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Four large-sized species of the family Aporcelaimidae (Nematoda, Dorylaimida) with proposal of a new genus, *Epacrolaimus* gen. n.

By

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Abstract. Four uncommonly large species of the family Aporcelaimidae are presented. Two of them belong to the genus *Aporcelaimus: A. americanus* Thorne & Swanger, 1936 and *A. caesar* sp. n., two to a newly suggested genus, *Epacrolaimus* gen. n.: *E. declinatoaculeatus* (Kreis, 1924) and *E. imperator* sp. n. The new genus resembles *Aporcelaimus* in several respects, but it clearly differs from that in structure of the labial region, shape of the spear and arrangement of the oesophageal gland nuclei.

The representatives of the family Aporcelaimidae Heyns, 1965 are predominantly large nematodes, in general between 2 and 4 mm, but also some extremely long species may occur among them. In the present paper, such large-sized (7 to 10 mm) aporcelaimoid nematodes are discussed. Of the four species described below, two are members of the old genus *Aporcelaimus* Thorne & Swanger, 1936: *A. americanus* Thorne & Swanger, 1936 and *A. caesar* sp. n. The other two species however represent another group showing several *Aporcelaimus*-like characters on the one hand, but also a number of differing morphological structures on the other hand. For these latter species, *declinatoaculeatus* (Kreis, 1924) and *imperator* sp. n., a new genus, *Epacrolaimus* gen. n., is proposed.

Three of the species were collected in Hungary, one came from Alaska.

Aporcelaimus americanus Thorne & Swanger, 1936

(Figs. 1 A-E, 2 A-C and 5)

Present specimens

Females (n = 3): L = 7.00-7.27 mm; a = 50-53; b = 5.5-6.8; c = 104-125; V = 50-54 %; a′ = 241-245; c′ = 0.8-0.9.

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Males (n = 2): L = 7.70–7.74 mm; a = 50–51; b = 5.8-6.0; c = 116–118; a′ = 257–266; c′ = 0.7–0.8.

Measurements after Thorne and Swanger, 1936

Females: L = 5.0–7.0 mm; a = 45; b = 5.2; c = 100; V = 49 %; c′ = 0.7.

Males: L = 5.0–7.0 mm; a = 41; b = 4.7; c = 100; c′ = 0.8.

Very large nematodes, between 7 and 8 mm. Figure slender, 136–150 µm wide on mid-body region. Cuticle thick, 7–9 µm on most part of body, 12–13 µm on the preanal region; possessing two dorsal and two ventral canals on the neck. Head offset by a deep constriction, 29–30 µm wide. Lips practically not separated from one another, papillae small, not elevated. Body at posterior end of oesophagus as wide as 4.2–5.0 labial widths. Amphids as usual in the genus with slightly arcuate anterior contour and fine medial ribs, nearly half the corresponding body width.

Odontostyle 28–29 µm, 2.3–2.9 % of oesophagus length, about equal to labial width, a little thinner than cuticle at same level. Aperture 2/3 of spear length or more; ventral wall more than twice as long as dorsal wall, both thin, slightly sclerotized. Oesophagus 1010–1320 µm long, massive, strongly muscular, gradually expanding from well before its middle. Cardial gland (disc) dorsal. Intestine thick-walled with dense contents. Prerectum 2.8–3.3 anal body widths long, rectum nearly equal to anal diameter. Distance between posterior end of oesophagus and vulva 1.9–2.6 times as long as the oesophagus.

Oesophageal glands uni-nucleate, well visible. Dorsal nucleus lying slightly behind the oesophagus middle, in 8.4 to 9.6 % of total length of body, far behind its orifice. Glandularium 480–620 µm long, 45–49 % of oesophagus. Nucleus AS_1 in one-third, AS_2 in mid-region of glandularium. The distance between the two AS nuclei is fairly constant, 144–150 µm.

Oesophageal gland nuclei in Aporcelaimus americanus

D = 51–55 %	AS_1 = 26–30 %
	AS_2 = 48–52 %
	PS_1 = 70–71 %
K = 57–60 %	PS_2 = 72–73 %

Vulva transverse with well sclerotized heart-shaped inner lips measuring 22–23 µm in width. Vagina more or less spheroid, 70–72 µm long, occupying about 1/2 body diameter. Amphidelphic. Both gonads together amount to 30–32 % of body length; each is 15–16 % or 8–9 body widths long. Anterior gonad on the right, posterior gonad on the left side of intestine. A gravid female contained two uterine eggs measuring 155–158 × 80–85 µm and being as long as or a little longer than corresponding body diameter. Uterus differenciated to form a spermatheca-like chamber on each end.

Distance vulva-anus as long as 50–57 tail lengths. Female tail 58–65 µm, only 0.7- 0.8 % of body length, conoid-rounded with blunt tip and two pairs of subdorsal papillae.

Male prerectum beginning at level of the anteriormost supplement(s). The entire genital tract (from anterior tip of T_1 to cloaca) amounts to 60 % of body length. Each testis 6–7 body diameters long. Spermatozoa irregular or more or less rounded, 6–7 µm. Spicula large, 200–210 µm in curved medial axis; postcorpus swollen, longer than precorpus. Comites[1] 46–49 µm long, obliquely tipped distally. Ventromedial supplements 15 or 16, small, separated by fine blisters between them. One or two of the posterior supplements being within the range of the spicula. Male tail similar to that of female, 65–71 µm, provided with 5 pairs of small papillae.

Locality. Budakeszi in Hungary, forest soil, collected in May, 1972 (3 females and 2 males).

Remarks. *Aporcelaimus americanus* is fairly similar to *A. eurydoris* (Ditlevsen, 1911) Thorne & Swanger, 1936, from which it differs in the much thicker cuticle, the comparatively gracile spear being thinner than the cuticle at same level (*vs.* spear thicker than cuticle), the longer spicula (200–210 µm *vs.* 150–170 µm), and in the arrangement of the supplements of which the posterior one or two level with the proximal ends of the spicula (*vs.* all supplements lying in front of the spicula).

This species was described by Thorne and Swanger (1936) from the United States, and subsequently mentioned (but morphologically not detailed) by some other authors. The Hungarian specimens agree well with the original description in having a large body, a spear being as long as head diameter and thinner than cuticle on neck, conspicuously swollen spicula, supplements possessing small refractive elements (blisters) between them and ending at level of the proximal tips of the spicula. The present animals were identical with the American ones, except for being somewhat longer and having 15–16 supplements (instead of 12–15). These are however no real differences, only may be due to variability.

One of the most important characters of *A. americanus* is the position of the last supplements: they always are within the range of the spicula.

Thorne and Swanger mentioned another „main" character: the cuticle being three-layered on neck. However, this is not a true distinguishing mark since every species of *Aporcelaimus* I have studied hitherto showes the same cuticular pattern: three layers namely, being the external layer (exocuticula) conspicuously duplex.

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[1] A technical term for the „lateral guiding pieces"; see Andrássy, 1998, P. 177.

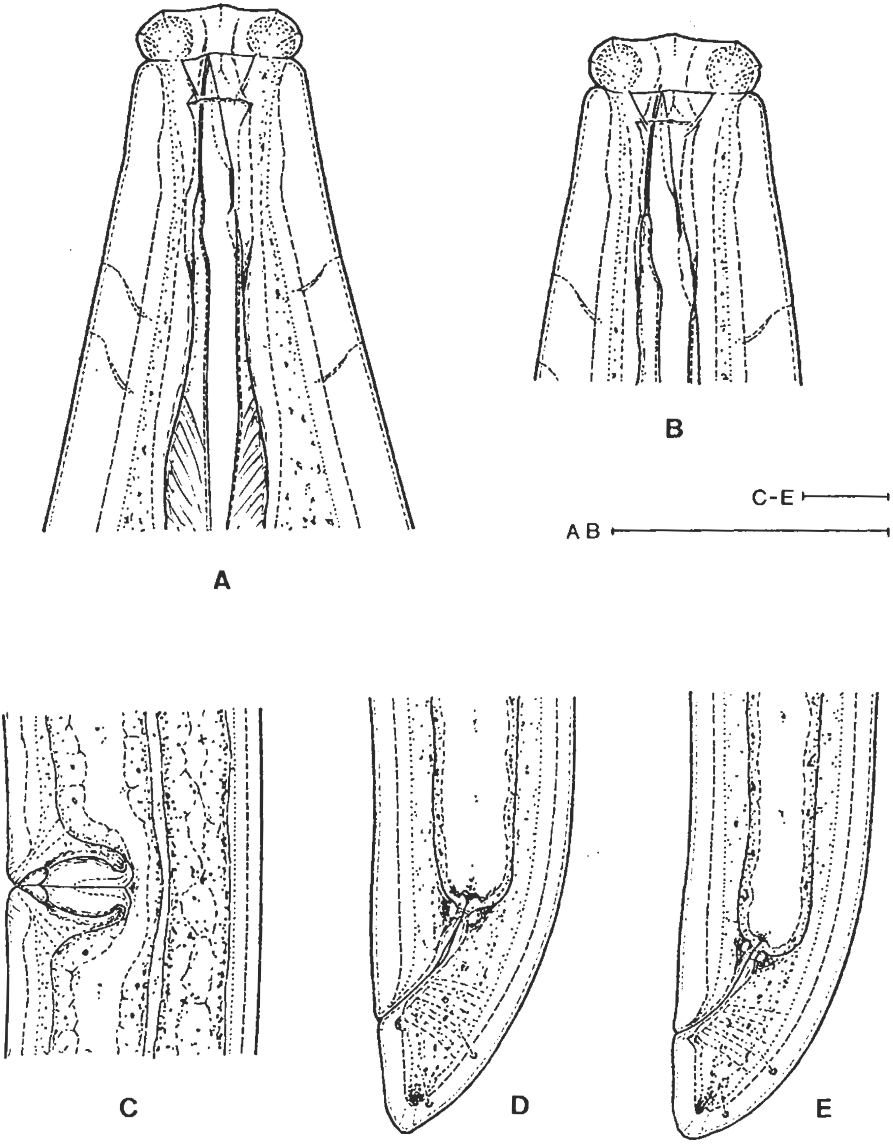

Fig. 1. *Aporcelaimus americanus* Thorne & Swanger, 1936. A–B: anterior regions; C: vulval area; D–E: female posterior regions. (Scale bars 50 µm each)

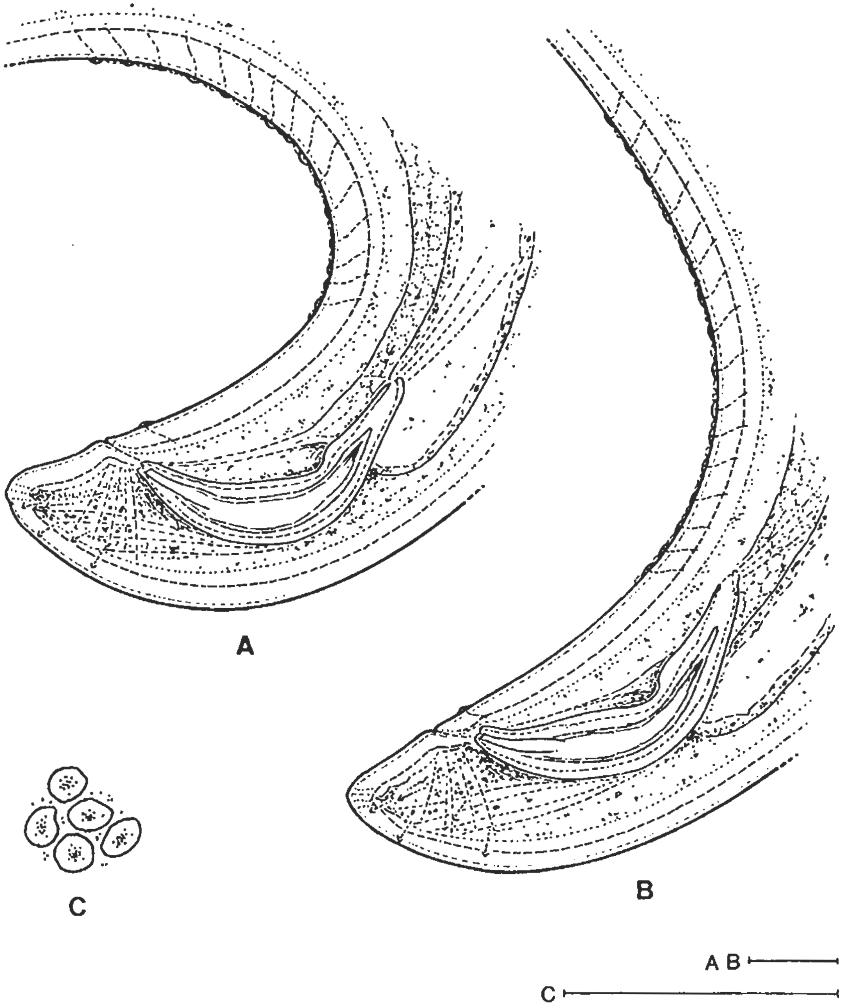

Fig. 2. *Aporcelaimus americanus* Thorne & Swanger, 1936. A–B: male posterior body regions; C: spermatozoa. (Scale bars 50 µm each)

Distribution. *Aporcelaimus americanus* is a comparatively rare species. As far as I know, it has been recorded from Holland (Loof & Coomans, 1970), Poland (Winiszewska-Slipinska, 1987; Wasilewska, 1997), France (Loof & Coomans, 1970), Hungary (present data), and the United States (Thorne & Swanger, 1936; Loof & Coomans, 1970).

Aporcelaimus caesar sp. n.

(Figs. 3 A–E, 4 A–C and 6)

Holotype male: L = 8.52 mm; a = 57; b = 6.4; c = 138; a′ = 240; c′ = 0.8, PO: 24.

Paratype females (n = 2): L = 10.05–10.50 mm; a = 58–60; b = 6.8–7.0; c = 128–132; V = 46–52 %; a′ = 287–300; c′ = 0.8.

Paratype males (n = 2): L = 7.50–8.64 mm; a = 45–50; b = 5.4–6.2; c = 94–116; a′ = 214–243; c′ = 0.7–0.8.

Body unusually large, in females as long as or longer than 10 mm, in males up to 8.6 mm; as far as known, this is the largest-sized species in the family Aporcelaimidae. Figure slender, body 160–190 µm wide at the middle. Cuticle thick, 10–12 µm on most part of body, 15–17 µm on the preanal region and 17–18 µm on neck; finely striated radially and marked by fine criss-cross fibers. Labial region in comparison with body length fairly narrow, 35–36 µm wide, sharply separated from neck. Lips hardly set off from one another, almost fused. Amphids aporcelaimoid, somewhat less than half the corresponding lip region width.

Odontostyle 35–37 µm, about equal to labial width, 2.3–2.7 % of oesophagus length, distinctly narrower than cuticle at same height. Aperture occupying 3/4 spear length, with straight or (more at males) slightly concave contour. Oesophagus 1380–1520 µm long, strongly muscular in entire length, gradually enlarging posterior to its first third. Cylindrus very strong. Cardial gland dorsally wider than ventrally. Intestine unusually thin-walled, with dark and compact contents. Prerectum 1.7–3.0 times, rectum 1.3 times anal body width. Distance between posterior end of oesophagus and vulva 2.2–2.5 times longer than oesophagus.

Oesophageal gland nuclei large, well visible; at lower magnification they appear to be more conspicuous. Dorsal nucleus hardly greater than other nuclei, located well behind the oesophagus middle, in 8–10 % of total length of body. Orifice far before the dorsal nucleus. Glandularium 538–667 µm long, 41–44 % of oesophagus length. AS_1 nucleus before one-third, AS_2 at middle of glandularium. PS nuclei smaller than the anterior subventral nuclei.

Oesophageal gland nuclei in Aporcelaimus caesar

D = 56–59 %	AS_1 = 28–31 %
	AS_2 = 47–52 %
	PS_1 = 72–75 %
K = 58–62 %	PS_2 = 73–76 %

Vulva transverse, with strongly sclerotized heart-shaped inner lips and very finely striated outer lips. Vagina 98–120 µm, as long as 1/2 to 2/3 body width. Amphidelphic species. Gonads 38–40 % of body length; O_1 18–19 % or 9–10 body widths, on the left side, O_2 17–19 % or 8–10 body widths, on the right side of intestine. Ovaries reflexed to the half-length, uterus long, packed with sperm. One female possessed five eggs; these are 235–290 × 114–140 µm, 1.2–1.6 times longer than one body diameter.

Distance vulva–anus equal to 63–68 tail lengths. Female tail 77–82 µm, bluntly conoid-rounded with two pairs of papillae.

Male gonad (from anterior tip of T_1 to cloaca) measuring 66–70 % of body length. Each testis 13–19 % of body, T_1 located on the right, T_2 on the left side. Spermatozoa ovoid, 8–10 µm. Spicula 210–230 µm in the curved medial line, fairly slender with elongate collum, swollen venter, conspicuous sinus and almost straight pes[2]. Antecorpus hardly shorter than postcorpus. Comites 55–63 µm long. Supplements 23, 24 or 27 in number, contiguous or nearly so, the posterior ones lying a little anterior to the spicular tips. Prerectum beginning in range of the first supplements. Male tail 67–78 µm, similar to female tail, with 6 pairs of sublateral/subdorsal papillae.

Holotype. Male on the slide Nr. 7373/H. Paratypes: 2 females, 2 males and 1 juvenile. All type specimens are in the collection of the author.

Type locality. Buda Mountains, soil samples from oak forests, collected in December, 1970, December, 1971 and March, 1972, respectively.

Remarks. *Aporcelaimus caesar* sp. n. is distinctive because of its extremely large body, the very thick cuticle, posterior position of the dorsal oesophageal nucleus, heart-shaped vulval lips, very large and distally not swollen spicula, and the great number of contiguous supplements.

This is the biggest species within the genus. Among the members of *Aporcelaimus* only two species are known that possess so numerous (23 to 30) supplements: *A. paraspiralis* Thorne & Swanger, 1936 and *A. fortis* Gagarin, 1992. *Aporcelaimus caesar* sp. n. differs from *paraspiralis* in having a longer body (7.5–10.5 mm *vs.* 5.8–6.1 mm) and a longer precloacal space (*vs.* posterior four supplements lying within the range of spicula). It differs from *fortis* in having a much narrower spear (*vs.* spear distinctly thicker than cuticle) and more slender spicula (*vs.* spicula strongly swollen).

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[2] Technical terms of spicular nomenclature see in Andrássy, 1999, Page 18.

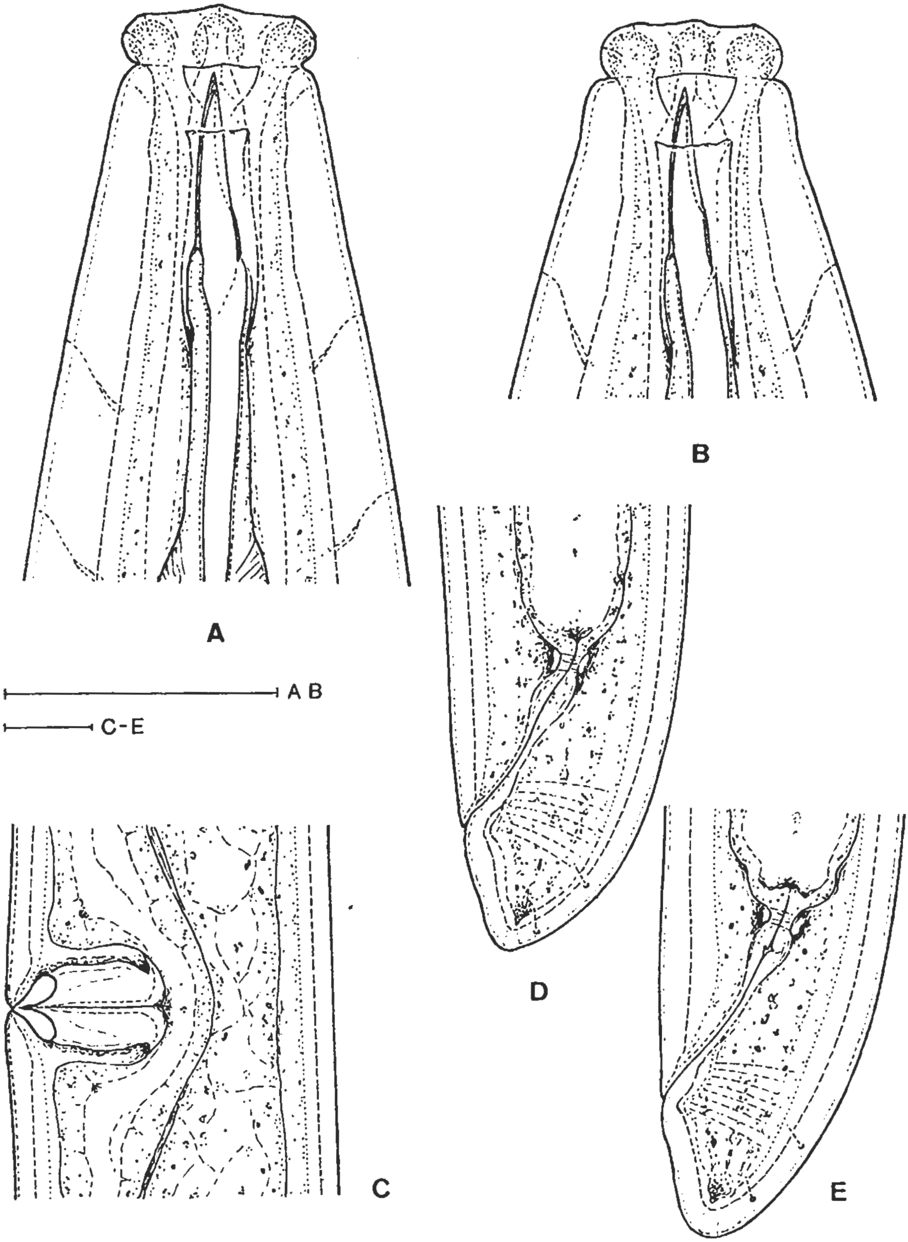

Fig. 3. *Aporcelaimus caesar* sp. n. A–B: anterior ends; C: vulval region; D–E: forms of female tails. (Scale bars 50 µm each)

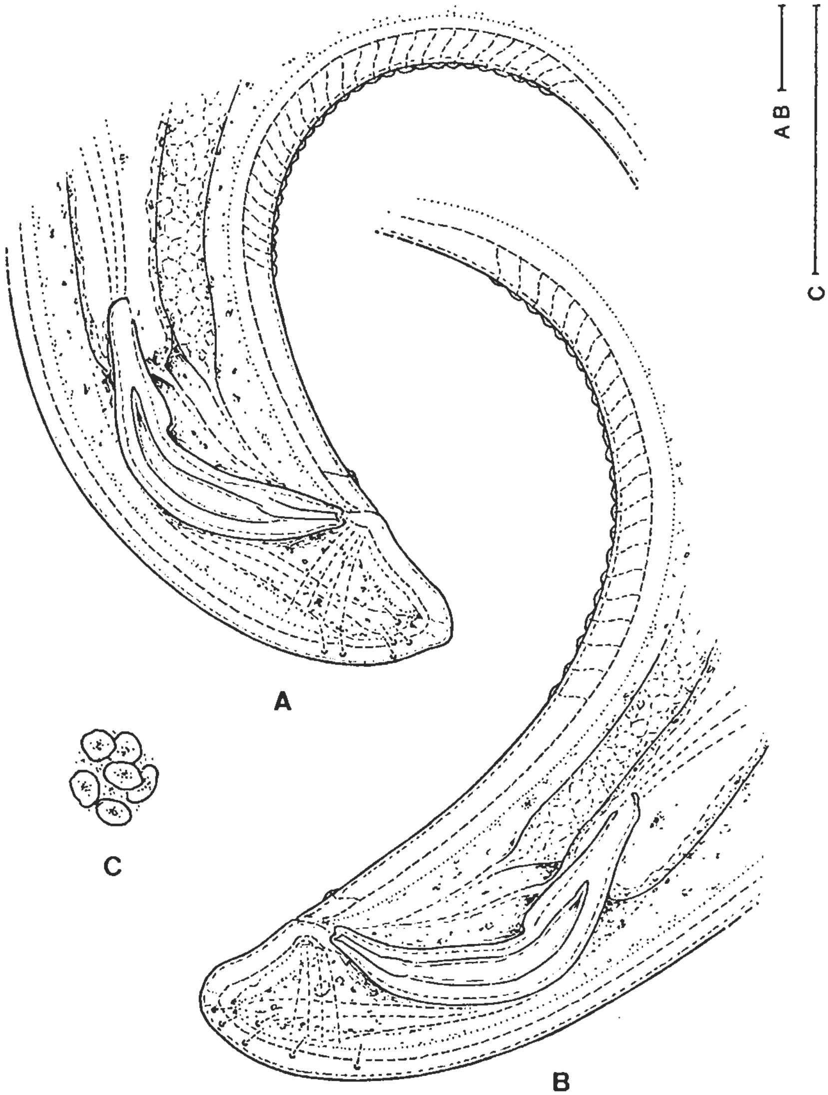

Fig. 4. *Aporcelaimus caesar* sp. n. A–B: male posterior body regions; C: spermatozoa. (Scale bars 50 µm each)

Etymology. The species name „*caesar*" (Latin) means „emperor". In its body size this species bears „rule" over the other members of the genus, even over those of the whole family.

Epacrolaimus gen. n.

Aporcelaimidae. Very large animals with body length of 7–9 mm. Cuticle thick, marked with fine criss-cross lines. Labial region offset by a deep constriction. Lips very distinctly separated from one another, each provided with a protruding inner liplet. Odontostyle slightly or heavily arched inward on the dorsal contour, with thin blade and large aperture. Oesophagus in its entire length muscular, gradually widening from far before the middle. Oesophageal glands often with duplex nuclei; anterior subventral nuclei lying close to each other, but far from dorsal nucleus. Reproductive system amphidelphic. Vulva transverse with wrinkled cuticle. Male supplements 11 to 16, mostly separate. Tail form in each sex similar, shorter than anal body diameter, dorsally convex-conoid with bluntly rounded or slightly subdigitate terminus.

Type species: *Dorylaimus declinatoaculeatus* Kreis, 1924 = *Epacrolaimus declinatoaculeatus* (Kreis, 1924) comb. n.

The new genus includes two species:

E. declinatoaculeatus (Kreis, 1924) comb. n.
  Dorylaimus declinatoaculeatus Kreis, 1924
  Aporcelaimus declinatoaculeatus (Kreis, 1924) Thorne & Swanger, 1936
  Dorylaimus (Aporcelaimus) declinatoaculeatus Kreis, 1924 (Altherr, 1950)
  Drepanodorus declinatoaculeatus (Kreis, 1924) Brzeski, 1964
  Aporcelaimus vorax Thorne & Swanger, 1936 syn. n.
  Drepanodorus vorax (Thorne & Swanger, 1936) Brzeski, 1964 syn. n.

E. imperator sp. n.

Remarks. Whereas *Epacrolaimus* gen. n. is closely related to *Aporcelaimus* Thorne & Swanger, 1936, it differs from that in several morphological and anatomical characters. Thus, it differs in having cephalic lips strongly separated from one another (lips hardly differenciated or practically fused in *A.*), conspicuous inner liplets (no such liplets in *A.*), thin-bladed spear (spear thick-bladed in *A.*), strongly wrinkled cuticle on the outer vulval lips (vulval cuticle not wrinkled, at most finely striated in *A.*), and other arrangement of the oesophageal gland nuclei. As for the latter, the first anterior subventral oesophageal nucleus (AS_1) lies much closer to its partner (AS_2) than to the dorsal nucleus (D), the value of K is therefore high, about 70 to 80 % (AS_1 nucleus more or less midway between D and AS_2, the value of K lower, generally 45 to 60 % in *A.*), in addition, the nucleus AS_2 is located well behind the middle of the glandularium (before or exceptionately a little behind the middle of glandularium in *A.*), and the glandularium is longer than half-a-length of the oesophagus (shorter in *A.*)

Etymology. The genus name is composed of two Greek words: *επακρυς* = sharpened, *λαιμυς* = throat, but here: spear. *Epacrolaimus* is a latinized form meaning „a sharpened spear". At the same time, *Epacrolaimus* is an anagram of *Aporcelaimus.*

Epacrolaimus declinatoaculeatus (Kreis, 1924) comb. n.

(Figs. 7, 9 A–F and 10 A–F)

Present specimens

From Budakeszi: Females (n = 3): L = 7.15–8.25 mm; a = 48–58; b = 4.9–5.7; c = 103–110; V = 48–54 %; a' = 248–294; c' = 0.7–0.8. - Male: L = 9.30 mm; a = 70; b = 6.1; c = 130; a' = 320; c' = 0.8.

From Keszthely: Female: L = 7.62 mm; a = 62; b = 6.0; c = 116; V = 52 %; a' = 272; c' = 0.8.

From Baradla: Female: L = 8.10 mm; a = 58; b = 5.6; c = 115; V = 53 %; a' = 288; c' = 0.8.

Measurements after other authors

Kreis, 1924 *(declinatoaculeatus):* Female: L = 6.91 mm; a = 47; b = 5.5; c = 102; V = 45 %.

Thorne & Swanger, 1936 *(vorax):* Females: L = 7.0–9.0 mm; a = 50; b = 6.3; c = 125; V = 54 %; c' = 0.8.

Thorne, 1939 *(vorax):* Male: L = 7.2 mm; a = 59; b = 6.8; c = 111; PO: 11.

Body very large, 7–9 mm; in contrast with most dorylaimids the male specimen was the longest, 13 to 30 % times longer than the females. Body figure slender, especially at male; body width 124–128 µm in the mid-region. Cuticle thick, 7–9 µm on most part of body, 16–20 µm on the preanal region; more strongly thickened on neck where possessing three ventral and three dorsal canals. Cuticle on tail marked by fine radial striation and criss-cross lines. Labial region 28–29 µm wide, offset by a profound constriction. Lips distinctly separated from one another, spheroid, possessing small protruding inner liplets. Body at posterior end of oesophagus 3.7–4.2 times the labial width. Amphid stirrup-shaped with arcuate anterior margin and fine medial rib, its aperture occupying half the corresponding body width.

