1,9 ± 1,0
Cylindroiulus luridus	7,2 ± 1,1	6,8 ± 0,5
Megaphyllum projectum		
Herbst	4,1 ± 0,6	6,3 ± 0,8
Frühling	4,4 ± 0,6	4,5 ± 1,0

Tabelle 4. Vergleich der Konsumcharaktere bei Männchen und Weibchen von M. projectum im Frühjahr und Herbst

	Männchen		Weibchen	
	t	P	t	P
Konsum:				
Fallaub	2.212	< 0,1	3,785	< 0,01
Exkrementtabletten	4,225	< 0,005	0,603	< 0,8
Gesamt	0,541	< 0,8	3,027	< 0,02
Kotproduktion	0,195	> 0,8	3,350	< 0,02
Assimilationseffizienz	1,440	< 0,2	2,481	< 0,05

mehr von den Exkrementtabletten. Die bei den Männchen aller drei Arten signifikante Unterschiede zwischen dem Konsum der Laubstreu bzw. den Tabletten bestehen. Von den Weibchen wiesen C. *luridus* und M. *projectum* (im Herbst) weniger signifikante Unterschiede im Konsum auf. Die bedeutendere Preferenz der Laubstreu bei C. *luridus* ist wahrscheinlich darauf zurückzuführen, daß sie die Exkremente gleichartiger Tiere erhielten und diese ungern konsumierten (POBOZSNY, im Druck).

Zusammenfassung

Wie aus den Versuchen ersichtlich, bestehen zwischen der Konsummenge und der Preferenz des Fraßangebotes bei Männchen und Weibchen von Diplopoden manchmal bedeutende Unterschiede. Die Gründe dieser Unterschiede können – da sie nicht bei allen untersuchten Arten (und nicht zu jeder Jahreszeit) auftraten – nicht in erster Linie in den Größen und Gewichtsunterschieden der verschiedenen Geschlechter liegen, sondern sind in der verschiedenen Ernährungsphysiologie zu suchen, die aber noch weitere langfristige Untersuchungen erfordern.

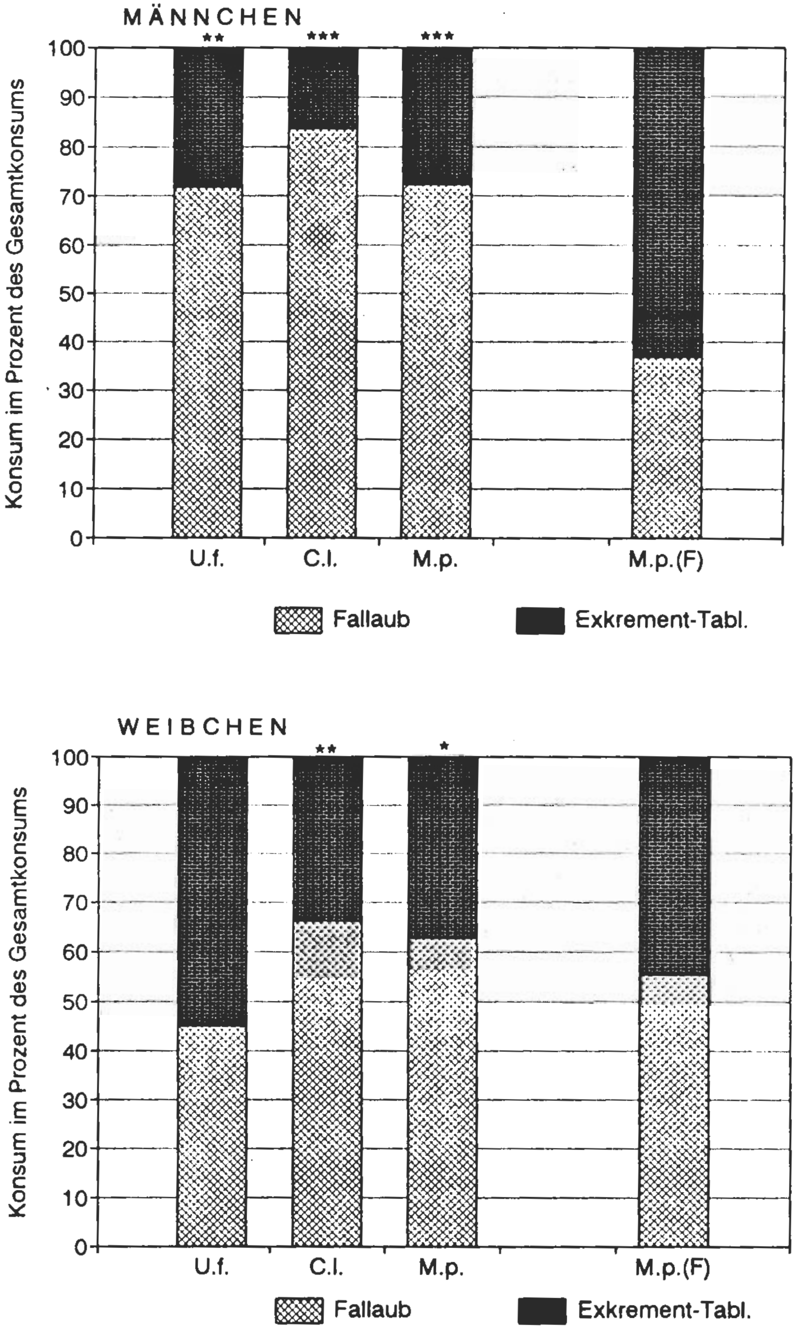

Abb. 1. Verhältnis des Laub- und Exkrementtabletten-Konsums bei verschiedenen Geschlechtern der in Versuchen gehaltenen Diplopoden-Arten. (U. f. = *U. foetidus*, C. l. = *C. luridus*, M. p. = *M. projectum*, F: im Frühling)

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On the protective role of maternal organism in amphibians

By
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Abstract. The heavy metal accumulation characteristics of semi-aquatic amphibians (*Rana esculenta* complex, *Bombina bombina*) were studied to collect information on their possible use as bioindicators. Two different biotops were chosen for our investigations, an underseepage fed series of ponds at Göd, near the River Danube and the fish pond system of the Warmwater Fish Hatchery (TEHAG) at Százhalombatta, where a part of the water supply comes from the cooling water of the nearby power plant. Sample collection, storage, digestion and the atomic absorption analysis was made after Parker. A new example for the protective role of maternal organism has been found in an animal group, where it had not been proved before while comparing the heavy metal concentration of anuran ovaries and eggs, where significant differences were recognised. In most cases the heavy metal concentration of eggs was much lower, with the exception of Cu and Zn, which are known to have a coenzyme role. This way the adult organisms maximises the fitness of the future offspring. At the moment there are no data on how the metals are bound in the ovary and the eggs.

The pollution of receiving waters has dramatically increased in the last few decades and its character has also changed, containing more hazardous micropollutants including heavy metals. Because of their significance in environmental protection, the study of pollutants of anthropogenic origin (particularly heavy metals) and the use of organisms in biomonitoring have been focal points of scientific interest all over the world.

The decline of amphibians is a worldwide problem, which is in close correlation with increasing pollution (BLAUSTEIN and WAKE, 1990). Due to their considerable sensitivity to environmental changes (PAVEL and KUCERA, 1986) amphibians as bioindicator organisms were studied for 5 years. Since they are available in large numbers and in different water types, they also form an intermediate link in the aquatic food chain so they are good representatives of freshwater life. They also correspond to the late embryonic stage of higher vertebrates and undergo significant anatomical, histological and physiological changes during their development, making the formation of easily - recognisable deformities caused by environmental pollution possible (KHANGAROT et al, 1985). What is more, amphibians are not only important links between aquatic and terrestrial ecosystems but some species, e.g. the edible frog, *Rana esculenta* also serve as human food.

In spite of these facts there is only little information available on the heavy metal accumulation of amphibians. On the basis of LC1 values, some amphibian species generally exhibited equal or slightly greater sensitivity than that of being observed for the embryo-larval stages of the rainbow trout (BIRGE et al, 1980). TERHIVUO et al (1984) found

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that the mercury concentration of common toad (*Bufo bufo*) kidneys originating from polluted areas was thirty times greater than at semi-natural control sites.

The present paper discusses the heavy metal (Ag, Cd, Cu, Fe, Hg, Zn) distribution in the eggs and ovaries of semi-aquatic, highly water-bound amphibian species (ZUG, 1978), *Rana esculenta* L. (Ranidae) and *Bombina bombina* L. (Discoglossidae).

Sites and method

Two different biotops were chosen to be investigated. A series of four ponds of about 1,800 m^2 at the Hungarian Danube Research Station 20 km north of Budapest, near the River Danube. It is alimented by an underseepage originating from gravel terraces situated above the Danube level. In former investigations it was established that its total salt content was higher than in the Danube, dominated by Ca^{2+} and HCO_3^- ions, the pH varied between 7.6 - 8.4 (DVIHALLY and KOZMA, 1966). Because of the water supply there is a small, but practically negligible current in the pond. The existence of non-point pollution sources (e.g. heavy metals) can not be excluded.

The other site is at Százhalombatta, 25 km south of Budapest, near the River Danube within the territory of a Warmwater Fish Hatchery (TEHAG). Samples were collected from 40 fish ponds of 100 - 300 m^2, individually, which can be considered as one network. The ponds get their water supply partly from the Danube, partly from the cooling water of a nearby power station. The latter also originates from the Danube, although it is warmer by 5 - 8° C. The chemical characteristics of the ponds and the Danube - including pollution - are nearly the same. There are smaller or greater currents in the ponds because the water supply is continuous. Fish farming sometimes causes extra heavy metal load by fertilising, feeding and disinfecting.

Tadpoles were caught by netting. Adult frogs and toads were collected by netting, fishing and by hand. Tadpoles were killed by 4% formalin solution, adults with ether. Species were identified in accordance with DELY (1967), developmental stages in accordance with ANGELIER and ANGELIER (1968), who differentiated ten stages (named as A, B, C, D, E, F, G, H, I) on the basis of outer morphological marks. Five to fifteen samples were collected from each locality at each sampling.

The same digestion method was used for tadpole and adult samples. After measuring the dry weights of the tissues and organs, digestion was made in teflon bombs with the mixture of 10 ml cc. HNO_3 and 5 ml cc. H_2O_2. Sample collection, storage, digestion and the atomic absorption analysis was made after PARKER (1972). Acid mixture without any samples provided control values. The atomic absorption analysis was made by a Varian Techtron AA-275 ABD type spectrophotometer: Fe and Zn were determined with flame atomisation; Ag, Cd and Cu with electrothermal atomisation using a Varian Carbon Rod Atomizer (CRA-90). The total Hg was digested at room temperature by OMANG's (1971) method. The determination was made by cold vapour technique with a Varian Model 65 type apparatus.

Results

The heavy metal distribution among *Bombina bombina* organs can be seen in Figure 1. In all cases the highest heavy metal concentration was found in the kidney (even if there is e.g. a larger Cu storage in liver due to the 1:9.27 weight ratio between the two organs).

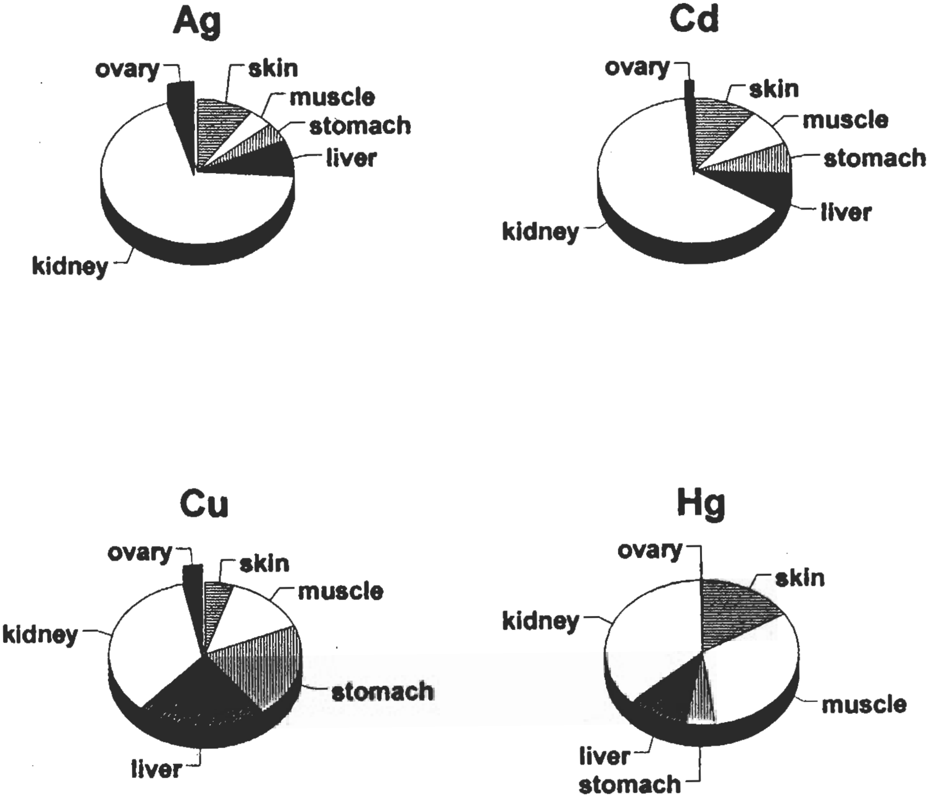

Fig. 1. Percentage distribution of heavy metals in *Bombina bombina*

Table 1. Mean heavy metal concentration of Rana esculenta c. ovary and eggs (mgkg^{-1}, Hg in µgkg^{-1}).

	Spring		Summer		Autumn	
	Göd	Százhalombatta	Göd	Százhalombatta	Göd	Százhalombatta
Ag						
ovary	1.08±0.79	50.3±7.1	30.0±18.1	94.3±4.8**	24.1±31.1	171±97***
eggs	0.59±0.35	0.00	7.26±4.99	47.1±8.2	3.52±3.17	81.6±37.8**
Cd						
ovary	13.5±1.1	77.0±38.2	114±47*	100±7	41.2±51.2	237±130***
eggs	8.78±0.71	0.11±0.08	18.8±6.4	50.8±12.3	8.99±0.09	69.6±62.9
Cu						
ovary	6.89±0.69	0.00	1.9±3.81	3.64±2.43	6.49±3.92	7.04±2.79
eggs	11.5±2.1	16.5±12.7	72.3±15.6***	2.07±3.93	14.3±2.1	5.95±2.86
Fe						
ovary	71.2±49.2	279±10	335±240	150±144	279±287	389±69
eggs	122±56	78.2±34.7	243±122	313±234	143±36	214±167
Hg						
ovary	17.2±15.3	88.9±23.4*	107±24**	33.5±7.3	3.8±1.2	41.3±122
eggs	3.68±3.29	35.2±11.3	4.27±1.41	13.5±6.2	0.00	11.3±4.9
Zn						
ovary	52.2±7.9	541±659	549±182	590±490	102±31	261±222
eggs	2736±446***	2229±1126***	2427±1691***	2736±550***	2084±1324***	1798±105**

Göd = Semi-natural ponds at Göd, Százhalombatta = fish ponds at Százhalombatta * ** *** significant difference at p = 5%, 1%, 0.1% level

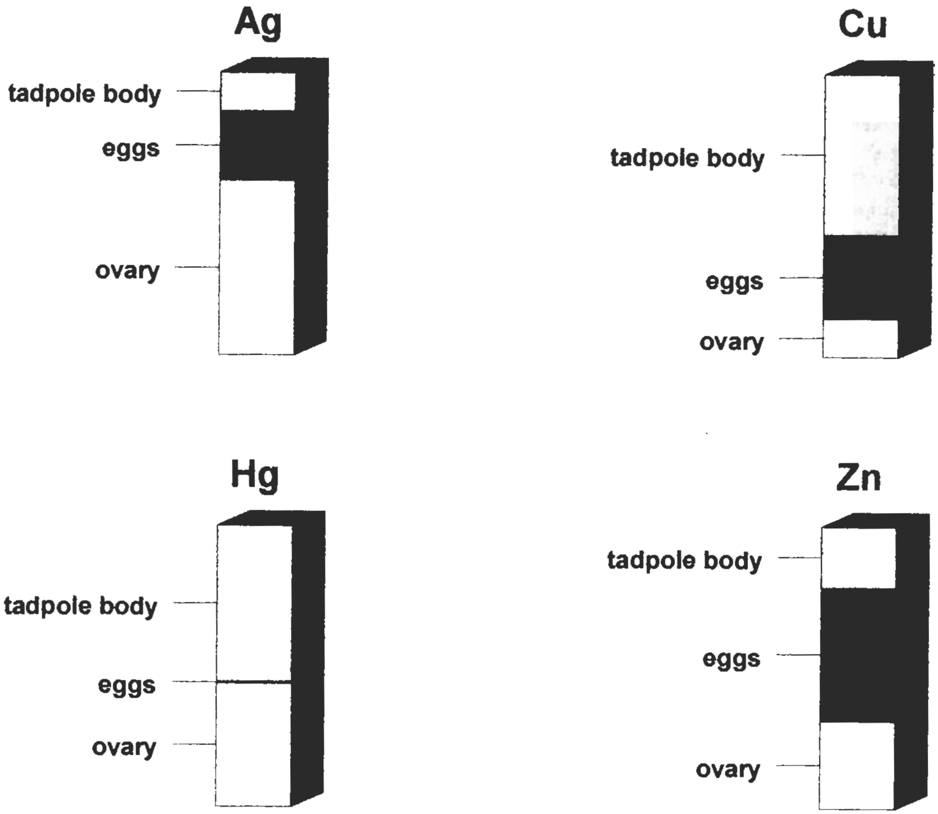

Fig. 2. Heavy metal concentration changes during the development of *Bombina bombina* (ovary, eggs, stage C tadpole) at Százhalombatta.