Odontostyle 22–25 µm, 1.5–1.8 % of oesophagus length, shorter than labial width and a little thinner than cuticle at the same level. Aperture measuring 2/3 (occasionally to almost 3/4) of spear length, and very characteristic from

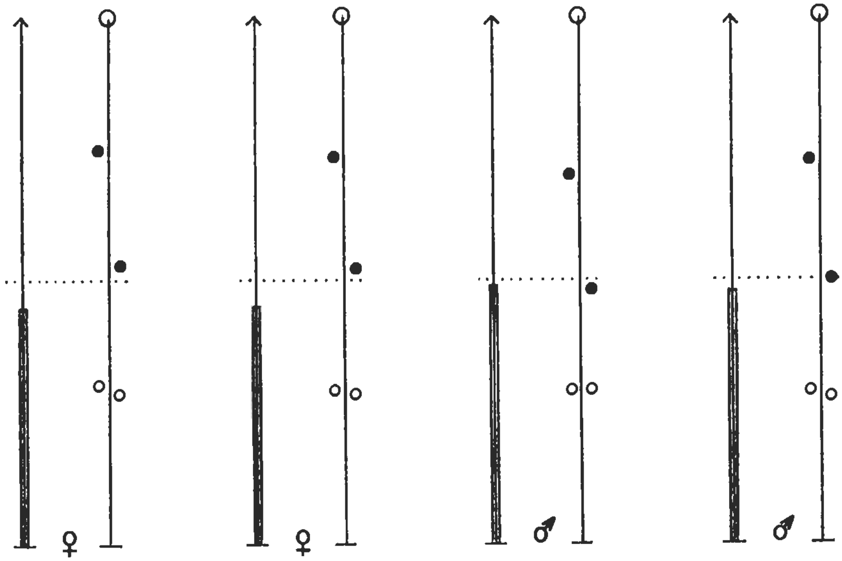

Fig. 5. Map of oesophageal gland nuclei in *Aporcelaimus americanus* Thorne & Swanger, 1936

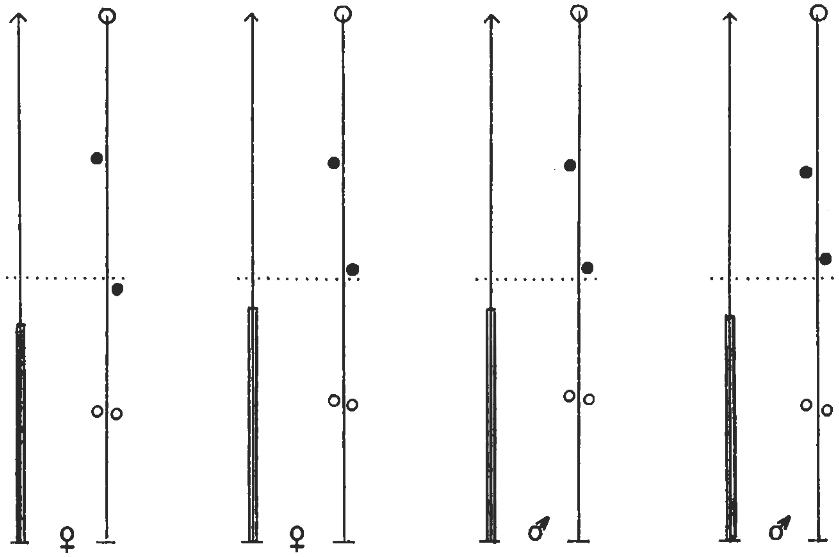

Fig. 6. Map of oesophageal gland nuclei in *Aporcelaimus caesar* sp. n.

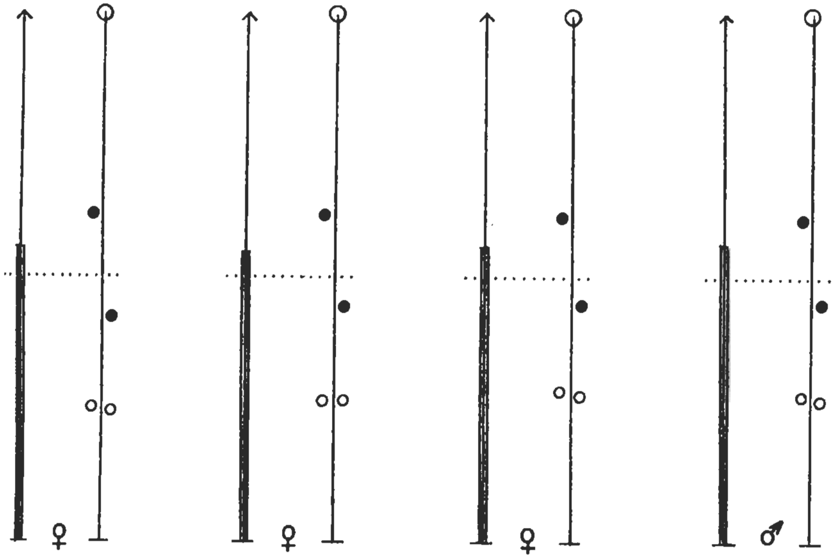

Fig. 7. Map of oesophageal gland nuclei in *Epacrolaimus declinatoaculeatus* (Kreis, 1924) comb. n.

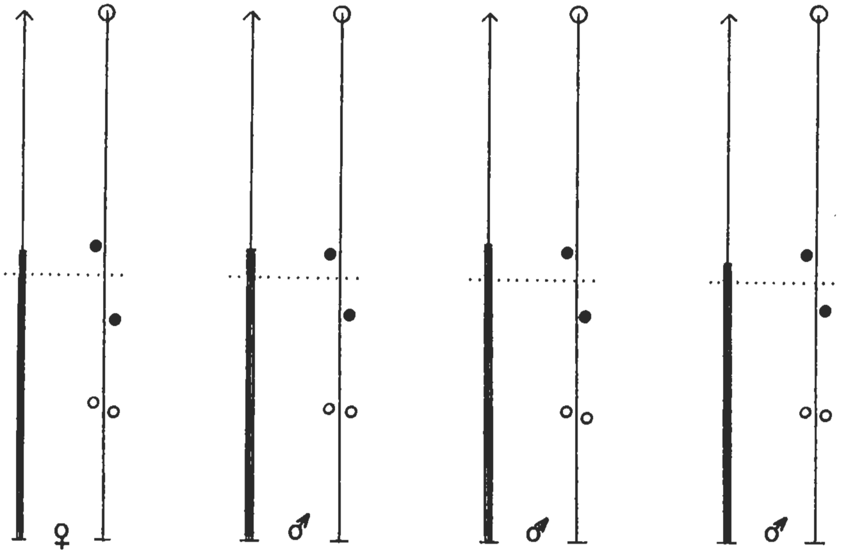

Fig. 8. Map of oesophageal gland nuclei in *Epacrolaimus imperator* sp. n.

lateral view: its border is strongly incurved giving the spear an angular appearance. The „blade" of spear (the part from distal tip of spear to proximal end of aperture) is much narrower than the „haft". Guiding sheath wide but thin mostly with plicate anterior margin. Oesophagus 1300–1495 µm long, 16–20 % of body length, strongly muscular in its entire length, somewhat narrowing where encircled by the nerve ring, then gradually widening from before its middle; the actual beginning of the cylindrus cannot be determined. Cardia consisting of an anterior discoid and a posterior conoid element. Prerectum 2.8-3.5 anal body widths long, rectum a little longer than one anal diameter. Distance between posterior end of oesophagus and vulva longer (1.5–2.1 times) than oesophagus.

Gland nuclei in oesophagus large, well discernible; occasionally some of the glands are binucleate, i.e. within the halo (court) a larger and a smaller nucleus can be observed (especially in the D and AS_2 glands). Glandularium 760 to 852 µm long, 55–57 % of oesophagus. Dorsal nucleus mostly oval, always located before the middle of oesophagus, in 9–10 % of the entire length of body. Orifice far before the nucleus D. Nucleus AS_1 at 2/3 of the distance between D and AS_2 or more posterior in position. AS_2 lying behind the middle of glandularium; the distance of AS_2 from AS_1 was very constant in the six specimens examined: 128 to 130 µm. PS nuclei nearly levelling with each other, and lying at a distance of 210–230 µm from posterior margin of cylindrus.

As may be seen on the small tables below, the arrangement of the oesophageal gland nuclei of the present specimens agrees very well with the gland map given by Loof and Coomans (1970) for *A. declinatoaculeatus.* This is a good example again to demonstrate the constant location of the oesophageal gland nuclei within one species. This anatomical character ought to be followed with more attention in the future.

Oesophageal gland nuclei in Epacrolaimus declinatoaculeatus

Present specimens

D = 43–45 %	AS_1 = 37–39 %
	AS_2 = 54–57 %
	PS_1 = 71–74 %
K = 66–72 %	PS_2 = 72–75 %

After Loof & Coomans (1970)

D = 44–46 %	AS_1 = 37–38 %
	AS_2 = 55–57 %
	PS_1 = 71–72 %
K = 64–70 %	PS_2 = 72–73 %

Vulva a large transverse slit, with strongly sclerotized, 35–37 µm wide inner lips and heavily wrinkled outer lips. Vagina very strong, 73–105 µm, 2/3 to almost 3/4 body diameter. Amphidelphic species. Gonads comparatively short, O_1 6–11 % or 3–7 body widths, O_2 6–10 % or 3-5 body widths; all together amount 12–21 % of body length. Both gonads lying seemingly on the same side, either on the right or on the left side of body. Uteri in fertilized females packed with sperm. Ovaries reflexed 1/3 to 1/2 the distance back to vulva. Mature eggs were not present in the uteri.

Vulva–anus distance 48–54 times as long as tail. Female tail 63–75 µm, only 0.8–0.9 % of body length, shorter than anal diameter, bluntly conoid, rounded on tip or with a minute peg.

Posterior end of male slightly arcuate ventrally. Spermatozoa roughly globular, 10–13 µm. Spicula 215 µm along the curved medial line, massive with narrow collum, swollen venter, strongly widening pes and spacious inner lumen. Comites 50 µm, obliquely tipped. Ventromedial supplements 12, separate, the posterior ones lying well before the spicula; the distance between the anteriormost supplement and cloaca amounts to 260 µm. Male tail 75 µm long, with four pairs of small papillae.

Material studied: Budakeszi, Julianna-major close to Budapest, Hungary, forest soil, December, 1970, 1 female; the same, January, 1971, 1 female; the same, March, 1972, 1 male. Keszthely, Hungary, cultivated soil, May, 1967, 1 female, 1 juvenile. Baradla cave, Hungary, interstitial habitat, March, 1967, 1 female.

Remarks. *Epacrolaimus declinatoaculeatus* is very easily recognizable by the characteristically curved spear aperture combined with the large size of body. The odontostyle structure gives it a special appearance, and distinguishes it from all other representatives of the family Aporcelaimidae. Kreis (1924) described the species from Switzerland as *Dorylaimus declinatoaculeatus.* His description was though rather laconic, still unambiguous because of the good illustration of the spear. When suggesting the genus *Aporcelaimus,* Thorne and Swanger (1936) transferred *declinatoaculeatus* to their genus. At the same time, they described another very similar species from the United States, *Aporcelaimus vorax* Thorne & Swanger, 1936. This large-sized (7–9 mm) nematode shows quite the same peculiar spear shape, and the figures of the head and tail are quite similar also. Later, Thorne (1937, 1939) reported on a male specimen, too. According to the American authors, the species *vorax* differs from *declinatoaculeatus* in two rather insignificant characters: the vulva lies more back (54 % *vs.* 45 %), and the uterine egg is somewhat longer than one body diameter (*vs.* a little shorter).

Rather few additional data can be found in the literature. Altherr (1950) described a juvenile *Dorylaimus (Aporcelaimus) declinatoaculeatus* from Switzerland. Under the name *Aporcelaimus vorax,* Heyns (1965, 1971) gave some good drawings (but no description) of South African specimens, then Coomans and Van der Heiden (1971) described the feeding apparatus of Belgian exemplars.

The present animals agree well with those of older descriptions. Considering the literature data of *declinatoaculeatus* and *vorax,* and comparing them with one another as well as with the present individuals, the

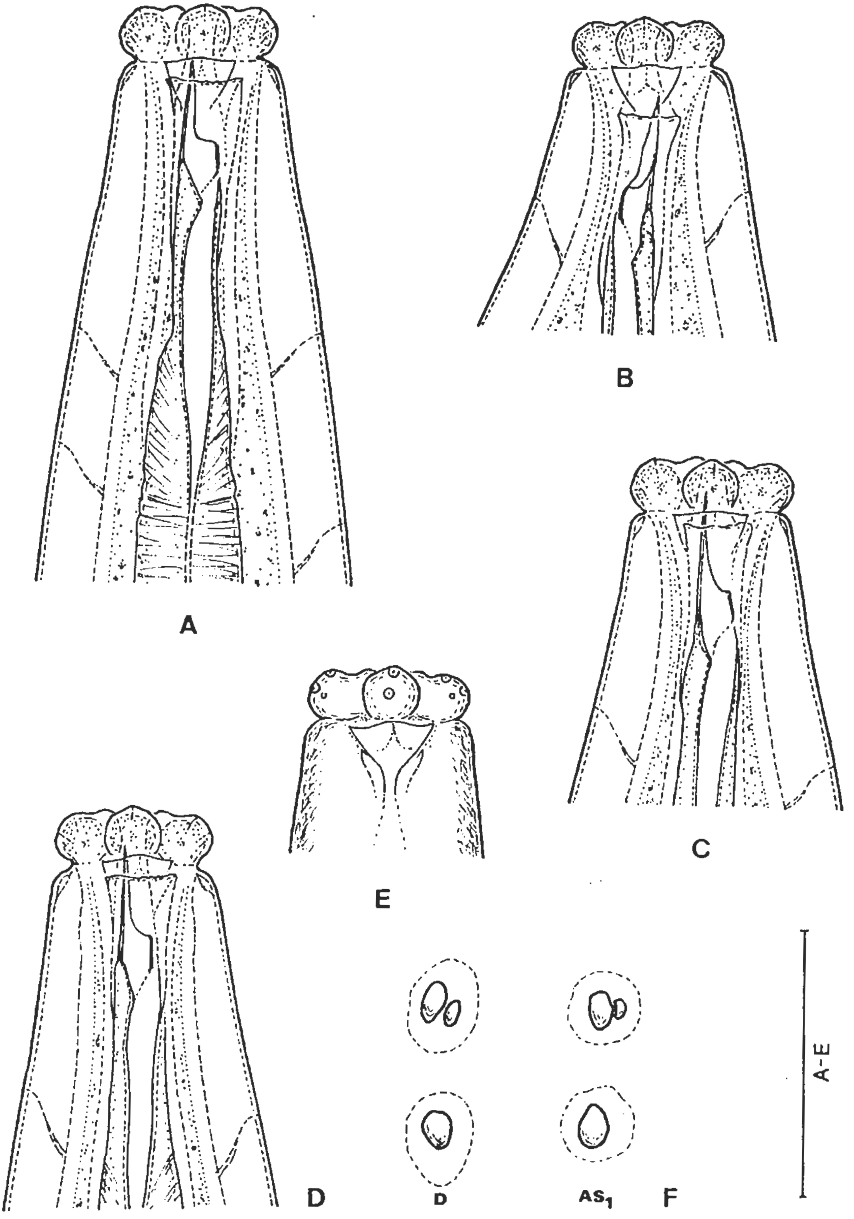

Fig. 9. *Epacrolaimus declinatoaculeatus* (Kreis, 1924) comb. n. A–D: variations of anterior regions; E: anterior end in surface view; F: binucleate and uninucleate forms of oesophageal gland nuclei D and AS_1. (Scale bars 50 µm each)

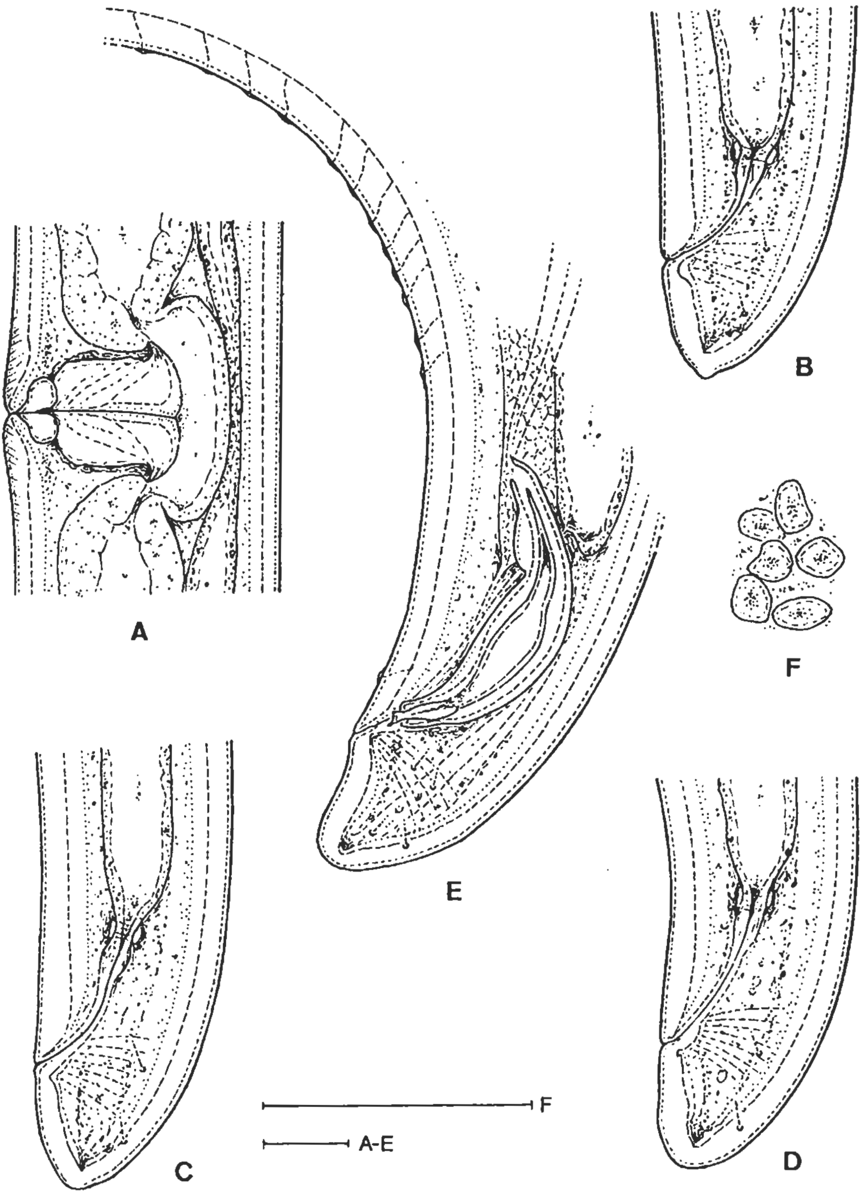

Fig. 10. *Epacrolaimus declinatoaculeatus* (Kreis, 1924) comb. n. A: vulval region; B–D: variations of female caudal regions; E: male posterior body; F: spermatozoa. (Scale bars 50 µm each)

conspecifity of these taxa can hardly be queried. On the one hand, the differences between the two species as mentioned by Thorne and Swanger are negligible[3]; on the other hand, the Hungarian animals show an intermediate position of the vulva between the two data. In addition, the number of copulatory supplements is practically the same in both known males: Thorne's (11) and the Hungarian's (12). As for the length of spear, Heyns (1965) illustrated it as being about 22 µm, Coomans and Van der Heiden (1971) as being 26 µm; these data coincide with the spear length of my specimens (22–25 µm). On account of the morphological and morphometrical congruence, I consider *A. vorax* a junior synonym of *A. declinatoaculeatus.*

Whether there exists another but much smaller *declinatoaculeatus*-like species, it is strongly questionable. Altherr's *Dorylaimus (Aporcelaimus) declinatoaculeatus* (1950) was a 2.6 mm long juvenile with discernible genital primordium, V = 58 % (?). Mateo and Campoy (1983) rather insufficiently described under the name *Aporcelaimus vorax* another small form from Spain. The 1.9 mm long females (?) showed the peculiar shape of spear; the position of the vulva was however quite unusual: 66 % (?). The „female" illustrated on Fig. 2a was surely a young animal since a conspicuous replacement spear was drawn in the oesophageal tissues. Finally, Brzeski (1964) described under the name *Drepanodorus declinatoaculeatus* a comparatively small-sized (3.5 mm) nematode from Poland, but the spear of his species did not show the typical shape, the lips were not separated from one another, etc.

Distribution: *Epacrolaimus declinatoaculeatus* seemingly prefers terrestrial habitats in temperate regions, but occurs also in limnic or semi-limnic biotopes. It has been recorded from three continents. Europe: Switzerland (Kreis, 1924; Altherr, 1950), Holland (Heyns, 1965; Loof & Coomans, 1970), Belgium (Coomans & Van der Heiden, 1971), Germany (Loof & Coomans, 1970; Altherr, 1974), Poland (Wasilewska, 1997), Hungary (Andrássy, 1973, 1990, and present data); Africa: South Africa (Heyns, 1965, 1971); North America: United States: New York, Utah (Thorne & Swanger, 1936, Thorne, 1939), California (Heyns, 1965). As large-sized dorylaims in general, *A. declinatoaculeatus* occurs in small individual numbers. Especially males appear to be rare.

Epacrolaimus imperator sp. n.

(Figs. 8, 11 A–D, 12 A–D and 13)

Holotype male: L = 7.82 mm; a = 52; b = 5.5; c = 99; a' = 252; c' = 0.7, PO: 13.

Paratype female: L = 8.18 mm; a = 48; b = 5.2; c = 93; V = 49 %; a' = 264; c' = 1.0.

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[3] Loof (1999, P. 99) also emphasized that these species seemingly differ only in the position of vulva from each other.

Paratype males (n = 5): L = 7.13–8.26; a = 48–55; b = 4.5–5.6; c = 90–105; a′ = 238–266, c′ = 0.7–1.0.

Very big animals, 7–8 mm or longer. Body slender, 156–160 µm at middle, markedly tapering to the anterior end. Cuticle thick, 10–14 µm throughout most of the body and 18–19 µm on the precloacal region; marked by fine criss-cross lines, and showing three S-shaped canals on both ventral and dorsal side of the neck region. Labial region as compared to the robust size of body fairly small, 30–31 µm wide, sharply offset by a deep constriction. Body at posterior end of oesophagus 4–5 times as wide as head. Lips well separated from one another, more or less spherical, provided with small protruding inner liplets. Labial papillae small, in the usual arrangement (6 + 10). Amphids nearly as wide as half a corresponding body width, slightly arched on anterior margin and provided with medial support.

Odontostyle fairly gracile, conspicuously thinner than cuticle at the same level, 29–31 µm long, about equal to labial diameter, 1.8–2.1 % of oesophagus length; thin-walled, dorsal wall nearly half as long as ventral wall. Aperture occupying 2/3 of spear length or so. Anterior margin of guiding sheaths close to the spear tip. Oesophagus 1420 to 1584 µm long, in its entire length muscular, gradually enlarging from far anterior to its middle; the effective beginning of the cylindrus is not to determine. Slightly narrowed and widened parts generally alternate on the cylindrus. Cylindrus wider than anterior end of intestine. Cardia short with a dorsolateral globular gland (disc). Intestinal walls thick, mostly wrinkled, intestinal contents compact, dark in colour with numerous transverse or oblique articulations. Definite food elements cannot be recognized. Prerectum three anal widths, rectum more than one anal diameter long. Distance between posterior end of oesophagus and vulva 1.6 times as long as oesophagus.

Oesophageal gland nuclei in Epacrolaimus imperator

D = 43–48 %	AS_1 = 44–46 %
	AS_2 = 54–58 %
	PS_1 = 74–76 %
K = 78–82 %	PS_2 = 76–77 %

Oesophageal gland nuclei large, well visible. Dorsal nucleus (D) anterior to oesophagus middle, in 8.0 to 9.8 % of the entire length of body, lying rather far from its orifice. Nucleus AS_1 as large as or even larger than AS_2. The two AS nuclei lie close to each other, AS_1 in about 80 % of the distance D–AS_2. Both of them are always situated in the posterior half of the distance between D and PS nuclei. PS nuclei almost at same level, at a distance of 365–390 µm from posterior margin of cylindrus. Very remarkable in the glandular picture is that all the oesophageal glands may show two nuclei each. These duplex nuclei were in the AS glands in 90 per cent, in the other glands in 60–70 per

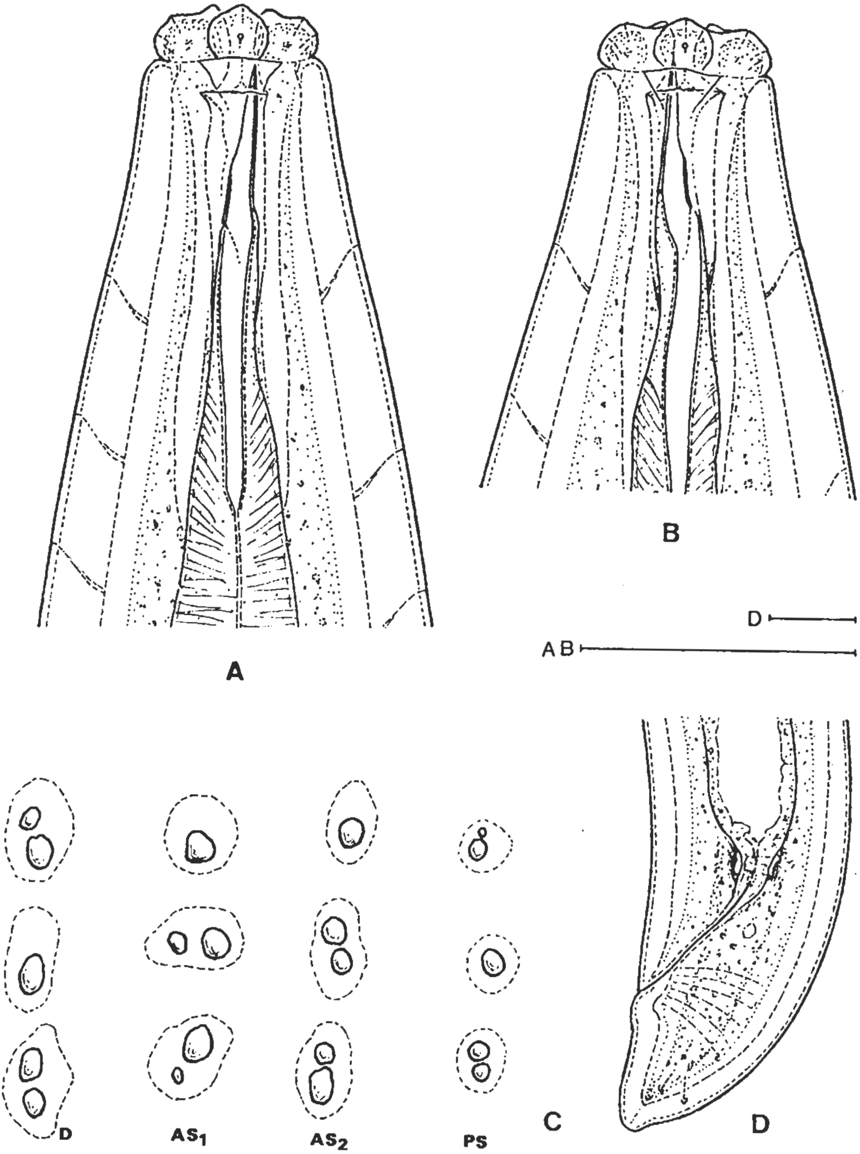

Fig. 11. *Epacrolaimus imperator* sp. n. A-B: anterior regions; C: variations of uni- and binucleate types of the oesophageal gland nuclei D, AS_1, AS_2 and PS; D: female posterior end. (Scale bars 50 µm each)

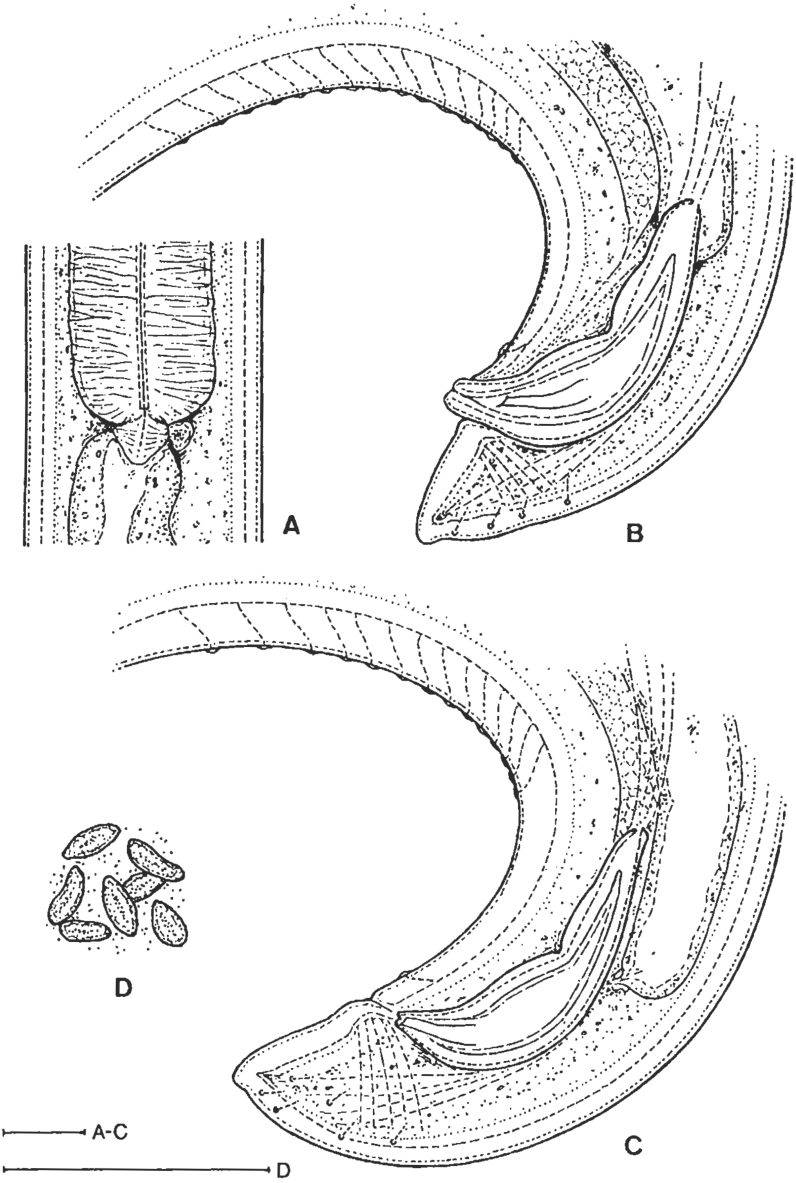

Fig. 12. *Epacrolaimus imperator* sp. n. A: cardial region; B-C: posterior ends of two males; D: spermatozoa. (Scale bars 50 µm each)

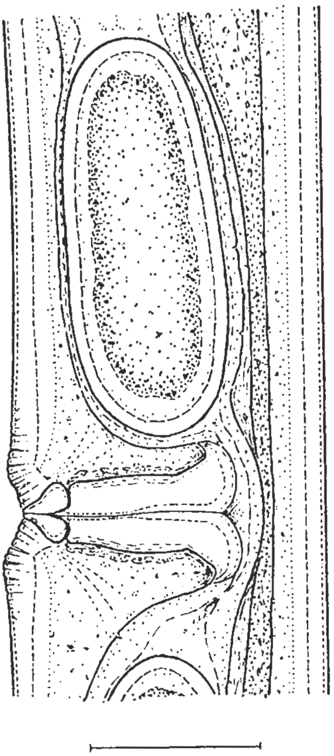

Fig. 13. *Epacrolaimus imperator* sp. n. Vulval region with egg. (Scale bar 100 µm)

cent present. There were animals in which all the nuclei were double, but none showing simple nuclei purely. Glandularium 762–900 µm long, 52–57 % of oesophagus.