The Hg concentration of muscle was significantly high. In general, the heavy metal concentration of ovary can be considered as relatively moderate.

There is a close relationship between the heavy metal concentration of *Rana esculenta* ovary and eggs (Table 1). Their concentrations often changed in the same direction between the seasons, which indicates a close physiological relation. With the exception of copper at Göd and zinc at both sites, the metal concentration was generally higher in the ovary. In mammals, high concentration of zinc was detected to lower the toxicity of cadmium (SENDELBACH et al, 1989). Besides, maternal metallothioneins are known to change the heavy metal distribution completely between the maternal organism and the offspring and ovary can act as a barrier (BRUS et al, 1995).

The hypothesis was checked again in 1987. Similarly to 1984, the relative concentrations of four heavy metals in the eggs remained low in 1987 though the concentration of some metals (Cd, Cu) increased several times in the water.

Besides eggs and ovary, the heavy metal concentration of tadpoles was also monitored. Figure 2 demonstrates how development affected the heavy metal concentration of *Bombina bombina*. This species had a more diverse metal distribution than *Rana esculenta c.*, which only had higher zinc concentration in the eggs than in the tadpole body of an early developmental stage (C). GRILLITSCH and CHOVANEC (1995) draw similar conclusions while investigating the Cd, Cu Pb and Zn concentrations of *Rana ridibunda*, *R. dalmatina* and *Bufo bufo*. They also found higher Zn and lower Cd and Cu concentrations in the eggs. *Bombina bombina* eggs seem to have a significantly low mercury concentration. There was a gradual decrease in silver concentration, just the opposite of what was measured with copper. The role of zinc in the embryonic phase is emphasised further by the presented results. The actual heavy metal concentration of the tadpoles are greatly influenced by the larval ecotype (WARINGER-LÖSCHENKOHL, 1988).

Discussion

Every parent tries to maximise its offspring's fitness, even through ways, which can be harmful for itself by lowering its own chances of survival if the survival chances of the offspring are raised to a greater extent (STILTING, 1992). During the investigation of the heavy metal accumulation in amphibians a phenomenon in agreement with this theory has been recognised. Having no hair or feathers heavy metals burden e.g. the kidney, liver, gonad and skin (BAUDO, 1976; SUZUKI & TANAKA, 1983; SUZUKI et al, 1983; TERHIVUO et al, 1984). After the eggs hatch, heavy metals could affect the skeletal system, growth and development, changes in the pigmentation and behaviour. These effects are probably caused by the inhibition of collagen synthesis, general membrane dysfunction and the osmotic regulatory system (BIRGE et al, 1983; CHANG et al, 1973; KHANGAROT et al, 1985).

There was a close relationship between the heavy metal concentration of *Rana esculenta* ovary and eggs. Their concentrations changed often in the same direction between the seasons which refers to a close physiological connection, with the exception of copper at Göd and zinc, ovary concentration can generally be said higher. The fire-bellied toad, *Bombina bombina* exhibited the same characteristics, Cu, Zn (and Fe) concentrations were higher in the eggs while others (i.e. Hg) were lower. The reason of the high Zn (and Cu) content in the eggs might be the higher quantity of enzymes with Zn (and Cu) coenzyme in the embryonic life. This is supported by the fact that all of the metals except Zn had a higher concentration in larval stage C than they had in eggs.

We followed the larval development and could conclude that with the exception of Cu and Zn in *Rana esculenta*, Ag and Zn in *Bombina bombina*, the heavy metal concentration of the tadpoles of the next developmental stage were higher than those of the eggs. Maternal organism may have a protective effect against heavy metals and its discontinuance can result in the increase of the concentration after hatching.

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Opusc. Zool. Budapest, XXIX–XXX, Budapest

Diversity of spiders (Araneae) in the diet of Edible Frog (Rana esculenta complex) in a protected wetland area in Hungary

By
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Abstract. This study deals with spiders obtained by stomach-flush method from 75 specimens of the Edible Frog (*Rana esculenta* complex) caught in wetland of the Kis-Balaton Nature Reserves in Hungary. We found 140 exemplars of spiders (Araneae) belonging to 47 taxa from the stomach contents of the frogs. Some differences were observed in the diet-structure of *Rana esculenta* living in the three investigated areas. As compared the present results to the former ones, we have found higher spider diversity in the feed of frogs in 1992 than before.

The study area is a protected wetland (Kis-Balaton Nature Reserves Hungary) close to Lake Balaton, by the mouth of the River Zala (Fig. 1). The water of Zala becomes clearer flowing across this wetland. Reflooding works started in this area in 1984 and helping this process a large artifical water reservoir having been built.

Since 1984 a lot of studies have tried to follow the changes in structure and diversity of the fauna following this strong intervention. Among them, investigations were carried out on anurans. The anurans are generalist feeders, so their diet as could be expected reflects the diversity of Arthropoda and other Invertebrata living in the area. Our aim is to monitor the long term changes in composition in the invertebrate communities being potential prey of the frogs.

Only few papers have been published on the feed composition of the anurans. After the early publications (MOLNÁR, 1967; RAINISS, 1959; SZABÓ, 1957; TYLER, 1958), there are some new studies on this theme (KOVÁCS & TÖRÖK, 1992, 1993, 1994; TÖRÖK & CSÖRGŐ, 1992; TÖRÖK & KOVÁCS, 1996) and especially on the Edible Frog (*Rana esculenta* complex) populations (KOVÁCS & TÖRÖK 1995, 1995). The author is studying the spiders (Araneae) found in the stomach contents of frogs and its composition from different sampling sites (SZATHMÁRY, 1996; SZATHMÁRY & KOVÁCS, 1995).

The spiders fed by anurans can be well identified, they remain fairly intact in the stomach; if they are in bad condition their strongly chitinised parts (cheliceras, sternum, epigyne, pedipalpus) are still useful for identification.

Material and methods

The spiders were obtained with stomach-flush method (LEGLER & SULLIVAN, 1979) from 75 specimens of Edible Frog (*Rana esculenta* complex) from the wetland of the Kis-Balaton Nature Reserves in Hungary. The stomach-flushing is a tactful method for the

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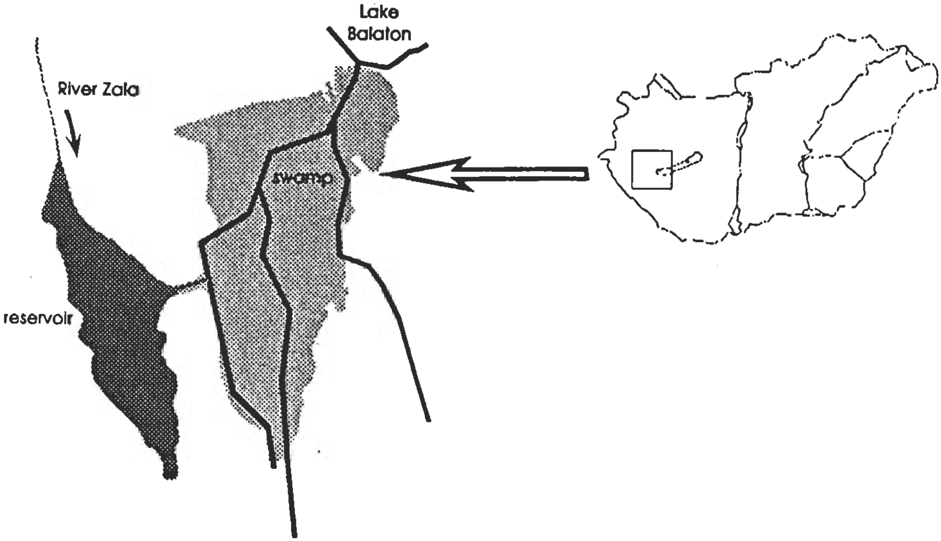

Fig. 1. Location of the investigated area

Table 1. List of spider species found in the stomach contents of Edible Frog (Rana esculenta complex) caught in Kis-Balaton Nature Reserves in Hungary in 1992

Rana esculenta complex	Indiv.	Diás Island	Reservoir	Babos Island
GNAPHOSIDAE	**4**	**1**	**3**	
Drassodes pubescens	2		2	
Haplodrassus silvestris	1		1	
Zelotes sp.	1	1		
CLUBIONIDAE	**28**	**10**	**15**	**3**
Clubiona spp.	8	2	4	2
Clubiona compta	3	2	1	
Clubiona pallidula	1		1	
Clubiona phragmitis	15	5	9	1
Agroeca sp	1	1		
ZORIDAE	**1**	**1**		
Zora sp	1	1		
THOMISIDAE	**8**	**4**	**2**	**2**
Xysticus spp.	4	1	1	2
Xysticus cristatus	1		1	
Xysticus lanio	1	1		
Xysticus ulmi	2	2		
SALTICIDAE	**1**	**1**		
Marpissa sp.	1	1		
LYCOSIDAE	**47**	**22**	**13**	**12**
Lycosida spp.	2	2		
Pardosa spp.	10	3	4	3
Pardosa amentata	1	1		
Pardosa lugubris	2	2		
Pardosa paludicola	1			
Pardosa prativaga	5	3		
Alopecosa spp.	3	2		1
Trochosa ruricola	3	1	2	
Arctosa spp.	3	2		
Arctosa cinerea	3	3		
Arctosa personata	1			1
Pirata spp.	10	3	5	2
Pirata piraticus	2		2	
Pirata tenuitarsis	1			1
ARGYRONETIDAE	**14**	**3**	**10**	**1**
Argyroneta aquatica	14	3	10	1
HAHNIIDAE	**2**	**2**		
Antistea elegans	2	2		
THERIDIIDAE	**4**	**2**	**1**	**1**
Dipoena sp.	1	1		
Enoplognatha sp.	1	1		
Enoplognatha mandibularis	1			1
Robertus arundineti	1		1	
TETRAGNATHIDAE	**7**	**5**	**1**	**1**
Tetragnatha pinicola	1			1
Pachygnatha clercki	2	1	1	
Pachygnatha degeeri	4	4		
ARANEIDAE	**9**	**2**	**6**	**1**
Araneida spp.	5	1	3	1
Larinioides cornutus	4	1	3	
LINYPHIIDAE	**15**	**5**	**8**	**2**
Linyphida spp.	8	3	3	2
Donacochara speciosa	2		2	
Erigone sp.	1		1	
Floronia bucculenta	1		1	
Microlinyphia impigra	1	1		
Oedothorax agrestis	1		1	
Walckenaeria sp.	1	1		
Spider specimens	**140**	**58**	**59**	**23**
Spider species	47	31	22	18
Investigated frogs (ind.)	75	25	34	16

amphibians, because they stay alive after the process. The stomach contents were preserved in metil-alcohol, then they were sorted in the laboratory and the spiders were determined under microscope by the author.

There are three investigated areas throughout the wetlands: *1*. Diás Island, surrounded surrounded rounded surrounded by undestroyed swamp; 2. along the shore of the large water reservoir (by Fekete Island), surrounded by reef beds and tufts; *3*. Babos Island, a meadow with poplar trees (Fig. 1). The spiders are from 25 specimens of frogs from the Diás Island, 34 from the shore of the reservoire and 16 from the Babos Island. Collecting was carried out at least once a month from April to September in 1992.

Results

Comparison of the present and the former results

In the present study we have found (in 1992) 140 specimens of spiders (belonging to 47 taxa from 12 families) found in stomachs of 75 Edible Frogs from the wetland of Kis-Balaton Nature Reserves.

In the material collected in 1984 only 9 exemplars of spiders (indet.) were observed from the stomachs of 47 Edible Frogs in the same area (Kis-Balaton Nature Reserves) (TÖRÖK & CSÖRGŐ, 1992). Publications covering different parts of Hungary (SZABÓ's collection, 1956-61) have mentioned 20 spiders (13 species belonging to 7 families) from 55 Edible Frogs (SZABÓ, 1957; TÖRÖK & CSÖRGŐ, 1992). There is no mention in the former papers about *Argyroneta aquatica*, the only spider species is living permanently in water. This species was present in the diet of *Rana esculenta* with a suprisingly high number (14 specimens) in 1992, especially near to the reservoir (10 specimens).

Comparison of the three collecting sites

There are some differences in the spider composition in the feed of Edible Frogs collecting in the three investigated sites. In total we found 140 spiders in the stomach-contents of the 75 anurans: 58 spiders from the Diás Island, 59 from the shore of the reservoire and 23 from the Babos Island. The list of the spider species can be seen in Table 1.

The differences in the spider family composition in the nutriment of Edible Frogs are represented on bar graphs (Figure 1). Most of the families (12) were found in frogs in the Diás Island, the least (8) was in frogs of the Babos Island. Lycosid and clubionid spiders were represented in the highest percentage in all three the sites but in different rates. The other spider families are present in dissimilar percentage. *Argyroneta aquatica* was found in all three collecting sites from the feed of anurans; the most (17%) by the reservoir. The web builder spider families (Theridiidae, Tetragnathidae /partim/, Araneidae and Linyphiidae) were also represented (about 25%) in the frog diet, not only the hunters.

Discussion

In this study we have found more spider specimens, species and families in the feed of the Edible Frog than were published in the former papers. We suspect that the diet of the anurans well reflects the invertebrate fauna living in an area, because the anurans are generalist feeders within the adequate size spectrum of the fauna (TÖRÖK & CSÖRGŐ,

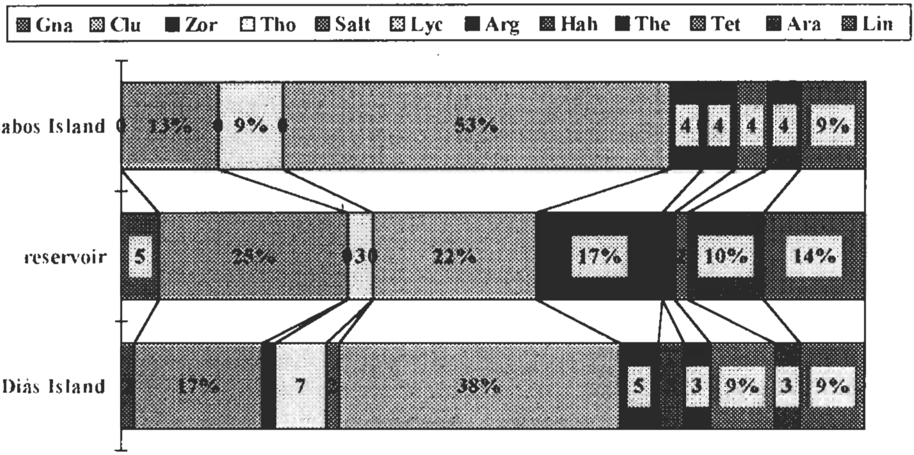

Fig. 2. Spider-family composition in the diet of Edible Frog found in three collecting sites in Kis-Balaton Nature Reserves, Hungary in 1992 – (Families: Gna = Gnaphosidae, Clu = Clubionidae, Zor = Zoridae, Tho = Thomisidae, Salt = Salticidae, Lyc = Lycosidae, Arg = Argyronetidae, Hah = Hahniidae The = Theridiidae, Tet = Tetragnathidae, Ara = Araneidae, Lin = Linyphiidae. Investigated frogs: Diás Island: 25, reservoir: 34, Babos Island: 16 specimens. Found spiders: Diás Island: 58, reservoir: 59, Babos Island: 23 specimens)

1992). The recent results show higher diversity of spider fauna in 1992 than it had been mentioned by the previous publications.

As for the distribution of the spider families in the diet of anuran communities, we have noted some differences among the collecting sites. The highest spider diversity was observed on the island (Diás Island) which was inside the undisturbed swamp. Lower diversity was along the shore of the reservoir, where the flora and fauna have been regenerated more or less after the technical intervention. The lowest spider diversity was observed on a relatively drier meadow (Babos Island).

It is not suprising that the families Clubionidae and Lycosidae occur in the highest proportions in all three places. These spiders are hunters and a large number of species lives in wetlands. It is interesting that the web builder spider families - like Theridiidae, Tetragnathidae in part, Araneidae and Linyphiidae - are also present in the frog diet in about 25 per cent. An other remarkable observation is the high number of *Argyroneta aquatica*, the only defintely aquatic spider. This spider was the part of the prey of anurans on every collecting site but in the largest percentage (17%) near the reservoir. Here is a peaceful part of water full with aquatic plants which is an ideal habitat for *Argyroneta aquatica.*

After all these results we gained data enabling us to monitor the coming changes in the wetland of the Kis-Balaton Nature Reserves.

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Distribution and coenotic composition of benthic testaceans (Protozoa, Rhizopoda) in the abandoned main channel of River Danube at Szigetköz (NW-Hungary)

By

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Abstract. Sediment inhabiting testaceans were examined from five sampling sites in the abandoned main channel of River Danube from the 1845.5th rkm to the 1813th rkm in three subsequent seasons (October 1995, April and August 1996). The main fields of interest were as follows: detecting the faunistic as well as the coenotic composition making qualitative and quantitative experiments and establishing the spatial distribution along the vertical core samples. The faunistic composition was characteristic to the aquatic sediment habitat. The sediment inhabitants were of low abundance, especially the active testaceans. Only 29 of the 70 identified species were seen alive. The mean proportion of the active cells was no more than 8% of the total. The testaceans inhabited the upper some centimeters, the majority was confined to the topmost 1-2 centimeters. Since this layer is being removed during floods, only temporary communities can be observed.

The main channel of River Danube at side river arm system Szigetköz has suffered considerable hydrological changes, which had serious effects on the riverbed. Presumably, the changes have also influenced the protozoan fauna of the sediment, though, due to the lack of former protozoological investigations in the River`s sediment till 1995, the only objective of the author remained to detect and follow the changes after the establishment of the bottom sill. This task was made more difficult owing to the sparse amount of literature referring to the benthic protozoans in running waters, with special regard to the really large rivers, like the Danube.

Generally, documentation of sediment inhabiting testaceans is plentyful (eg. PENARD, 1902; SCHÖNBORN, 1965, 1966, 1967; GOLEMANSKY, 1968; LAMINGER, 1971). Hungarian experts have studied the benthic testate amoebae of Lake Balaton (BERECZKY, 1973) and River Tisza (GÁL, 1961, 1970). Numerous studies on the subject have been carried out in the neighbouring countries (STEPANEK, 1967; OPRAVILOVA, 1980, 1993; ZIVKOVIC, 1975). GURVITS and DZJUBAN (1966) observed the microbenthos in the estuaries of Rivers Danube and Dnjeper, concluding that the species compositions in both rivers are fairly similar.

Quantitative researches into the microbenthos have been made by several authors (eg. BALDOCK and SLEIGH, 1988; FOISSNER, 1994; SCHMID-ARAYA, 1994). In general, quantitative investigations have been focused on the microbenthos of standing waters or narrow mountain streams of low water discharge. However, the qualitative and quantitative relations of the benthic testaceans in the lower reaches of a large river`s main channel have remained still unknown.

My recent job was to observe the qualitative and quantitative composition of the sediment inhabiting testacean communities in the main channel of River Danube

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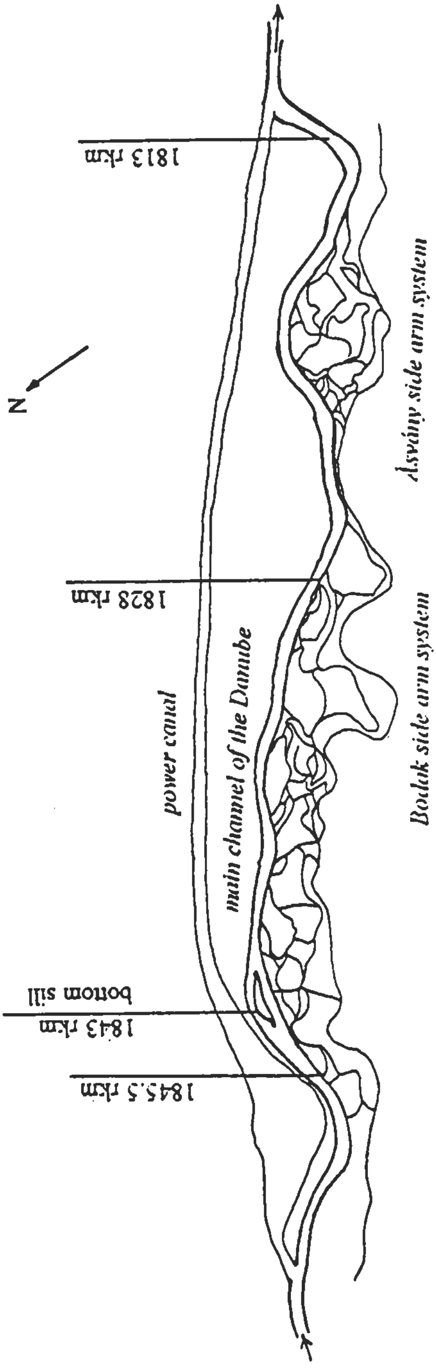

Fig. 1. Location of the sampling sites along the main channel of the Danube in Szigetköz

Table 1. The sampling sites. Upper: Characterization of the sites. Lower: Date of collectings and type of samples. (A_0: water/sediment interface; A,B: sediment layaers below A_0)

	Sampling site	Characteristics of the sampling site	Sediment type	Water depth
I.	1845.5 rkm	right side, directly below the beginning of the supply-channel	fine sand	2.5 m
II.	1843 rkm	right side, from the side of the bottom sill	gravel, sand	0.8 m
III.	1828 rkm "lake "	right side, "lake", isolated from the main channel	black sand	2 m
IV.	1828 rkm main channel	right side, main channel, close to a shallow	partially black, sand and mud	1 m
V.	1813 rkm	natural conditions, right and left sides	sand	1 m

		Date of collection	Type of vertical subsample
1	II	October 1995	no vertical subsamples
2	IV		- " -
3	I	April 1996	A_0, A, B
4	II		A_0, A, B
5	III		A_0
6	IV		A_0, A, B
7	V		A, B
8	I	August 1996	A_0, A, B
9	II		A_0, A, B
10	III		B
11	IV		A_0, A, B
12	V		A_0, A

river kilometers (rkms) 1845.5 and 1813. This section of the Danube was severely affected by the changes, through the dramatic fall of water discharge after the construction of the upstreams nearby beginning power canal of the Bős/Gabcikovo power plant in 1992, moreover, the establishment of the submerged dam at the 1843rd rkm in 1995 resulted in further decrease. There had been no information about the quality of the sediment in the area, whether it was suitable for the testate amoebae to inhabit it. Also the vertical and seasonal distribution of the testaceans were of great interest. Having all of these data may contribute to understand how the microbenthic fauna makes up after the significant hydrological changes. The present study introduces the results of the first three samplings.

Materials and methods

During the choice of the sampling areas the most important point of view was to follow the dynamics of the qualitative and quantitative changes in the testacean fauna.

In October 1995 preliminary study was carried out in order to mark out the proper sampling sites. Two of these sites proved to be suitable for further investigations, therefore the collected data are already involved in the article. Sampling took place at five different areas, for topological view see Fig. 1. The characteristics of the sites and the samples are given in Table 1.

Width of the main channel of the Danube between rkms 1846 and 1813 streches to 100-200 meters, respectively. Most parts of this river section represent the Hungarian-Slovakian border. Until 1992 mean water discharge fluctuated between 2000-3000 m^3/sec. The present mean water discharge is no more than 200-300 m^3/sec. In recent years explosive increase in the waterdischarge happened irregularly, resulting in a flood caused by the human regulation of the waterlevel of the power canal in the Slovakian side. In the latter case high waters of 1000-2000 m^3/sec maximum discharge flowed across the main channel, in order to exempt the power canal of the Bős/Gabcikovo power-plant (RÁKÓCZI, SASS, 1995). The main channel of the Danube at the investigated section was free from macrovegetation.

The first sampling site was situated at rkm 1845.5 right side of the river, just downstream to the beginning of the water recharge channel - opened by an artificial break through in 1993 - which supplies the side arm system with water since closing the main channel with the Dunacsún river barrage in 1992. The current velocity was relatively high, the bank was steep, the sediment probes were obtained from the crevices at about 0.8 m depth among the large stones supporting the bank. The second site was at rkm 1843, directly above the submerged dam, where the current velocity was significantly diminished by the latter. (The submerged dam was constructed in 1995 to increase the water discharge in the side arm system, which resulted in even less water in the main channel downstreams.) The current velocity in the 15 m region near to the right bank was quite low, the bottom was covered in sandy and to a lesser extent gravel sediment, generally exceeding 20 cm thickness. The bank was gently sloping towards the water. The next place was located at the 1828 rkm, comprising rather diverse conditions. Formerly the Kisbodak side branch flowed into the main channel at this point, but the mouth was closed in 1992. Three spur dikes were situated at the right bank, which caused the increased sedimentation among them especially after the fall of the water discharge. The final result was a small "lake" between two of the spur dikes having about 500 m^2 area, which became totally separated from the main channel by the large scale sediment deposition. This was the third sampling site. The lake had lost all connections with the main channel apart from the great floods, therefore the sediment made up from sand and mud became

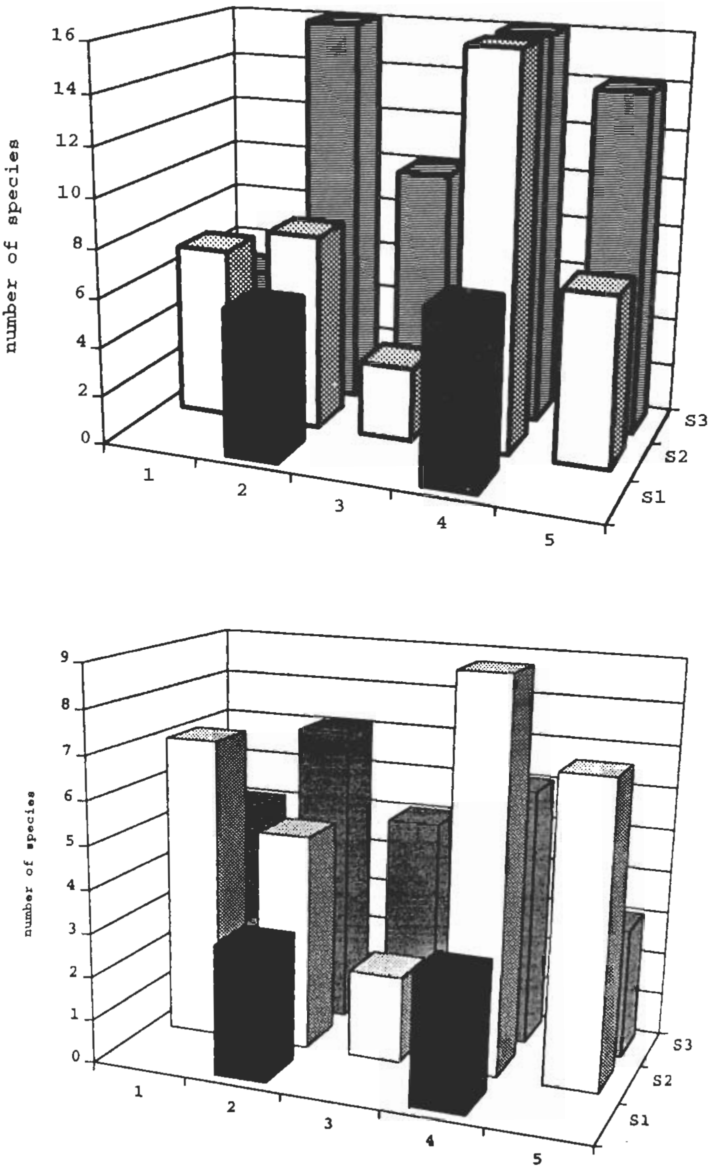

Fig. 2. Distribution of a) *Difflugia* spp., b) *Centropyxis* spp. according to the location and the date of sampling. (S_1, S_2 and S_3 correspond to the sampling times in October, April and August)

strongly anoxic if compared to the main channels sediment. The riverbed of the main channel has shrunk to almost half of the original (before 1992). Recently the originally coarse gravel bottom is being covered by muddy sediment along the right side. The fourth sample site was located here. The fifth site at the 1813rd rkm near the Ásvány branch comprised a so called "living" part of the main channel. This region had a higher waterlevel and discharge due to the reimpoundment caused by the vicinity of the outlet of the power canal, as well as upstreams the mouth of the Ásványi side branch meeting the main channel.

The samples were taken from the first four sites near the right side by snorkelling (for water depths see Table 1). At the last site, 1813 rkm, we used a boat to obtain samples, since otherwise we could not get to the area, furthermore the discharge and current velocity were too high. By means of this boat it was possible to take samples from a cross-section at the selected point.

A core-sampler modified after KAJAK was used to take samples. This equipment consisted of a 20x3.8 cm plastic tube which was inserted into a metall sampler. When taking samples from the boat, a long metallic rod of necessary length was fixed to the sampler. Afterwards the tubes were put into a cold chamber. In the laboratory the contens of the plastic tubes was cut into several vertical layers in order to establish the vertical distribution of the testaceans in the sediment. The thin 1-2 mm layer of the water/sediment interface (A_0) containing mainly detritus was pipetted from above. The rest of the sediment was separated letting out the sediment downwards, and getting the desired fractions, which were as follows (started from above): a 1-2 cm layer directly below the A_0 layer (called A), below 1-3 cm B layer, and the rest C layer. One part of the samples was observed alive, the other was fixed and stained after BERECZKY (1985).

The microscopic examination was carried out by direct observation and counting. This method seemed to be the most reliable. Other authors used dilution procedures at quantitative examination (FOISSNER, 1994; SCHMID-ARAYA, 1994). In the present study we assumed that dilution methods would serve misleading results on account of the extremely low abundance of specimens in the sediment.

Dominance and costancy values were calculated for each sampling series, the latter were clustered on the basis of the detected testacean species using the NCLAS program (PODANI, SYN-TAX, 1988; clustering method: simple average, distance function: Jaccard-formula), the result was represented on a dendrogram. Diversity of the sites was calculated using the Shannon-Weawer function.

Results

The metazoan fauna in the samples was made up of a low number of chironomid larvae, amphipods, rotifers, nematodes, tardigrades and bryozoan sporoblasts. The protozoan fauna consisted of flagellates, amoebae, testaceans, heliozoans and ciliates. Altogether 70 testacean species were identified (Table 2). First records in the Hungarian fauna were as follows: *Difflugia achlora*, *D. bicornis*, *D. bicruris*, *D. gassowskyi*, *D. minuta*, *D. urceolata olla* (Fig. 3). Majority of the species are considered to be aquatic, many of them consisting of xenosomes (eg. *Difflugia* and *Pontigulasia* spp.). The most numerous genus was *Difflugia* with 34 taxa, the following was *Centropyxis* with 12 ones. The distribution of *Difflugia* and *Centropyxis* species on the different sampling sites and periods are described in Fig. 2. 17 species occurred merely at one site, 14 of them were represented with only 1 specimen, two species were first records in the Hungarian fauna.