Vulva transverse, sunk in body contour with well-cuticularized inner lips and conspicuously wrinkled outer lips. Vagina large, 122 µm, 2/3 of corresponding body width, wider then the sclerotized vulval lips. Genital system amphidelphic. Both gonads together measuring 36 % of body length; each 9 body widths long. Gonads alternating in position, anterior branch on the right side of body, posterior branch on the left side. Uterus large, gravid females with up to four eggs of 220–236 × 95–120 µm; these latter are longer than one body width and provided with unusually thick shells. Oviducts slender, transversely striated.

Distance vulva–anus 46 times tail length. Female tail 84 µm, about 1 % of entire body length, convex-conoid, slightly subdigitate on tip.

Posterior body of male strongly curved ventrally. Prerectum beginning within the range of the anteriormost supplement(s). Testes long, T_1 7–8 body widths or 16 % of body length, +T_2 6.5–7.5 body widths or 13–14 % of body length. As for the position of testes, they lie on alternate sides of intestine: T_1 either on the right (4 males) or on the left side (2 males), T_2 on the left (4 males) or on the right side (2 males). Spermatozoa rather small, 13–15 µm, more or less spindle-shaped. Supplements 11 to 16 in number (11, 12, 13, 14, 14, 16), small, the anterior ones separate, the posterior ones contiguous. Posteriormost supplement at a short distance before the spicula. Spicula 202–210 µm along their curved medial axis, strongly developed with wide inner lumen; postcorpus longer and much wider than antecorpus, collum narrowly rounded at tip, venter and sinus well expressed, pes strongly swollen. Comites 45–52 µm. Male tail 70–86 µm long, about 1 % of body length, similar in shape to that of female, convex-conoid, slightly subdigitate with 5 or 6 pairs of small sublateral or subdorsal papillae.

Holotype. Male on the slide No. 13625/AI. Paratypes: 1 female and 5 males. All type specimens are preserved in the collection of the author.

Type locality. Chena Ridge along the Chena River near Fairbanks, Alaska, taiga soil with grass; collected in October 1998 by T. R. Christiansen (Copenhagen).

Remarks. The new species can be characterized by its very large and slender body, thick cuticle, relatively small head, slender spear with slightly arcuate dorsal contour, closely to each other arranged, but far from D lying AS nuclei, frequent occurrence of duplicated gland nuclei, vulva sunk in body contour, thick-walled eggs, posteriorly swollen spicula, mostly contiguous supplements, as well as by short and slightly subdigitate tails in both sexes.

Epacrolaimus imperator sp. n. shows the same generic characters as *E. declinatoaculeatus* (Kreis, 1924): very large body size, well separate lips, protruding inner liplets, narrow-bladed spear, close to each other lying anterior subventral oesophageal nuclei, conspicuously wrinkled cuticle at vulva. However, it can easily be distinguished from *E. declinatoaculeatus:* the dorsal contour of spear is never so strongly arched and therefore the spear has a thicker blade. In addition, the new species has a longer spear (29–31 µm *vs.* 22–25 µm), a thinner vagina, thick-walled eggs, oblong spermatozoa and an other arrangement of supplements. Furthermore, the nucleus AS_1 lies more closer to AS_2, the K-value is therefore higher (78–82 *vs.* 66–72).

Etymology. The species name *„imperator"* (Latin) means „a ruler" or „a monarch", and refers to the very imposing appearance of these nematodes.

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Composition and long-term changes of the invertebrate macrofauna in two streams of the Pilis Mountains, Hungary

By

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Abstract. This study surveys the changes occurred in the latest 45 years in the invertebrate macrofauna of two mountain streams formerly under regular examination. Changes detected in the composition of the fauna indicate the degradation of the stream habitats. Cluster analysis revealed that the fauna is similar in both streams.

The Hungarian Danube Research Station of the Hungarian Academy of Sciences in Göd has been investigating the streams running into the Danube from a hydrobiological point of view for several years. Within this program, I have studied the invertebrate macrofauna of two permanent streams in the Pilis Mountains: the Bükkös Stream and the Malom Stream (Csörgits, 1996). Hereby I want to show some series of data and results taken from this research.

Research of the workgroup initiated by Sebestyén was a pioneering work among the studies of Hungarian small streams, by which they started the comprehensive hydrobiological survey of waters flowing into Lake Balaton (Entz, 1958; Entz et al., 1954; Lukacsovics, 1958a, 1958b). With leadership of Ábrahám they also conducted successful research on the small streams and standing waters primarily of the Bükk Mountains and their surroundings (Ábrahám et al., 1951, 1952; Ábrahám, Horváth & Megyeri, 1956; Ábrahám, Biczók & Megyeri, 1960). Publication showing the hydrobiological situation of the Vörösvári Valley to the north of Budapest (Ponyi & Dvihally, 1956) describes not only the physiographic characteristics of the stream but also its phyto- and zooplankton coenoses, while research conducted on the Mánfa Stream in the Mecsek Mountains is of utmost importance from the viewpoint of research of interstitial fauna (Ponyi & Ponyi J-né, 1962).

UNESCO has founded the Pilis Biosphere Reserve in the Pilis- and the Szentendre–Visegrádi Mountains on 23,000 hectare territory of the Pilis State

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Forestry and the landscape-protection area in 1981, which stimulated comprehensive, regular series of studies in its territory (Berczik, 1984). Gróf (1967) reports the results of a zoological and hydrobiological survey of the Bükkös Stream. He describes the specific, hydro-ecologically different bed reaches from an ecological and zoological point of view, the latter mainly based on species spectrum of typical stream organisms (Ephemeroptera, Plecoptera, Trichoptera). Later studies have been done on the same sampling sites, including the collection of samples used for this paper.

Berky (1979) strove to trace the spatial and temporal changes of the hydrochemical conditions in the Malom- and the Bükkös Stream. The registered changes of state allow us to draw conclusions regarding the buffer capacity of the water. She found that water pollution can be detected *via* hydrochemical analyses, but components indicating pollution vary in time and space.

Barótiné Albert (1986) examined the chemical circumstances in the water and the sediment of the Malom Stream of Dömös and the valley of the Szőke Spring; in that paper a detailed plant coenological description of the area can also be found. The hydrochemical analysis showed that the Malom Stream is undisturbed till its mouth, where it is polluted by sewage influx.

Publications of Andrikovics (1988, 1991) are of high importance, in which he surveyed the insect fauna (Ephemeroptera, Plecoptera, Trichoptera) of streams in the Pilis Mountains. In his 1991 study he not only processed his samples but also samples of some earlier collections (Berczik & Wolf in 1951 and Oertel & Nosek in 1979), with which he created an opportunity to make long term surveys. Comparative part of my work is based on data series of this study.

The work describing the typical winter macrofauna of the Bükkös Stream (Andrikovics & Kéri, 1991) is pointing out to the connection between the pollution identifiable with hydrochemical investigations and the change in the species composition.

A study by Nógrádi, Uherkovich and Andrikovics (1991) gives a detailed picture of the Trichoptera fauna of the streams in the region, describing abundance and species pattern by the sampling sites of 59 Trichoptera species found in the area of the Visegrádi Mountains.

Study by Simonyi (1981) makes an important attempt to depict the ecological circumstances of another Pilis stream (Apátkúti Stream) on map. This work, well combining the detailed geographical description of the area with the surveyed hydroecological factors, reinforces that habitats of small streams are characterized by mosaic patterns.

Connection between the spatial and temporal hydrochemical patterns and Trichoptera species distribution was also shown (Csutákné, 1973) on a stream of similar type and size (the Morgó Stream in Börzsöny Mountains) to the ones I studied. Importance of long term surveys is reinforced by the results of

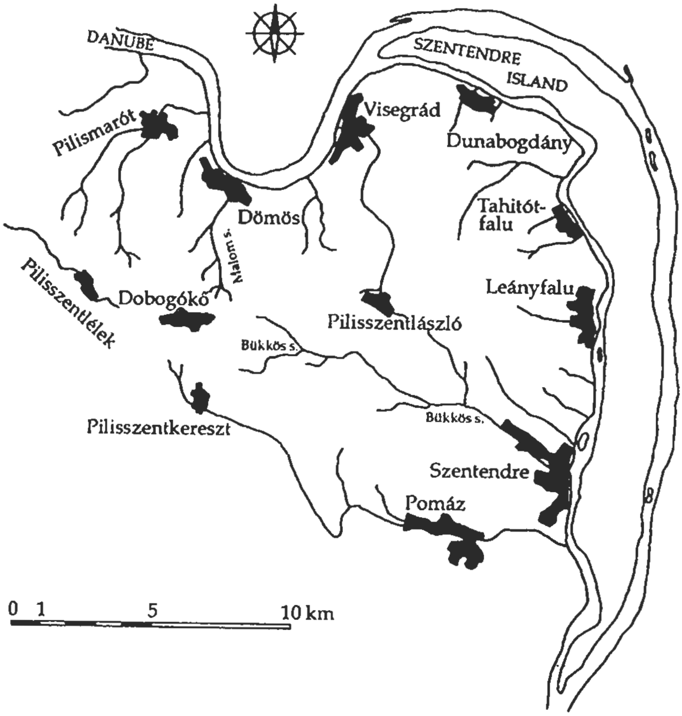

Fig. 1. The streams of the Pilis-Visegrádi Mountains

a research done on this stream 10 years later: the area became subject to heavy tourist activity, which was well reflected by the changes in the stream fauna: for example, only 6 Trichoptera species could be found out of the 20 found a decade earlier (Berczik & Pham Ngoc, 1988).

Description of the research area

Geologically and geomorphologically the Pilis-Visegrádi Mountains can be divided into two parts: the Pilis in the Southwest, made up of Triassic dolomite and limestone and the Visegrádi Mountains in the Northeast, which is of volcanic origin (primarily andesite). Highest peak of the latter (called Dobogó-kő) is 700 m high; average annual precipitation is 690 mm. The volcanic Visegrádi Mountains are significantly more abundant in surface water streams, the ones surveyed in this paper are situated here, too (Fig. 1).

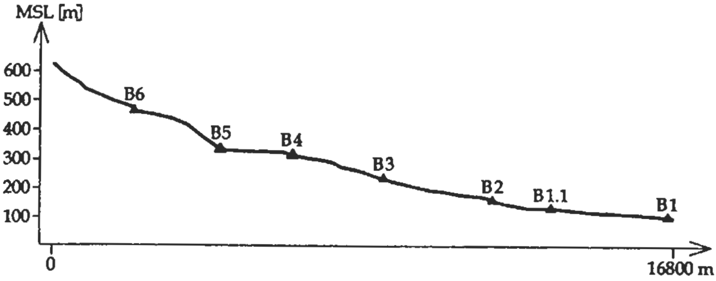

Fig. 2. Long section of the Bükkös Stream (B6–B1: sampling sites)

The Bükkös Stream

The Bükkös Stream is one of the longest and most water-abounding stream of the Visegrádi Mountains (its watershed area is approximately 39.2 square km). Length of its northwest-southeast directed valley is 16.8 km, fall of the bed is 525 m from the spring to the mouth. Average fall per km is 31 m, but reach characteristics is changing due to the varied fall (Fig. 2). The spring is on the southern part of the Dobogó-kő and the stream reaches the Danube in Szentendre.

The Bükkös Stream is of upper reach characteristics from its spring until the Sikáros Basin, where its narrow erosive valley changes into a middle reach bed from the northwestern part of the basin to the Schubert János Spring. From this part, it is again of upper reach type till Dömörkapu, where it changes to middle reach until the mouth.

Rate of flow and water level of the Bükkös Stream is not steady, it depends primarily on the quantity of rainfall and its distribution throughout the year. There is high water after the early spring melting of snow (March/April) and due to heavy rainfall in the early summer (May/June) and the late autumn (October/November) periods. When water is low (in summer: July/August, in autumn: September/October and in winter: December/January), the stream dries out above the Sikáros Basin. Width of the bed is 1.5–3 m at middle water. Depth becomes significant only at the erosive dips, at some sites of this kind a basin deeper than 1 m is formed, but characteristic sections are quick running ones of 10–30 cm depth. Material of

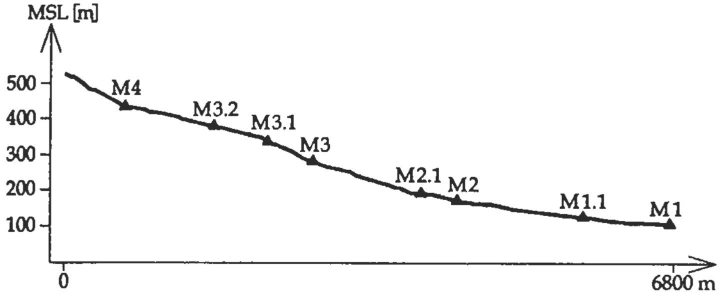

Fig. 3. Long section of the Malom Stream (M4–M1: sampling sites)

the streambed is almost everywhere smaller-bigger andesite stone blocks, but at the upper reach at some places the water runs between more sizable rocks.

Valley of the Bükkös Stream is made varied by different plant communities. Besides the communities typical of the upper reach (Melittio-Fagetum - beech-wood with hornbeam and some spots of Piceetum excelsae - spruce-wood with beech), others can also be found along the stream, namely Querco robori-Carpinetum (oak-wood with hornbeam), Corno quercetum pubescenti-petreae (wood of oak species preferring warmth) and Quercetum petreae-cerris (oak-wood with Turkey oak). The trees of the alder grove (Aegopodio-Alnetum), which accompanies the stream up until Szentendre, have their roots often stretching right into the bed. Within Szentendre, only weed communities (primarily Lolio-Alopecuretum) border the stream being directed by concrete dams, in its mouth it flows across a softwood grove (Salicetum albae-fragilis) and reaches the Danube.

Berky (1979) in the most detailed way provided summary of the hydrochemical characteristics of the Bükkös Stream.

The Malom Stream of Dömös

The Malom Stream of Dömös is situated in the northern part of the Visegrádi Mountains, in the valley of the Szőke Spring. Its watershed area is approximately 14.2 square km. It rises from several smaller seasonal springs in the surroundings of the Királykúti Saddle and reaches the Danube in Dömös. At the end of the 6.8 kilometer long valley zero point of the Danube is between 98 and 102 m above sea level, so fall of the stream is approximately 430 m, average fall by kilometer is around 63 m (Fig. 3).

At the uppermost part of the valley, the stream has hardly any water in its bed, even in the wet periods, while at lower parts it is typically of upper reach characteristics: in the V-shaped narrow valley the stream runs through several rapids, flowing around huge blocks of rock. After the Rám Cleft the valley becomes wider, the stream slower and the bed more muddy; and also the forest is not dense any more. After the Lukács Ditch feeds in, the stream is of middle reach characteristics, and reaches Dömös through a meadow with groves, then at the back of the gardens and gets polluted by sewage influx. In the area of Dömös the stream bed is almost completely open and its fall is very limited, so the water warms up in the summer to a high extent. Close to the mouth, the bed is pebbly and at some places heavily muddy, which is probably due to the periodic damming effect of the Danube.

Characteristics of water levels of the stream are quite similar to that of the Bükkös Stream. When there is low water in the summer and in the autumn, the upper section of the stream is dry, we can only find some stagnating ponds. At middle water the average width is 1.5-2 m, average depth is 10-20 cm. Erosive dips are less often found than in the bed of the Bükkös Stream.

There is Querco robori-Carpinetum (*Carex pilosa*-type oak-wood with hornbeam) along the Malom Stream up until the boundary of Dömös. This type of forest is dominating mostly on the more gentle slopes with eastern exposure. Beyond the Rám Cleft, in the widening valley the close forest becomes rather a grove. The streambed bordered with alder grove mixed with some willow and robinia trees (Aegopodio-Alnetum) reaches its mouth in the residential area of Dömös.

Berky (1979) in the most detailed way provided summary of the hydrochemical characteristics of the Malom Stream.

Description of sampling sites and their timings

When choosing sampling sites, those of earlier studies were also taken into consideration to allow comparisons between data of different origin. Sampling sites were numbered starting from the mouth, names of the streams are referred to by their initials. Sampling work was done at all sites in the spring, summer and autumn period.

The Bükkös Stream

- B6: at 465 m above sea level, 14.6 km from the mouth (there is 160 m fall between the highest point of the valley and the sampling site). The bed is dried up in the summer and in the autumn and is made terraced by huge amphibole-andesite rocks, therefore places of very different fall can be found even within a short section. At this site the valley is deep, V-shaped, upper reach-like. Rocks are covered by *Fontinalis antipyretica* at several places.
- B5: at 335 m above sea level, 12.3 km from the mouth (there is 130 m fall between sites B6 and B5). The bed is usually dried up in the summer and in the autumn. At

the sampling site an erosive dip has been formed - in the 6-7 m long, 2-3 m wide and 50-70 cm deep pond the water is only very slowly flowing. Near the sampling site, the stream is of middle reach characteristics.

- B4: at 315 m above sea level, 10.3 km from the mouth (there is 20 m fall between sites B5 and B4). The bed is 2-2.5 m wide, the shallow, slow-running sections are coupled with ponds. Bigger rocks form the bottom. At summer low water, the stream starts from this area.
- B3: at 235 m above sea level, 7.8 km from the mouth, at the pond of the Dömörkapu Waterfall (there is 80 m fall between sites B4 and B3). Erosive force of the water cascading down has formed the pond, being 5-6 m in diameter and its depth exceeds even 1 m. The bed is rocky everywhere, in the pond bigger rocks can also be found. Between them, some floating plant material (branched, leaves) are trapped in every season. Rocks of the waterfall are covered by *Fontinalis antipyretica*.
- B2: at 160 m above sea level, approximately 5 km from the mouth, near the Dömörkapu-Pilisszentlászló road fork (there is 75 m fall between sites B3 and B2). A ford is situated above the sampling site. The streambed is covered with rocks of different size, width is 2-2.5 m, depth is 5-25 cm. *Cladophora* and diatoms coat the bottom.
- B1.1: sampling site being at 133 m above sea level, 3.3 km from the mouth (there is 27 m fall between sites B2 and B1.1). The bed is 2-2.5 m wide, 10-20 cm deep at the quick-running places. Depths of the few ponds exceed even 50 cm at some places. There is litter in the bed.
- B1: at 101 m above sea level, 150 m from the mouth (there is 32 m fall between sites B1.1 and B1). The stream runs between dams, the bottom is rocky and muddy. Width is approximately 1-2.5 m, depth is 30-70 cm, and the current is slow. The bank is covered only with weedy grass, there is no shadow. The water is sometimes troubled, warm and smells badly from pollution. There is litter in the streambed. Damming effect of the Danube is sometimes significant. On the rocks at the bottom, sometimes *Cladophora*-coating or diatom periphyton can be found.

Dates of sampling

- 19 July 1995. After a several week-long very hot period, some days before the day of sampling there were some showers of rain, but these could increase the rate of flow only slightly and for a short period. It was warm and cloudless on the very day of the sampling. At the upper reach of the stream there was no water in the bed, so samples could not be taken from sites B6 and B5.
- 25 October 1995. Upper reach of the stream dried up due to the long, dry period, so sampling again could not happen at the two uppermost sites. Morning temperature was around zero, while until noon air temperature reached 6-7 °C. Edge of the ponds with slow-running water were covered by thin ice due the cold. At many places in the stream bed there was a big amount of leaves trapped.
- 30 April 1996. Due to late melting of the snow and frequent rains, water was running all along the stream. Sunshine made the air warm in a short time. At the mouth, section the water was turbid and smelt of chemicals.

- M4: at 435 m above sea level, 6.1 km from the mouth (there is approximately 95 m fall between the sampling site and the highest point of the valley). The stream flows in a narrow, deep valley with bigger stone blocks. Water can be found here for a longer time only in the spring period.
- M3.2: at 380 m above sea level, approximately 5.1 km from the mouth there are rapids formed by huge rocks, with a pond beneath. (Fall between sites M4 and M3.2 is 55 m). At low water, the stream usually dries up.
- M3.1: at 336 m above sea level, 4.5 km from the mouth (there is 44 m fall between sites M3.2 and M3.1). In summer and autumn the stream starts from here, at this
- time there is hardly any water in it. The bed is narrow, there is *Fontinalis antipyretica* growing in it; in the autumn there is a big amount of fallen leaves at the bed bottom.
- M3: sampling site at 280 m above sea level, 4 km from the mouth, under a stone bridge (fall is 56 m between sites M3.1 and M3). Small ponds and a few rapids characterize the stream. Width of the bed is 1.5-2 m. Depth of the stream at the flowing places is around 10 cm, that of the ponds is 20-30 cm, but the big pond under the stone bridge can be 1 m deep in spring.
- M2.1: at 190 m above sea level, 2.8 km from the mouth. The tourist path crosses the stream here. (Fall between sites M3 and M2.1 is 110 m.) Flowing parts alternate with smaller ponds, there are no rapids.
- M2: sampling site at 170 m above sea level, 2.4 km from the mouth, at the car park. (Fall between sites M2.1 and M2 is 20 m.) The bed is wide and shallow with banks being out of the water. Its width is 1-2 m, depth is 10-30 cm. The bottom is pebbly, with some bigger pieces of stone, there is some litter scattered.
- M1.1: at 123 m above sea level, approximately 1 km from the mouth. (Fall of the streambed between sites M2 and M1.1 is 47 m.) Water runs here slower, no rapids. The bed is shallow, 2-2.5 m wide, 5-10 cm deep. Water is muddier than at the upper parts.
- M1: 60-70 m from the mouth, 103 m above sea level, under the small wooden bridge (there is 20 m fall between sites M1.1 and M1). The bed is shallow, 1.5-2 m wide, and 10-35 cm deep. The slowly running water is definitely warm in the summer, there is a lot of *Cladophora* on the surface of stone pieces. The bed is often polluted with different kinds of litter.

Dates of sampling

- 8 July 1995. A typical warm, summer day. Samples were taken at the upper reach of the stream. Five days had passed since the latest bigger rain, the bed dried up at the uppermost part. Due to lack of water, I could not take a sample at the site M4, only at M3.2 and M3.1.
- 9 July 1995. Similar to the previous day. Lower reach of the stream was surveyed.
- 2 November 1995. Upper reach of the stream dried up due to the long, dry period, so I could only start taking samples at site M3.1. Air temperature reached only 6-7 °C. There were a lot of fallen leaves in the clean water.
- 17 April 1996. It was cold for the season. Air temperature went up from 9 °C at dawn to 14 °C in the afternoon. There was a lot of water in the stream everywhere, which was quite muddy at some places.

Table 1. Temperature data of the sampling sites

Bükkös Stream

Sampling	B6	B5	B4	B3	B2	B1.1	B1
Date	07. 19, 1995						
Time	8^{30}	9^{h}	10^{h}	11^{15}	12^{h}	13^{h}	13^{30}
Water T.	-	-	12.6	13.8	15.4	16.9	20.5
Air T. (C°)	24.2	24.0	25.3	26.0	27.8	27.3	29.0
Date	10. 25, 1995						
Time	9^{h}	9^{30}	10^{h}	11^{h}	12^{h}	13^{h}	13^{30}
Water T.	-	-	0.2	1.5	1.1	3.7	3.5
Air T. (C°)	-1.1	0.0	0.0	1.7	4.0	6.6	6.2
Date	04. 30,1996						
Time	9^{h}	10^{15}	11^{h}	12^{h}	13^{15}	14^{h}	14^{30}
Water T.	9.7	9.9	11.2	12.2	11.0	13.5	15.3
Air T. (C°)	13.1	13.6	14.9	16.2	18.4	17.5	18.6

Malom Stream

Sampling	M4	M3.2	M3.1	M3	M2.1	M2	M1.1	M1
Date	07. 08-09, 1995							
Time	9^{45}	10^{h}	10^{30}	11^{15}	12^{h}	14^{h}	14^{45}	15^{30}
Water T.	-	13.8	11.0	11.3	13.3	15.1	18.2	24.6
Air T. (C°)	21.2	21.8	21.6	22.2	23.1	24.5	28.1	31.0
Date	11. 02, 1995							
Time	8^{30}	9^{30}	10^{30}	11^{20}	12^{15}	13^{h}	14^{15}	15^{15}
Water T.	-	-	8.8	9.0	9.8	10.2	11.6	13.3
Air T. (C°)	5.5	5.6	6.9	7.2	7.4	7.3	6.6	8.9
Date	04. 17, 1996							
Time	9^{h}	9^{30}	10^{10}	11^{25}	12^{h}	13^{h}	14^{h}	14^{45}
Water T.	5.1	-	-	5.1	5.9	6.6	9.8	13.5
Air T. (C°)	8.9	9.1	9.0	10.2	9.8	11.0	14.2	16.1

Methods

Width of the bed and depth of the water was measured by a measuring rule. Temperature of the water and the air was recorded by a mercurial thermometer of 0.1 °C accuracy (Table 1).

Zoological sampling at the sites designated before was conducted (at a 2 m long section) from the bed bottom, from the coated stones and the tree roots hanging down into the water. Water plants and leaves found at the bottom were washed into a net. Living coating of stones and roots were removed with a brush and filtered through the dipping net. Caddisflies, leeches and part of the beetles and water bugs were collected with tweezers (with a singling method).

Throughout the collection phase always the same sampling method was used, and equal time was spent at all survey sites, therefore the semi-quantitative results can be compared within these studies. Sampling sites

*Table 2. Extreme hydrochemical values of the investigated streams (Berky, 1979)**

	Bükkös Stream	Malom Stream
Conduct. (μScm^{-1})	470 - 1355	305 - 715
pH	7.58 - 8.43	6.60 - 8.28
Total hardness (nk°)	12.1 - 32.0	9.6 - 11.8
Ca^{2+} (mg/l)	12.5 - 80.7	21.1 - 64.5
Mg^{2+} (mg/l)	18.0 - 60.1	10.9 - 19.5
HCO_3^-(mg/l)	70.0 - 444.8	20.7 - 187.1
Cl^- (mg/l)	4.4 - 23.2	4.7 - 7.4
NH_4^+ (mg/l)	0.20 - 1.83	0.54 - 1.01
NO_2^- (mg/l)	0.0 - 0.145	0.0 - 0.057
NO_3^- (mg/l)	0.7 - 5.3	0.9 - 2.7
O_2 consumption (mg/l)	2.4 - 4.4	2.7 - 3.9

** Samplings: April – November 1978, three times in each streams; sampling sites: Bükkös Stream: B4-B3-B2-B1, Malom Stream: M4-M3-M2-M1*

were classified based on the characteristic species composition. Cluster analysis was conducted with the help of the SYN-TAX 5.0 software using the WPGMC algorithm and the Sørensen index (Sørensen, 1948).

Conclusions

Water temperature goes very high at the mouth section of both streams in the spring and summer, and furthermore, at the Bükkös Stream temporary heat pollution of human origin was also detected (Table 1). Warmth basically stems from the lack of macro-vegetation that would provide shadow, decreased speed of flow and heat pollution from sewage influx. Hydrochemical data show a picture typical of Hungarian mountain streams (with regards of concentration of Ca^{2+} and HCO_3^-, water hardness, pH, O_2 consumption and O_2 saturation), however, anthropogenous influence strongly modifies them at certain periods (Table 2). Out of the two streams, the Malom Stream of Dömös is the less disturbed. Concentrations of most of the chemical ingredients indicative of pollution (NH_4^-, NO_2^-, NO_3^-, Cl^-) signal the worsening quality of the water only near the mouth (Berky, 1979). Anthropogenous influence is significant at the middle and lower reach of the Bükkös Stream. Due to the high level of organic pollution, at times the stream is completely dead, only some Diptera larvae can be found.

As a result of this survey, 2 Nemathelminthes, 4 Annelida, 5 Mollusca and 91 Arthropoda taxa could be shown. Highest numbers of taxa are the larvae of hemihydrobiont (Berczik, 1973) insect orders: 19 Ephemeroptera, 10 Plecoptera and 33 Trichoptera taxa were identified. The above orders, especially the *Gammarus fossarum* and the Simuliida larvae represent the highest numbers of individuals. In the summer, in quiet ponds of the middle reach, several Coleoptera taxa were also found.

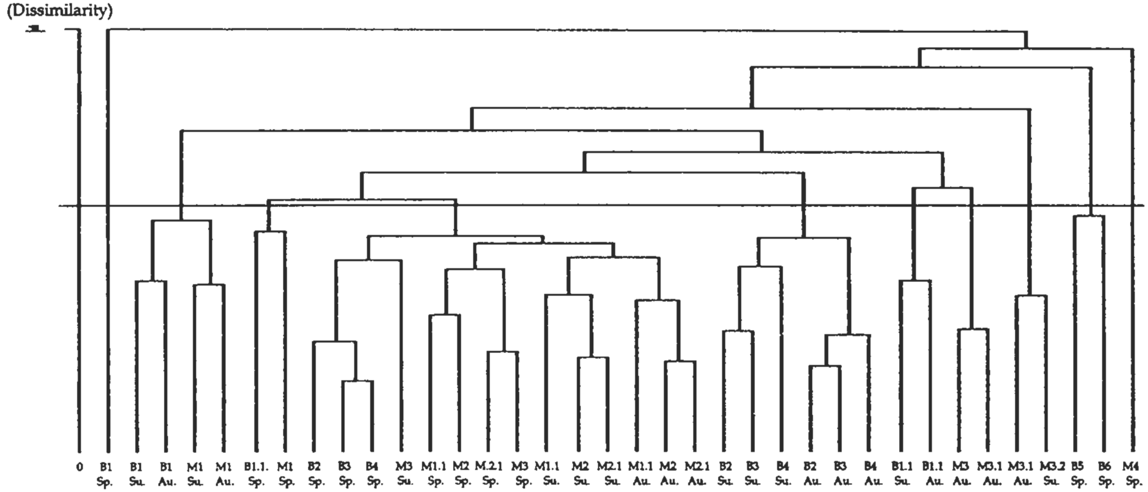

Fig. 4. Dendrogram of the macroinvertebrates based on cluster analysis (Sørensen index). (B1-B6: sampling sites in Bükkös Stream; M1-M4: sampling sites in Malom Stream; Sp. = spring, Su. = summer, Au. = autumn

Table 3. Species collected from Bükkös Stream

Sampling sites and dates of samplings Taxa:	B6	B5	B4	B3	B2	B1. 1	B1	'95. 07. 19.	'95. 10. 25.	'96. 04. 30.
Tubifex sp.	-	-	-	-	-	-	19	7	12	-
Erpobdella octoculata L.	-	-	-	-	-	-	2	2	-	-
Erpobdella monostriata G.	-	-	-	-	-	-	3	2	1	-
Bythinia tentaculata L.	-	-	-	-	-	-	3	-	3	-
Physa fontialis L.	-	-	-	-	-	-	4	-	4	-
Ancylus fluviatilis O. F. Müller	-	-	78	4	13	-	-	3	32	60
Pisidium sp.	-	-	-	-	-	-	62	35	27	-
Astacus torrentium Schrank	-	-	-	2	1	-	-	2	1	-
Gammarus fossarum L.	-	-	419	959	661	215	5	462	610	118
Gammarus roeseli Gerv.	-	-	-	-	-	1	-	-	1	-
Ephemera danica Müll.	-	-	-	3	2	-	-	2	-	3
Baetis sp.	-	-	62	80	107	23	16	30	67	191
Cloeon dipterum L.	-	-	1	1	4	9	1	8	6	2
Cloeon rufulum Müll.	-	-	12	10	14	3	4	2	6	35
Procloeon bifidum Bgtss.	-	-	2	2	1	-	-	2	-	3
Caenis macrura Steph.	-	-	-	5	14	3	-	12	-	10
Habrophlebia fusca Curt.	-	-	4	1	1	-	-	2	-	4
Habrophlebia lauta Mc.L.	-	-	2	2	-	1	-	2	-	3
Habroleptoides modesta Hag.	-	-	3	2	1	-	-	3	3	-
Ephemerella ignita Poda	-	-	6	1	3	-	-	8	-	2
Epeorus assimilis Etn.	-	-	2	7	4	1	-	-	-	14
Ecdyonurus fluminum Pict. (?)	-	-	2	3	2	-	-	1	4	2
Ecdyonurus venosus Fabr.	-	-	51	42	35	12	-	26	110	4
Ecdyonurus subalpinus Klp. (?)	-	-	7	4	3	-	-	4	9	1
Ecdyonurus sp.	-	-	18	8	5	2	-	7	25	3
Heptagenia lateralis Curt.	-	-	-	3	2	-	-	-	-	5
Heptagenia sp.	-	-	-	3	2	-	-	2	-	3
Rhitrogena semicolorata Curt.	-	-	3	41	64	12	-	-	3	117
Rhitrogena sp.	-	-	3	19	23	3	-	3	5	40
Nemoura flexuosa Aub.	8	22	14	29	8	1	-	2	-	80
Nemoura sp.	6	10	7	20	3	2	-	1	3	44
Leuctra digitata Kempny	-	1	4	1	-	-	-	1	-	5
Leuctra hippopus Kempny	-	2	1	4	-	-	-	-	1	5
Leuctra sp.	2	3	3	6	1	-	-	2	-	13
Capnia bifrons Newm.	-	2	13	12	1	-	-	-	-	28
Chloroperla sp.	-	-	4	2	7	1	-	-	-	14
Isoperla sp.	-	-	2	4	3	-	-	-	-	9
Perla burmeisteriana Claass.	-	-	8	4	-	-	-	1	-	11
Gerris paludum F.	-	-	-	5	4	-	-	-	-	9
Sialis fuliginosa Pict.	-	-	3	3	1	-	-	3	4	-

Table 3. (Continued)

Sampling sites and dates of samplings Taxa:	B6	B5	B4	B3	B2	B1 1	B 1	'95. 07. 19.	'95. 10. 25.	'96. 04. 30.
Platambus maculatus L.	-	-	3	2	2	-	-	6	-	1
Hydaticus transversalis Pontopp.	-	-	1	-	-	-	-	1	-	-
Gaurodytes bipustulatus L.	-	-	-	-	2	-	-	2	-	-
Dytiscus marginalis L.	-	-	-	-	1	-	-	1	-	-
Dytiscus sp.	-	-	3	1	1	-	-	2	2	1
Gyrinus substriatus L.	-	-	13	9	12	-	-	22	12	-
Orectochilus villosus Fbr.	-	-	1	-	-	-	-	1	-	-
Rhyacophila tristis Pict.	-	-	1	-	1	-	-	-	2	-
Rhyacophila fasciata Hag.	-	-	4	9	5	1	-	3	5	11
Glossosoma vernale Pict.	-	-	1	-	-	-	-	1	-	-
Cyrnus trimaculatus Curt.	-	-	1	-	-	-	-	-	1	-
Polycentropus flavomaculatus Pict.	-	-	5	7	4	1	-	3	11	3
Plectronemia conspersa Curt.	-	2	15	7	5	-	-	11	11	7
Plectronemia sp.	-	1	2	3	-	-	-	-	3	3
Lype reducta Hag.	-	-	-	1	-	-	-	-	1	-
Ecnomus tenellus Ramb.	-	-	3	2	3	-	-	-	-	8
Hydropsyche angustipennis Curt.	-	-	11	22	35	6	-	7	9	58
Hydropsyche pellucidula Curt.	-	-	1	6	7	1	-	1	2	12
Hydropsyche instabilis Curt.	-	-	-	2	2	-	-	-	1	3
Hydropsyche sp.	-	-	3	9	8	1	-	2	5	14
Grammotaulius nigropunctatus Retz	-	13	9	17	39	6	-	-	-	84
Chaetopteryx fusca Brau.	-	-	12	2	3	-	-	-	17	-
Limnephilus lunatus Curt.	-	1	1	2	-	-	-	1	-	3
Limnephilus affinis Curt.	4	3	16	5	2	1	-	3	1	27
Limnephilus extricatus Mc.L.	1	-	1	1	-	-	-	-	-	3
Limnephilus vittatus Fabr.	3	2	-	-	-	-	-	-	-	5
Limnephilus griseus L.	7	14	9	11	3	-	-	2	-	42
Limnephilus ignavus Mc.L.	-	-	4	1	3	-	-	8	-	-
Limnephilus sp.	8	24	44	38	16	1	-	16	1	114
Ironoquia dubia Steph.	-	4	12	3	-	-	-	-	-	19
Mycropterna nycterobia Mc.L.	-	-	1	3	1	-	-	-	-	5
Mycropterna sp.	-	-	2	1	-	-	-	-	-	3
Stenophilax permistus Mc.L	-	1	9	7	1	-	-	-	-	18
Halesus digitatus Schr.	-	-	13	10	3	-	-	-	-	26
Sericostoma personatum Spence	-	-	11	8	6	-	-	-	-	25
Tipulidae	4	1	5	-	-	-	-	2	2	6
Simuliidae	5	8	-	3	3	56	43	72	21	25
Tanypodinae	-	-	3	5	4	-	-	3	6	3
Chironominae	3	-	26	13	17	66	77	100	37	65
Orthocladiinae	-	-	14	14	19	8	-	16	8	31
Hydrachna sp.	-	-	-	22	36	-	-	-	-	58

Table 4. Species collected from Malom Stream of Dömös

Sampling sites and dates of samplings Taxa:	M 4	M3. 2	M3. 1	M 3	M2. 1	M 2	M1. 1	M 1	'95 07. 08-09.	'95 11. 02.	'96 04. 17.
Gordius aquaticus L.	-	4	-	-	-	-	-	-	4	-	-
Parachordodes tolosanus (Duj.)	-	1	-	-	-	-	-		1	-	-
Tubifex sp.	-	11	-	-	-	-	-	38	20	19	10
Trocheta bykowskii G.	-	4	1	1	-	-	-	-	6	-	-
Erpobdella octoculata L.	-	-	-	-	-	-	-	7	2	2	3
Erpobdella monostriata G.	-	-	-	-	-	-	-	1	-	-	1
Bythinia tentaculata L.	-	-	-	-	-	-	-	10	3	5	2
Radix peregra O. F. Müller	-	-	-	-	-	-	-	16	8	7	1
Physa fontialis L.	-	-	-	-	-	-	-	3	-	3	-
Ancylus fluviatilis O. F. Müller	-	-	-	-	-	-	-	1	-	-	1
Astacus torrentium Schrank	-	-	-	5	10	3	-	-	11	5	2
Gammarus fossarum L.	-	37	85	224	281	304	600	32	323	1098	142
Gammarus tatrensis Wrzejn.	-	-	-	-	1	6	9	-	11	3	2
Gammarus roeseli Gerv.	-	-	-	-	-	-	1	-	-	1	-
Ephemera danica Müll.	-	-	-	-	2	5	2	-	2	4	3
Baetis sp.	-	-	1	25	14	21	16	22	28	32	39
Cloeon dipterum L.	-	-	-	4	3	3	5	3	13	3	2
Cloeon rufulum Müll.	-	-	-	6	5	1	11	3	7	13	6
Procloeon bifidum Bgtss.	-	-	-	4	6	2	-	3	-	-	15
Caenis macrura Steph.	-	-	-	4	17	7	1	1	25	4	1
Habrophlebia fusca Curt.	-	-	-	1	1	-	-	-	2	-	-
Habrophlebia lauta Mc.L.	-	-	-	1	1	-	-	-	2	-	-
Habroleptoides modesta Hag.	-	-	-	2	4	2	5	1	-	4	10
Ephemerella ignita Poda	-	-	-	-	1	1	1	-	3	-	-
Epeorus assimilis Etn.	-	-	-	6	4	5	89	1	-	90	15
Ecdyonurus venosus Fabr.	-	2	8	46	24	17	9	29	75	55	5
Ecdyonurus sp.	-	-	2	19	8	8	3	11	20	17	14
Heptagenia lateralis Curt.	-	-	5	8	17	16	5	-	24	11	16
Heptagenia sp.	-	-	6	9	9	10	3	-	19	3	15
Rhitrogena semicolorata Curt.	-	-	18	60	31	32	31	16	5	90	93
Rhitrogena sp.	-	-	2	21	12	17	11	7	3	19	48
Calopteryx virgo L.	-	-	-	-	-	-	-	6	-	6	-
Nemoura flexuosa Aub.	-	-	1	8	22	15	19	10	7	10	58
Nemoura sp.	2	-	-	5	13	10	8	3	3	6	32
Leuctra digitata Kempny	-	-	-	4	6	2	3	1	-	5	11
Leuctra hippopus Kempny	-	-	-	1	5	2	3	1	-	5	7
Leuctra sp.	-	-	1	6	21	6	6	6	1	17	28
Capnia bifrons Newm.	-	-	-	1	7	2	2	-	3	3	6
Chloroperla sp.	-	-	-	-	-	8	10	1	-	7	12
Isoperla grammatica Poda	-	-	-	1	2	1	-	-	-	-	4
Isoperla sp.	-	-	-	1	2	1	-	-	-	-	4
Perla burmeisteriana Claass.	-	-	-	3	-	-	6	-	-	-	9
Nepa cinerea L.	-	-	-	-	-	-	-	12	11	1	-
Sialis fuliginosa 7	-	-	-	1	4	-	1	-	3	2	1

Table 4. (Continued)

Sampling sites and dates of samplings Taxa:	M 4	M3. 2	M3. 1	M 3	M2. 1	M 2	M1. 1	M 1	'95. 07. 08-09.	'95. 11. 02.	'96. 04. 17.
Dytiscus sp.	-	1	1	3	-	-	-	-	2	2	1
Gyrinus substriatus L.	-	-	-	3	1	-	-	-	-	4	-
Hydroporus planus Fbr.	-	7	2	1	-	-	-	-	10	-	-
Hydrobius fuscipes L.	-	-	1	-	-	-	-	-	1	-	-
Helodes minuta L.	-	-	1	-	2	-	-	-	1	-	2
Helmis maugei Bedel.	-	-	-	1	-	-	-	-	1	-	-
Rhyacophila tristis Pict.	-	-	-	-	-	1	1	-	-	-	2
Rhyacophila fasciata Hag.	-	-	-	-	-	2	8	-	2	-	8
Glossosoma vernale Pict.	-	-	-	-	-	-	284	37	-	-	321
Agapetus sp.	-	-	-	-	-	2	16	3	-	-	21
Synagapetus sp.	-	-	-	-	-	1	11	4	-	-	16
Hydroptila sp.	-	-	-	-	-	-	2	1	3	-	-
Philopotamus montanus Donov.	-	-	1	-	-	1	1	-	1	-	2
Polycentropus flavomaculatus Pict.	-	-	-	-	1	1	-	-	-	2	-
Plectronemia conspersa Curt.	-	-	1	3	2	2	4	1	6	4	3
Plectronemia sp.	-	-	-	1	2	1	-	-	-	2	2
Ecnomus tenellus Ramb.	-	-	-	-	1	-	-	-	-	-	1
Hydropsyche angustipennis Curt.	-	-	3	11	11	6	23	7	10	12	39
Hydropsyche pellucidula Curt.	-	-	-	2	3	4	3	1	3	3	7
Hydropsyche instabilis Curt.	-	-	-	-	1	-	1	-	-	-	2
Hydropsyche sp.	-	1	5	12	10	9	9	2	19	8	21
Grammotaulius nigropunctatus Retz	11	4	1	14	6	16	35	40	11	-	116
Chaetopteryx fusca Brau.	-	-	-	-	-	4	8	-	-	-	12
Limnephilus flavicornis Fabr.	-	-	-	7	4	3	2	-	4	-	12
Limnephilus vittatus Fabr.	-	-	-	1	-	-	-	-	-	-	1
Limnephilus griseus L.	-	-	3	5	2	1	1	-	7	-	5
Limnephilus ignavus Mc.L.	8	-	-	9	11	5	6	1	9	-	31
Limnephilus sp.	3	1	2	21	16	21	11	13	33	-	55
Mycropterna nycterobia Mc.L.	-	-	-	1	1	-	3	-	2	-	3
Mycropterna sp.	-	-	-	-	-	-	7	2	-	-	9
Stenophilax permistus Mc.L.	-	-	-	1	3	-	5	-	3	-	6
Halesus digitatus Schr.	-	-	-	-	-	-	9	-	-	-	9
Goera sp.	-	-	5	3	-	2	-	-	10	-	-
Silo pallipes Fabr.	-	-	-	-	5	12	8	-	11	-	14
Tipulidae	3	-	4	-	5	-	-	1	3	4	6
Aedes sp.	-	-	-	-	-	-	-	13	13	-	-
Culex sp.	-	-	-	-	-	-	-	7	7	-	-
Simuliidae	-	-	-	2	28	51	454	458	699	58	194
Tanypodinae	2	-	-	3	1	5	1	-	7	-	5
Chironominae	8	12	1	19	4	5	11	45	41	47	24
Orthocladiinae	1	2	1	8	6	20	8	-	18	9	19
Crysops sp.	-	-	-	-	-	-	-	1	-	-	1

Table 5. Presence of holohydrobiont taxa

Bükkös Stream

Sampling sites →	B6	B5	B4	B3	B2	B1.1	B1
Date of sampling →	07. 19, 1995						
Number of total taxa	-	-	22	26	21	10	7
Holohydrobiont taxa	-	-	7	5	6	1	4
Holohydrobiont %	-	-	31.8%	19.2%	28.6%	10.0%	47.1%
Date of sampling →	10. 25, 1995						
Number of total taxa	-	-	22	18	17	8	10
Holohydrobiont taxa	-	-	4	3	3	1	6
Holohydrobiont %	-	-	18.2%	16.7%	17.6%	12.5%	60.0%
Date of sampling →	04. 30, 1996						
Number of total taxa	6	10	31	37	32	16	2
Holohydrobiont taxa	0	0	4	3	2	1	0
Holohydrobiont %	0%	0%	12.9%	8.1%	6.3%	6.3%	0%

Malom Stream

Sampling sites →	M4	M3.2	M3.1	M3	M2.1	M2	M1.1	M1
Date of sampling →	07. 08-09, 1995							
Number of total taxa	-	13	15	26	24	19	18	18
Holohydrobiont	-	5	4	4	2	2	1	6
Holohydrobiont %	-	38.4%	26.7%	15.4%	8.3%	10.5%	5.6%	33.3%
Date of sampling →	11. 02, 1995							
Number of total taxa	-	-	10	15	22	17	17	15
Holohydrobiont	-	-	1	4	3	2	1	7
Holohydrobiont %	-	-	10.0%	26.7%	13.6%	11.8%	5.9%	46.7%
Date of sampling →	04. 17, 1996							
Number of total taxa	7	-	-	21	27	30	29	25
Holohydrobiont	0	-	-	3	2	1	1	7
Holohydrobiont %	0%	-	-	14.3%	7.4%	3.3%	3.4%	28.0%

Vast majority of the collected animals (Table 3 and 4) were of reophilous species, characteristic of fluvial communities, though at some sites and at some times there were typical standing water (limnophilous) organisms found in higher numbers. These latter appeared either in the ponds of widened bed sections (e.g. Chironominae, *Grammotaulius nigropunctatus*) or in the slower-flowing water of the mouth sections (e.g. *Tubifex* sp., *Nepa cinerea, Culex* spp.), sometimes in large numbers. Reophilous species can always be found in the ponds: there is satisfactory oxygen supply, not limiting the presence of sensitive, stream dweller organisms. At the undisturbed middle reaches of the streams, it is the local rate of flow that primarily determines the structure of the communities. Fauna of sections with a higher rate of flow (0.5-1 m/s) is characterized mostly by euryceleric species (e.g. *Rhyacophila fasciata, Epeorus assimilis, Rhitrogena semicolorata, Nemoura* sp., etc.), but species

Table 6. Numbers of species of the most numerous animal groups

Taxa:	Bükkös Stream	Malom Stream	Similar species
Hirudinoidea	2	3	2
Gastropoda	3	4	3
Decapoda	1	1	1
Amphipoda	2	3	2
Ephemeroptera	15	13	13
Plecoptera	5	6	5
Coleoptera	6	6	1
Trichoptera	20	24	17

apparently not sensitive to the rate of flow also appear at some periods of time (e.g. *Ecdyonurus* ssp., *Isoperla grammatica*; Andrikovics & Kéri, 1991).

There are few taxa found in the slowly flowing, warm and often polluted water of the mouth areas, usually Diptera larvae (e.g. Simuliidae, Chironominae) are dominant. Influence of the Danube is also significant: several taxa characteristic of the Danube (e.g. *Erpobdella* spp., *Pisidium* sp., *Bythinia tentaculata*) were found at the lower part of both streams. Only once, at the mouth of the Malom Stream were a middle reach community found (17 April 1996), which was most probably due to the longer term abundance of water.

Uppermost part of the streams is not populated by many species either, reason for which can be the fact that the bed dries up quickly. These parts have water only in the spring, so only some hemihydrobiont organisms (e.g. *Nemoura* spp., *Limnephilus* spp.) are able to dwell here. Presence of holohydrobiont taxa is strongest at the middle reach and at the mouth (Table 5). The more sensitive holohydrobiont stream-dweller organisms (e.g. *Trocheta bykowskii, Gammarus fossarum*) are probably not able to tolerate the worse water quality at the lower reach.

Fauna compositions of the two surveyed streams are similar (Table 6). Results of the cluster analysis (Fig. 4) indicate that stream habitats are present along the stream according to the mosaic principle, which corresponds with the results of earlier studies (Andrikovics, 1991; Gróf, 1967; Simonyi, 1981). Isolation of the clusters supports the findings written above. Summer and autumn samples from the mouth sites of the two streams, summer and autumn samples from the middle reach of the Bükkös Stream and spring samples from the upper reach represent separate clusters. The biggest cluster is made up of the samples taken from the middle reach of the Malom Stream, only 3 spring sampling sites of the Bükkös Stream (B2, B3, and B4) belong to this cluster. Interestingly, the spring sample from the M1 site was put to the

Table 7. Long-term changes: Ephemeroptera species

Investigations	Bükkös Stream					Malom Stream	
	1951	1965	1978-9	1985-8	1995-6	1985-8	1995-6
Species	A*	A*	A*	A**	Cs*	A**	Cs*
Ephemera danica Müll.	-	-	++	++	+	+	+
Baetis sp.	+	+	++	+	++	++	++
Centroptilum luteolum Müll.	-	-	+	++	-	+	-
Centroptilum pennulatum Etn.	-	-	+	-	-	-	-
Cloeon dipterum L.	+	-	-	++	++	+	+
Cloeon rufulum Müll.	-	-	-	-	+	-	++
Procloeon bifidum Bgtss.	-	-	+	-	+	+	+
Caenis macrura Steph.	-	-	++	++	++	+	++
Paraleptophlebia submarginata Steph.	+	-	+	+	-	-	-
Habrophlebia fusca Curt.	-	+	-	+	+	+	+
Habrophlebia lauta Mc.L.	-	++	+	+	+	+	+
Habrophleptoides modesta Hag.	-	+	+	+	+	-	+
Ephemerella ignita Poda	-	++	++	++	+	+	+
Siphlonurus lacustris Etn.	-	+	+	+	-	-	-
Epeorus assimilis Etn.	-	-	++	++	+	++	++
Ecdyonurus fluminum Pict. (?)	+	-	+	+	+	-	-
Ecdyonurus venosus Fabr..	-	-	+	+	++	+	++
Ecdyonurus subalpinus Klp. (?)	-	+	+	+	+	-	-
Ecdyonurus sp.	-	++	++	++	+	+	++
Heptagenia lateralis Curt.	-	+	+	+	+	+	++
Heptagenia sp.	+	++	++	++	+	+	+
Rhitrogena semicolorata Curt.	-	-	+	+	++	+	++
Rhitrogena sp.	++	++	++	++	++	+	++

*A.: Andrikovics Cs.: Csörgits * larvae ** larvae or imago + 1-2 indiv. ++ frequent*

same cluster with the B1.1 site. Pollution of the Bükkös Stream is most probably the main cause behind the occasional low number of species in the mouth area. The two clusters with only one element are the ones with the least number of species (B1 Sp, M4 Sp).

Information collected on the Bükkös Stream and the Malom Stream of Dömös can be compared easily to the results of earlier studies, making it possible to register and evaluate the long-term changes, which are in the focus of research nowadays. These studies were made at the same sites in most of the cases, and were primarily focusing on the most frequent hemihydrobiont insect orders (Ephemeroptera, Plecoptera and Trichoptera), so comparisons are limited to these taxa. To demonstrate these long-term changes, these results were fit to the tables published by Andrikovics (1991; Tables 7, 8, 9).

Table 8. Long-term changes: Plecoptera species

Investigations	Bükkös Stream					Malom Streem	
	1951	1965	1978-9	1985-8	1995-6	1985-8	1995-6
Species	A*	A*	A*	A**	Cs*	A**	Cs*
Brachyptera risi Mort.	-	-	+	+	-	+	-
Protonemura intricata Ris	-	-	+	+	-	-	-
Protonemura praecox Mort.	-	-	+	+	-	-	-
Nemoura flexuosa Aub.	++	++	++	++	++	++	++
Nemoura cambrica Steph.	-	-	-	+	-	-	-
Nemoura sp.	+	+	+	+	++	+	+
Nemurella picteti Klap.	-	-	+	++	-	+	-
Leuctra pseudosignifera Aub.	-	-	-	+	-	-	-
Leuctra digitata Kempny	-	-	+	++	++	+	+
Leuctra hippopus Kempny	-	-	+	+	+	-	+
Leuctra sp.	+	+	+	+	+	+	++
Capnia bifrons Newm.	-	-	++	++	++	++	+
Isoperla grammatica Poda	-	-	+	+	+	+	+
Isoperla sp.	-	-	+	+	+	+	+
Perla burmeisteriana Claass.	+	-	++	++	++	-	+
Perla marginata Panz.	-	-	-	+	-	-	-
Chloroperla sp.	-	-	++	++	++	+	+

*A.: Andrikovics Cs.: Csörgits * larvae ** larvae or imago + 1-2 indiv. ++ frequent*

Surveys done by Andrikovics between 1985 and 1988 included collection of imagoes with light trap, so processed results contain several species that can be classified only as imagoes. Furthermore, we cannot exclude the possibility that representatives of some species did not swarm from the streams. Data make it clear that the mass species (with relatively low number of individuals) of the material collected in 1951 correspond to the overall picture of the current fauna. It is also instructive to notice that at that time sensitive rhitron organisms dwelt all along the streams, however, according to latest surveys there are scarcely any Ephemeroptera, Plecoptera and Trichoptera living at the upper parts of the two streams having water only temporarily and at the polluted lower reach of the Bükkös Stream (Andrikovics, 1991).

Out of the Ephemeroptera species collected with my samples, only 3 were missing from the area in the latest decade, while I several times managed to collect *Cloeon rufulum*, which did Gróf (1967) only find here. 7 out of the listed Plecoptera taxa were not detected in the streams with my samplings, however, 3 species of these were only represented by imagoes collected with the light trap. On the other hand, I did not detect 19 out of the Plecoptera taxa

Table 9. Long-term changes: Trichoptera species

Investigations	Bükkös Stream					Malom Stream	
	1951	1965	1978-9	1985-8	1995-6	1985-8	1995-6
Species	A*	A*	A*	A**	Cs*	A**	Cs*
Rhyacophila tristis Pict.	+	+	++	++	+	-	+
Rhyacophila fasciata Hag.	+	++	++	++	++	+	+
Glossosoma vernale Pict.	-	-	-	-	+	-	++
Agapetus sp.	-	+	-	+	+	-	+
Synagapetus sp.	-	+	++	++	+	-	+
Hydroptila sp.	+	+	-	+	+	+	+
Philopotamus montanus Donov.	-	-	-	+	+	-	+
Cyrnus trimaculatus Curt.	-	-	-	+	-	-	-
Polycentropus flavomaculatus Pict.	+	+	+	++	++	+	+
Plectronemia conspersa Curt.	-	-	+	++	++	+	+
Plectronemia sp.	-	-	+	+	+	+	+
Neureclipsis bimaculata L.	-	-	+	+	-	-	-
Ecnomus tenellus Ramb.	-	-	-	++	+	-	+
Lype reducta Hag.	-	-	-	+	+	-	-
Tinodes rostocki Mc.L.	-	-	-	++	-	+	-
Hydropsyche angustipennis Curt.	+	+	+	+	++	+	++
Hydropsyche instabilis Curt.	+	+	+	+	+	+	+
Hydropsyche pellucidula Curt.	-	-	+	+	+	+	+
Hydropsyche fulvipes Curt.	-	-	-	+	-	-	-
Hydropsyche sp.	+	+	+	+	++	+	++
Cheumatopsyche lepida Pict. ✰	-	-	-	-	-	-	-
Phryganea grandis L. ✰✰	-	-	-	-	-	-	-
Athripsodes bilineatus L.	-	-	-	++	-	+	-
Trianodes bicolor Curt.	-	-	-	+	-	-	-
Glyphotaulius pellucidus Retz.	-	-	-	+	-	+	-
Grammotaulius nigropunctatus Retz.	++	+	+	+	++	+	++
Chaetopteryx fusca Brau.	-	+	++	++	+	++	+

*A.: Andrikovics Cs.: Csörgits * larvae ** larvae or imago + 1-2 indiv ++ frequent*
✰ Dömös, 1928 ✰✰ Esztergom, 1961

that have been registered in the area, the cause of which can be again that the previous survey was partly done by using a light trap. In the case of thecaddisflies, species composition and numbers of individuals have definitely changed in the latest 10 years. Apart from the species not found, *Glossoma vernale* has appeared, which was mostly detected in this area in the streams of the Börzsöny Mountains up until now. *Chaetopteryx fusca, Silo pallipes* and some species of the genus *Limnephilus* became less frequent, while *Grammotaulius nigropunctatus* and *Hydropsyche angustipennis*

Table 9. (Continued)

Investigations **Species**	**Bükkös Stream**					**Malom Stream**	
	1951	1965	1978-9	1985-8	1995-6	1985-8	1995-6
	A*	A*	A*	A**	Cs*	A**	Cs*
Limnephilus flavicornis Fabr.	-	-	-	++	++	+	+
Limnephilus lunatus Curt.	-	-	-	++	+	+	-
Limnephilus affinis Curt.	-	+	-	++	++	+	-
Limnephilus bipunctatus Curt.	-	-	-	+	-	-	-
Limnephilus extricatus Mc.L.	-	-	-	+	+	-	-
Limnephilus sparsus Curt.	-	-	-	+	-	-	-
Limnephilus vittatus Fabr.	-	-	-	++	+	+	+
Limnephilus griseus L.	-	-	-	+	++	+	+
Limnephilus auricula Curt.	-	-	-	++	-	+	-
Limnephilus ignavus Mc.L.	-	-	-	+	++	+	++
Limnephilus sp.	+	++	++	++	++	++	++
Ironoquia dubia Steph.	-	-	-	+	+	-	-
Mycropterna testacea Gmel.	-	-	-	+	-	-	-
Mycropterna sequax Mc.L.	-	-	-	+	-	+	-
Mycropterna nycterobia Mc.L.	-	-	++	++	++	++	+
Anabolia furcata Brau.	-	-	+	++	-	+	-
Anabolia nervosa Leach	-	-	-	+	-	-	-
Stenophylax permistus Mc.L.	+	+	+	++	++	+	+
Halesus digitatus Schr.	+	++	++	++	++	+	+
Sericostoma personatum Spence	-	-	-	++	+	+	-
Goera pilosa Fabr.	-	-	-	++	-	-	-
Goera sp.	-	-	-	+	+	+	+
Silo pallipes Fabr.	-	-	-	++	+	+	+
Lithax obscurus Hag.	-	-	-	++	-	-	-
Crunoecia irrorata Curt.	-	-	-	+	-	-	-

*A.: Andrikovics Cs.: Csörgits * larvae ** larvae or imago + 1-2 indiv. ++ frequent*

became frequent. This latter appeared in mass also in the Morgó Stream in the Börzsöny (Berczik & Pham Ngoc, 1988).