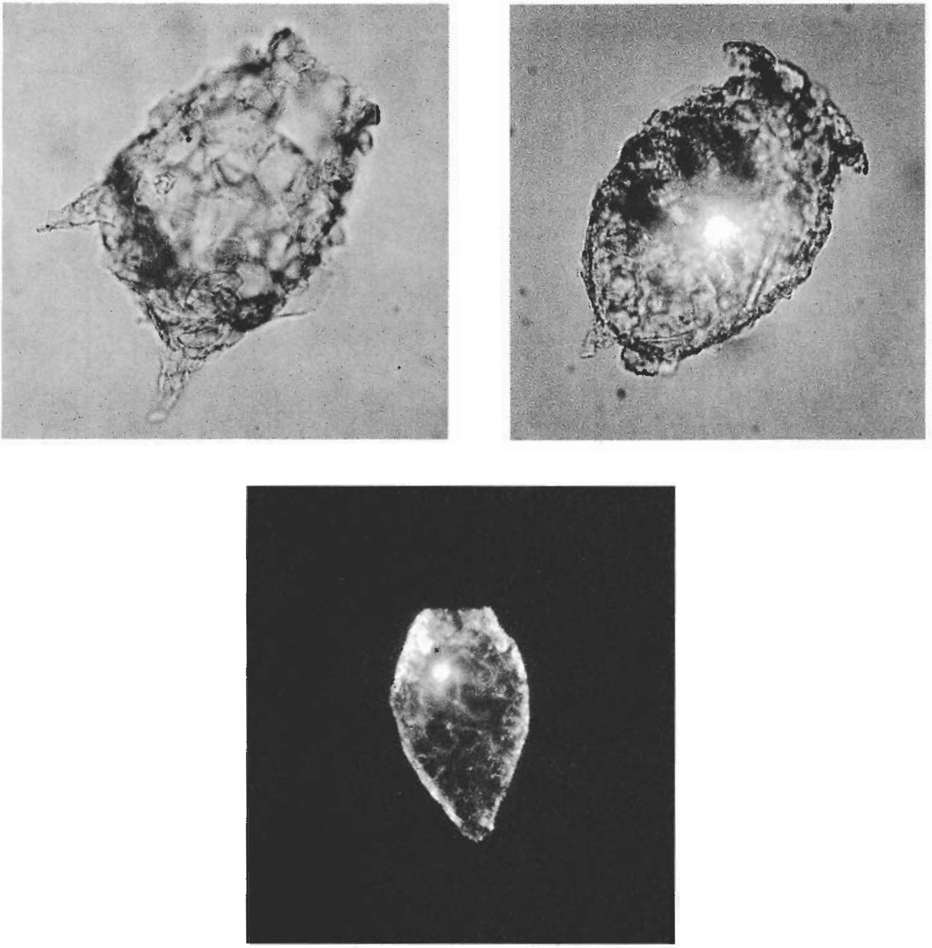

Fig. 3. a) *Difflugia bicornis* PENARD, first record in Hungary, b) *Difflugia urceolata olla* PENARD, first record in Hungary, c) *Difflugia mammillaris* PENARD, a fairly frequent species

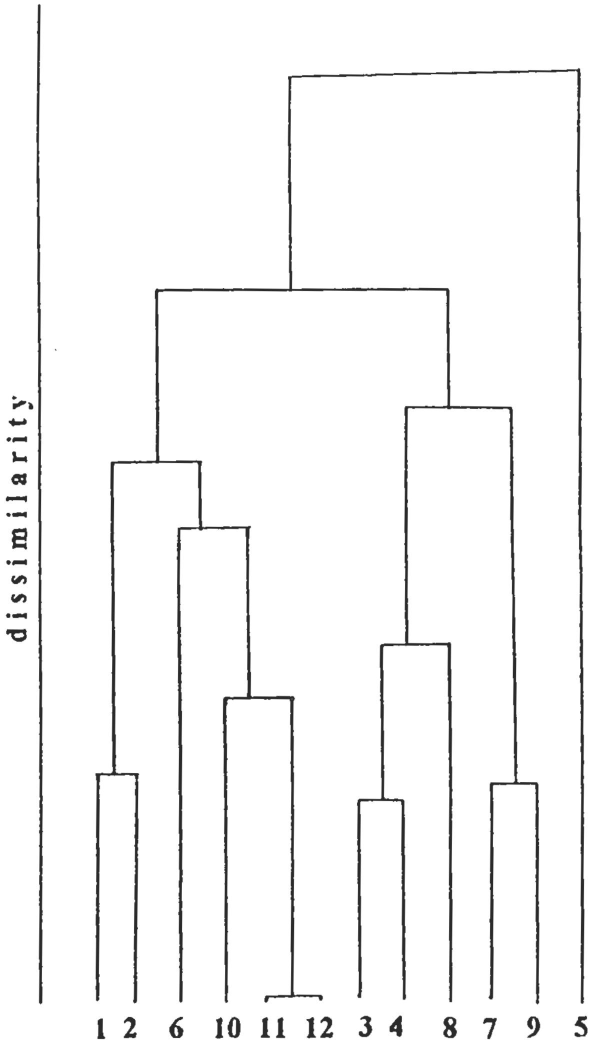

Fig. 4. Similarity of the units of the sample series on the basis of the faunistic composition

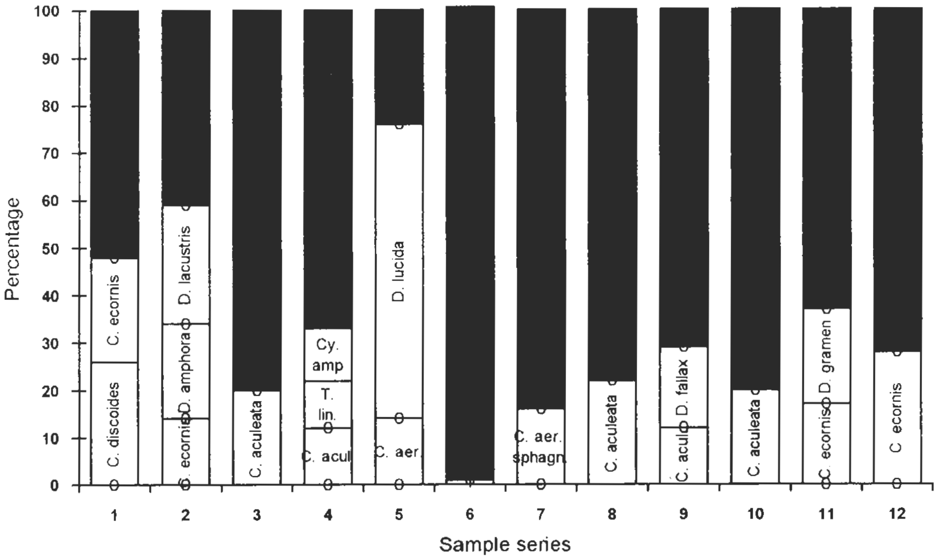

Fig. 5. Dominant species in the sample series

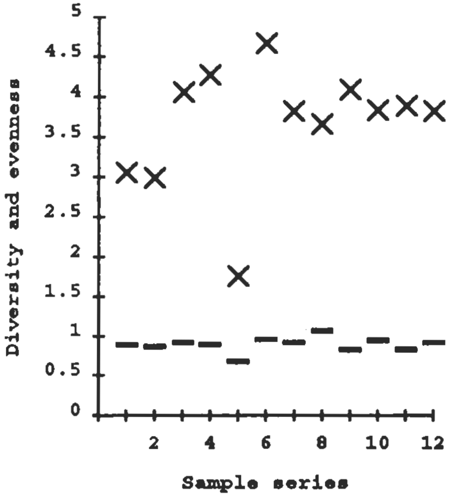

Fig. 6. Diversity and evenness values in the sample series

Fig. 4 shows the dendrogram of the sampling sites calculated on the basis of the resident testacean population.

Euconstant species present in at least 10 of the 12 sample series were as follows: *Centropyxis aculeata*, *C. discoides*, *C. ecornis*. Constant species, occurring at minimum 7 sites were *Arcella hemisphaerica*, *Difflugia amphora*, *D. elegans*, *D. mammilaris*. Distribution of dominant species - those comprising at least 10% of a community - are displayed on Fig. 5. *Centropyxis ecornis* and *C. aculeata* proved to be dominant in four sample series. The bulk of species of high dominance value were members of the genera *Difflugia* and *Centropyxis*. Numbers of dominant species per sample series fluctuated between 1 and 3. Fig. 6 shows the diversity and evenness values given for each sample series.

Proportion of active cells to empty shells was extremely low. All in all 29 species of the total 70 were observed alive, the living individuals made up only 8% of the total abundance. Occurrence of cysts was sparse. The three sample series, taken in autumn, spring and summer were slightly different regarding the presence of active cells: the number of species represented with living specimens was 18 in summer, 11 in autumn and 10 in spring.

The A_0 and A vertical layers were the richest regarding the number of active cells. The B layers were poorly inhabited, although empty shells were accumulated there in a large number. As a whole, A_0 and A layers provided the 77 % of the active cells, while the B only 23 % . The C layers did not contain any living specimens and the occurrence of empty shells was scattered.

Discussion

The species composition agrees well with those found by other authors. Majority of the species have already been found in other inland waters, such as Balaton and Tisza (BERECZKY 1973, GÁL, 1961). The numbers of species at the different sites were not really high: the mean number was 19, whereas STEPANEK (1967) found on the average 36 species in one sample site in the Vranov storage lake.

The detected Testacea fauna was unanimously aquatic. On the contrary, the composition of testacean fauna found by FOISSNER (1994) in Bavarian streams was similar in many features to that of wet mosses or soils. In case of the Danube there was no remarkable communication between the aquatic and terrestrial testacean fauna.

The sampling took place close to the river bank, where sediment deposition happened on the surface of the river gravel. The quality of the sediment was sandy or muddy. The present bank comprised a former part of the waterbed, the previous littoral zone being totally above the waterlevel today. The main channel of the Danube, as a wide river of great discharge and high current velocity, cannot be characterized by intensive sediment deposition as a rule. However, along the investigated length considerable sediment layer has formed. This phenomenon was a result of the decreased discharge, causing lower waterlevel, latter resulting in the loss of connections with the side arm system (RÁKÓCZI & SASS, 1995, 1997). The sediment load increased, in the vicinity of the bank in a 1 - 2.5 meters deep water more 10 cm thick sediment layer could be found. Where the streamline lied close to one of the banks, the reduced velocity on the other side forced the river to deposit its load forming shallows (eg. rkm 1828). These areas were rather of pool than riffle types. Only the streamline region preserved its original character, with the coarse gravel on the bottom, therefore core samples could not have been taken from that area (rkm 1813). Consequently, proper conditions were given to the testaceans to colonize the benthos in the investigated region.

Table 2. List of species in the different sample series. (1: one specimen only; 2: 1-3 individuals; 3: 4-9 individuals; 4: 10-20 individuals; 5: more than 20 individuals)

Species	1	2	3	4	5	6	7	8	9	10	11	12
Arcella discoides Ehr.								1				
A. excavata Cunningham								1				
A. hemisphaerica Perty			3	2		2	2	3	2	2		
A. vulgaris Ehr.			2									
Centropyxis aculeata Penard		2	3	3	3	3	3	4	3	3	4	3
C. aculeata oblonga Deflandre				2	2	3					3	
C. aërophila Deflandre			4	3	3			3		2	4	
C. aërophila sphagnicola Defl.			2	2		3	3	2	2			
C. constricta Deflandre						2	3	3	2		2	
C. discoides Deflandre	3	2		2		2	2		2	2	3	3
C. ecornis Leidy	3	3	3	2		2	2	2	2	2	3	3
C. elongata (Pen.) Thomas			1					2		2		
C. gibba Deflandre						2						
C. marsupiformis Deflandre	2					2						
C. orbicularis Deflandre							2	2				
C. platystoma (Pen.) Deflandre				2		3						
Cyclopyxis sp.					2			2				
C. arcelloides Deflandre			2	2			2					
Plagiopyxis intermedia Bonnet			2	2								
P. declivis Penard			3	2			2	3				
Difflugia achlora Ogden						2		2		2		
D. acuminata Ehr.											2	2
D. amphora Leidy	2	4		2	2	2					2	2
D. avellana Penard							2				2	2
D. bicornis Penard	2							2			3	2
D. bicruris Gauthier-L. & Thomas								1				
D. bryophila (Pen.) Jung							1					
D. corona Wallich	2	2				2				2	3	2
D. curvicaulis Penard	2	2				2		3			2	
D. curvicaulis inflata Decloitre							2			2	2	3
D. distenda Ogden	2		2					2	2	2		2
D. elegans Penard		2	2	2		2		3		2	3	2
D. elegans teres Penard								2			2	
D. fallax Penard			3					4				
D. gassowskyi Ogden		2				2	2					
D. gramen Penard				2		3		3			5	
D. lacustris Penard		2				2						2
D. lebes Penard						2				2	2	2
D. lemani Blanc							2		2		2	2
D. limnetica Levander						2				2	2	
D. linearis Gauthier-L.&Thomas										1		
D. lobostoma Leidy			2							2		2
D. lucida Penard					5			2				
D. mammillaris Penard			2	2		2	2	2	2		3	
D. manicata Penard						2			2			
D. microclaviformis Kourov						1						
D. oblonga Ehr.				2				2		2	2	
D. pristis Penard			2	2				2	2			
D. pulex Penard			1									
D. rubescens Penard								1				
D. scalpellum Penard							2	2			2	2
D. urceolata Carter	2	3	2			2						
D. urceolata olla Penard						2						2
Pontigulasia bigibbosa Penard		2									2	2
P. spectabilis Penard						2	2			2	3	
D. minuta Rampi				2	2	2		2				
Lesquereusia modesta Rhumbler											1	
Netzelia oviformis (Cash)						1						
Nebela dentistoma Penard			2					2				
N. retorta (Leidy) Stepánek				1								
Schoenbornia viscicula (Schönborn)			2									
Euglypha acanthophora Perty			3			2		2				
E. laevis Ehr.			2	2								
E. rotunda Wailes			1									
Trinema enchelys Leidy	2		2									
T. lineare Penard			4	2		2						
Cyphoderia ampulla Leidy	2		4	2				3				
C. laevis Penard			3									
Paulinella chromathophora Lauterborn			1									
Pseudodifflugia sp.								1				

that area (rkm 1813). Consequently, proper conditions were given to the testaceans to colonize the benthos in the investigated region.

There were several surveys referring to the distribution pattern of the benthic microfauna, including testaceans both in standing and running waters, nevertheless there was no literature about any running water of Danube size. BRETSCHKO (1991) demonstrated, that the river zoobenthos is not confined to the water/sediment interface exclusively, but also penetrates into the sediment, unless the low oxigen level or the lack of interstitial space obstructs it. Bretschko`s examinations showed out that 95 % of the zoobenthos in a second order alpine gravel stream was distributed in the upper 40 cm of the sediment. SCHMID-ARAYA (1994), investigating the same stream, involved also the testate amoebae, concluding that in riffle type areas about 50 specimens were detected in the topmost 5 cm layer, 120 specimens by 25 cm depth, and 240 specimens by 40 cm depth per 1 litre sediment. Much reduced occurrence was detected in the pool type areas. The Danube served with much contrasting evidences. Its sediment was rather sandy, sometimes muddy throughout the investigated area. The interstitial spaces got plugged by the fine sediment particles and the colmatation prevented the testaceans from penetrating the lower sediment layers below 1-2 cm from the surface. Moreover, some of the cores were almost black in appearence, suggesting the inside prevailing low oxigen level, which is not tolerable for testate amoebae.

The dendrogram, describing the similarity of the sampling series does not allow to make clear conclusions. The sampling series taken in October and August, appeared to be closer to each other than the April series. Latter can be explained by the sudden high water supply let into the main channel in that month. The vertical distribution of testaceans in our sampling series was restricted to the topmost 4 centimeters. However, the floods occurring regularly in the Danube mobilize the upper sediment layers, removing almost the whole community from the original habitat. The new community must form from the beginning. Two hypotheses may be set up for the recolonization. On one hand, the Testacea fauna can regenerate after each flood from individuals which were not carried along, but remained in refugia, like crevices of large stones etc. This way was not supported by the results shown on the dendrogram, because in most cases no remarkable resemblance existed among the 2-3 samples on the same sites. On the other hand, active testaceans may arrive from the upstreams removed sediment, which settle down together with the sediment particles.

The diversity values calculated for each sampling series were quite high, fluctuating around 3 and 4. The only exception was estimated in one of the the "lake" samples (no. 5), which was a really particular habitat, due to the total isolation from the main channel and the dominating low oxygen level. Regarding the rest of the matter, the diversity values were of the same order of magnitude, like those measured by OPRAVILOVA (1983) in the sediment of River Jihlava. Since the numbers of individuals in the Danube were rather restricted, the calculated values are a bit high, comparing to the reflected relations.

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Opusc. Zool. Budapest. XXIX–XXX. 1997

Revision der Gattung Aptodrilus Cognetti 1904 (Oligochaeta: Glossoscolecidae)

Von

A. ZICSI*

Abstract. Revision of the genus Aptodrilus Cognetti 1904. (Earthworms from South America, 27). After a revision of the morphological and anatomical characters, the genus *Aptodrilus* COGNETTI 1904 is resurrected. All the known species are characterized in details, furthermore 5 new species, *A. lacteus*, *A. tandajapaensis*, *A. griseus*, *A. loksai* and *A. chilesensis* are described.

In vorausgehenden Arbeiten (ZICSI 1988, 1990, ZICSI & CSUZDI 1988) haben wir uns bei der Bekanntmachung von Vertretern der Gattung *Aptodrilus* (*A. excelsus* COGNETTI 1904, *A. ruvidus* COGNETTI 1904, *A. uncinatus* MICHAELSEN 1910, *A. fuhrmanni* MICHAELSEN 1918) sowie der von uns beschriebenen Taxa (*baloghi* und *botari* ZICSI & CSUZDI 1988) der Ansicht MICHAELSENs (1936) angeschlossen und sie in der Gattung *Thamnodrilus* BEDDARD 1887, für die als Typusart *Th. gulielmi* BEDDARD 1887 bestimmt wurde, angeführt. Bereits MICHAELSEN (1910) erkannte an der sehr bescheidenen Zahl der Exemplare, die seinerzeit zur Beschreibung vorlagen, daß die zur Begrenzung von Arten herangezogenen Merkmale sehr beschränkt sind, so daß er vor der Wahl stand, entweder die bisher beschriebenen Arten zu vereinen oder sie in weitere Arten abzusondern. Das sehr reiche Material aus Kolumbien und Ekuador, die Serien von Populationen eines Fundortes ermöglichen es mir, die Begrenzung der einzelnen Arten mit Sicherheit durchzuführen bzw. für die Wissenschaft neue Arten zu beschreiben.