Results of the survey, changes detected in the fauna composition indicate that increasing degradation of habitats is extremely strong at the polluted parts. Due to the habitats degrading and being destroyed even the species composition deform: the diverse, sensitive species disappear and only 1-2 taxa with broad tolerance take their place, therefore more regularly conducted surveys would give us more chance to reveal the dynamics of such processes.

Almost the whole of the Malom Stream of Dömös and the middle reach of the Bükkös Stream is characterized by diverse fauna community, which give a place for the sensitive rhitron organisms that became less frequent all over Europe, therefore definitely deserving protection.

Closing thoughts

As it was already shown by several other studies done in Hungary, there is a characteristic invertebrate fauna bound to the diverse habitats of streams of low mountains. Besides studying the diverse living conditions and varied animal communities, question of protecting biodiversity came into focus nowadays. Fauna changes of these small streams must be tracked by repeated surveys, analyzing the changes of the various anthropogenous influence (pollution, streambed control, etc.) in parallel. After the reference survey covering a whole year, at least in every 8-10 years control surveys are needed on the more important streams.

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A review of the Benhamiinae collection of The Natural History Museum, London (Oligochaeta: Acanthodrilidae)

By

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Abstract. During a visit to The Natural History Museum, London, in the spring of 1994, the author revised the material of the earthworm subfamily Benhamiinae. This report summarises that work, and gives descriptions of five new species: *Dichogaster* (*Dichogaster*) *calabarensis*, *Dichogaster* (*Diplothecodrilus*) *hindei*, *D.* (*Diplothecodrilus*) *oxtobyae*, *D.* (*Diplothecodrilus*) *simsi*, and *Eutrigaster* (*Graffia*) *maya* spp. nov.

One of the richest earthworm collections can be found in The Natural History Museum, London. It contains many type series belonging to different genera of the subfamily Benhamiinae. The collection also contains numerous other specimens from various localities of Africa and South America. So far only a part of this material has been identified. During the present investigations, each species was re-appraised, and previously unnamed specimens of the subfamily Benhamiinae were identified.

The subfamily Benhamiinae was erected by Michaelsen (1897a) to accommodate the earthworm genera with meronephric excretory system, duplicated gizzards and three pairs of calciferous glands. It was not clearly defined, so present day specialists can only guess whether it would have contained all of the closely related genera *Benhamia* Michaelsen, 1889; *Dichogaster* Beddard, 1888; *Microdrilus* Beddard, 1893 and *Millsonia* Beddard, 1894.

Michaelsen (1900) united all of the above genera under the name *Dichogaster* and placed them into the subfamily Trigastrinae Michaelsen, 1900. Later on, different authors placed this continuously increasing genus into various families or subfamilies (Stephenson, 1930; Omodeo, 1958; Jamieson, 1971; Sims, 1980), meanwhile the genus *Dichogaster* tripled its size and became a "catch-all" taxon. The repeated partial revisions (Omodeo, 1955,

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1958; Sims, 1987; Csuzdi & Zicsi, 1991) have not solved its taxonomic problems. However, Csuzdi and Zicsi (1994a), Csuzdi (1995, 1996) published detailed revisions of this group and proposed the following system.

Family ACANTHODRILIDAE Claus, 1880, emend. Csuzdi, 1996

Diagnosis. Body cylindrical, dorsal pores present. Male pores usually paired on *xvii* with paired prostatic pores on both *xvii* and *xix*, or paired on *xvii* or *xix* with a single pair of prostatic pores on the same segment. Prostatic pores rarely more numerous or more posteriorly. Usually 1-3 oesophageal gizzards (occasionally rudimentary or absent), intestinal gizzards absent. Calciferous glands common, supra-oesophageal vessel often present. Prostatic glands tubular in structure of ectodermal origin with central canal. Excretory system holonephridial, or meronephridial with one pair of megameronephridia lying in the posterior part of the body.

Subfamily *BENHAMIINAE* Michaelsen, 1897, emend. Csuzdi, 1996

Diagnosis. Male terminalia acanthodriline, sometimes with microscolecine or balantine reduction, rarely with 3 pairs of prostatic glands. Several stalked extramural calciferous glands paired on the oesophagus behind the genital segments. Excretory system holonephridial, or meronephridial with one pair of caudal megameronephridia.

Tribe Benhamiini Michaelsen, 1897

Diagnosis. Excretory system meronephric with caudal megameronephridia. Two or three stalked extramural calciferous glands paired on the oesophagus between segments *xiv-xvii*. Two simple or one fused gizzards before the genital segments, rarely vestigial.

Genus *Agastrodrilus* Omodeo & Vaillaud, 1967

Agastrodrilus dominicae Lavelle, 1981

Material examined: *Agastrodrilus dominicae*, Paratypes; Ivory Coast, shrub savanna, forest close to Foro Foro; Leg. P. Lavelle; IX. 1980; Reg. No. BM(NH) 1981.3.1-4.

Agastrodrilus insolitus Sims, 1986

Material examined: *Agastrodrilus insolitus,* Syntypes; S.E. Ghana, under tomato plants Ada, Kanyanga; Leg. J. D. Plisko; Reg. No BM(NH) 1984.4.27-45; *Agastrodrilus insolitus;* S.E. Ghana, sugar cane plantations, Kpong; Leg. J.D. Plisko; Reg. No. BM(NH) 1984.4.46-47 (Sims, 1986); S.E. Ghana, cultivated field, Ada Koloidaw; Leg. J.D. Plisko; Reg. No. BM(NH) 1984.4.48-52 (Sims, 1986).

Agastrodrilus lavellei Sims, 1986

Material examined: *Agastrodrilus lavellei,* Syntypes; Ghana, S.E., bush near Achimota (N. of Accra); Leg. J. D. Plisko; Reg. No. BM(NH) 1984.4.456-467; *Agastrodrilus lavellei;* S.E. Ghana, bush near Achimota (N. of Accra); Leg. J. D. Plisko; Reg. No. BM(NH) 1984.4.468-471 (Sims, 1986); S.E. Ghana, Green Hill, Legon, Achimota; Leg. J.D. Plisko; 26.06.1965; Reg. No. BM(NH) 1984.4.472 (Sims, 1986); S.E.Ghana, Bodonya, New Achimota Village; Leg. J.J. Niles; Reg. No. BM(NH) 1968.2.30. (Sims, 1986).

Agastrodrilus opisthogynus Omodeo & Vaillaud, 1967

Material examined: *Agastrodrilus opisthogynus;* Ivory Coast, Lamto, 60 km south of Toumodi; Leg. P. Lavelle; 1969; Reg. No. BM(NH) 1970.4.1-4.

Remarks. The specimens are desiccated with no taxonomic value.

Genus *Benhamia* Michaelsen, 1889, emend. Csuzdi & Zicsi, 1994

Benhamia itoliensis Michaelsen, 1892

Syn.: *Benhamia itoliensis* var. *coerulea* Michaelsen, 1899 (Cognetti, 1909)
Benhamia johnstoni Beddard, 1901 (Cognetti, 1909)
Benhamia mollis Beddard, 1901 (Michaelsen, 1912)
Benhamia moorei Beddard, 1901 (Cognetti, 1909)
Dichogaster jaculatrix Baylis, 1915 (Stephenson, 1933)
Dichogaster itoliensis var. *minor* Stephenson, 1933 (Csuzdi, 1995)

Material examined: *Benhamia mollis,* Type; Nyanza Lake; Reg. No. BM(NH) 1904.10.5.659; *Benhamia moorei,* Type; Kurungu Mts. Lake Kivu; Reg. No. BM(NH) 1904.10.5.660; *Benhamia johnstoni,* Type; Ruwenzori, 6500 ft.; Leg. Sir Harry Johnston; Reg. No. BM(NH) 1902.1.21.1.

New records: British East Africa, Kabale, Bukoba; Leg. Loveridge; 4. I. 1923; Reg. No. BM(NH) 1924.10.20.1, 1 Ex.; Tanzania, Kigoma Region, Gombe Nat. Park near chimpanzee observation point; Leg. Ian Bryceson; 28. IX. 1981; Reg. No. BM(NH) 1982.9.4, 1 Ex.

Genus *Benhamiona* Csuzdi & Zicsi, 1994

Benhamiona balantina (Omodeo, 1958)

Material examined: *Benhamia balantina*; Ivory Coast, savanna on summit of Mt. Nimba, 1750 m; Leg. P. Lavelle; I. 1968; Reg. No. BM(NH) 1971.22.1.

Benhamiona budgetti (Beddard, 1900)

Material examined: *Benhamia budgetti*, Types; Gambia, McCarthy Island; Leg. Budgett; Reg. No. BM(NH) 1904.10.5.650-652; *Benhamia budgetti*; Gambia, Birkama Ba, 10 miles W. of Georgetown; Leg. & det. R.W. Sims; 5-7. X. 1964; Reg. No. BM(NH) 1966.30.2-10 (Sims, 1967); Gambia, Willigara, 13 miles W. of Georgetown; Leg. & det. R.W. Sims; 7. X. 1964; Reg. No. BM(NH) 1966.30.11-19 (Sims, 1967); Gambia, forest reserve Nyamba, 16 miles S. of Bathurst; Leg. & det. R.W. Sims; 23. IX. 1964; Reg. No. BM(NH) 1966.30.20-21 (Sims, 1967); Gambia, Jakali swamp, Sapu, 12 miles W. of Georgetown; Leg. & det. R.W. Sims; 3. X. 1964; Reg. No. BM(NH) 1966.30.37-45 (Sims, 1967); Gambia, Willigara, 13 miles W. of Georgetown; Leg. & det. R.W. Sims; 7. X. 1964; Reg. No. BM(NH) 1966.30.46-123 (Sims, 1967).

Benhamiona buettikoferii (Horst, 1884)

Syn.: *Acanthodrilus büttikoferii* Horst, 1884

New record: Liberia, Harbel; Leg. W.C. Osman Hill; 13. XI. 1961; Reg. No. BM(NH) 1961.30.1, 1 Ex.

Benhamiona esca (Stephenson, 1931)

Material examined: *Dichogaster esca* Types; Reg. No. BM(NH) 1930.9.16.10-11; *Dichogaster esca*; Gold Coast, Aburi, 25 km. N. of Accra; Leg. F.R. Irvine; Reg. No. BM(NH) 1932.9.28.3-4; Gold Coast, Tafo, Akim, closed forest; Leg. F.R. Irvine; I. 1939; Reg. No. BM(NH) 1949.12.12.25-26; Ghana, S.E., Prempeh College, Kumasi; Leg. M.A. Tazelaar; 17. XI. 1955; Reg. No. BM(NH) 1964.2.14 (Sims, 1965); Ghana, S.E. Tafo; Leg. M.A. Tazelaar; 17. X. 1952; Reg. No. BM(NH) 1964.2.1-3 (Sims, 1965); Ghana, Kunst, Kumasi; Leg. J.J. Niles; 18. VII. 1964; No. BM(NH) 1965.1.8-9.

New record: Gold Coast, Axim, open valley to Dunkwa; Leg. A.E. Kitson; 1915; Reg. No. BM(NH) 1917.5.13.3, 1 Ex.

Genus *Dichogaster* Beddard, 1888, emend. Csuzdi, 1996

Subgenus *Dichogaster* Beddard, 1888, emend. Csuzdi, 1996

Dichogaster (Dichogaster) arcifera Omodeo, 1958

New record: Ivory Coast, Lamto 60 km S. of Toumodi, beside Bandama stream, gallery forest; Leg. P. Lavelle; 1969; Reg. No. BM(NH) 1970.4.44-46, 2 Ex., AF/3308, 1 Ex.

Dichogaster (Dichogaster) baeri Sciacchitano, 1952

Material examined: Ivory Coast, Lamto, gallery forest; Leg. P. Lavelle; Reg. No. BM(NH) 1971.22.59-69.

Dichogaster (Dichogaster) ehrhardti (Michaelsen, 1898)

Syn.: *Dichogaster ehrhardti* var. *linneli* Michaelsen, 1910 (Csuzdi, 1995).

Material examined: Bissao, W. Africa; Leg. E. Cambridge; Reg. No. BM(NH) 1924.3.1.250-254; Nigeria, Oyo state, Univ. Ile Ife campus; Leg. A. O. Segun; X. 1976; Reg. No. BM(NH) 1976.24.4; Gambia, Willigara, 13 miles W. of Georgetown; Leg. R.W. Sims; 7. X. 1964; Reg. No. BM(NH) 1966.30.224-238 (Sims, 1967); Gambia, Birkama Ba, 10 miles W. of Georgetown; Leg. R.W. Sims; 7. X. 1964; Reg. No. BM(NH) 1966.30.219-221 (Sims, 1967); Gambia, Bakau, 7 miles W. of Bathurst; Leg. R.W. Sims; 10. X. 1964; Reg. No. BM(NH) 1966.30.217 (Sims, 1967); Gambia, Jakali swamp, Sapu, 12 miles W. of Georgetown; Leg. R.W. Sims; 5. X. 1964; Reg. No. BM(NH) 1966.30.222-223 (Sims, 1967); Gambia, Abuko reservoir 10 miles S. of Bathurst; Leg. R.W. Sims; 29. IX. 1964; Reg. No. BM(NH) 1966.30.213-216 (Sims, 1967); Gambia, Birkama, 20 km S. of Bathurst; Leg. R.W. Sims; 25. IX. 1964; Reg. No. BM(NH) 1966.30.218 (Sims, 1967).

New records: Nigeria, around zool. garden, Univ. of Ile Ife Oyo state; Leg. A.O. Segun; Reg. No. BM(NH) 1978.23.1-2, 2 Ex.; Nigeria, Nsukka, zool. garden; Leg. A.O. Segun; 2. IX. 1977; Reg. No. BM(NH) 1978.44.4, 1 Ex.; Nigeria, Nsukka, zool. garden; Leg. A.O. Segun; 10. VIII. 1977; Reg. No. BM(NH) 1978.44.3, 1 Ex.; Ivory Coast, Lamto, 60 km. S. of Toumodi, beside Bandama stream, gallery forest; Leg. P. Lavelle; 1969; Reg. No. BM(NH) 1970.4.39-43, 5 Ex.

Dichogaster (Dichogaster) greeffi Michaelsen, 1902

Syn.: *Dichogaster thomeana* Cognetti, 1910 (Csuzdi, 1995).

New record: Sao Thome island, Gulf of Guinea; Leg. W.H.T Tams; 1. XI. 1932; Reg. No. BM(NH) 1935.1.9.1, 1 Ex.

Dichogaster (Dichogaster) ligula Sims, 1964

Material examined: *Dichogaster ligula*, Holotype; Sierra Leone, gravel bed of stream entering R. Aberdeen close to sea, Freetown; Leg. J. Phipps; 1956; Reg. No. BM(NH) 1964.10.1; *Dichogaster ligula*, Paratypes; Sierra Leone, gravel bed of stream entering R. Aberdeen close to sea, Freetown; Leg. J. Phipps; 1956; Reg. No. BM(NH) 1964.10.3-8; *Dichogaster ligula*; Sierra

Leone, gravel bed of stream entering R. Aberdeen close to sea, Freetown; Leg. J. Phipps; 1956; Reg. No. BM(NH) 1964.10.10-30 (belonging to the type series).

Dichogaster (Dichogaster) terraenigrae Omodeo & Vaillaud, 1967

Material examined: Ivory Coast, scrub savanna forest, close to Foro Foro; Leg. P. Lavelle; IX. 1980; Reg. No. BM(NH) 1981.3.10-11; Ivory Coast, under palm trees, savanna Lamto, 60 km S. of Toumodi; Leg. P. Lavelle; 1969; Reg. No. BM(NH) 1970.4.31-33.

Remarks: Previously, Csuzdi and Zicsi (1994a) transferred this species to the genus *Benhamia* on the condition that it required further corroboration. The recent investigations of the excretory system on the specimens housed in the Museum showed that this species undoubtedly belongs to the genus *Dichogaster (Dichogaster).*

Dichogaster (Dichogaster) titillata Sims, 1967

Material examined: *Dichogaster titillata,* Syntypes; Gambia, Willigara, 7-9. X. 1964; Reg. No. BM(NH) 1966.30.240-426, 1966.30.429-480.

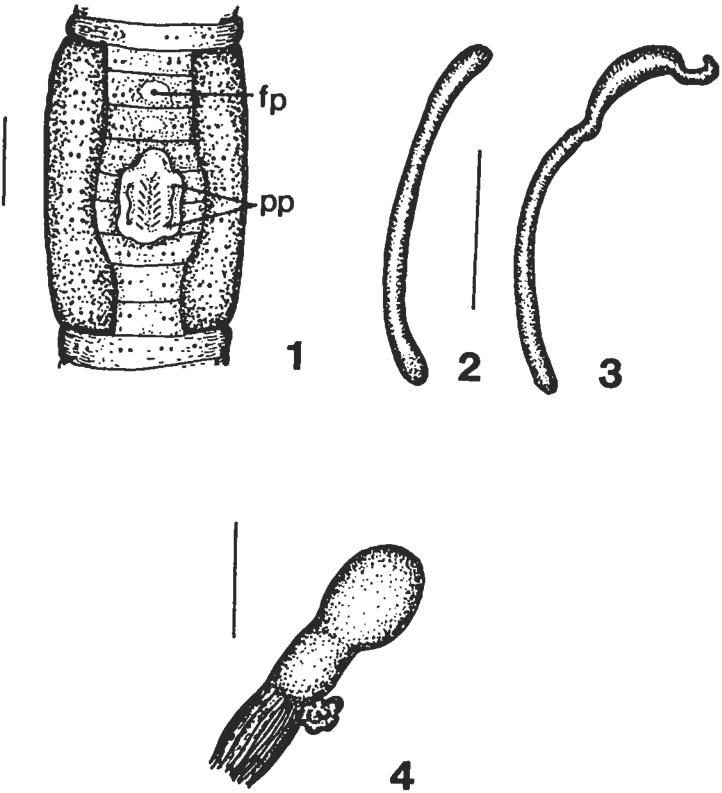
Dichogaster (Dichogaster) wenkei (Michaelsen, 1931)

Syn.: *Dichogaster agilis* Omodeo & Vaillaud, 1967 (Csuzdi, 1995)

Material examined: *Dichogaster agilis*; Ivory Coast, Bandama Stream, Lamto, 60 km S. of Toumodi; Leg. P. Lavelle; 1969; Reg. No. BM(NH) 1970.4.19-22.

Dichogaster (Dichogaster) calabarensis sp. n.

External characters. Length of the Holotype 120 mm, diameter just after the clitellum 2 mm, number of segments 244. Paratypes are 105-115 mm in length, 2 mm in diameter, number of segments 238-251. The colour of the preserved specimens is yellowish-brown. Prostomium withdrawn, the first dorsal pore occurs in intersegmental furrow 13/14. Setae are closely paired and all on the ventral surface of the body. Setal formula at segment *xxiv*: *aa:ab:bc:cd:dd* = 3:1:4:1:50. Female pore single, situated on segment *xiv* mid-ventral on an oval porophore. Two pairs of spermathecal pores are present in furrows 7/8 and 8/9 in setal lines *b*. Male pores are paired on segment *xviii* situated at the end of seminal grooves. Clitellum saddle-shaped, extends over segments *xiii-xxi*. There are one pair of prostatic pores on segment *xvii* in setal line connected with the male pores on each side by a bow-shaped seminal groove. Unpaired ventromedian genital papilla present on segment *xv* (Fig. 1).



Figs. 1–4. *Dichogaster (Dichogaster) calabarensis* sp. n. 1. Ventral view of the clitellar region; fp = female pore, pp = prostatic pores. 2. Smaller penial seta. 3. Larger penial seta. 4. Spermatheca. (Scale bar 1 mm)

Internal characters. The anterior septa to 7/8 are not recognizable. There are no septa notably strengthened. Two large distinct gizzards in segments *v* and *vi.* Calciferous glands are lamellate and paired in segments *xv-xvii.* The anterior pair is notably smaller than the others. Typhlosole arising in segment *xxi* is followed on both sides by a simple accessory ridge extending as far as the *xi*th segment. Paired lateral hearts are present in segments *x, xi* and *xii.* The excretory system is meronephridial; there are 5 sac-shaped meronephridia on each side of the intestine. In addition to meronephridia, there is a pair of ventromedian megameronephridia on the posterior part of the body. Testes and funnels are paired in segments *x* and *xi* closed into perioesophageal testis sacs. Two pairs of small seminal vesicles present in *xi, xii,* and a pair of large racemose ovaries suspending from the posterior face of septum 12/13. Ovarial funnels are small leading into a little ovisac in segment *xiv.* The two vasa deferentia of each side are easily seen entering the body wall in segment *xviii.*

One pair of tubular prostatic glands is present in *xvii.* They are long highly coiled tubes occupying 2-3 segments. Each prostate is accompanied by a penial setal sac containing two different types of mature seta. The larger seta is 3.1 mm in length, and at the middle 0.05 mm thick. Its ectal third is curved, sickle-shaped. The tip is sharply pointed and hooked. Under the curved part, the seta bears a very fine ornamentation of transversely arranged minute teeth. The second seta is smaller, 2.2 mm in length and at the middle 0.05 mm in diameter. Its tip is rounded knob-shaped. There is no ornamentation (Fig. 2—3). Two pairs of spermathecae present in segments *viii* and *ix* of almost equal size. The duct is short and about one-third diameter of the sac-shaped ampulla which is divided into two parts. The lower part of ampulla is slightly thinner than the upper one. There is a multilocular diverticulum arising from the junction of the ampulla and the duct (Fig. 4).

Remarks. This species is unique within the subgenus *Dichogaster* with its incomplete microscolecine reduction of the male terminalia.

Localities: Holotype; Nigeria, 27 km E. of Calabar, under rotten leaves; Leg. J.C. Reid; 1. IX. 1980; Reg. No. BM(NH) 1985.4.4. Paratypes; Nigeria, 27 km E. of Calabar, under rotten leaves; Leg. J. C. Reid; 1. IX. 1980; Reg. No. BM(NH) 1985.4.5-6, 2 Ex., AF/3317, 1 Ex.

Subgenus *Diplothecodrilus* Csuzdi, 1996

Dichogaster (Diplothecodrilus) aequatorialis (Michaelsen, 1896)

Syn.: *Dichogaster variabilis* Černosvitov, 1938 (Csuzdi, 1995)

Material examined: *Dichogaster variabilis,* Type; Mt. Elgon, Omo 20; 8. I. 1933; Reg. No. BM(NH) 1949.3.1.734-736.

Remarks: The type specimen is deposited in the Muséum national d'Histoire naturelle, Paris (Jamieson, 1975). In the Natural History Museum, London, only several microscope slides could be found.

Dichogaster (Diplothecodrilus) affinis (Michaelsen, 1890)

Syn.: *Benhamia mexicana* Rosa, 1891 (Csuzdi & Zicsi, 1989)
Benhamia crassa Beddard, 1893 (Csuzdi & Zicsi, 1989)
Benhamia floresiana Horst, 1893 (Pickford, 1938)
Dichogaster sinuosus Stephenson, 1931a (Pickford, 1938)
Dichogaster sinicus Chen, 1938 (Csuzdi & Zicsi, 1989)

Material examined: *Benhamia crassa,* Type; Lagos, W. Africa; Reg. No. BM(NH) 1904.10.5.829; *Dichogaster sinuosus,* Syntypes; Burma, Lalaw; Leg. G.E. Gates; Reg. No. BM(NH) 1930.5.9.22-24.

New records: Kenya, Fort Hull 4400 ft; Leg. Hinde; Reg. No. BM(NH) 1910.8.3.24, 1 Ex.; Kenya, Aberdares, Kararumo road, forest (0° 41' S., 36° 50'E.); Leg. Miss. E.A. Oxtoby; 12.XII.1974; Reg. No. BM(NH) 1981.6.2867-2879, 13 Ex.; Kenya, Nairobi, Kenyatta College; Leg. Miss, E.A. Oxtoby; 22.VII.1974; Reg. No BM(NH) 1981.6.2862-2864, 3 Ex.; Kenya, Muranga district, Kimandi; edge of stream near forest, Oxtoby's Shamba field (0° 43' S., 37° 09' E.); Leg. Miss E.A. Oxtoby; IX.1976. Reg. No. BM(NH) 1981.6.2692-2700, 9 Ex.; Kenya, Meru, Nkubu Kionyo forest (0° 04' S., 37° 40' E.); Leg. Miss E.A. Oxtoby; 14.VIII.1974; Reg. No. BM(NH) 1981.6.2885, 1 Ex.; Kenya, Aberdares foothills, Castle forest station, N. of Nairobi, near river, 6800 ft.; Leg. Miss E.A. Oxtoby; 30.I.1974; Reg. No. BM(NH) 1981.6.2728-2782, 38 Ex.; Kenya, Nairobi, Kenyatta College house garden; Leg. Miss E.A. Oxtoby; IX.1977; Reg. No. BM(NH) 1981.6.2792-2801, 10 Ex.; Kenya, Aberdare Mts. Nat. Park, roots of giant lobelias; Leg. Miss E.A. Oxtoby; VI.1972; Reg. No. BM(NH) 1981.6.2524-2529, 5 Ex., AF/3307, 1 Ex.; Kenya, forest side of road Thika-Ghatanga -Kinangop, 6000 ft. (0° 50' S. , 36° 50' E.); Leg. Miss E.A. Oxtoby; 23.VII.1974; Reg. No. BM(NH) 1981.6.2881-2884, 4 Ex.; Kenya, Meru district, forest near Nkubu, mainly *Podocarpus* vegetation (0° 04' S., 37° 40' E.); Leg. Miss. E.A. Oxtoby; VI.1974; Reg. No. BM(NH) 1981.6.2789-2790, 2 Ex.; Kenya, pine plantation, Nduru near Kisii (0° 41' S. , 34° 46' E.); Leg. Miss E.A. Oxtoby; VI.1971; Reg. No. BM(NH) 1981.6.2890-2995 6 Ex.; Kenya, Mombasa, Shino-la-Tewa school; Leg. Miss E.A. Oxtoby; Reg. No. BM(NH) 1981.6.2539, 1 Ex.; Kenya, Kimande forest, 7500 ft. (0° 49' S. , 36° 48' E.); Leg. Miss E.A. Oxtoby; XII.1976; Reg. No. BM(NH) 1981.6.2831-2854, 24 Ex.; Kenya, Kikuyu Escarpment forest near Nairobi (1° 15' S., 36° 40' E.); Leg. Miss. E.A. Oxtoby; III.1972; Reg. No. BM(NH) 1981.6.2886-2889, 4 Ex.; Kenya, Aberdare Mts.; Leg. Miss E.A. Oxtoby; 18.XI.1974; Reg. No. BM(NH) 1981.6.2631-2659, 29 Ex.; Galapagos, transition vegetation at top of the lava flow at James Bay; 1500 ft.; Leg. Hugh A. Ford; 17.VIII.1968. Reg. No. BM(NH) 1982.40.1-6, 6 Ex.; Galapagos, wet zone at top of lava flow in James Bay, 1800 ft. Leg. Hugh A. Ford; 23.IX.1968; Reg. No. BM(NH) 1982.40.21-22, 2 Ex.; Burma, Rangoon; Leg. G.E. Gates; Reg. No. BM(NH) 1933.2.15.50, 1 Ex.

Dichogaster (Diplothecodrilus) annae (Horst, 1893)

Syn.: *Dichogaster travancorensis* Fedarb, 1898 (Csuzdi, 1995)
Dichogaster curgensis Michaelsen, 1921 (Csuzdi, 1995)
Dichogaster curgensis var. *unilocularis* Stephenson, 1931a (Csuzdi, 1995)
Dichogaster cheranganiensis Černosvitov, 1938 (Csuzdi, 1995)
Dichogaster silvestris cacaois Righi, 1968 (Righi, 1984)
Dichogaster servi Righi & Ayres, 1975 (Csuzdi, 1995)
Benhamia parva Michaelsen, 1896 (Csuzdi, 1995)

Material examined: *Benhamia travancorensis,* Type; Travancore; Reg. No. BM(NH) 1904.10.5.664; *Dichogaster cheranganiensis,* Type; Omo exp. 31; 13.III.1933; Reg. No. BM(NH) 1949.3.1.741; *Dichogaster curgensis unilocularis,* Types; Burma, Loshio; Leg. G.E. Gates; Reg. No. BM(NH) 1930.5.9.15-16;

New records: Ghana, Tafo; Leg. H.C. Evans; 1.IV.1971; Reg. No. BM(NH) 1972.2.109-114, 6 Ex.; Kenya, Kakamega forest beneath bark of rotting fallen log (0° 15' N., 34° 51' E.); Leg. Miss. E.A. Oxtoby; 20.XI.1976; Reg. No. BM(NH) 1981.6.2714-2717, 4 Ex.; Uganda, Kampala, house garden 25. January Avenue; Leg. Miss. E.A. Oxtoby; V.1974; Reg. No. BM(NH) 1981.6.2532-2536, 5 Ex.; Kenya, Kakamega, forest, 1600 m, under bark of rotting fallen tree; Leg. McKay; 24.XI.1976. Reg. No. BM(NH) 1981.6.2718, 1 Ex.