Für die Überlassung von Typenmaterial spreche ich Herrn Prof. Dr. M. DZWILLO, Zoologisches Institut und Museum der Universität, Hamburg, Herrn Dr. A. ROLANDO, Museo ed Istituto di Zoologica Sistematica della Università, Torino, sowie meinem Mitarbeiter Herrn Dr. CS. CSUZDI, der mir aus der Sammlung des British Museums, London, das Typenmaterial von *Th. gulielmi* zur Überprüfung mitbrachte, auch an dieser Stelle meinen besten Dank aus.

Bearbeitung des Materials

Aptodrilus COGNETTI 1904

1904 *Aptodrilus* COGNETTI, Boll. Mus. Torino 19(474): 15.
1906 *Rhinodrilus (Aptodrilus)* COGNETTI, Mem. Accad. Torino, 56(2): 226.
1910 *Rhinodrilus (Aptodrilus)* MICHAELSEN, Mitt. Mus. Hamburg, 27: 53.
1913 *Rhinodrilus (Aptodrilus* part.) MICHAELSEN, Mém. Soc. Neuchâtel, 5: 241.
1936 *Thamnodrilus* MICHAELSEN, Proc. Zool. Soc. London, 1121-23.
1988 *Thamnodrilus* ZICSI & CSUZDI, Opusc. Zool. Budapest, 23: 210.

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In der großen Sammelgattung *Thamnodrilus* BEDDARD 1887 sind nach der Revision der Typusart *Th. gulielmi* BEDDARD durch MICHAELSEN (1936) nur noch einige Arten mit 5-6 Paar Chylustaschen (Rispenschlauchtaschen), gelegen im 9., 10.-14. Segment, verblieben. Außer den in der Einleitung erwähnten Arten wurden von MICHAELSEN noch *Th. ohausi* MICHAELSEN 1918 und *Th. salathei* MICHAELSEN 1934 dieser Gattung zugefügt. Ohne das Typenmaterial dieser beiden Spezies gesehen zu haben, bin ich auf Grund der Überprüfung von *Th. gulielmi* der Meinung, daß die in Kolumbien und Ekuador verbreiteten, früher der Gattung *Aptodrilus* COGNETTI angehörenden Arten wieder in diese Gattung rückgestellt werden müssen.

Da vom Typenmaterial (Inv. Nr. BM(NH) 1904.10.5.273-280. 3 Ex.) noch verschiedene Teile und Organe nachbestimmt werden konnten (Dissepimente hinter dem Muskelmagen, Form und Struktur der Chylustaschen, Zahl der Samentaschen, Form und Struktur des Nephridien), kann mit Sicherheit angenommen werden, daß die Rückstellung von *Aptodrilus* gerechtfertigt ist. MICHAELSEN vereinte nämlich die beiden Gattungen auf Grund der Chylustaschenstruktur, die Rispenschlauchtaschen sein sollen. Ein Vergleich der Chylustaschenstrukturen von *gulielmi* mit denen der Typusart von *Aptodrilus* (*A. exelsus*) zeigen eine so große Abweichung, daß sie bloß auf Grund dieser in getrennt geführte Gattungen aufgenommen werden müssen (Abb.1-2). Außerdem weichen sie auch noch in der Zahl der Chylustaschen voneinander ab, da alle *Aptodrilus*-Arten konstant über 5 Paar dieser im 10.-14. Segment gelegenen Organe, verfügen, während *Th. gulielmi* 6 Paar dieser Organe besitzt. Ferner treten grundlegende Unterschiede noch in der Zahl der Samentaschen auf (bei *gulielmi* 1 Paar, bei den *Aptodrilus*-Arten 3 Paar). Die kennzeichnenden verdickten Dissepimente hinter dem Muskelmagen bei den *Aptodrilus*-Arten fehlen bei *gulielmi*. Die Verbreitung der beiden Artengruppen ist ebenfalls so verschieden (*Aptodrilus*-Arten kommen nur im Anden-Gebiet von Kolumbien und Ekuador, *Thamnodrilus*-Arten nur in Neu Guinea und Brasilien vor), daß eine Rückstellung der Gattung *Aptodrilus* auch aus diesem Gesichtspunkt berechtigt erscheint.

Diagnose. Normale Borsten in 8 Längslinien angeordnet, selten zerfallen sie am Körperende. Männliche Poren intraclitellial. Dissepimente hinter dem Muskelmagen verdickt. 5 Paar Chylustaschen im 10.-14. Segment, münden frei in die Leibeshöhle. Geschlechtsapparat holoandrisch und metagyn. Samensäcke im 11. und 12. Segment, Samentaschen vorhanden.

Typusart. *Aptodrilus excelsus* COGNETTI 1904

Bemerkung. Wie vorausgehend einwandfrei nachgewiesen werden konnte (ZICSI & CSUZDI 1988), hat sich die Typusart der Gattung *Aptodrilus* in der späteren Literatur falsch als *A. festae* COGNETTI 1904 eingebürgert (COGNETTI 1906 p.226, MICHAELSEN 1918 p.155). In der Originalbeschreibung wird *A. excelsus* als nov. gen., nov. spec. designiert und nicht *A. festae*. Für *A. festae* und ihren Artenkreis wurde eine gesonderte Gattung: *Onoreodrilus* ZICSI 1988 aufgestellt.

Aptodrilus excelsus COGNETTI 1904

1904 *Aptodrilus excelsus*, COGNETTI Boll. Mus. Torino, 19(474): 15
1906 *Rhinodrilus (Aptodrilus) excelsus*, COGNETTI Mem. Accad. Torino, 56(29 : 230
1918 *Aptodrilus excelsus*, MICHAELSEN Zool. Jb. Syst., 41: 161
1988 *Thamnodrilus excelsus* ZICSI & CSUZDI Opusc. Zool. Budapest 23: 216

Laut Originalbeschreibung lagen von 3 verschiedenen Fundorten (Cuenca 2580 m, Gualaceo 2320 m, Paredones 4042 m) Tiere zur Bestimmung vor. Es konnten zahlreiche

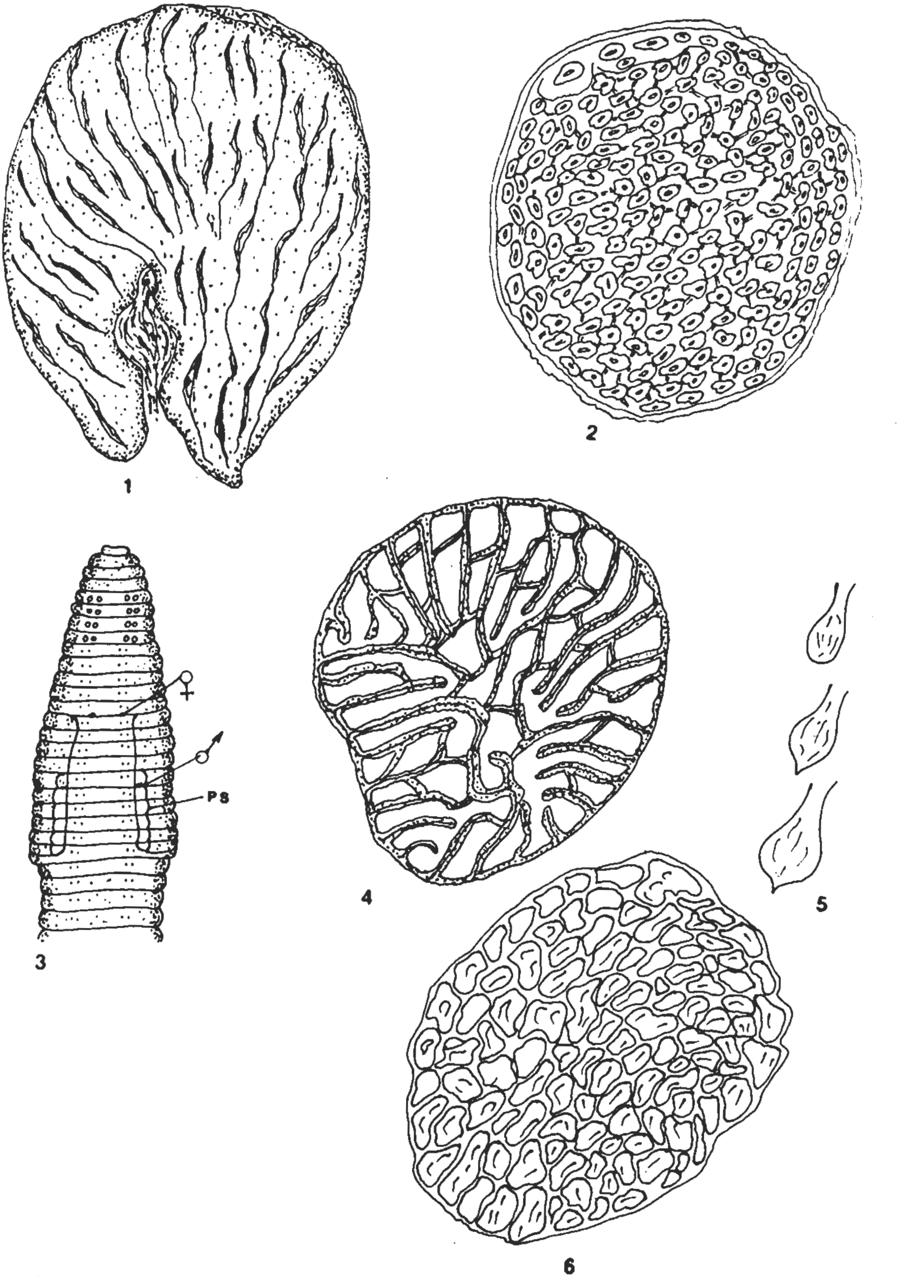


Abb. 1–6. 1. *Thamnodrilus gulielmi* BEDDARD 1887. Struktur der Chylustasche. – 2. *Aptodrilus excelsus* COGNETTI 1904. Struktur der Chylustasche. – 3-5. *Aptodrilus lacteus* sp. n. 3. Ventralansicht, PS = Pubertätsstreifen, 4. Struktur der Chylustasche, 5. Form der Samentaschen. – 6. *Aptodrilus ruvidus*. Struktur der Chylustasche

Exemplare aus Cuenca (OL 349) und ein Exemplare aus Paredones (OL 33) überprüft werden. Die aus Gualaceo stammenden Tiere lagen in der Sammlung von Torino nicht vor. Ebenfalls nachbestimmt wurde das aus der Sammlung von Hamburg vorliegende, von COGNETTI an MICHAELSEN zugesandte Exemplar (ZICSI und CSUZDI 1988), ohne jedoch zu wissen, von welchem Fundort es stammt. Das reiche Typenmaterial aus Cuenca ermöglichte einen Vergleich der variierenden Merkmale, die vorwiegend die Lage des Gürtels und die der Pubertätsstreifen betrafen. Die Ausdehnung der Pubertätsstreifen vom 20.-23. Segment, wie dies in der Originalbeschreibung angegeben wird, konnte nicht bestätigt werden. Obwohl das Verfolgen dieses Merkmales bei einigen Exemplaren wegen undeutlicher Ausbildung und Veralterung des Materials auf Schwierigkeiten stößt, konnte mit Hilfe von neuerem Material vom Locus typicus eindeutig erkannt werden, daß die Pubertätsstreifen vom 1/2 19., 19.–23., 1/4 24., 1/2 24. Segment reichen. Der Gürtel erstreckt sich vom 1/2 14., 14., 15.–1/2 23., 23. Segment. Im Typenmaterial, aber auch in unserem Material kommen bedeutende Größenunterschiede vor. So beträgt die Länge 50-190 mm, Dicke 7-10 mm, Segmentzahl 69-170. Geschlechtsborsten konnten am Vorderkörper erkannt werden, hier ist die Länge 1,06 mm, Durchmesser 0,04 mm, Zahl der Kerben 11-12. Am Gürtel sind die Borsten nur mit 6-7 Kerben versehen und besitzen auch einen Nodulus. Mitteldarm im 17., Typhlosolis im 27. Segment beginnend. Nephrostom des Nephridialorganes einfach ausgebildet. Unter Inv. Nr. OL 34/a wird ein von COGNETTI geöffnetes Tier als Lectotypus designiert.

Fundorte. Ekuador. Prov. Canar. AF/1155 13+15 juv. Ex., 16 km hinter Cuenca, 2500 m, Wiese, 26. 4. 1988 leg. ZICSI & CSUZDI. - AF/2188 3+4 juv. Ex., zwischen El Tambo und Zhud, 84 km von Cuenca, 3000 m, 4. 5. 1988 leg. ZICSI & CSUZDI. - AF/2186 13+10 juv. Ex., hinter Biblian, 36 km von Cuenca, Wiese, 2600 m, 4. 5. 1988 leg. ZICSI & CSUZDI. - Prov. Azuay. AF/2190 5+4 juv. Ex., über Gualaceo in Richtung Sigsig, 34 km von Cuenca, Wiese, 2200 m, 3. 5. 1988 leg. ZICSI & CSUZDI. - AF/2191 3 Ex., hinter Cordeleg, 39 km von Cuenca, 2300 m, 3. 5. 1988 leg. ZICSI & CSUZDI.

Aptodrilus botari (ZICSI & CSUZDI 1988)

1988 *Thamnodrilus botari*, ZICSI & CSUZDI Opusc. Zool. Budapest 23: 214

Bei dieser Art sind die Größenunterschiede noch bedeutender als bei A. *excelsus*. Außer Exemplaren, die dem Typenmaterial von 1988 nahestehen, sind Tiere angetroffen worden, die auch eine Größe von 290 mm und eine Dicke von 18 mm am Gürtel erreichen und eine Segmentzahl von 180-190 besitzen. Der Gürtel erstreckt sich bei den großen Formen konstant auf das 15.– 3. Segment, die Pubertätsstreifen liegen auf dem 1/2 19.–1/2 25. Segment. Die Struktur der Chylustaschen zeigt vereinzelt auch rein runde Gebilde im Querschnitt wie bei A. *excelsus*, ansonsten sind sie wie bei den kleinen Formen. Geschlechtsborsten der kleinen Formen vor dem Gürtel auf dem 6.–10. Segment sind 0,77 mm lang, 0,04 mm dick und mit 5 Kerben versehen, die der großen Formen sind 1,16 mm lang, 0,40 mm dick und haben 12 Kerben. Da nur in der Größe Unterschiede zwischen den beiden Formen bestehen, werden die letzteren nicht als eine gesonderte Unterart beschrieben. Mitteldarm im 17., Typhlosolis im 27. Segment beginnend.

Fundorte. Ekuador. Prov. Cotopaxi. AF/2143 9 Ex., vor El Tingo, 34 km von La Mana entfernt, 1300 m, 23. 4. 1990 leg. ZICSI & CSUZDI & GAVILANES. - AF/2145 19 Ex., hinter El Tingo, beim Dorf Macuchi, Wiese, 1700 m, 23. 4. 1990 leg. ZICSI & CSUZDI & GAVILANES. - AF/2147 4+1 juv. Ex., vor El Tingo, 32 km von La Mana, 23. 4. 1990 leg. ZICSI & CSUZDI & GAVILANES. - AF/2148 11 praead. Ex., hinter Pilalo, 54 km von La Mana, 2920 m, 23. 4. 1990 leg. ZICSI & CSUZDI. - AF/2149 4 + 8 juv. Ex., hinter Pilalo, 51 km von La Mana, 2650 m, 23. 4. 1990 leg. ZICSI & CSUZDI. - AF/2150 7 Ex., hinter Pilalo, 32 km von La Mana, 3250 m, 23. 4. 1990 leg. ZICSI & CSUZDI. - AF/2153 4+7 juv. Ex., 81 km von Latacunga, in Richtung La Mana, 3600 m, 24. 4. 1990 leg. ZICSI & CSUZDI & GAVILANES. - Prov. Bolivar. AF/2181 7 Ex., Talahua, 3000 m, 3. 4. 1990 leg. ONORE. - AF/2193 Cajas, Park, 3200 m, 11. 1988 leg. ONORE.

Aptodrilus lacteus sp. n.

Von dieser neuen Art liegen mehrere gut erhaltene und geschlechtsreife Tiere von verschiedenen Fundorten vor.

Holotypus. Länge 80 mm, Breite 6 mm, Segmentzahl 94. Paratypen. Länge 70-110 mm, Breite 6-7 mm, Segmentzahl 90-24.

Farbe milchweiß, unpigmentiert. Kopf fingerförmig eingezogen. 1.-2. Segment verwachsen. Segmente bis zum 10. Segment ungeringelt, von da doppelt geringelt. Borsten am ganzen Körper gepaart, in 4 Längsreihen verlaufend. Borstenverhältnis hinter dem Gürtel aa: ab: bc: cd: dd wie 10: 1,5: 5: 1: 30. Borsten ab des 6.–9. Segmentes von kleinen Papillen umgeben, Borsten zu Geschlechtsborsten umgewandelt. Im Inneren sind hier große Drüsenpölster vorhanden, in denen 2 Paar kleine und eine große Geschlechtsborste steckt. Länge der großen Borste 0,87 mm, Breite 0,081 mm, mit 9-10 Kerben ornamentiert. Die kleinen Borsten, wo nur der vordere, mit 10 Kerben versehene Teil vorhanden ist, haben eine Länge von 0,25 mm, Durchmesser 0,067 mm.

Gürtel sattelförmig auf dem 15.–1/2 24. Segment, breite Pubertätsstreifen vom 19., 1/2 19.–3/4 24., 24. Segment (Abb.3). Weibliche Poren auf dem 14. Segment, männliche Poren auf Intersegmentalfurche 19/20.

Innere Organisation. Dissepimente 6/7–10/11 etwas verdickt, 11/12 nur schwächer angedeutet. Schlund bis zum 4. Segment reichend. Oesophagus vor dem Muskelmagen, nicht von Schlunddrüsen umgeben. Muskelmagen im 6. Segment, zwiebelförmig, sehr groß. Lateralherzen im 7.–9. Segment. Intestinalherzen im 10. u. 11. Segment, sind mit dem suboesophagealen Blutgefäß in Verbindung. Hoden und Samentrichter im 10. u. 11. Segment, in oesophageale Testikelblasen eingeschlossen, die ventral miteinander in Verbindung stehen. Samensäcke im 11. u. 12. Segment, die des 11. Segmentes häufig bedeutend kleiner als die des 12. Segmentes. Ovarien im 13. Segment, sehr kleine Gebilde. Fünf Paar Chylustaschen im 10.–14. Segment, seitlich am Oesophagus angeheftet, ragen frei in die Leibeshöhle. Sie sind am Ende nicht abgeschnürt, sondern rund angeschwollen. Es sind Rispenschlauchtaschen, die z.T. rund sind, aber auch eine etwas verzogene Struktur besitzen (Abb. 4). Mitteldarm im 17., Typhlosolis im 27. Segment beginnend.

Nephridien mit großen Nephridialblasen, Nephrostom normal ausgebildet. Samentaschen im 7.–9. Segment, kleine herzförmige oder längliche Gebilde mit kurzem Ausführungsgang (Abb.5).

Die neue Art unterscheidet sich von allen Arten der Gattung durch die Form der Samentaschen und durch die Zahl der Geschlechtsborsten vor dem Gürtel.

Fundorte. Holotypus. Prov. Canar. AF/2941 zwischen El Tambo und Zhud, 84 km von Cuenca entfernt 3000 m, 4.5. 1988 leg. ZICSI & CSUZDI. - Paratypen. AF/2187 7 Ex., Fundort wie beim Holotypus. - AF/2189 17 Ex., 12 km vor El Tambo, 3100 m, 25. 4. 1988 leg. ZICSI & CSUZDI. - Prov. Cotopaxi. AF/2151-52 6+5 juv. Ex., 83 km von Latacunga in Richtung La Mana, 3400 m, 24. 4. 1940 leg. ZICSI & CSUZDI.

Aptodrilus ruvidus COGNETTI 1904

Aptodrilus ruvidus, COGNETTI 1904 Boll. Mus. Torino 19 (474) : 16
1906 *Rhinodrilus (Aptodrilus) ruvidus*, COGNETTI Mem. Accad. Torino 56 (2): 57
1918 *Aptodrilus ruvidus*, MICHAELSEN Zool. Jb. Syst. 41: 161

Unter Inv. Nr. OL 31 werden in der Sammlung von Torino mehrere juvenile und adulte Tiere dieser Art aufbewahrt. Letztere sind aufgeschnitten und zerschnitten, so daß die Merkmale nur teilweise nachbestimmt werden konnten. Es handelt sich vorwiegend um die tief in der Muskelwand verborgenen Samentaschen, die bei einer Nachbestimmung erkannt werden müßten. Es ist mir nicht immer einwandfrei gelungen, die Samentaschen zu erkennen. Durch die tief in der Muskelwand verborgenen Samentaschen weicht sie von allen anderen Arten der Gattung ab. Die Samensäcke des 11. Segmentes sind winzig klein. Der Gürtel erstreckt sich bei einigen Tieren nur bis ins 1/2 22. Segment, sonst reicht er bis ins 23. Segment. Die Pubertätsstreifen verlaufen vom 1/2 19.–23., 1/2 24. Segment. Die Struktur der Chylustaschen wird in Abb. 6 veranschaulicht, es sind etwas verzogene Rispenschlauchtaschen. Mitteldarm im 17., Typhlosolis im 27. Segment beginnend.

Fundorte. Prov. Carchi. AF/1955 1 Ex., Tulcan leg. VAN LIPPKE. - AF/1958-59 2 Ex., Tulcan, 28. 12. 1986 leg. MEDINA. - AF/1957 3 Ex., Chiles Vulkan 4000 m, oberhalb Tufino, 8. 5. 1990 leg. ZICSI & CSUZDI.

Aptodrilus tandajapaensis sp. n.

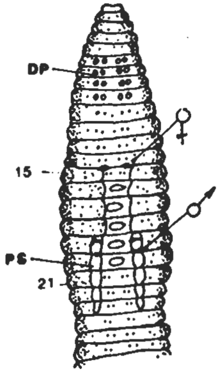
Von dieser Art liegen zwei adulte, etwas erweichte Exemplare vor.

Holotypus. Länge 80 mm, Breite 5 mm, Segmentzahl 108. Paratypus. Länge 67 mm Breite 5 mm, Segmentzahl 70.

Farbe grau, unpigmentiert. Kopflappen eingezogen, 1.–2. Segment verwachsen, 2. Segment mit Längsfurchen dicht besetzt. Segmente am Vorderkörper ungeringelt, hinter dem Gürtel nur undeutlich doppelt geringelt. Borsten am ganzen Körper eng gepaart. Borstenverhältnis hinter dem Gürtel aa: ab: bc: cd: dd wie 15: 1,3: 5,3: 1: 33. Borsten ab vom 7.–10. Segment von kleinen runden Papillen umgeben. Im Inneren sind diese von dunkelbraunen Drüsenzellen umgeben, in denen die Geschlechtsborsten liegen. Länge dieser Borsten 0,63 mm, Durchmesser 0,038 mm, mit 4-5 Kerben ornamentiert.

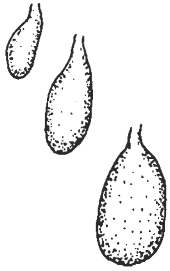
Gürtel sattelförmig vom 15.–21. Segment. Pubertätsstreifen vom 1/2 19.–23. Segment. Weibliche Poren auf dem 14. Segment hinter der Borstenlinie ab. Männliche Poren auf Intersegmentalfurche 19/20 (Abb. 7).

Innere Organisation. Dissepimente 6/7–10/11 schwach verdickt, aber deutlich zu erkennen. Schlund bis ins 4. Segment reichend. Muskelmagen im 6. Segment. Lateralherzen im 7.–9. Segment. Intestinalherzen im 10. u. 11. Segment mit dem suboesophagealen Blutgefäß verbunden. Chylustaschen im 10.–14. Segment, am Ende etwas verengt, doch nicht abgeschnürt, es sind Rispenschlauchtaschen von fjordförmigem Aussehen (Abb.8). Hoden und Samentrichter im 10. u. 11. Segment in oesophageale Testikelblasen eingeschlossen, die ventral miteinander verbunden sind. Samensäcke im 11. u. 12. Segment, die im 11. Segment sehr klein, die im 12. Segment sehr große lappenförmige Gebilde. Ovarien im 13. Segment winzig klein. Mitteldarm im 17., Typhlosolis im 27. Segment.

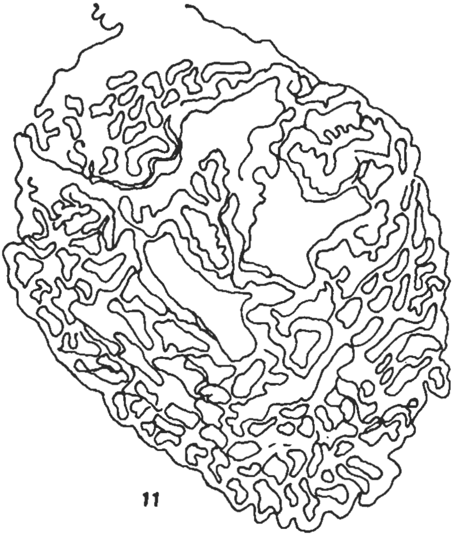


7

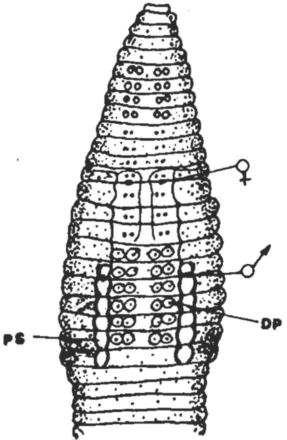
8



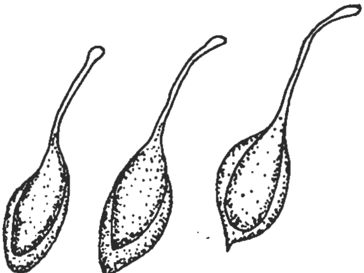
9



11



10



12

Abb. 7–12. 7-9. *Aptodrilus tandajapaensis* sp. n. 7. Ventralansicht, DP = Drüsenpapillen, PS = Pubertätsstreifen, 8. Struktur der Chylustasche, 9. Form der Samentaschen. – 10 -12. *Aptodrilus griseus* sp. n. 10. Ventralansicht, DP = Drüsenpapillen, PS = Pubertätsstreifen, 11. Struktur der Chylustasche, 12. Form der Samentaschen

Samentaschen im 7.–9. Segment, sehr kleine sackförmige Gebilde mit kurzem Ausführungsgang, Ampulle birnenförmig plattgedrückt, ohne Samenmassen (Abb. 9).

Die Samentaschenform erinnert an die von *A. ruvidus*, ist aber etwas größer und nicht in der Muskelwand verborgen.

Die neue Art steht *A. baloghi* durch die Lage des Gürtels, *A. ruvidus* in der Form der Samentaschen am nähesten. Von *A. baloghi* unterscheidet sie sich durch die Form der Samentaschen, von *A. ruvidus* durch die Lage des Gürtels.

Fundort. Holotypus. Prov. Pichincha. AF/2943 Tandajapa, 5.12. 1986 leg. RIVOS. - Paratypus. AF/2107 1 Ex., Fundort wie beim Holotypus.

Aptodrilus griseus sp. n.

Von dieser Art, deren Borsten am Körperende zerfallen sind (Quinkunx Stellung), liegen zahlreiche Exemplare vor.

Holotypus. Länge 90 mm, Breite 8 mm, Segmentzahl 136. Paratypen. Länge 70-95 mm, Breite 6-7 mm, Segmentzahl 120-145.

Farbe grau. Kopf eingezogen, prolobisch. 1.–2. Segment verwachsen. Segmente bis zum 10. Segment ungeringelt, von da doppelt, hinter dem Gürtel mehrfach geringelt. Borsten vor dem Gürtel gepaart, hinter dem Gürtel, dem Körperende zu, zerfallen die Reihen. Borstenverhältnis gleich hinter dem Gürtel aa: ab: bc: cd: dd wie 12: 1,6: 5: 1: 28. Borsten ab des 7.–10. Segmentes auf kleinen Papillen zu Geschlechtsborsten verwandelt. Länge der Borsten 0,45 mm, Durchmesser 0,03 mm, Zahl der Kerben cca. 12-13. Samentaschenporen auf Intersegmentalfurche 6/7–8/9 in der Borstenlinie cd. Nephridialporen in der Borstenlinie cd.

Gürtel beinahe ringförmig vom 1/4 14.–1/4 24. Segment, Pubertätsstreifen vom 1/2 19.–24. Segment. Ventralseite vom 18.–23. Segment stark drüsig, nur ein dünner Streifen nicht drüsig. Weibliche Poren auf dem 14. Segment zwischen der Borstenlinie ab. Männliche Poren auf Intersegmentalfurche 19/20 (Abb. 10).

Innere Organisation. Dissepimente 6/7–10/11 verdickt, 11/12 schwach angedeutet. Schlund bis ins 4. Segment reichend. Muskelmagen im 6. Segment. Lateralherzen im 7.-9. Segment, Intestinalherzen im 11. u. 12. Segment mit dem suboesophagealen Blutgefäß verbunden. Hoden und Samentrichter im 10. u. 11. Segment in oesophageale Testikelblasen eingeschlossen. Die Testikelblasen eines Segmentes sind ventral miteinander verbunden. Chylustaschen im 10.–14. Segment, ventral an den Oesophagus angeheftet, münden frei in die Leibeshöhle. Am Ende sind die Chylustaschen nicht abgeschnürt, nur etwas zugespitzt oder rund. Es sind Rispenschlauchtaschen mit verzogener Struktur (Abb. 11). Ovarien im 13. Segment. Mitteldarm im 17., Typhlosolis im 27. Segment mit einer sehr breiten Lamelle beginnend. Nephridien mit Nephridialblasen vom 14. Segment beginnend, Nephrostom normal ausgebildet.

Samentaschen im 7.–9. Segment, mit langem, dünnem Ausführungsgang und plattgedrückter runder Ampulle (Abb. 12).

Die neue Art steht der *A. loksai* sp. n. durch die zerfallene Borstenanordnung am Körperende am nähesten, unterscheidet sich von ihr durch die Lage des Gürtels und der Pubertätsstreifen und durch die Lage der Geschlechtsborsten und deren Kerbenzahl.

Fundorte. Holotypus. Prov. Bolivar. AF/2940, Cascha-Totoras, 3200 m, 2. 4. 1987 leg. ZICSI & LOKSA. - AF/2183-84 11 + 4 juv. Ex., Fundort wie beim Holotypus.

Aptodrilus loksai sp. n.

Von einer weiteren Art mit zerfallener Borstenanordnung am Hinterkörper liegen mehrere adulte Exemplare vor.

Holotypus. Länge 100 mm, Breite 6 mm, Segmentzahl 144. Paratypen. Länge 90-95 mm, Breite 5,6-6 mm, Segmentzahl 135-137.

Farbe weißlichgrau, unpigmentiert. Kopf fingerförmig eingezogen. 1. und 2. Segment gefurcht, 4.–9. Segment ungeringelt, vom 10.–11. Segment doppelt geringelt, vom 12.–14. mehrfach geringelt. Borsten am Vorderkörper ab weitläufig, cd eng gepaart. Borsten am Hinterkörper zuerst weitläufig gepaart, dann zerfallen die Borstenreihen. Borsten ab vom 7.–13. und die vom 16.–19. Segment von kleinen Papillen umgeben, zu Geschlechtsborsten verwandelt. Länge der Borsten 0,58-0,60 mm, Durchmesser 0,032 mm, Zahl der Kerben bis ungefähr 9. Die Borsten ab des 20.–22. Segmentes ebenfalls auf drüsigen Erhebungen, doch nicht zu Geschlechtsborsten verwandelt. Samentaschenporen auf Intersegmentalfurche 6/7–8/9 in der Borstenlinie cd.

Gürtel sattelförmig vom 15.–1/2 22. Segment, nur ein kleiner Streifen geht auf der Dorsalseite auf 1/2 22 über. Pubertätsstreifen vom 1/2 19.–1/4 24. Segment. Weibliche Poren auf dem 14. Segment, in der Borstenlinie b. Männliche Poren auf Intersegmentalfurche 19/20 (Abb. 13).

Innere Organisation. Dissepimente 6/7–9/10 sehr stark, 10/11 mäßig stark, die übrigen nicht verdickt. Schlund bis ins 4. Segment reichend. Muskelmagen im 6. Segment. Lateralherzen im 7.–9. Segment, Intestinalherzen im 10. u. 11. Segment. Suboesophageales Blutgefäß vorhanden. Chylustaschen im 10.–14. Segment mit deutlich abgeschnürtem Kopfteil. Es sind Rispenschlauchtaschen mit fjordförmiger Struktur (Abb. 14). Hoden und Samentrichter in oesophageale Testikelblasen eingeschlossen, sie sind ventral miteinander verbunden. Ovarien im 13. Segment, Mitteldarm im 17., Typhlosolis im 27. Segment beginnend. Nephridialblasen vom 14. Segment vorhanden.

Samentaschen im 7–9. Segment, Ampulle löffelförmig mit sehr langem, dünnem Ausführungsgang (Abb. 15).

Die neue Art steht *A. griseus* sp. n. am nähesten. Sie unterscheidet sich von ihr in der Lage des Gürtels und der Pubertätsstreifen; von *A. baloghi* durch den Zerfall der Borsten am Körperende.