Dichogaster (Diplothecodrilus) austeni (Beddard, 1901)

Syn.: *Dichogaster loveridgei* Stephenson, 1933 (Csuzdi, 1991)
Dichogaster monticellii Cognetti, 1915 (Csuzdi, 1995)
Dichogaster pafuriensis Reinecke & Ackermann, 1977 (Csuzdi, 1995)

Material examined: *Benhamia austeni,* Types; Nyasaland; Reg. No. BM(NH) 1904.10.5.631-649; *Dichogaster loveridgei,* Paratypes; Tanganyika, Kigogo, Uzungve Mts; Leg. A. Loveridge; Reg. No. BM(NH) 1932.11.18.1-3.

New record: Tanzania, Mwanikana Forest Reserve, 5000 ft, in rotten log; Leg. K.M. Howell & S.N. Stuart; 4.I.1978; Reg. No BM(NH) 1982.28.1-2, 2 Ex.

Dichogaster (Diplothecodrilus) bolaui (Michaelsen, 1891)

Syn.: *Dichogaster bolaui* var. *decanephra* Michaelsen, 1915 (Righi, 1968)
Dichogaster bolaui var. *malabaricus* Stephenson, 1920 (Righi, 1968)
Benhamia bolaui pacifica Eisen, 1900 (Michaelsen, 1900)
Dichogaster lageniformis Friend, 1916 (Csuzdi & Zicsi, 1989)
Dichogaster hatomaana Ohfuchi, 1957 (Csuzdi, 1995)
Benhamia malayana Horst, 1893 (Pickford, 1938)
Benhamia octonephra Rosa, 1895 (Michaelsen, 1900)
Benhamia rugosa Eisen, 1896 (Pickford, 1938)

Material examined: *Dichogaster bolaui,* Type; Germany, Hamburg; Leg. W. Michaelsen; Reg. No. BM(NH) 1924.3.1.244.

New records: Kenya, Muranga district, Kimandi, edge of stream near forest, Oxtoby's Shamba field (0° 43' S., 37° 09' E.); Leg. Miss. E.A. Oxtoby; IX.1976; Reg. No. BM(NH) 1981.6.2701, 1 Ex.; Kenya, Ngorengore-Bomet road (0° 47' S. , 35 °12' E.); Leg. Miss. E.A. Oxtoby; 7.III.1978. Reg. No. BM(NH) 1981.6.2613-261, 5 Ex.; Kenya, Nairobi, Kenyatta College; Leg. Miss. E.A. Oxtoby; 22.VII.1974; Reg. No. BM(NH) 1981.6.2860-2861, 2 Ex.; Kenya, Kakamega forest station nursery (0° 16' N., 34° 53' E.); Leg. Miss. E.A. Oxtoby; 14.XI.1978; Reg. No. BM(NH) 1981.6.2583-2584, 2 Ex.; Kenya, Muewa grassland (0° 45' S., 37° 29' E.); Leg. Miss. E.A. Oxtoby; 7.III.1978. Reg. No. BM(NH) 1981.6.2823-2824, 2 Ex.; Kenya, Machakos district, Mbooni (1° 40' S., 37° 40' E.); Leg. Miss. E.A. Oxtoby, IX.1974. Reg. No. BM(NH) 1981.6.2802-2811, 11 Ex.; Kenya, Mombasa, Shinno-la-Tewa school; Leg. Miss. E.A. Oxtoby; VI.1974; Reg. No. BM(NH) 1981.6.2865-2866, 2 Ex.; Kenya, Mbooni, Machakos district (1° 39' S., 37° 28' E.); Leg. J. Kamen; IX.1974; Reg. No. BM(NH) 1981.6.2572-2580, 9 Ex.; Kenya, Mombasa, Shino-la-Tewa school; Leg. J. Kamen; Reg. No. BM(NH) 1981.6.2541-2567, 27 Ex.; Oman, 2 km. N. of Al Khadra, wadi Saktan Jabal 1500 ft; (23° 22' N., 57° 19 E.); Leg. M.D. Gallagher; 6.V.1977; Reg. No. BM(NH) 1977.18.13, 1 Ex.; Galapagos, Santa Cruz, S.W. of Mount Crocker (main peak) 1800 ft; Leg. Hugh A. Ford; 7.IX.1968; Reg. No. BM(NH) 1982.40.20, 1 Ex.

Remarks: In addition to this newly identified material, there are other series of *D. (Dt.) bolaui* originating from various parts of the world.

Dichogaster (Diplothecodrilus) christyana Michaelsen, 1937

Material examined: *Dichogaster christyana,* Types; Lake Nyasa, Vua; Leg. C. Christy; Reg. No. BM(NH) 1926.7.27.8-13.

Dichogaster (Diplothecodrilus) culminis (Michaelsen, 1896)

Syn.: *Dichogaster duwonica* Cognetti, 1907 (Csuzdi, 1995)
Dichogaster dorsalis Michaelsen, 1915 (Csuzdi, 1995)

Material examined: *Dichogaster daemoniaca,* Cognetti, 1907; Ruwenzori, Nyamgasani valley; Leg. D. Buxton, I. 1935 Reg. No. BM(NH) 1935.4.24.1-4 (Michaelsen, 1937).

New record: Uganda, S.W., Ruwenzori Nyamagasani valley; Leg. B. Jamieson; 21.I.1956; Reg. No. BM(NH) 1957.3.8.1, 4, 9, 3 Ex.

Dichogaster (Diplothecodrilus) djemdjemensis Stephenson, 1932

Material examined: *Dichogaster djemdjemensis,* Type; Abyssinia, Djem-Djem forest; Leg. J. Omer-Cooper; 10.X.1926; Reg. No BM(NH) 1931.12.9.12.

Dichogaster (Diplothecodrilus) elgonensis Michaelsen, 1937

New record: Uganda, Mt. Elgon, river Sasa; Leg. B. Jamieson; Reg. No. BM(NH) 1973.20.2-10, 7 Ex., AF/3311, 2 Ex.

Dichogaster (Diplothecodrilus) erlangeri Michaelsen, 1903

Syn.: *Dichogaster kenyae* Michaelsen, 1914b (Csuzdi, 1995)

Material examined: *Dichogaster aequatorialis* (Michaelsen, 1896); Kenya, 7000 ft; Leg. S.L. Hinde; Reg. No. BM(NH) 1911.9.22.6-9.

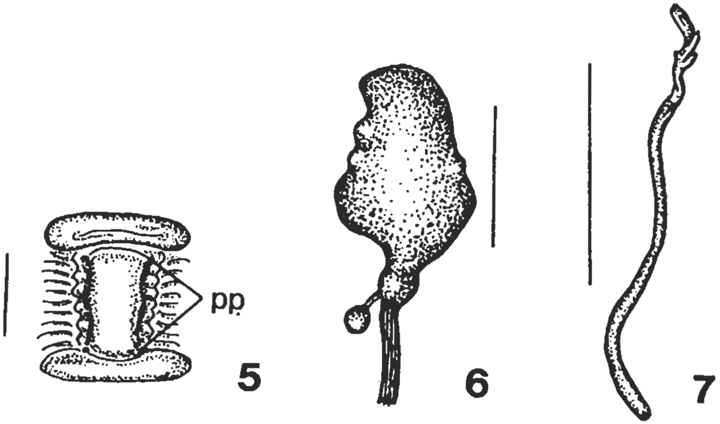
New records: Kenya, Muranga district Kimandi, Oxtoby's Shamba field (0° 43' S., 37° 09' E.); Leg. Miss. E.A. Oxtoby; Reg. No. BM(NH) 1981.6.2691, 1 Ex.; Kenya, Kimande, forest lake in plantation (0° 49' S., 36° 48' E.); Leg. Miss. E.A. Oxtoby 1.V.1976; Reg. No. BM(NH) 1981.6.2722, 1 Ex.; Kenya, Meru district, forest near Nkubu, mainly *Podocarpus* vegetation (0° 04' S., 37° 40' E.); Leg. Miss. E.A. Oxtoby; VI.1974; Reg. No. BM(NH) 1981.6.2791, 1 Ex.; Kenya, Meru forest (0° 05' N., 37° 37' E.); Leg. Miss. E.A. Oxtoby; 1970; Reg. No. BM(NH) 1981.6.2785, 1 Ex.; Kenya, Muranga district Kimandi, above Oxtoby's Shamba field (0° 43' S., 36° 48' E.) 7500 ft.; Leg. Miss. E.A. Oxtoby, XII. 1976; Reg. No. BM(NH) 1981.6.2702-2703, 1 Ex., AF/3310, 1 Ex.

Dichogaster (Diplothecodrilus) gracilis (Michaelsen, 1892)

Syn. *Benhamia pallida* Michaelsen, 1892 (Michaelsen, 1907)

Material examined: Kenya, Mt. Kenya Sirimoni track (0° 03' S , 37° 17' E), 4000 m; Leg. E.A. Oxtoby; 19 XI. 1974; Reg. No. BM(NH) 1981.6.2467-2492, 21 Ex.

New records: Kenya, Aberdares foothills, Castle forest, N. of Nairobi, near river, 6800 ft; Leg. Miss. E.A. Oxtoby; 30.I.1974; Reg. No. BM(NH) 1981.6.2724-2727, 4 Ex., AF/3304, 1 Ex.



Figs. 5 – 7. *Dichogaster (Diplothecodrilus) guildingi* Baird, 1871. 5. Ventral view of the prostatic region: pp = prostatic pores. 6. Spermatheca. 7. Penial seta. (Scale bar 1 mm)

Dichogaster (Diplothecodrilus) guildingi Baird, 1871

Material examined: *Lumbricus guildingi*, Types; St. Vincent, W. Indies; Leg. Rev. Lansdown Guilding; Reg. No. BM(NH) 1839.12.26.28, 2 Ex.

Remarks: This species was regarded as *species incertae sedis* by Michaelsen (1900). The two preadult type specimens in the Museum are however in good condition, so that a short redescription can be given.

External characters. Length of the specimens 50 mm, diameter 2.5 mm. The colour of the preserved specimens is yellowish. First dorsal pore occurs in intersegmental forrow 5/6. Setae are closely paired and all on the ventral surface of the body. Female pores are paired on segment *xiv*, situated somewhat ventrally from the setae *a*. Two pairs of spermathecal pores are present in furrows 7/8 and 8/9 in setal lines *ab*. Male pores are paired on segment *xviii*, they are inconspicuous, situated along the seminal grooves. There is no clitellum, but a ventromedian genital field situated between segments *xvii* and *xix*. There are two pairs of prostatic pores on segments *xvii* and *xix* in setal line *b* connected on each side by a bow-shaped seminal groove (Fig. 5). Genital papillae absent.

Internal chatacters. Two large distinct gizzards in segments *v* and *vi*. Calciferous glands are lamellate and paired in segments *xv-xvii*, about equal in size. Paired lateral hearts are present in segments *x*, *xi* and *xii*. The excretory system is meronephridial with 7 sac-shaped meronephridia on each side. Apart from meronephridia, there is a pair of ventromedian megameronephridia on the posterior part of the body. Testes and funnels are paired, situated in segments *x* and *xi*. Two pairs of small seminal vesicles presents in *xi, xii*. Two pairs of tubular prostatic glands are present as big highly coiled tubes in *xvii* and *xix*. Each prostate is provided with a large penial setal sac containing only one fully developed and several immature setae. The fully formed seta is somewhat curved, 2 mm in length, and at the middle 0.025 mm thick. Its ectal end is sharply pointed, and the upper third shows a very characteristic ornamentation of scattered teeth becoming gradually stronger towards the tip (Fig. 6). There are two pairs of spermathecae of almost equal size in segments *viii* and *ix*. The duct is short, its length is about one-third of the ampulla. The ampulla consists of a small lower part that is provided with a little spherical diverticulum as well as with a large irregular sac-shaped upper part (Fig. 7).

Dichogaster (Diplothecodrilus) heterochaeta Michaelsen, 1922

Syn.: *Dichogaster chappuisi* Černosvitov, 1938 (Csuzdi, 1995)

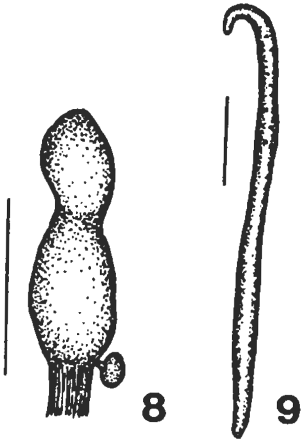
Material examined: *Dichogaster chappuisi*, Syntypes; Mt. Elgon; 20. VIII. 1933; Reg. No. BM(NH) 1949.3.1.732-733.

Remarks. The type specimen is located in the Muséum national d'Histoire naturelle, Paris (Jamieson, 1975). In the Natural History Museum, London, only several microscope slides could be found.

Dichogaster (Diplothecodrilus) ? jamaicae (Eisen, 1900)

Material examined: *Eutrigaster orobia* (Graff, 1957); Jamaica, Coley near Kellits, 950 m; from an epiphyte; Leg. R.W. Sims; 13. XI. 1973; Reg. No. BM(NH) 1986.2.601 (Sims, 1987). *Eutrigaster orobia* (Graff, 1957); Jamaica, St. Anne's District, 3-4 km north of the Mason River Research Station, 850 m, from epiphytes; Leg R.W. Sims, 14. XI.1073; Reg. No. BM(NH) 1986.2.602-604. (Sims, 1987).

Remarks: In his revision of the genus *Eutrigaster* Cognetti, 1904, Sims (1987) published a new occurrence of *E. orobia* (Graff, 1957) from Jamaica but there are some differences from the original description of *E. orobia* (Graff, 1957): the diverticulum of the spermatheca is unilocular (Fig. 8), and penial setae are attached to each prostate. These setae are short, about 0.4 mm long and 0.008 mm wide. Their tip is somewhat curved, hook-shaped. The ornamentation is almost missing, only several small, hardly visible teeth are present on the ectal end (Fig. 9). There are only 3 meronephridia on each side.



Figs. 8 – 9. *Dichogaster (Diplothecodrilus) ? jamaicae* (Eisen, 1900). 8. Spermatheca. 9. Penial seta. (Scale bar 1 mm: 8., and 0.1 mm: 9.)

Dichogaster (Diplothecodrilus) jordani Michaelsen, 1937

Material examined: *Dichogaster jordani*, Types; Angola, Kongulu, Amboim district, 800 m; Leg. K. Jordan; Reg. No. BM(NH) 1935.1.28.1-5, 1935.1.28.13-22, 1935.3.24.1.

Dichogaster (Diplothecodrilus) kigogoana Stephenson, 1932

Syn.: *Dichogaster hamburgensis* Omodeo, 1958 nom. nov. pro *Dichogaster rosea* Michaelsen, 1935 nec *Dichogaster rosea* (Michaelsen, 1889) (Csuzdi, 1995)

Material examined: *Dichogaster kigogoana*, Type; Reg. No. BM(NH) 1933.2.22.646-647.

Remarks: Only several microscope slides could be found.

Dichogaster (Diplothecodrilus) loboziana Michaelsen, 1915

Syn. nov. *Dichogaster flagellifera* Stephenson, 1933

Material examined: *Dichogaster flagellifera*, Types; Zaire, Albertville; Leg. A. Loveridge; 21.V.1930; Reg. No. BM(NH) 1932.11.18.6-7.

Dichogaster (Diplothecodrilus) loennbergi Michaelsen, 1912

New records: Kenya, Meru district, forest near Nkubu, mainly *Podocarpus* vegetation (0° 04' S., 37° 40' E.); Leg. Miss. E.A. Oxtoby; VI.1974; Reg. No. BM(NH) 1981.6.2786-2787, 2 Ex., AF/3315, 1 Ex.; Kenya, Aberdares foothills, Castle forest station, N. of Nairobi, near river, 6800 ft; Leg. Miss. E.A. Oxtoby; 30.I.1974; Reg. No. BM(NH) 1981.6.2723, 1 Ex.

Dichogaster (Diplothecodrilus) macfadyeni Csuzdi, 1991

New record: Tanzania, Tanga region, W. Usambara Mts., Mazumbai Forest Reserve, under log; Leg. K.M. Howell, S.N. Stuart; XII. 1978; Reg. No. BM(NH) 1980.34.1, 1 Ex.

Dichogaster (Diplothecodrilus) modesta Michaelsen, 1903

Syn.: *Dichogaster hamatus* Stephenson, 1932 (Csuzdi, 1995)

Material examined: *Dichogaster hamatus,* Types; Abyssinia, Djem-Djem forest; Leg. J. Omer-Cooper; 21.IX.1926; Reg. No. BM(NH) 1931.12.9.5-10.

Dichogaster (Diplothecodrilus) modiglianii (Rosa, 1896)

Syn.: *Dichogaster doveri* Stephenson, 1931 (Stephenson, 1931a)
Benhamia kafuruensis Michaelsen, 1896 (Csuzdi & Zicsi, 1989)
Benhamia nana Eisen, 1896 (Csuzdi & Zicsi, 1989)
Benhamia papillata Eisen, 1896 (Omodeo, 1973)
Benhamia papillata var. *hawaiiensis* Eisen, 1900 (Omodeo, 1973)

Material examined: *Dichogaster doveri,* Types; In ditch, museum compound, Kuala Lumpur, Selangor, Federated Malay States; Leg. C. Dover 1933.2.14.60-61.

New records: Kenya, Ngorengore-Bomet road (0° 47' S. , 35° 12' E.); Leg. Miss E.A. Oxtoby; 7.III.1978; Reg. No. BM(NH) 1981.6.2618-2630, 13 Ex.; Kenya, Nairobi Kenyatta College; Leg. Miss E.A. Oxtoby; 22.VII.1974; Reg. No. BM(NH) 1981.6.2856-2859, 4 Ex.; Kenya, Kakamega forest station nursery (0° 16' N., 34° 53' E.), Leg. Miss E.A. Oxtoby; 14.XI.1978; Reg. No. BM(NH) 1981.6.2581-2582, 2 Ex.; Kenya, Muewa grassland (0° 45' S., 37° 29' E.); Leg. Miss E.A. Oxtoby; 7.III.1978; Reg. No. BM(NH) 1981.6.2815-2822, 8 Ex.; Kenya, pine plantation Nduru near Kisii (0° 41' S. , 34° 46' E.); Leg. Miss E.A. Oxtoby; VI.1971; Reg. No. BM(NH) 1981.6.2896-2898, 3 Ex.; Kenya, Mombasa, Shino-la-Tewa school; Leg. Miss E.A. Oxtoby; Reg. No. BM(NH) 1981.6.2540, 1 Ex.; Sudan, Dafur; Leg. Admiral Lynes; Reg. No. BM(NH) 1923.10.31.13, 1 Ex.

Dichogaster (Diplothecodrilus) mundamensis (Michaelsen, 1897)

Syn.: *Dichogaster mansfeldi* Michaelsen, 1915 (Csuzdi, 1995)

New records: Nigeria, 27 Km. E. of Calabar, under rotten leaves; Leg. J.C. Reid; 22.VI.1982; Reg. No. BM(NH) 1985.4.5, 1 Ex.; Canary Islands, La Laguna, Tenerife; Leg. Thomas; 22.IX.1978; Reg. No. BM(NH) 1982.5.21-45, 25 Ex.; Canary Islands, La Laguna, Tenerife; Leg. Thomas; 7.XI.1981; Reg. No. BM(NH) 1982.5.47-59, 10 Ex., AF/3312, 3 Ex.; Canary Islands, Santa Maria Del Mar, Tenerife; Leg. J.A.Talavera Sosa; 20.II.1977; Reg. No. BM(NH) 1982.5.46, 1 Ex.

Dichogaster (Diplothecodrilus) neumanni (Michaelsen, 1897)

New record: Uganda, Makerere, Resthouse near Butiaba, Lake Albert (1° 49′ N., 31° 19′ E.); Leg. Miss. E.A. Oxtoby; V.1974; Reg. No. BM(NH) 1981.6.2531, 1 Ex., AF/3303, 1 Ex.

Dichogaster (Diplothecodrilus) rubella Michaelsen, 1935

Material examined: *Dichogaster rubella*; Uganda, Kigezi Kayansa forest, 7500 ft; Leg. Pittman; Reg. No. BM(NH) 1934.4.23.1 (Michaelsen, 1937).

Dichogaster (Diplothecodrilus) rungweensis Stephenson, 1933

Material examined: *Dichogaster rungweensis*, Types; Tanganyika, Ukinga Mts. Madehani; Leg. A. Loveridge; Reg. No. BM(NH) 1932.2.23.644-668.

Dichogaster (Diplothecodrilus) ruwenzorii Cognetti, 1907

Material examined: *Dichogaster ruwenzorii*; Uganda, S.W., Ruwenzori Nyamagasani valley; Leg. B. Jamieson; 21.I.1956; Reg. No. BM(NH) 1957.3.8.2, 3, 5, 6, 7, 8, 10, 11.

Dichogaster (Diplothecodrilus) saliens (Beddard, 1893)

Syn.: *Dichogaster crawi* Eisen, 1900 (Stephenson, 1931a)

New records: Ghana, Tafo; Leg. M. A. Tazelaar; 1956; Reg. No. BM(NH) 1984.5.129; Penang; Coll. Beddard; Reg. No. BM(NH) 1904.10.5.185, 1 Ex.; Galapagos, Santa Cruz "Pampas" region, 2 km. N.W. of Media Luna, ca. 675 m; Leg. R. Silberglied; 4.VI.1970; Reg. No. BM(NH) 1982.42.3-8, 6 Ex.; Galapagos, Santa Cruz, S.W. of Mount Crocker (main peak), 1800 ft; Leg. Hugh A. Ford; 7.IX.1968; Reg. No. BM(NH) 1982.40.17-19, 3 Ex.

Dichogaster (Diplothecodrilus) scotti Stephenson, 1932

Material examined: *Dichogaster scotti*, Type; Abyssinia, Djem-Djem forest; Leg. J. Omer-Cooper. Reg. No. BM(NH) 1931.12.9.16.

Dichogaster (Diplothecodrilus) tanganyikae (Beddard, 1902)

New records: Zaire, Kivu; Leg. Gasana Ndoli; 1973; Reg. No. BM(NH) 1976.22.15-18; Zaire, Kivu; Leg. Gasana Ndoli; 1973; Reg. No. BM(NH) 1976.22.19-24.

Remarks. The three species *D.* (*Dt.*) *tanganyikae*, *D.* (*Dt.*) *tenuiseta* Michaelsen, 1936 and *D.* (*Dt.*) *silvestris* (Michaelsen, 1896) are closely related. In a previous paper, Csuzdi and Zicsi (1994a) have raised the question of uniting the first two, but later, after examining series of specimens from all the three species, remarkable differences have been found between them. They are as follows:

D.(Dt) tenuiseta: Penial setae maximum 0.01 mm wide in the middle, and the ectal end putty-knife shaped. Meronephridia about 10 on each side of the intestine.

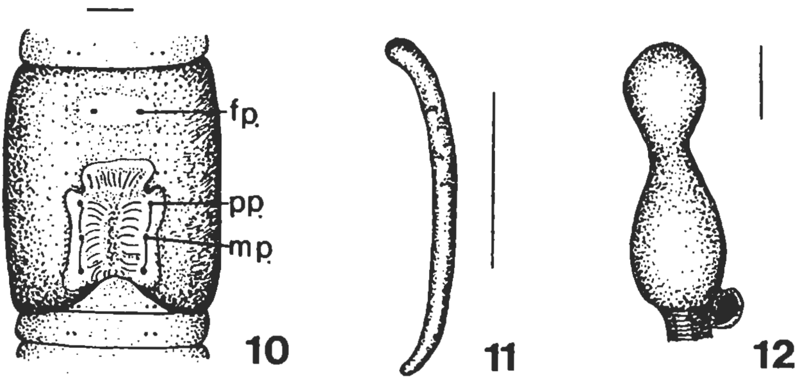
D.(Dt.) silvestris: Penial setae about 0.02 mm wide in the middle, the ectal tip sharply pointed. Meronephridia about 6 on each side of the intestine.

D. (Dt.) tanganyikae: Penial setae around 0.012 mm wide in the middle, the ectal end sharp. Meronephridia about 10 on each side of the intestine.

Dichogaster (Diplothecodrilus) hindei sp. n.

External characters. Holotype: length 120 mm; diameter just after the clitellum 7 mm; number of segments 173. Paratypes are 105-125 mm in length, 5-7 mm in diameter; there are 172-181 segments. The colour of the preserved specimens is yellowish. The prostomium is epilobous 1/2 open and the first dorsal pore occurs in intersegmental furrow 5/6. Setae are closely paired and all on the ventral surface of the body. Setal formula at segment *xxii: aa:ab:bc:cd:dd* = 15:2:15:1.5:130. Female pores are paired on segment *xiv* situated somewhat anteriorly to the setae *a*. Two pairs of spermathecal pores present in furrows 7/8 and 8/9 in setal lines *ab*. Male pores paired on segment *xviii* in setal line *a*, small but conspicuous, situated along the seminal grooves. Clitellum extends over segments *xiii-xx*, excluding the *xiiith* and *xxth* annular, interrupted by a ventromedian genital field situated between segments *xvii* and *xix*. Two pairs of prostatic pores on segment *xvii* and *xix* in setal line *b* connected on each side by a straight seminal groove (Fig. 10). Genital papillae absent.

Internal characters. The anterior septa to 7/8 are hardly visible while septa 9/10-10/11 slightly thickened and those of 11/12-13/14 strongly strengthened. Two large distinct gizzards in segments *v* and *vi*. Calciferous glands lamellate and paired in segments *xv-xvii*, of about equal size.



Figs. 10–12. *Dichogaster (Diplothecodrilus) hindei* sp. n. 10. Ventral view of the clitellar region; fp = female pores, pp = prostatic pores. 11. Penial seta. 12.; Spermatheca. (Scale bar 1 mm)

Typhlosole arises in segment *xx* as a low slender ridge gradually becoming a large bilobate organ. Paired lateral hearts are present in segments *x*, *xi* and *xii*. The excretory system is meronephridial with 7 sac-shaped meronephridia on each side. Apart from meronephridia, there is a pair of ventromedian megameronephridia on the posterior part of the body. Testes and funnels paired in segments *x* and *xi*, filled with free sperm masses. Two pairs of small seminal vesicles presents in *xi*, *xii* and a pair of large racemose ovaries pendent from the posterior face of septum 12/13. Ovarian funnels small, leading into a little ovisac in segment *xiv*. The two vasa deferentia of each side are easily seen entering the body wall in segment *xviii*. The ectal portions of sperm ducts are highly convoluted and somewhat thickened.

Two pairs of tubular prostatic glands present as short slightly coiled tubes each confined to segment *xvii* or *xix*. Each prostate is provided with a large penial setal sac containing only one fully developed and several immature setae. The fully formed seta is somewhat curved, 2 mm in length, and at the middle 0.03 mm thick. Its ectal end is rather rounded and the upper third shows a very characteristic ornamentation of densely arranged transverse toothed bars (Fig. 11). There are two pairs of spermathecae in segment *viii* and *ix* of almost equal size. The duct is very short and about half of the diameter of the ampulla, which is large, oval shaped, divided into two parts by a narrow neck. The lower part of the ampulla is somewhat larger than the upper one carrying an oval sessile diverticulum that sometimes contains two sperm-balls (Fig. 12).

Remarks: This species shows affinities with *D. (Dt.) princeps* Cognetti, 1910, but differs in the form of the penial setae and the spermathecae as well as in the absence of genital papillae.

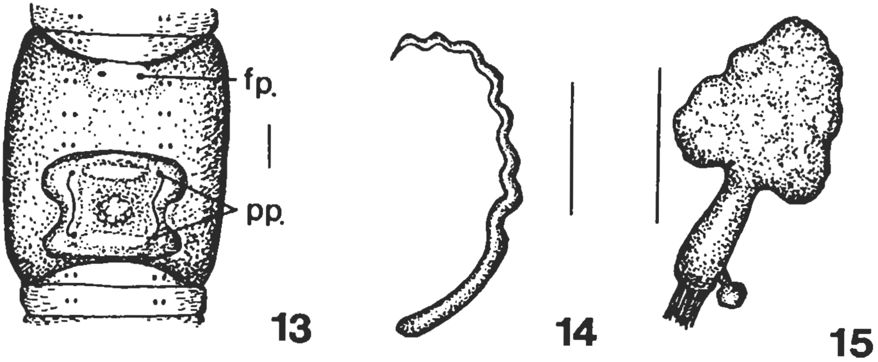
Localities: Holotype; Kenya, Aberdare Mts., 10000 ft., Leg. Hinde, Reg. No. BM(NH) 1910.8.3.5; **Paratypes**; Kenya, Aberdare Mts., 10000 ft., Leg. Hinde, Reg. No. BM(NH) 1910.8.3.6-21, 16 Ex., AF/3318, 6 Ex.; Kenya, Aberdare Mts. Nat. Park, roots of giant lobelias; Leg. Miss. E.A. Oxtoby, IV.1972, Reg. No. BM(NH) 1981.6. 2516, 1 Ex.; Kenya, Aberdares, 3000 m, Leg. Miss. E.A. Oxtoby, 18.XI.1974, Reg. No. BM(NH) 1981.6.2537-2538, 2 Ex.

Dichogaster (Diplothecodrilus) oxtobyae sp. n.