Die neue Art wird zu Ehren meines lieben Freundes und Kollegen, des verstorbenen Herrn Doz. Dr. I. LOKSA zum Andenken an die gemeinsamen Sammlungen in Ekuador benannt.

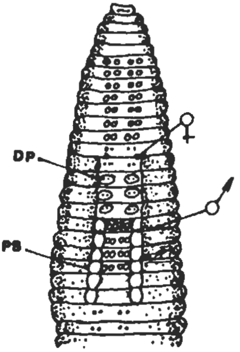
Fundort. Holotypus. Prov. Pichincha. AF/2937 10 km vor Lloa aus der Richtung vom Rio Blanco 2950 m, 29. 4. 1989 leg. ZICSI & LOKSA & DE VRIES. - Paratypen. AF/2938 2 Ex., Fundort wie beim Holotypus. - Prov. Imbabura. AF/1965 6+3 Ex., 37 km von Otavalo in Richtung Apuela, 2750 m, 7. 5. 1990 leg. ZICSI & CSUZDI.

Aptodrilus baloghi ZICSI & CSUZDI 1988

Von dieser am häufigsten angetroffenen Art liegen uns sehr zahlreiche Exemplare vor. Die Ausdehnung des Gürtels bei adulten Tieren vom 15.–1/2 21., 21. Segment ist ein konstantes Merkmal, so auch die Lage der Pubertätsstreifen vom 1/2 19.–1/2 24. Segment. Ganz selten ist auch ein dünner Streifen auf der Dorsalseite des Gürtels auf dem 22. Segment noch verdickt. Die Borsten ab des 7.–10. Segmentes sind zu Geschlechtsborsten verwandelt und von kleinen runden Papillen umgeben. Länge der Borsten 0,63 mm, Durchmesser 0,04 mm, Zahl der Kerben 6-7. Auf dem Gürtel sind die ab Borsten des 17. und 18. Segmentes zu Geschlechtsborsten verwandelt, sie sind 0,63 mm lang. Durchmesser 0,05 mm. Zahl der Kerben 4-5. Nodulus vorhanden.

Form der Nephridien in Höhe des Mitteldarmes bei allen Arten dieser Gattung ziemlich gleich ausgebildet, eine Abbildung dieser wird bei *A. baloghi* angeführt (Abb. 16). Mitteldarm im 17., Typhlosolis im 27. Segment beginnend.

Fundorte: Prov. Imbabura. AF/1958 5 Ex., von Otavalo in Richtung Mojanda Laguna 3350 m, Paramo Vegetation, Braunerde, 19. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/1962 29+16 juv. Ex., von Otavalo in Richtung Mojanda Laguna, 3700 m, Paramo Schwarzerde, 19. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/1981 1 Ex., 30 km von Otavalo in Richtung Otocique, 3250 m, Paramo-Vegetation, 20. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/1982 1 Ex., 53 km von Otavalo in Richtung Apuela, 2850 m, Regenwald, 20. 4. 1989 leg. Zicsi & Loksa.- AF/1961 1 Ex., 39 km von Otavalo in Richtung Apuela, Tablachupa, 3350 m, Paramo-Schwarzerde, 20. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/1983 1 Ex., 43 km von Otavalo in Richtung Apuela, 3200 m, Mooswald, 20. 4. 1989. leg. Zicsi & Loksa & Troya. - AF/1984 2 Ex., 43 km von Otavalo in Richtung Apuela, 2180 m, 7. 5. 1990 leg. Zicsi & Csuzdi. - AF/1985 1 Ex., 41 km von Otavalo in Richtung Apuela, 2350 m, 7. 5. 1990 leg. Zicsi & Csuzdi. - AF/1973 5 Ex., 50 km von Otavalo in Richtung Apuela, 2950 m, Braunerde, 20. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/1969 11+2 juv. Ex., 4 km von Otavalo, Wiese und Eukaliptus-Wald, 21. 4. 1989 leg. Zicsi & Loksa & Lopez. - AF/1960 1+10 pread. Ex., 28 km von Otavalo in Richtung Selva Allegre, 3500 m, Paramo-Vegetation, Schwarzerde, 21. 4. 1989 leg. Zicsi & Loksa & Lopez. - AF/1979 2 Ex., 28 km von Otavalo in Richtung Selva Allegre, 3500 m, Paramo-Vegetation, Schwarzerde, 21. 4. 1989 leg. Zicsi & Loksa & Lopez. - AF/1971 10 Ex., 56 km von Otavalo vor Selva Allegre, 1800 m, 24. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/1980 3 Ex., 56 km von Otavalo vor Selva Allegre, 1800 m, 24. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/1977 13 Ex., 10 km von Otavalo in Richtung Apuela, 3000 m, 7. 5. 1990 leg. Zicsi & Csuzdi & Paz. - AF/1968 17 Ex., 31 km von Otavalo in Richtung Apuela, 3500 m, 7. 5. 1990 leg. Zicsi & Csuzdi & Paz. - AF/1966 19+1 juv. Ex., 27 km von Otavalo in Richtung Apuela, 2700 m, 7. 5. 1990 leg. Zicsi & Csuzdi & Paz. - AF/1967 6+7 juv. Ex., 38 km von Otavalo in Richtung Apuela, 2600 m, 7. 5. 1990 leg. Zicsi & Csuzdi & Paz. - AF/1963 19+2 juv. Ex., Mojanda Laguna, 150 m vom Ufer, 3800 m, 9. 5. 1990 leg. Zicsi & Csuzdi & Paz. - AF/1964 9 Ex., von Otavalo in Richtung Mojanda Laguna, 3850 m, 9. 5. 1990 leg. Zicsi & Csuzdi & Paz. - Prov. Pichincha. AF/1992 5+5 juv. Ex., zwischen Quito und Santo Domingo, beim 46. Kilometerstein, 3600 m, Strauch-Vegetation, Paramo-Schwarzerde, 21. 4. 1988 leg. Zicsi & Csuzdi. - AF/1993 4+1 juv. Ex., 56 km von Quito in Richtung Santo Domingo, 3600 m, Wald am Wegrand, 7. 5. 1988 leg. Zicsi & Csuzdi. - AF/1994 7+3 juv. Ex., 71 km von Quito, in Richtung Santo Domingo, 2500 m, 24. 4. 1988 leg. Zicsi & Csuzdi. - AF/1997 4 Ex., Alluriquin 700 m Regenwald, 12. 4. 1989 leg. Zicsi & Loksa. - AF/2101 8 Ex., Quajalito, 1950 m, Wiese, 17. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/2113 4+1 juv. Ex., Sta. Rosa, 2400 m, 19. 4. 1990 leg. Zicsi & Csuzdi. - AF/2116 6+1 juv. Ex., Sta. Rosa, 2400 m, 19. 4. 1990 leg. Zicsi & Csuzdi. - AF/2126 5 Ex., 5 km vor Lloa, 2950 m, Paramo-Schwarzerde, 29. 4. 1989 leg. Zicsi & Loksa & De Vries. - AF/2129 1 Ex., Palmeras, 21. 10. 1989 leg. Simenez. - AF/2130 1+1 juv. Ex., Chiriboga, 8. 1. 1990 leg. Rom. - AF/2134 1 Ex., Palmeras, 21. 5. 1989 leg. Utreras. - AF/2135 2 Ex., Chiriboga, 21. 1. 1990 leg. Carraseo. - AF/2137 1 Ex., Palmeras Chiriboga, 21. 1. 1989 leg. Pleza. - AF/2125 5 Ex., hinter Lloa in Richtung Mindo, 3900 m, 27. 4. 1990 leg. Zicsi & Csuzdi. - AF/2124 4 Ex., bei Lloa, 3850 m, 27. 4. 1990 leg. Zicsi & Csuzdi. - AF/2098 Las Palmeras, Regenwald, 1900 m, 17. 4. 1989 leg. Zicsi & Loksa & Troya. - AF/2099 17 Ex., Las Palmeras, Regenwald, 1900 m, 17. 4. 1989 leg. Zicsi & Loksa & Troya. - Prov. Cotopaxi. AF/2138 20 Ex., Las Pampas, 5. 1989 leg. Onore. - AF/2167 42+6 juv. Ex., Las Pampas, 6. 12. 1989 leg. Onore. - AF/3333 5+6 Ex., Naquipuma Finca Carmen, leg. Ana Mariscal. - AF/2146 3 Ex., hinter El Tingo bei Macuchi, Wiese 1700 m, 23. 4. 1990 leg. Zicsi & Csuzdi & Gavilanes. - AF/2158 1 Ex., 74 km von Latacunga in Richtung La Mana, 4050 m, 24. 4. 1990 leg. Zicsi & Csuzdi & Gavilanes. - Prov. Manabi. AF/2171 6 Ex., 7 km hinter Flavio Alfaro, 21-22. 4. 1990 leg. Zicsi & Csuzdi. - AF/2172 9 Ex., 7 km hinter Flavio Alfaro, 21-22. 4. 1990 leg. Zicsi & Csuzdi. - Prov. Napo. AF/2197 10 Ex., San Marcos Laguna, 3500 m, 28. 4. 1990 leg. Zicsi & Csuzdi. - AF/2198 14 Ex., San Marcos Laguna, 3500 m, 28. 4. 1990 leg. Zicsi & Csuzdi. - Prov. Sucumbios. AF/2199 1 Ex., 20 km von Santa Barbara in Richtung Julio Andrade, 2900 m, Ackerland, 26. 4. 1989 leg. Zicsi & Loksa & Lopez.



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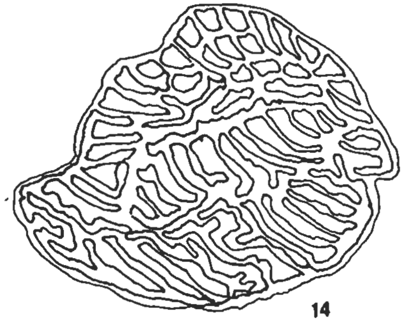

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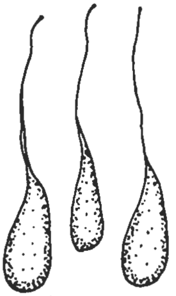

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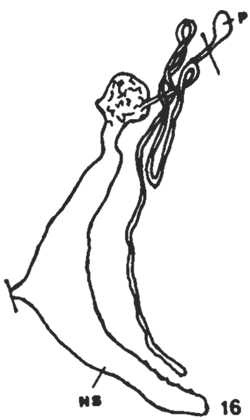

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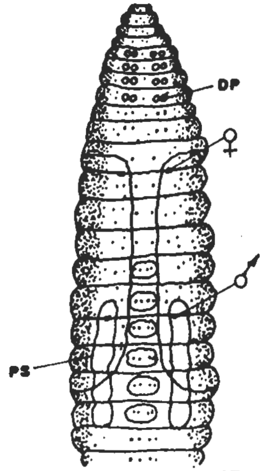

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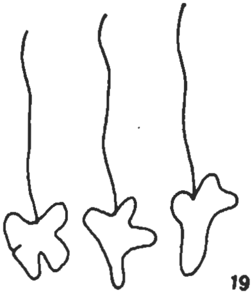

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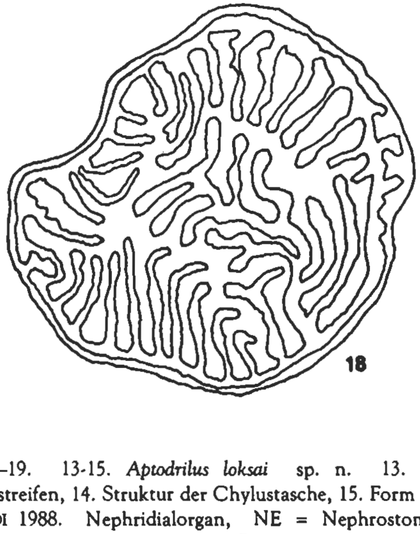

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Abb. 13–19. 13-15. *Aptodrilus loksai* sp. n. 13. Ventralansicht, DP = Drüsenpapillen, PS = Pubertätsstreifen, 14. Struktur der Chylustasche, 15. Form der Samentaschen. – 16. *Aptodrilus baloghi* ZICSI & CSUZDI 1988. Nephridialorgan, NE = Nephrostom, NB = Nephridialblase. – 17-19. *Aptodrilus chilesensis* sp. n. 17. Ventralansicht, DP = Drüsenpapillen, PS = Pubertätsstreifen, 18. Struktur der Chylustasche, 19. Form der Samentaschen

Aptodrilus chilesensis sp. n.

Von einem einzigen Fundort am Fuß des Chiles-Vulkan liegen mehrere Exemplare einer neuen Art vor.

Holotypus. Länge 100 mm, Dicke 5,2 mm, Segmentzahl 90. Paratypen. Länge 90-110 mm, Durchmesser 5-5,5 mm, Segmentzahl 87-110.

Kopf prolobisch, Kopflappen fingerförmig hervorstehend. 2.–3. Segment gefurcht. Borsten weitläufig gepaart. Borstenverhältnis hinter dem Gürtel aa: ab: bc: cd: dd wie 2: 1: 1,6: 1: 24. Borsten ab des 7.–10. Segmentes von kleinen Papillen umgeben, Borsten zu Geschlechtsborsten verwandelt. Innen keine Drüsenfelder an diesen Segmenten. Länge der Borsten 0,8 mm, Durchmesser 0,04 mm, mit 8-9 Kerben versehen. Nephridialporen in der Borstenlinie d. 3 Paar Samentaschenporen auf Intersegmentalfurche 6/7–8/9, kleine runde Öffnungen, die von einem Hof umgeben sind.

Gürtel vom 1/2 14.–1/2, 2/3 22. Segment, sattelförmig und stark drüsig. Pubertätsstreifen vom 1/2 19.–23. Segment. Weibliche Poren auf dem hinteren Rand des 14. Segmentes, männliche Poren auf Intersegmentalfurche 19/20 (Abb. 17).

Innere Organisation. Dissepimente 6/7–9/10 stark verdickt, 10/11 etwas verdickt, 11/12–12/13 nicht verdickt. Schlund durch mehrere Querbinden an die Muskelwand und an Dissepiment 6/7 gebunden. Muskelmagen im 6. Segment, von Dissepiment 6/7 überdeckt. Oesophagus vor dem Muskelmagen von 2 großen Nephridien umgeben. Lateralherzen im 7.–9. Segment, große Intestinalherzen im 10. und 11. Segment. Suboesophageales Blutgefäß vorhanden. Chylustaschen im 10.–14. Segment, Kopf deutlich abgeschnürt, etwas verzogene Rispenschlauchtaschen (Abb. 18). Hoden und Samentrichter in oesophageale Testikelblasen im 10. u. 11. Segment eingeschlossen, die ventral miteinander verbunden sind. Samensäcke im 11. und 12. Segment, nierenförmige Gebilde. Ovarien im 13. Segment, klein. Mitteldarm im 17. Segment, Typhlosolis im 27. Segment beginnend. Nephridien mit Nephridialblase versehen.

3 Paar Samentaschen im 7.–9. Segment, fadenförmiger, sehr langer Ausführungsgang (1,2-1,4 mm) mit einer plattgedrückten schmetterlingsförmigen Ampulle (Abb. 18).

Die neue Art steht *A. baloghi* am nähesten, unterscheidet sich von ihr durch die Lage des Gürtels und der Pubertätsstreifen sowie durch die Form der Samentasche.

Die neue Art wird nach dem Vulkan Chiles in Ekuador benannt.

Fundort. Holotypus. Prov. Carchi. AF/3465 Chiles Vulkan, Südseite 4300-4500 m, 15. 5. 1988 leg. ZICSI & CSUZDI. - Paratypen. AF/1011 20+8 juv. Ex. Fundort wie beim Holotypus.

Aptodrilus uncinatus (MICHAELSEN 1910)

1910a *Rhinodrilus (Aptodrilus) uncinatus* MICHAELSEN Miss. Mer. équat. Amer. Sud. 9:(3) 135
1910b *Rhinodrilus (Aptodrilus) uncinatus* MICHAELSEN Mitt. Mus. Hamburg 27 : 153
1913 *Rhinodrilus (Aptodrilus) uncinatus* var. MICHAELSEN Mem. Soc. Neuchatel 5:242
1988 *Thamnodrilus uncinatus* ZICSI Opusc. Zool. Budapest 28: 218

Von dieser in Ekuador ebenfalls häufig vorkommenden Art sind auch zahlreiche Exemplare angetroffen worden. Die Borsten ab des 7.–10. Segmentes sind auch hier zu Geschlechtsborsten verwandelt. Länge 0,34-0,85 mm, Durchmesser 0,043-0,049 mm, Zahl der Kerben 6-9, je nach Größe der Tiere verschieden viele. Am Gürtel sind die Geschlechtsborsten 0,59 mm lang, Durchmesser 0,032 mm, mit 9 Kerben versehen.

Normale Borsten am Hinterkörper 0,91 mm lang, Durchmesser 0,057 mm, stark gebogen. Mitteldarm im 17., Typhlosolis im 27. Segment beginnend.

Fundorte. Prov. Carchi. AF/1951 3 Ex., 10 km hinter La Libertad, in Richtung Tulcan, 3400 m, 25. 4. 1989 leg. ZICSI & LOKSA & LOPEZ. - AF/1956 5 Ex., am Fusse des Chiles Vulkan, 33 km von Tulcan, 4000 m, 8. 5. 1990 leg. ZICSI & CSUZDI & Paz. - Prov. Imbabura. AF/1964 5 Ex., von Otavalo in Richtung Mojanda Laguna, 3850 m, 9. 5. 1990 leg. ZICSI & CSUZDI & PAZ. - AF/2163 1 pread. Ex., von Otavalo in Richtung Mojanda Laguna, 3850 m, 9. 5. 1990 leg. ZICSI & CSUZDI & PAZ. - Prov. Pichincha. AF/1990 3 Ex., 56 km von Quito in Richtung Santo Domingo, 3600 m, Wald am Wegrand, 7. 5. 1988 leg. ZICSI & CSUZDI. - AF/1988 2+4 juv. Ex., 58 km von Quito in Richtung Santo Domingo, 3600 m, Wald am Wegrand, 24. 4. 1988 leg. ZICSI & CSUZDI. - AF/1998 55 Ex., 13 km von Quito, Urbanisation Ludres, 3100 m, Paramo-Schwarzerde, 13. 4. 1989 leg. ZICSI & LOKSA & TROYA. - AF/2110 2+2 juv. Ex., 15 km hinter Sta. Rosa, 2350 m, 19. 4. 1990 leg. ZICSI & CSUZDI & GAVILANES. - AF/2112 4+1 juv. Ex., 11 km hinter Sta. Rosa, 2400 m, 19. 4. 1990 leg. ZICSI & CSUZDI. - AF/3439 10+12 juv. Ex., zwischen Sta. Rosa und Los Bancos, 1900 m, 26. 4. 1990 leg. ZICSI & CSUZDI & NONN. - AF/2114 6 Ex., zwischen Sta. Rosa und Los Bancos, 1900 m, 26. 4. 1990 leg. ZICSI & CSUZDI & NONN. - AF/2115 2 Ex., 12 km hinter Sta. Rosa, 2000 m, 19. 4. 1990 leg. ZICSI & CSUZDI. - AF/2117 5 Ex., St. Juan, 3100 m, 6. 2. 1989 leg. ONORE. - AF/2128 1 Ex., Palmeras, 20. 10. 1989 leg. SAMENIQUE. - AF/2131 - AF/2133 6 + 1 juv. Ex., Falda del Atacazo, 15. 10. 1988 leg. TRUGILLO. - Prov. Cotopaxi. AF/2139 - AF/2141 18 Ex., Las Pampas, 5. 1986 leg. ONORE. - AF/2168 1 Ex., Las Pampas, 6. 12. 1986 leg. ONORE. - Prov. Manabi. AF/2179 - AF/2180 9 Ex., 20 km von San Miguel, 500 m Bananenplantage, 22. 4. 1990 leg. ZICSI & CSUZDI. - AF/2169 4 Ex., 20 km von San Miguel, 500 m Bananenplantage, 22. 4. 1990 leg. ZICSI & CSUZDI. - AF/2170 5 Ex., zwischen Calderon und Quevedo, 70 km von La Mana entfernt, 450 m, Regenwald, 22. 4. 1990 leg. ZICSI & CSUZDI. - Prov. Sucumbios. AF/2200 4 Ex., 20 km von Santa Barbara in Richtung Andrade, 2900 m, 26. 4. 1989 leg. ZICSI & LOKSA.

Aptodrilus fuhrmanni MICHAELSEN 1918

1913 *Rhinodrilus (Aptodrilus) uncinatus* var. MICHAELSEN, Mém. Soc. Neuchatel 5 : 242
1988 *Thamnodrilus fuhrmanni* ZICSI & CSUZDI , Opusc. Zool. Budapest 23: 210

Trotz der großen Entfernung zwischen den Fundorten in Kolumbien und denen in Ekuador stimmen die angetroffenen Tiere in allen wesentlichen Merkmalen überein. Allein in der Größe der Geschlechtsborsten und deren Kerbenzahl sind wesentliche Unterschiede vorhanden. Bei den Exemplaren aus Kolumbien sind die ab Borsten des 7.-11. Segmentes zu Geschlechtsborsten verwandelt, 0,8 mm lang, Durchmesser 0,08 mm, Zahl der Kerben 8. Bei den Exemplaren aus der Prov. Bolivar sind sie 0,55 mm lang, Durchmesser 0,04 mm, Zahl der Kerben 12. Auch in der Struktur der Chylustaschen, die fjordförmig verzogene Rispenschlauchtaschen sind, stimmen die Tiere überein. Mitteldarm im 17. Segment, Typhlosolis im 27. Segment beginnend.

Fundorte. Ekuador. Prov. Cotopaxi. AF/2140 3 Ex., AF/2166 2 Ex., San Francisco de Las Pampas 2200 m, 5. 12. 1986 leg. ONORE. - Prov. Napo. AF/2198 5 Ex., San Marcos Laguna, 3500 m, 28. 4. 1990 leg. ZICSI & CSUZDI. – Kolumbien. Prov. Valle del Cauca. AF/2314 2 Ex., Palmira, 2600 m, 8. 5. 1991 leg. FEIJOO. - AF/2334 2 Ex., Cuenca de El Amaine, 2040 m, 30. 7. 1991 leg. FEIJOO. - AF/2461 1+4 juv. Ex., Finca la Sirena, 17. 4. 1993 leg. ZICSI & CSUZDI & FEIJOO. - AF/2465 2 Ex., Sendero el Miradoa, 2650 m, 17. 4. 1993 leg. ZICSI. - AF/2470 5+6 juv. Ex., AF/2478 3+5 juv. Ex., AF/2485 2 Ex., AF/2486 5+4 juv. Ex., AF/2493 23 pread. Ex., Finca la Sirena, 17. 4. 1993 leg. ZICSI. - AF/2926 3 Ex., Paramo de Tinajas-Florida, 3400 m, 15. 5. 1992 leg. FEIJOO. - AF/2927 2+2 juv. Ex., Vereda Las Guaguas-Tenjo Palmira, 2900 m, 12. 2. 1992 leg. FEIJOO. - AF/2928 3 pread. Ex., Toche-Palmira, 3120 m, 11. 2. 1992 leg. FEIJOO. - AF/2929 3 Ex., Tenjo la Vereda Palmira, 2800 m, 27. 3. 1991 leg. FEIJOO. - AF/2930 2 Ex., Popoyan Slevia, 3200 m, 16. 4. 1993 leg. ZICSI & CSUZDI & FEIJOO. - AF/2931 5 Ex., Aguazul-Tenjo Palmira, 2050 m, 23. 4. 1991 leg. FEIJOO. - AF/2932 2 Ex., Paramo de Las Tinajas-Florida, 3400 m, 19. 5. 1990 leg. FEIJOO. - AF/2933 1+2 juv. Ex., Vereda Aguazul-Tenjo Palmira, 2080 m, 2. 4. 1992 leg. FEIJOO. - AF/2936 3 Ex., Aguazul-Tenjo Palmira, 2300 m, 14. 9. 1991 leg. FEIJOO.

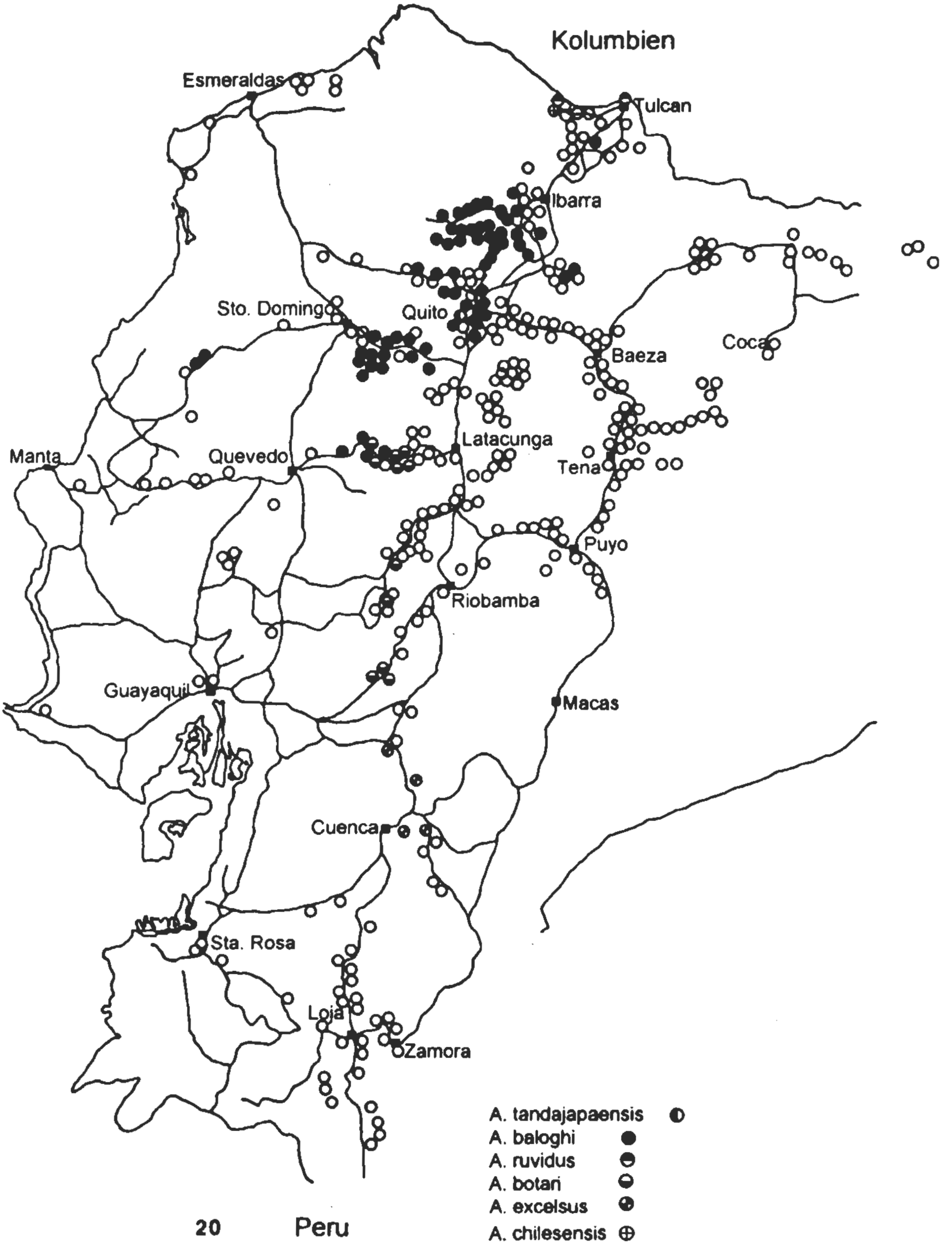

Abb. 20. Verbreitungskarten der *Aptodrilus*-Arten in Ekuador. Leere Kreise beziehen sich auf die 300 eingezeichneten Fundorte der 900 Sammelstellen, wo während der Jahre 1986–1990 und 1993 gesammelt wurde

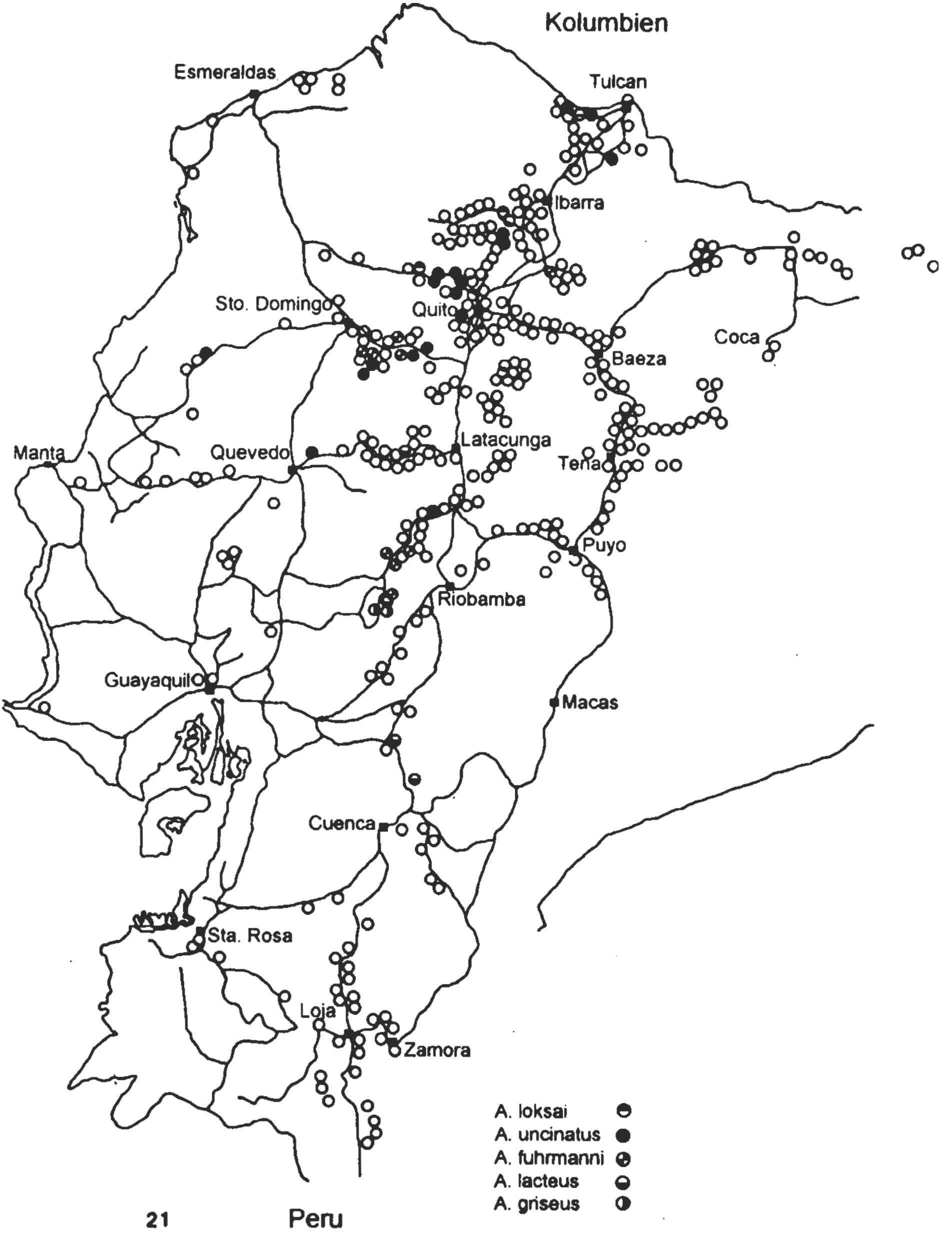

Abb. 21. Verbreitungskarten der *Aptodrilus*-Arten in Ekuador. Leere Kreise beziehen sich auf die 300 eingezeichneten Fundorte der 900 Sammelstellen, wo während der Jahre 1986–1990 und 993 gesammelt wurde

Interpretation der faunistischen Ergebnisse

Von den ungefähr 900 Sammelstellen, an denen während der Jahre 1986-90 und 1993 in Ekuador Regenwürmer gesammelt wurden, sind aus zeichentechnischen Gründen auf den Verbreitungskarten nur 300 Fundorte angeführt worden, die mindestens 10 km entfernt voneinander liegen und als leere Kreise belassen werden.

Wie aus der Verbreitung der Arten ersichtlich, kommen die Vertreter der Gattung *Aptodrilus* vorwiegend in der Andenregion vor und auch hier in 2000 bis 4800 m Höhe. Nur ganz wenige Funde sind in der Kosta verzeichnet, aber auch hier aus Gebirgsgegenden. Wie aus Abb. 19-20 zu ersehen, sind einige Arten wie *A. ruvidus* oder *A. botari* und *A. excelsus* nur auf einige Provinzen beschränkt. Auch die häufigste Art, *A. baloghi* kommt nur nördlich von Latacunga vor.

Interessant ist es ferner, daß die Vertreter dieser Gattung von Südkolumbien bis Cuenca in Ekuador vorkommen, weiter südlich aber nicht angetroffen werden konnten, obwohl auch hier noch an zahlreichen Stellen gesammelt wurde. Die Tiere bevorzugen die Paramo-Schwarzerde, wo sie horizontale und senkrechte Gänge anlegen, in denen sie leicht beim ersten Spatenstich gefangen werden können, da sie nicht sehr beweglich sind. Mit der Formolmethode sind sie nicht zu erbeuten.

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