External characters. Holotype 65 mm in length, diameter just after the clitellum 4 mm, number of segments 141. The Paratypes are 40-80 mm in length, 3-4 mm in diameter. There are 122-135 segments. The colour of the preserved specimens is yellowish. Prostomium epilobous 1/2 open and the first dorsal pore occurs in intersegmental furrow 5/6. The setae are closely paired and all on the ventral surface of the body. Setal formula at segment *xxiv: aa:ab:bc:cd:dd* = 11:3.5:14:4:140. Female pores paired on segment *xiv* situated somewhat anteriorly to the setae *a*. Two pairs of spermathecal pores are present in furrows 7/8 and 8/9 in setal lines *a*. Male pores are paired on segment *xviii*, they are inconspicuous, situated in the seminal grooves. The clitellum extends over segments *xiii-xx*, annular, incomplete ventrally on *xiii* and *xx*. There is a ventromedian genital field situated between segments *xvii* and *xix*. Two pairs of prostatic pores present on segment *xvii* and *xix* in setal line *b* connected on each side by a bow-shaped seminal groove (Fig. 13). Genital papillae absent.

Internal characters. Anterior septa to 6/7 are hardly visible while septa 7/8-16/17 are slightly thickened. There are two large distinct gizzards in segments *v* and *vi*. Calciferous glands are lamellate and paired in segments *xv-xvii*, of about equal size. Typhlosole simple undulated ridge arising in segment *xxiv*. Paired lateral hearts are present in segments *x*, *xi* and *xii*. Excretory system meronephridial with 6-7 sac-shaped meronephridia on each side. The meronephridia are followed by a pair of ventromedian megameronephridia on the posterior part of the body. Testes and funnels are paired, situated in segments *x* and *xi* enclosed into perioesophageal spermsacs. Two pairs of seminal vesicles present in *xi*, *xii* and a pair of large racemose ovaries pendent from the posterior face of septum 12/13. Ovarian funnels are small, ovisacs lacking. The two vasa deferentia of each side are easily seen entering the body wall in segment *xviii*. Ectal portions of sperm ducts are straight and somewhat thickened.

Two pairs of tubular prostatic glands are present as long highly coiled tubes in segment *xvii* and *xix*. Each prostate is provided with a large penial

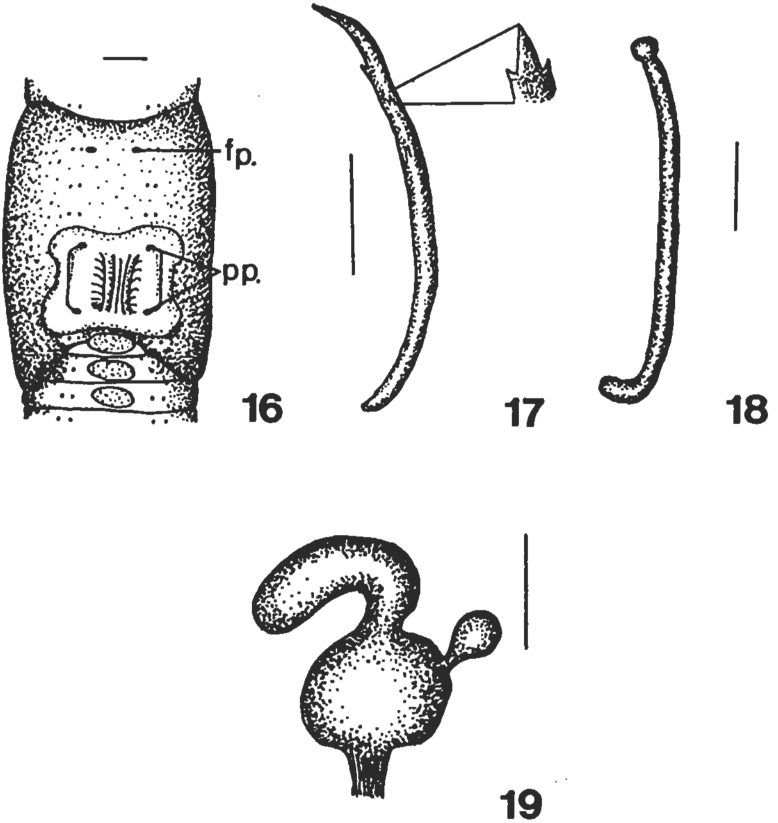


Figs. 13—15. *Dichogaster (Diplothecodrilus) oxtobyae* sp. n. 13. Ventral view of the clitellar region; fp = female pores, pp = prostatic pores. 14. Penial seta. 15. Spermatheca. (Scale bar 1 mm)

setal sac containing only one fully developed and several immature setae. The fully formed seta is somewhat curved, 3 mm in length, and at the middle 0.01 mm thick. Its ectal tip is simple and moderately sharply pointed. The ornamentation of the seta is restricted to its ectal half, consisting of scattered little teeth (Fig. 14). There are two pairs of spermathecae in segment *viii* and *ix* of almost equal size. The duct is short and somewhat narrower than the lower part of the ampulla. The ampulla which is three times longer than the duct, is divided into two parts by a narrow neck. The lower part of the ampulla carrying a roundish diverticulum somewhat longer than the pear-shaped upper one (Fig. 15).

Remarks. This species shows close affinities with *D. (Dt.) kiwuensis* Michaelsen, 1910, but there are significant differences in form of the spermathecae and in situation of the clitellum.

Localities: Holotype; Kenya, Meru forest (0° 05' N., 37° 37' E.); Leg. Miss. E.A. Oxtoby; 1970; Reg. No. BM(NH) 1981.6.2783; Paratypes; Kenya, Meru forest (0° 05' N., 37° 37' E.); Leg. Miss. E.A. Oxtoby; 1970; Reg. No. BM(NH) 1981.6.2784, 1 Ex; Kenya, Kimande forest, 7500 ft; (0° 49' S. , 36° 48' E.); Leg. Miss. E.A. Oxtoby; XII. 1976; Reg. No. BM(NH) 1981.6.2829-2830, 2 Ex., AF/3313, 1 Ex.; Kenya, Muranga district Kimandi, above Oxtoby's Shamba field (0° 43' S., 36° 48' E.), 7500 ft.; Leg. Miss. E.A. Oxtoby, XII. 1976; Reg. No. BM(NH) 1981.6.2704-2713, 8 Ex., AF/3309, 2 Ex.



Figs. 16–19. *Dichogaster (Diplothecodrilus) simsi* sp. n. 16. Ventral view of the clitellar region; fp = female pores, pp = prostatic pores. 17. Larger penial seta. 18. Smaller penial seta. 19. Spermatheca. (Scale bar 1 mm [16., 19.]; 0.5 mm [17.] and 0.25 mm [18.])

Dichogaster (Diplothecodrilus) simsi sp. n.

External characters. Length of the Holotype 65 mm, diameter just after the clitellum 4 mm, number of segments 137. Paratypes are 60-70 mm in length, 3-5 mm in diameter, number of segments 112-142. The colour of the preserved specimens is yellowish. The prostomium is prolobous, the first dorsal pore occurs in intersegmental forrow 5/6. Setae are closely paired and all on the ventral surface of the body. Setal formula at segment *xxii: aa:ab:bc:cd:dd* = 19:3:15:2:130. Female pores are paired on segment *xiv,* situated in the setal ring within *aa,* distance from *a* = 1/2 *ab.* Two pairs of spermathecal pores are present in furrows 7/8 and 8/9 in setal lines *ab.* Male pores are paired on segment *xviii,* they are inconspicuous, situated in the seminal grooves. Clitellum extends over segments *xiii-xxi,* 1/2 *xxii,* excluding the *xiiith* and *xxith* segments annular, interrupted by a genital field situated on the ventral surface between segments *xvii* and *xix.* There are two pairs of prostatic pores on segment *xvii* and *xix* in setal line *a* connected on each side by a straight seminal groove. Unpaired ventromedian genital papillae present on segment *xx-xxii* (Fig. 16).

Internal characters. Anterior septa to 7/8 are not recognisable. There are no septa notably strengthened, but 10/11-13/14 are slightly thickened. There are two large distinct gizzards in segments *v* and *vi.* Calciferous glands are lamellate and paired in segments *xv-xvii,* of about equal size. The typhlosole arises in segment *xxii* as a low slender ridge gradually becoming a moderate bilobate organ. Paired lateral hearts are present in segments *x, xi* and *xii.* Excretory system is meronephridial, there are 5 sac-shaped meronephridia on each side of the intestine. In addition to meronephridia, there is a pair of ventromedian megameronephridia on the posterior part of the body. Testes and funnels are paired in segments *x* and *xi,* closed into a large ventromedian testis sac. Two pairs of seminal vesicles present in *xi, xii,* and a pair of large racemose ovaries hanging from the posterior face of septum 12/13. Ovarial funnels are small leading into a little ovisac in segment *xiv.* The two vasa deferentia of each side are easily seen entering the body wall in segment *xviii.* The ectal portions of sperm ducts are slightly convoluted and somewhat thickened.

Two pairs of tubular prostatic glands are present in *xvii* and *xix.* They are short, slightly coiled tubes confined into their own segment. Each prostate is accompanied by a penial setal sac containing two different types of mature setae. The larger seta is somewhat curved, 1.35 mm in length, and at the middle 0.025 mm thick. Its ectal tip is simple and moderately sharply pointed. The upper third of this seta shows a very characteristic ornamentation of scattered prominent teeth, of which the first under the tip is a very strong forward standing one. The second seta is smaller, 0.65 mm in length and at the middle 0.01 mm in diameter. Its tip is rounded knob shaped, the ornamentation consists of small thorns situated on the ectal third of the seta (Figs. 17–18). There are two pairs of spermathecae in segment *viii* and *ix* of almost equal size. The duct is short and about one-third of the diameter of the ampulla that is pear-shaped, divided into two parts. The lower part of ampulla is slightly larger than the sometimes downward bent upper one. There is a small, almost sessile diverticulum arising from the lower part of ampulla (Fig. 19).

Remarks. This species appears to be close to *D. (Dt.) macfadyeni* Csuzdi, 1991 but differs in several characters, for example the extension of clitellum, shape of spermatheca, dimension and ornamentation of the larger penial seta.

Localities: Holotype; Kenya, Aberdare Mts., 10000 ft., Leg. Hinde, Reg. No. BM(NH) 1910.8.3.25; **Paratypes**; Kenya, fort Hull, 4400 ft; Leg. Hinde; Reg. No. BM(NH) 1910.8.3.22-23, 2 Ex.; Kenya, Aberdare Mts., 10000 ft., Leg. Hinde, Reg. No. BM(NH) 910.8.3.26-40, 15 Ex., AF/3319, 5 Ex.; Kenya, Aberdare Mts., 3000 m (0° 25' S , 36° 38' E), Leg Miss. E.A. Oxtoby, 18. XI. 1974, Reg. No. BM(NH) 2497-2515, 14 Ex., AF/3316, 5 Ex.; Kenya, Aberdare Mts. Nat. Park. roots of giant lobelias; Leg. Miss. E.A. Oxtoby, VI. 1972, Reg. No. BM(NH) 1981.6. 2517-23, 5 Ex., AF/3306, 2 Ex.

Genus *Eutrigaster* Cognetti, 1904, emend. Csuzdi & Zicsi, 1991

Subgenus *Eutrigaster* Cognetti, 1904

Eutrigaster (Eutrigaster) grandis Sims, 1987

Material examined: *Eutrigaster grandis,* Syntypes; Jamaica, Coley, near Kellits, Calderon, 925 m; Leg. R.W. Sims; 13. XI. 1973; Reg. No. BM(NH) 1986.2.582-587.

Remarks: In contrast to the original description (Sims, 1987, p. 435), the species is holoandric. It has two pairs of testes in segments *x* and *xi* and two pairs of seminal vesicles in segments *xi* and *xii.*

Eutrigaster (Eutrigaster) montecyanensis Sims, 1987

Syn. *Eutrigaster franzi* Csuzdi & Zicsi, 1991 (Csuzdi, 1995)

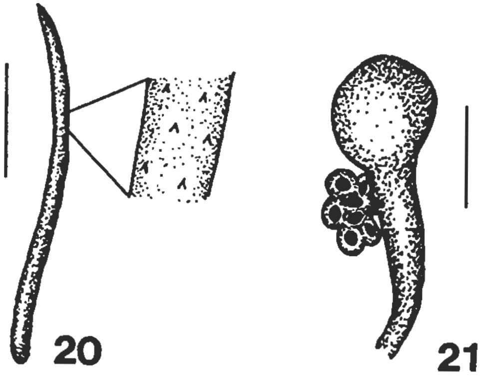
Material examined: *Eutrigaster montecyanensis,* Syntypes; Jamaica, near Irish Town, beside the road to Newcastle, Blue Mountains, 1000 m; Leg. R.W. Sims; 6. XI. 1973; Reg. No. BM(NH) 1986.2.593-596; *Eutrigaster montecyanensis,* Jamaica, St. Anne's area, 5 km north of the Mason River Research Station, Calderon; Leg. R.W. Sims; Reg. No. BM(NH) 597-600.

Remarks: In contrast to the original description (Sims, 1987, p. 435), the species is holoandric. It has two pairs of testes in segments *x* and *xi* and two pairs of small seminal vesicles in segments *xi* and *xii.*

Subgenus *Graffia* Csuzdi & Zicsi, 1991

Eutrigaster (Graffia) maya sp. n.

External characters. Length of the incomplete Holotype 52 mm, diameter just after the clitellum 3.5 mm, number of segments 95. Paratypes 48-65 mm in length, 3-3.5 mm in diameter, 107-132 segments present. The colour of the preserved specimens is reddish-brown. Prostomium is almost tanylobic, V-



Figs. 20–21. *Eutrigaster (Graffia) maya* sp. n. 20. Penial seta. 21. Spermatheca. (Scale bar 0.1 mm: 20., and 0.5 mm: 21.)

shaped. First dorsal pore in furrow 11/12. Setae closely paired along the ventral surface of the body. Setal formula at segment *xxiv* is *aa:ab:bc:cd:dd* = 9:2.5:9:3:75. Female pores paired on segment *xiv,* situated somewhat anteriorly to the setae *a.* Two pairs of spermathecal pores are present in furrows 7/8 and 8/9 in setal lines *ab.* Male pores are paired on segment *xviii,* they are minute but conspicuous, situated in the seminal grooves. The clitellum extends over segments *xiii-xx,* annular but not fully developed. Two pairs of prostatic pores present on segment *xvii* and *xix* in setal line *b* connected on each side by a bow-shaped seminal groove. Genital papillae absent.

Internal characters. There are no thickened septa. A slightly muscular proventriculus present in segment *v.* Two large distinct gizzards situated in segments *vi* and *vii.* Calciferous glands are lamellate and paired in segments *xv-xvii,* of about equal size. Typhlosole simple, arises in segment *xxiv.* There is a pair of accessory ridges between segments *xxiv-xxxi.* Paired lateral hearts present in segments *x, xi* and *xii.* Excretory system meronephridial with 6 sac-shaped meronephridia on each side. The meronephridia are followed by a pair of ventromedian megameronephridia on the posterior part of the body. Testes and funnels paired in segments *x* and *xi,* enclosed in perioesophageal sperm sacs. Seminal vesicles present in *xi, xii,* and a pair of large racemose ovaries pendent from the posterior face of septum 12/13. Ovarian funnels and ovisacs are small. The two vasa deferentia of each side are easily seen entering the body wall in segment *xviii.*

Two pairs of tubular prostatic glands are present as short slightly coiled tubes in segments *xvii* and *xix*. Each prostate is accompanied with a small setal sac containing two simple penial setae. The form of the penial setae is similar to the normal setae. They are very small, somewhat curved, 0.3 mm in length, and at the middle 0.01 mm thick. Its ectal tip is simple and moderately sharply pointed. The ornamentation of the seta is restricted to its ectal third, consisting of scattered minute teeth (Fig. 20). There are two pairs of spermathecae in segment *viii* and *ix* of almost equal size. The duct is long and its ental end somewhat widened. The ampulla is almost round. The widened ental part of the duct carries a multilocular diverticulum containing 4-7 sperm balls (Fig. 21).

Remarks. This species shows affinities with *E. (E.) lineri* (Righi, 1972) but in the case of Righi's species the penial setae show a stronger reduction.

Localities: Holotype; Mexico, Chiapas, Cerro Mozotal, 2990 m, 16.7 miles from pass on continental divide above Huixtila, from bromelias; Leg. R.L. Seib; Reg. No. BM(NH) 1985.33.25; **Paratypes**; Mexico, Chiapas, Cerro Mozotal, 2990 m, 16.7 miles from pass on continental divide above Huixtila, from bromelias; Leg. R.L. Seib; Reg. No. BM(NH) 1985.33.26-33, 8 Ex. and 1985.33.34-39, 6 juvenile Ex., AF/3314, 3+2 juv. Ex.

Genus *Guineoscolex* Csuzdi & Zicsi, 1994

Guineoscolex bolamensis (Cognetti, 1910)

Syn.: *Benhamia fula* Sims, 1967 (Csuzdi & Zicsi, 1994a).
Benhamia mandinka Sims, 1967 (Csuzdi & Zicsi, 1994a).

Material examined: *Benhamia fula*, Syntypes; Gambia, Birkama Ba, 10 miles W. of Georgetown. Leg. R.W. Sims, 5-7. X. 1964; Reg. No. BM(NH) 1966.30.155-189; *Benhamia mandinka*, Syntypes; Gambia, Birkama Ba, 10 miles W. of Georgetown. Leg. R.W. Sims; 5-7. X. 1964; Reg. No. BM(NH) 1966.30.129-150.

Genus *Millsonia* Beddard, 1894, emend. Sims, 1986

Remarks: As Sims (1986) presented a detailed synopsis of *Millsonia* material housed in the Natural History Museum, London, only the species found are listed hereby: *M. artesetosa* Sims, 1986; *M. ashantiensis* Sims, 1986; *M. brevicingulata* Sims, 1986; *M. caecifera* (Benham, 1894); *M. centralis* Sims, 1986; *M. cruciventris* Sims, 1986; *M. ditheca* Sims, 1965; *M. ghanensis* Sims, 1965; *M. guttata* (Michaelsen, 1912); *M. hemina* Sims, 1965; *M. heteronephra* (Michaelsen, 1897); *M. hortensis* Sims, 1986; *M. inermis* (Michaelsen, 1892); *M. jadwigae* Sims, 1986; *M. lamtoiana* Omodeo & Vaillaud, 1967; *M. mima* (Michaelsen, 1891); *M. moderata* Sims, 1986; *M. nigra* Beddard, 1894; *M. nilesi* Sims, 1986; *M. nota* Sims, 1986; *M. oracapensis* Sims, 1986; *M. pulvillaris* Sims, 1986; *M. pumilia* Sims, 1965; *M. riparia* Sims, 1986; *M. schlegeli* (Horst, 1884).

Genus *Monothecodrilus* Csuzdi & Zicsi, 1994

Monothecodrilus reductus (Sims, 1967)

Material examined: *Benhamia reducta,* Syntypes; Gambia, Jakali swamp, Sapu, 12 miles W. of Georgetown; Leg. R.W. Sims; 5. X. 1964; Reg. No. BM(NH) 1966.30.209-211.

Genus *Omodeona* Sims, 1967

Omodeona fallax (Cognetti, 1910)

Syn.: *Omodeona proboscoides* Sims 1967 (Csuzdi & Zicsi, 1994)

Material examined: *Omodeona proboscoides;* Syntypes; Gambia, Abuko, 10 miles S. of Bathurst. Reg. No. BM(NH) 1966.30.483-512.

Tribe Neogastrini Csuzdi, 1996

Diagnosis. Excretory system holonephric or meronephric with caudal megameronephridia. Two stalked extramural calciferous glands paired on the oesophagus in segments *xiv-xv*. One gizzard before the genital segments, sometimes reduced.

Genus *Wegeneriella* Michaelsen, 1933

Wegeneriella valdiviae (Michaelsen, 1902)

Material examined: *Wegeneriella valdiviae;* Nigeria, 27 km N.E. of Calabar, ca 20 % natural forest, in life bluish green; Leg. J.C. Reid; Reg. No. BM(NH) 1985.9.7.

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Achaeta gigantea sp. n., a large-sized species of Enchytraeidae (Oligochaeta) from South Africa

By

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Abstract. *Achaeta gigantea* sp. n. is described from South Africa. It is the largest known species within the genus *Achaeta*. Its main characteristics are: epidermal sacs (setal follicles) absent; clitellum on XII-1/2 XIII showing a very typical arrangement of different cells; septal glands very much lobed and not united dorsally; dorsal vessel originates in IX; sperm funnel bent on itself; an odd big seminal vesicle in XI; spermatheca well developed, free, extending backwards to the VIII-Xth segments.

In the course of his trip in South Africa in 1991, Dr. A. Zicsi collected some large enchytraeid specimens and handed them to the present author. The animals belong to a species new to science which is described here as *Achaeta gigantea* sp. n.

Very few terrestrial enchytraeids have been described from South Africa so far (Michaelsen, 1907, 1913 a, 1913 b). The genus *Achaeta* is new to the country.

Material and methods

The enchytraeid worms studied were collected from sandy soil of a small indigenous forest near to a stream, 5 km from Grahamstown, South Africa. They were preserved in ethanol immediately after collection, *i.e.* the animals were examined only in preserved condition. Owing to the thick cuticle and the sand grains in the intestine the big worms were not transparent. Therefore seven specimens were cut up along the dorsal midline from XVth segment till the prostomium. Afterwards, they were stained in borax-carmine, haematoxilin-eosine or bromphenol-blue. In some cases, the organs (spermathecae, seminal vesicle, sperm funnel, septal glands) were picked up, and permanent mounts were made in euparal. The length and the diameter (at VIIIth segment

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and at the clitellum) of the intact specimens were measured also under light microscope.

Althogether 17 adult and 2 subadult specimens + 3 fragments were examined.

Achaeta gigantea sp. n.

(Figs. 1 A–G and 2 A–C)

Large species, length 23.0–45.5 mm, diameter at VIII 0.9–1.2 mm, at the clitellar region 1.0–1.5 mm. Number of segments about 66-85. It is difficult to count them, because they are ringed secondarily in the apical part and at the end of the body. In the middle part the body is entirely smooth and the septa are absent especially after the clitellar region. Colour whitish or brown, respectively, due to sand grains in the gut content. Head pore on tip of 0, dorsal pores absent. Setae, epidermal sacs (setal follicles) and lens-shaped epithelial cells absent. Cuticle thick, cutaneous surface with 2, at the end of body 7–8, afterwards 4–2 ring-shaped thickenings per segment, small cutaneous glands with small oval hyaline cells arranged in transverse rows. Clitellum extends from XII–1/2 XIII, ring-shaped, well developed (Fig. 2). Dorsally, granular and hyaline cells arranged in transversal rows forming a mosaic pattern (Fig. 2 C). Laterally, only granular cells in rows. Ventrally, an oval white pad is striking, composed by 20–22 (20–22 µm wide) rows of hyaline cells arranged into two-cell layers each (Fig. 2 A, B). The pad is surrounded by granular cells. Brain about 150-230 µm long, rounded posteriorly (Fig. 1 A). Three pairs of multiply lobed septal glands with ventral lobes in IV/V–VI/VII, none of them connected dorsally. Oesophageal appendage hardly visible in V. Chloragogen cells from V weakly developed. Lymphocytes oval or round, 15-30 µm long, gently granulated. Nephridia of the usual type of the genus, postseptal tapers gradually into a terminal efferent duct (Fig. 1 D). Two pairs of preclitellar nephridia present at VIII/IX and IX/X. The dorsal vessel originates in IX with large dilatation in IX, VIII and VII. Blood probably colourless (in the fixed animals it is not stained with eosin).

Seminal vesicle large, unpaired, dorsally in XI (Fig. 1 E). Testis and ovarium odd in the ventral midline of X/XI and XI/XII, respectively (Fig. 1 B). Sperm funnel about 800 µm long, three times longer than wide, strongly bent on itself or S-shaped (Fig 1 C). Collar wider than the funnel itself. The sperm duct (16 µm wide) wound into a more or less distinct spiral. The main opening simple without any glands. The male openings located 430 µm from each other (Fig. 2 A). Spermatheca free, consists of a short ectal duct with distinct canal. No glands at the ectal orifice. Mid-part of the spermatheca wider than the duct, displaying circular invaginations then expanding into a large

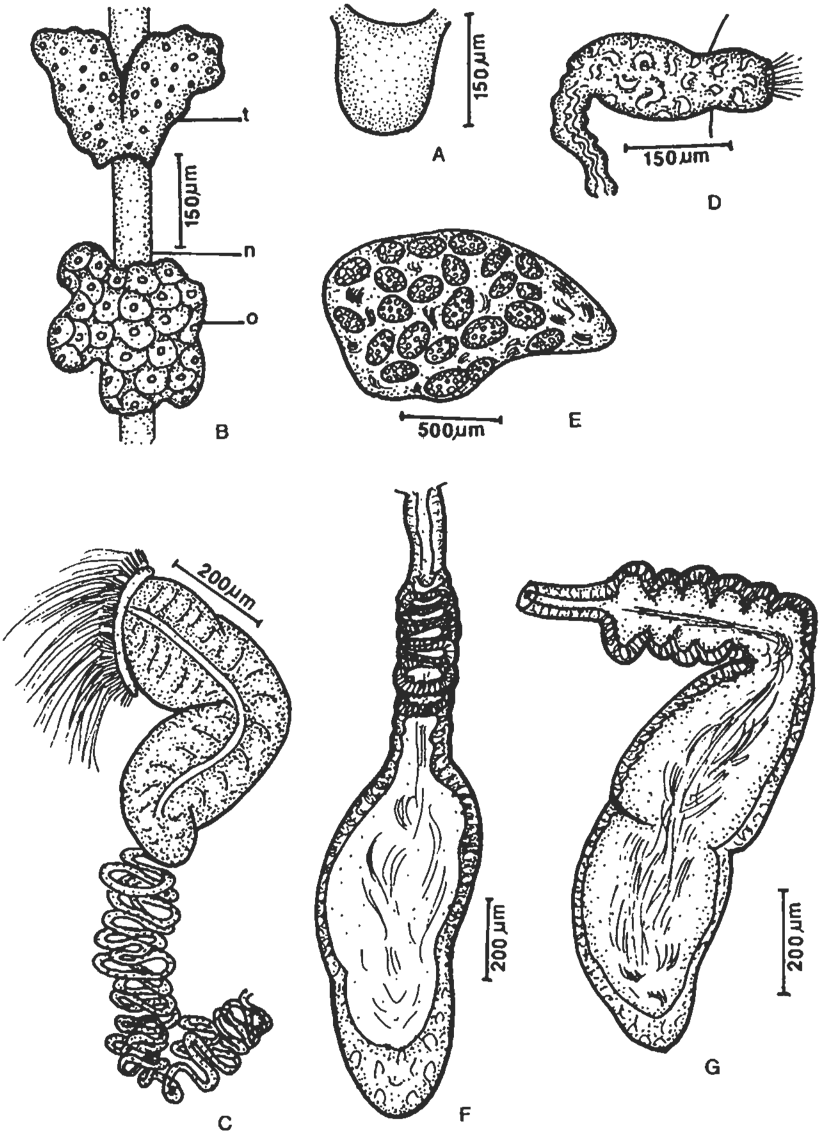

Fig. 1. *Achaeta gigantea* sp. n. A: brain; B: t = testis, o = ovarium, n = ventral nerve chord; C: sperm funnel; D: nephridium; E: seminal vesicle; F and G: spermathecae

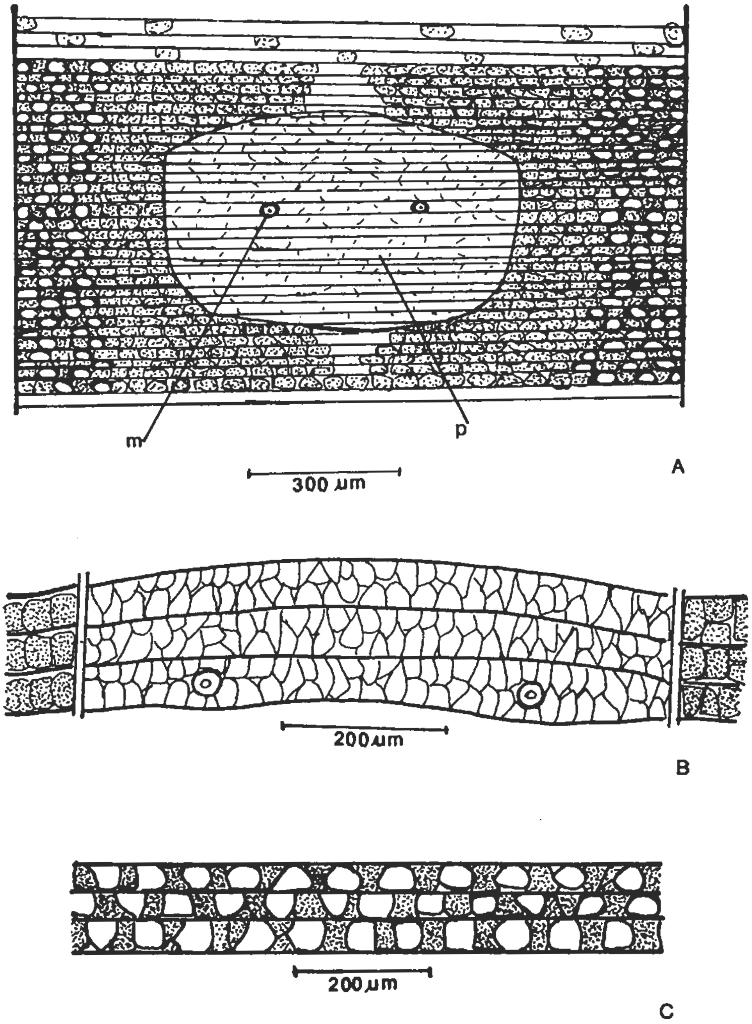

Fig. 2. *Achaeta gigantea* sp. n. A: ventral side of the clitellum of a dissected specimen, p = white pad with the male opening; B: three rows from the white oval pad magnified; the male opening is visible in the third row; C: three rows of glandular cells from the dorsal side of the clitellum (detailed in the text)

ampulla which also invaginated in the middle, filled with sperm and reaching to IX-X (Fig. 1 F, G).

Holotype: A. 3 (conserved in 70 % ethanol).

Paratypes: P. 72.1: 10 adult and 2 subadult specimens + 3 fragments (in 70 % ethanol); P. 72.2: three slides in euparal of a dissected and disjointed specimen stained in borax-carmine; P. 72.3: organs from a dissected specimen one slide in euparal, not stained; P. 72.4: three slides in euparal of a dissected and disjointed specimen stained in haematoxilin-eosine; P. 72.5: a total dissected specimen in euparal, stained in bromphenol-blue; P. 72.6: a dissected worm stained in borax-carmine (in 70 % ethanol); P. 72.7: three slides in euparal of a dissected and disjointed specimen stained in haematoxilin; P. 72.8: organs from a dissected specimen stained in borax carmine (in 70 % ethanol).

The type material is deposited in the collection of the author, Department of Systematic Zoology and Ecology, Eötvös Loránd University, Budapest.

Type locality: South Africa, Cape Province, 5 km from Grahamstown, sandy soil in the vicinity of a small stream in a indigenous forest, 33°20′ S and 26°31′ E; collected by A. Zicsi, 22. 11. 1991.

The distinguishing features of the new *Achaeta* species are: large size, characteristic arrangement of clitellar glands, form of the spermatheca and unique form of the septal glands having many lobes both dorsally and ventrally.

Etymology: The species name refers to the large size of the new species: *γιγαντειυσ* (Greek), or giganteus (Latin) = gigantic, uncommonly large.

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The fish fauna of the streams and ponds in the Pilis, Visegrádi and Börzsöny Mountains, Hungary – a review of the scientific literature

By

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Abstract. This paper summarises the ichthyological research on the small streams and ponds of the Danube Bend region. Based on the scientific literature the presently known fish fauna is listed and evaluated together with the human impacts responsible for fish fauna changes. The necessity of regional fish community monitoring is emphasised.

The calcareous Pilis- (757 m), and the volcanic Visegrádi- (700 m) and Börzsöny (939 m) Mountains are situated along a scenic bend of the River Danube, to the north of Budapest (Fig. 1). The so-called Danube Bend region is of high priority from a nature conservation viewpoint. Belonging to the management of the Danube-Ipoly National Park, the area has been functioning also as a UNESCO MAB Biosphere Reserve („Pilis Biosphere Reserve") since 1981 (Berczik, 1984). The aim of the present paper is to summarise the ichthyological knowledge on the region with special regard to faunistic data, on the basis of the scientific literature.

Chronological review of fish biological research

Table 1 shows the published scientific papers in chronological order with an indication of the examined waters. Among streams, mainly mountain streams with permanent flow have been studied so far. As regards lowland streams belonging to the region, only the fish fauna of the Lókos Stream, Ilka Stream, Sződrákos Stream, and its tributaries have been examined. Besides watercourses, additional data exist on a few standing water bodies, namely the pond of Pannóniatelep at Szentendre, the pond of Göd (Feneketlen Pond), and the fish pond system of Veresegyház. The fish fauna of a special habitat, the peat pit at Göd and its overflow is also known.

Research was carried out with a wide range of aims in the area. Mihályi (1954) and Berinkey (1972) reviewed the fish material of the Natural History Museum of Hungary and provided data on some streams of the Visegrádi and

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Table 1. List of small water bodies in the Visegrádi and Börzsöny Mountains examined for ichthyological purposes
(The name of each watercourse or standing water body is followed by the name of the nearest town, in parenthesis. The letters following the town names are as follows: V: stream in the Visegrádi Mountains, B: stream in the Börzsöny Mountains, S: lowland stream or pond)

Authors	Streams and ponds on the right bank of the Danube						Streams and ponds on the left bank of the Danube														Streams of the Ipoly water basin			
	Apátkúti Stream (Visegrád) V	Bükkös Stream (Szentendre) V	Lepence Stream (Visegrád) V	Malom Stream (Dömös) V	Pond of Pannóniatelep (Szentendre) L	Pilismaróti Stream (Pilismarót) V	Bőszobi Stream (Zebegény) B	Feneketlen Pond (Göd) L	Ilka Stream (Göd) L	Keskenybükki Stream (Szendehely) B	Lesvölgyi Stream (Verőce) B	Lókos Stream (Diósjenő) L	Malomvölgyi Stream (Zebegény) B	Morgó Stream (Kismaros) B	Sződrákos Stream (Sződliget) L	Tece Stream (Sződ) L	Peat pit and overflow (Göd) L	Fish pond system of Veresegyház (Veresegyház) L	Verőce Stream (Verőce) B	Zlebi Stream (Szokolyahuta) B	Bernecei Stream (Bernecebaráti) B	Csarna Stream (Kemence) B	Kemence Stream (Kemence) B	Rózsa Stream (Kemence) B
Mihályi, 1954																				+			+	+
Jászfalusi, 1950 a, b		+						+	+					+	+									
Berinkey, 1972	+	+		+			+			+	+		+	+							+		+	
Botta et al., 1981, 1984	+	+		+					+	+				+	+	+	+				+		+	
Keresztessy, 1992, 1993 a, b, c, 1994, 1995	+	+		+	+	+				+		+		+	+		+	+	+		+		+	
Erős, 1997, 1998 a, b, c	+	+	+	+		+																		
Sallai, 1997																					+	+	+	

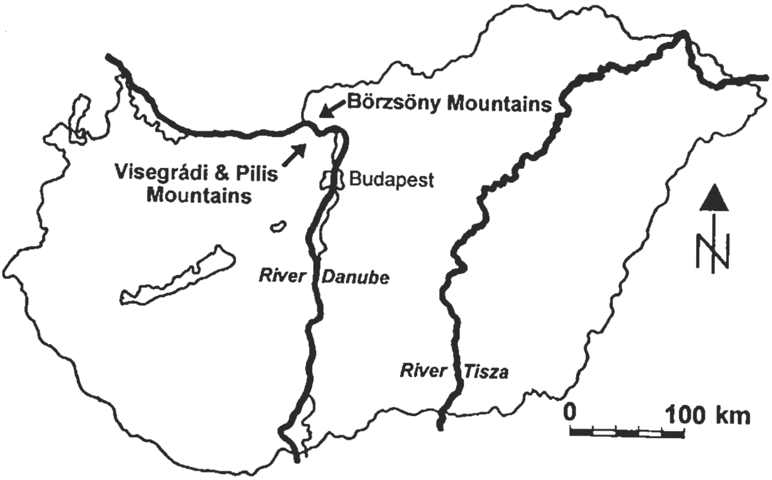

Fig. 1. The location of the Pilis-, Visegrádi- and Börzsöny Mountains in Hungary

Börzsöny Mountains. Jászfalusi (1950 a, b) investigated the hydrobiological state of some streams and lakes making suggestions for their management. Botta *et al.* (1981, 1984), Keresztessy (1992, 1993 a, b, c, 1994, 1995), Erős (1998 a) and Sallai (1997) made faunistic surveys, while Erős (1997, 1998 b, c) also provided some data on the ecology of two streams in the Visegrádi Mountains.

The presently known fish fauna

Altogether 39 fish species were recorded from the streams and ponds of this part of Hungary (Table 2), half of the presently known Hungarian fish fauna. Of the 39 species 12 are protected, 1 is strictly protected. Regarding the nature conservation status of fishes in Hungary (Guti, 1993), the fish fauna of this region comprises 8 vulnerable, 13 rare, 13 abundant, 4 introduced and 1 immigrant species. The distribution of fish according to their nature conservation status is presented in Table 3, in three categories (streams of the Visegrádi Mountains, streams of the Börzsöny Mountains, lowland streams and standing water bodies).

Table 2. Fish fauna list of small water bodies in the Danube Bend region, based on the scientific literature.
(CS: Conservation status (V: vulnerable, R: rare, A: abundant, Im: immigrant, In: introduced), V: streams of the Visegrádi Mountains, B: streams of the Börzsöny Mountains, L: lowland streams and standing water bodies. Note: the Latin names of protected species are in bold)

Fish species		CS	V	B	L
Abramis brama (Linné, 1758)	Common bream	A	+	-	+
Alburnoides bipunctatus (Bloch, 1782)	Schneider	V	+	+	-
Alburnus alburnus (Linné, 1758)	Bleak	A	+	+	+
Aspius aspius (Linné, 1758)	Asp	R	-	-	+
Barbatula barbatula (Linné, 1758)	Stone loach	R	+	+	+
Barbus barbus (Linné, 1758)	Barbel	A	+	+	+
Barbus peloponnesius petenyi (Heckel, 1758)	Southern barbel	V	+	+	-
Carassius auratus Linné, 1758	Gibel carp	A	+	-	+
Carassius carassius Linné, 1758	Crucian carp	R	-	-	+
Chondrostoma nasus (Linné, 1758)	Nase	R	+	+	+
Cobitis sp. (Linné, 1758)	Spined loach	R	-	+	+
Cyprinus carpio Linné, 1758	Carp	A	-	-	+
Esox lucius Linné, 1758	Pike	A	+	+	+
Gobio albipinnatus Lukasch, 1933	White-finned gudgeon	R	+	+	-
Gobio gobio (Linné, 1758)	Gudgeon	A	+	+	+
Gobio kessleri Dybowski, 1862	Kessler's gudgeon	V	-	+	-
Gymnocephalus cernuus (Linné, 1758)	Ruffe	A	-	-	+
Ictalurus nebulosus (Le Seur, 1819)	Brown bullhead	In	-	-	+
Lepomis gibbosus (Linné, 1758)	Pumpkinseed	In	+	+	+
Leucaspius delineatus (Heckel, 1843)	Sunbleak	V	-	-	+
Leuciscus cephalus (Linné, 1758)	Chub	A	+	+	+
Leuciscus idus (Linné, 1758)	Ide	R	+	-	-
Leuciscus leuciscus (Linné, 1758)	Dace	R	+	+	+
Lota lota (Linné, 1758)	Burbot	R	-	-	+
Misgurnus fossilis (Linné, 1758)	Weatherfish	R	-	-	+
Neogobius kessleri Günther, 1861	Kessler's goby	Im	+	-	-
Oncorhynchus mykiss (Walbaum, 1792)	Rainbow trout	In	+	-	-
Perca fluviatilis Linné, 1758	Perch	A	+	-	+
Phoxinus phoxinus (Linné, 1758)	Minnow	V	+	+	-
Proterorhinus marmoratus (Pallas, 1811)	Monkey goby	R	+	+	+
Pseudorasbora parva (Schlegel, 1842)	False rasbora	In	+	-	+
Rhodeus sericeus (Bloch, 1843)	Bitterling	A	+	+	+
Rutilus rutilus (Linné, 1758)	Roach	A	+	-	+
Salmo trutta m. fario Linné, 1758	Brown trout	R	+	+	-
Scardinius erythropthalmus (Linné, 1758)	Rudd	A	-	-	+
Tinca tinca (Linné, 1758)	Tench	R	-	-	+
Umbra krameri Walbaum, 1792	Hungarian mudminnow	V	-	-	+
Vimba vimba (Linné, 1758)	Zahrte	V	-	-	+
Zingel streber (Siebold, 1863)	Streber	V	-	+	-

Table 3. Percentage distribution of fish species with different conservational status in the three (V, B, L) water chategories.
(V: streams of the Visegrádi Mountains, B: streams of the Börzsöny Mountains, L: lowland streams and standing water bodies)

	V	B	L
Vulnerable	11.5	26.3	13.8
Rare	34.6	36.8	31
Abundant	38.5	31.6	44.8
Immigrant	3.9	0	0
Introduced	11.5	5.3	10.4

The fauna of the lowland streams and ponds can easily be discriminated from the fauna of the streams of the Visegrádi and Börzsöny Mountains (Table 2). The most frequent fish species of the Visegrádi and Börzsöny Mountains typical also in other montane streams in Hungary are the stone loach, chub, and the gudgeon. Rarer fish species are the minnow, southern barbel, schneider and the dace. In the upper sections of three streams (Apátkúti Stream (V), Morgó Stream (B), Kemence Stream (B)) brown trout can be found probably due to introductions. Other fish species are common exclusively at the mouth of the streams or get into the watercourses from small water reservoirs established for various reasons like sport fishing, basin irrigation or flood control.

The most common fish species of the lowland streams and ponds are the spined loach, bitterling, rudd, Hungarian mudminnow, pike, pumpkenseed, perch, and the tubenose goby. Beside these species, the list contains fish frequent in larger water bodies such as the asp, żahrte, common bream, barbel, burbot, nase; fish showing preference for standing water rich in aquatic vegetation such as the tench, crucian carp, mud loach, sunbleak, roach; fish common also in mountain streams such as the stone loach, chub, gudgeon; and fish introduced and bred in fish ponds such as the carp, gibel carp, false rasbora, and the brown bullhead.

Human impact-induced fish fauna changes

The growth of Budapest and increased tourism in the Danube Bend will have to be taken into account in nature conservation and environment policy n the the coming years. Shorelines are preferred recreational target places for tourism. Furthermore, the effects of local pollution caused by settlements, channelisation, concrete dams that obstruct fish movement, the possible

Table 4. List of fish species in the Visegrádi Mountains

Fish species	Apátkúti Stream				Bükkös Stream					Lepence S.	Malom Stream				Pilismaróti Stream	
	Berinkey, 1972	Botta *et al.*, 1984	Keresztessy, 1992	Erős, 1998a	Jászfalusi, 1950b	Berinkey, 1972	Botta et al., 1984	Keresztessy, 1992	Erős, 1998a	Erős, 1998a	Berinkey, 1972	Botta et al., 1984	Keresztessy, 1992	Erős, 1998a	Keresztessy, 1992	Erős, 1998a
Abramis brama									+							
Alburnoides bipunctatus				+	+											
Alburnus alburnus				+				+	+							
Barbatula barbatula		+	+	+	+	+	+	+	+		+	+	+		+	+
Barbus barbus				+												
Barbus peloponnesius pet.	+		+	+	+	+			+		+		+			
Carassius auratus			+	+					+							
Chondrostoma nasus				+					+							
Esox lucius			+						+							
Gobio albipinnatus								+					+			
Gobio gobio		+	+	+		+	+	+	+		+	+	+			
Lepomis gibbosus													+			
Leuciscus cephalus		+	+	+	+	+	+	+	+		+					
Leuciscus idus				+					+							
Leuciscus leuciscus				+												
Neogobius kessleri				+												
Oncorhynchus mykiss			+													
Perca fluviatilis				+												
Phoxinus phoxinus		+	+									+			+	+
Proterorhinus marmoratus		+	+	+					+							
Pseudorasbora parva				+					+							
Rhodeus sericeus													+			
Rutilus rutilus				+				+	+							
Salmo trutta m. fario			+	+												

impacts of introduced fish species on ecological interactions, and other passive or active human works threaten the natural fish fauna of the region.

The fishes of the examined waters and the gradual changes in the fauna lists from collection to collection are presented in Tables 4, 5, 6.

Owing to sporadic collections and the lack of definite aim of monitoring, the long term changes of the fish fauna cannot be followed. Among the reviewed papers only Erős (1998 a) gave some information on human impacts that imperil local fish fauna. Therefore, only in the case of some streams can we draw conclusions regarding the alteration of their biota.

Table 5. List of fish species in the Börzsöny Mountains

Fish species	Bernecei Stream				Bőszobi Stream	Csarna Stream	Kemence Stream					Keskenybükki Stream				Lesvölgyi Stream	Malomvölgyi Stream	Morgó Stream				Verőce Stream
	Berinkey 1972	Botta *et al.* 1984	Keresztessy 1993a	Sallai 1997	Berinkey 1972	Sallai 1997	Mihályi 1954	Berinkey 1972	Botta *et al.* 1984	Keresztessy 1993a	Sallai 1997	Berinkey 1972	Botta *et al.* 1981	Botta *et al.* 1984	Keresztessy 1993a	Berinkey 1972	Berinkey 1972	Jászfalusi 1950	Berinkey 1972	Botta *et al.* 1981	Keresztessy 1993a	Keresztessy 1993a
Alburnoides bipunctatus										+	+								+			
Alburnus alburnus										+								+				
Barbatula barbatula	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+
Barbus barbus																		+				
Barbus peloponnesius petenyi		+	+	+	+				+	+	+	+	+			+			+			
Chondrostoma nasus										+	+								+			
Cobitis sp.			+		+								+									
Esox lucius										+	+	+				+						
Gobio albipinnatus									+	+												
Gobio gobio		+		+					+	+	+	+					+		+			
Gobio kessleri										+												
Lepomis gibbosus											+											
Leuciscus cephalus				+					+	+	+	+	+						+			
Leuciscus leuciscus		+							+	+								+				
Phoxinus phoxinus		+	+	+		+	+	+	+	+	+	+	+	+				+	+	+	+	
Proterorhinus marmoratus										+												
Rhodeus sericeus										+					+							
Salmo trutta m. fario						+					+							+		+		
Zingel streber																			+			

Table 6. List of fish species in the lowland streams and small water bodies

Species	Feneketlen Pond	Ilka Stream		Lókos Stream	Pond of Pannónia	Szódrákos Stream				Tece Stream	Peat pit (Göd)	Peat pit overflow (Göd)		Veresegy-ház
	Jászfalusi, 1950 b	Jászfalusi, 1950b	Botta *et al.*, 1984	Keresztessy, 1993a	Keresztessy, 1992	Jászfalusi, 1950b	Botta *et al.*, 1981	Botta *et al.*, 1984	Keresztessy, 1993a	Botta *et al.*, 1984	Botta *et al.*, 1981	Botta *et al.*, 1984	Keresztessy, 1995	Keresztessy, 1995
Abramis brama			+				+							
Alburnus alburnus					+		+	+	+					+
Aspius aspius				+			+							
Barbatula barbatula				+		+	+		+					
Barbus barbus		+												
Carassius auratus							+	+	+					+
Carassius carassius	+						+	+	+		+	+		
Chondrostoma nasus								+						
Cobitis sp.		+	+	+			+	+	+			+	+	+
Cyprinus carpio														+
Esox lucius	+				+		+	+					+	+
Gobio gobio			+	+				+	+	+				
Gymnocephalus cernua								+	+					
Ictalurus nebulosus	+							+	+			+	+	
Lepomis gibbosus	+				+		+	+	+	+	+	+	+	+
Leucaspius delineatus					+		+							
Leuciscus cephalus				+		+	+	+	+					
Leuciscus leuciscus		+												
Lota lota	+													
Misgurnus fossilis		+					+	+	+					
Perca fluviatilis	+				+	+		+	+			+	+	+
Proterorhinus marmoratus		+				+	+	+	+		+	+	+	
Pseudorasbora parva							+							+
Rhodeus sericeus	+	+		+	+		+	+	+					+
Rutilus rutilus					+	+	+	+	+					+
Scardinius erythropthalmus	+		+		+		+	+	+	+				+
Tinca tinca	+							+	+					+
Umbra krameri	+						+	+	+		+	+	+	+
Vimba vimba							+	+	+					

From the streams of the Visegrádi Mountains, the fish fauna of the Bükkös and the Apátkúti streams became richer. This increase in species number is certainly the result of more intensive collections and sampling methods and not the improvement of the biological integrity of the streams. The Apátkúti Stream showed the most diverse fish fauna. However, because of a dam and the possible competitive and predatory effect of brown trout, all the other fish species are restricted to a two-km-long reach from the mouth.

This section is in the town of Visegrád and therefore is especially exposed to human disturbance. Special attention should be paid to the protection and long term maintenance of its fish fauna. The Bükkös Stream is the largest watercourse of the Visegrádi Mountains. Yet, its fish fauna is not so diverse as expected. Flowing through the town of Szentendre the stream becomes heavily polluted. Channelisation significantly decreases the diversity of habitats available for both streamdwelling, resident fish, and the broods of some Danubian fish species. No fish were found in the Malom Stream at Dömös in 1996, the watercourse which had had a relatively diverse fauna earlier. The reason for the total disappearance of fish is unknown. The Lepence Stream was also void of fish, but this result is not surprising. At the mouth there was a big concrete step which completely impeded fish moving upstream in the otherwise concrete channel. The stream had also received occasional chemical pollution from the local wood-mill.

From the streams of the Börzsöny Mountains, relatively detailed fish fauna data exist only on the Kemence (Bernece-Kemence-Csarna streams) and Morgó (Keskenybükki-Lesvölgyi-Verőce-Morgó Streams) waterbasin streams. The fluctuations in fish presence-absence data, however, may be due to the different sampling sites of the different researchers. It would be important to survey these systems again in detail to find the real reason for such small scale changes.

Changes in the fish fauna of the lowland streams and the ponds cannot be followed since only fractional data were found about these waters. An exception is the Sződrákos Stream, where the fish fauna did not have major changes.

From the comparative analysis of the material collected for museological purposes, and the results of fish faunistic surveys, it can be concluded that the waters of the mountains and lowlands of the Danube Bend region are rich in fish species. From a nature conservation viewpoint the fauna contains especially valuable protected, rheophilous and limnophilous fish species in high numbers. The more detailed re-investigation of the region following the rules and standardised methods of monitoring is highly recommended in order to fully understand the possible changes in the fish fauna and the reasons governing this process. It would also help to develop a more detailed picture about the fish fauna of the region. These first, thorough surveys could exclusively make future comparisons of fish communities possible both in space and time. The nature conservation status of the region (national park, biosphere reserve), the general scarcity of research on small waters in Hungary, and increasing human disturbance are among the main reasons that urge the earliest implementation of monitoring.

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A comparison of the nutrition utilization abilities of some small mammals and song-birds

By

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Abstract. Our study describes the experiments on two species of small mammals (rodents) and two species of birds. These are listed in the itroductory passage. For the duration of the experiment, the animals were fed only millet seed. Birds consumed relatively (expressed as a function of their body weights) twice as much food as small mammals. However, the latter utilized their food better than birds. For each unit of food, mammals produced only half as much faecal and urinal matter as birds. At the same time, the two mammal species were similar to each other, and the two bird species were similar to each other. From a production biological viewpoint, mammals and birds - perhaps as a result of the phylogenetic development - represent two clearly delimitable types.

The process of thermoregulation requires a lot of energy, which means that homoiotherm animals (mammals and birds) oxidize significantly more food than they need for the maintenance of their metabolism (Gere, 1982, 1993). Based on this fact, Hemmingsen (1960) grouped mammals and birds into one category from the point of view of production biology. At the same time, it seems that there are significant differences between birds and mammals. Studies that deal with environmentally or agriculturally important species of these two groups of animals call attention to the fact that mammals consume relatively less food in a given time period than birds. A few other reports support this observation as well. According to Turček (1956), the consumption intensity (the dry weight of the daily amount of food consumed as a percentage of live body weight) of the Yellow-necked mouse (*Apodemus flavicollis*) fed on tree-seeds is 7.6 % at temperatures between 18 and 26 °C. The same figure for the Tree sparrow (*Passer montanus*), which also feeds on seeds and has a body weight slightly less than the mouse, was 2.3 times greater (Gere, 1981). A similar difference can be observed by comparing the Red-backed vole (*Clethrionomys rutilus*) (Gere, 12973) to the Zebra finch (*Taeniopygia guttata*) (Grodzinski, 1971). Shrews, however, according to the above author, constitute an exception because of their high metabolic rate.

Thus, no overall generalizations can be made concerning the metabolic rate of animals, and it seems that only limited generalizations can be made

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about birds. Lasiewsky and Dawson (1967), as well as Kendeigh (1970) differentiate between the productivity of song-birds and nonsong-birds. Our previous studies support the likelihood of this difference (Gere, 1973, 1974, 1980-81, 1981; Gere & Andrikovics, 1986, 1994).

The above points prove that several more examinations are necessary in order to obtain an overall picture of the production biological performances of birds and mammals, as well as the differences between these two groups of animals. Towards this end, we have made comparative studies on two rodent species and two song-bird species. The species involved were the following:

Dwarf campbells Russian hamster (*Phodopus campbelli* Thomas) (Fam. Cricetidae)
Chinese hamster (*Cricetulus barabensis* Pallas) (Fam. Cricetidae)
Zebra finch (*Taeniopygia guttata* Vieill.) (Fam. Estrildidae)
Bengalese finch (*Lunchura striata* (L.) forma *domestica*) (Fam. Estrildidae)

For the purposes of better comparison, we chose only seed-eating species that can be fed with the same food for the duration of the experiment. Furthermore, we chose species whose individuals have been kept in captivity for several generations, thus the experimental situation is less stressful for them. At the same time, we believe that partial domestication has not influenced the nature of their metabolism because their selection for breeding has not been done on this basis. Let us note that we have previously done similar experiments on the two bird species involved (Gere, 1973, 1974). In order to provide better comparison and to maintain the same circumstances, we have repeated these experiments.

Methods

The experimental small mammals were housed individually in 17 × 15 cm plastic boxes. These boxes were covered with wire-mesh having 4 mm^2 holes. The birds were housed - also individually - in 31 x 18 cm bird cages, equipped with 2 sitting rods.

The animals were fed 3.0 g of air-dried millet seed daily. Every day, the leftover food was collected and measured in order to determine the amount of food consumed. Daily production of faecal and urinal matter (FU matter) was also collected and measured in air-dried state. Water was available to the animals as needed.

The natural habitat of the small mammals is the continental steppe (Wilson & Reeder, 1993). The Zebra finch is native in the dry areas of inner Australia (Immelmann, 1871). Although the Bengalese finch does not inhabit dry areas, it feeds mainly on monocotyledonous plants' seeds (Robiller, 1978). Thus the food of ripe (dry) millet seeds was not alien to any of the involved species.

Table 1. Average live weight of animals on the first day of the experiment

Species	Dwarf campbells Russian hamster	Chinese hamster	Zebra finch	Bengalese finch
Gramme	23.91	20.87	11.91	12.10

Table 2. Data for food consumption by the animals

Species	Dwarf campbells Russian hamster	Chinese hamster	Zebra finch	Bengalese finch
Day	Extreme values and averages of daily consumptions (g)			
1.	2.45-2.90 2.62	1.44-2.50 2.15	2.07-2.72 2.41	2.39-2.59 2.49
2.	2.50-2.90 2.70	2.04-2.54 2.39	2.41-2.60 2.49	2.08-2.57 2.40
3.	1.00-2.90 2.42	2.24-2.49 2.42	2.33-2.59 2.48	2.43-2.55 2.48
4.	1.00-2.60 1.97	0.50-2.50 2.23	2.40-2.77 2.50	2.39-2.54 2.49
5.	1.70-2.90 2.54	2.22-2.55 2.44	2.27-2.76 2.49	2.42-2.64 2.48
5-day averages	2.45	2.33	2.47	2.47

We used 10 developed (adult) individuals of each of the four species in our experiment. The experiment lasted for 10 days. The first five days were devoted to getting the animals accustomed to their new homes and the monotonous (but not unnatural) food necessary for the experiment. Measurements were taken during the next five days only.

Temperature was maintained between 20 and 22 °C. Light was provided for 11 hours daily.

Results and evaluation

Table 1 presents the average live body weight of animals on the first day of the experiment. As can be observed, the body mass of the mammals was approximately double that of the birds. Since the individuals involved in the experiment were not in their growing stages, we do not consider changes in their body weights. Production (P) can be considered zero.

Table 2 presents the extreme values and the averages of daily food intake. The distribution of these data is quite small, indicating that the animals' metabolism took place under balanced circumstances.

Table 3. Data for faecal and urinal matter (FU) produced by the animals

Species	Dwarf campbells Russian hamster	Chinese hamster	Zebra finch	Bengalese finch
Day	Air-dried mass (extreme values and averages) of daily FU matter (g)			
1.	0.12-0.23 0.18	0.02-0.28 0.12	0.24-0.38 0.32	0.22-0.51 0.35
2.	0.17-0.26 0.21	0.05-0.27 0.14	0.27-0.37 0.32	0.27-0.38 0.31
3.	0.14-0.23 0.19	0.12-0.25 0.16	0.24-0.57 0.37	0.25-0.44 0.33
4.	0.10-0.23 0.15	0.09-0.22 0.15	0.30-0.60 0.39	0.24-0.40 0.31
5.	0.12-0.22 0.16	0.09-0.36 0.18	0.24-0.46 0.34	0.22-0.38 0.30
5-day averages	0.18	0.15	0.35	0.32

It is striking to notice that the smaller birds consumed about as much food as the larger mammals. The results thus confirm what could be expected based on the above-mentioned facts; namely, that seed-eating birds need relatively more food than small rodents. The difference in the intensity of food consumption between the two groups of animals is great enough to be significant even if we account for the "law of body-surface." This law states that the amount of food consumed by animals is primarily determined by the surface area of their bodies, not by body weight. Thus, smaller animals eat relatively more than larger ones.

Several other important observations can be made based on the data presented in Tables 3 and 4. Table 3 gives daily productions of faecal and urinal matter (FU matter) for each of the 4 species' 10 individuals. Table 4 indicates the average ratios of FU matters to consumption (C). The "production" of the two mammal species as well as of the two bird species are very similar in this area; however, there are major differences between the mammals and the birds. Mammals utilize the food they consume to a much greater extent than birds. The ratio of FU matter to food consumed was twice as much in the case of birds as in the case of mammals. Therefore, birds meet their matter and energy needs by consuming larger amounts of less utilized food than mammals, which consume smaller amounts of more effectively utilized food. In this respect, the animals represent two clearly delimitable types, which can perhaps be explained by phylogenetic development. Our prior studies (Gere, 1982) also indicate that the food utilization abilities of animals, besides the occasional adaptation and the resulting convergences, is a function of phylogenetic development as well.

Table 4. The ratio of faecal and urinal (FU) matter production to food consumption (C) during the experiment

Species	Dwarf campbells Russian hamster	Chinese hamster	Zebra finch	Bengalese finch
$\frac{FU \times 100}{C}$				
5-day averages	0.18	0.15	0.35	0.32

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Limnological investigations of small water bodies in the Pilis Biosphere Reserve, Hungary

Two forest ponds: Tólaki-láp and Csikóvári-tó

By

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Abstract. The regular limnological investigation of small, lentic, forest water bodies in the Pilis Biosphere Reserve began in 1998. In the course of the present investigations the water chemistry and the Crustacea (Cladocera, Ostracoda, Copepoda) fauna of these waters were studied seasonally. The pH of the surveyed temporary ponds was acidic and moderately acidic, respectively, their conductivity, Ca^{++}, Mg^{++} and HCO_3^- concentrations were low. Nineteen and twenty Crustacea species were recorded in the Tólaki-láp (Tólaki Bog), and Csikóvári-tó (Csikóvári Pond), respectively. From among the investigated water bodies, *Bunops serricaudata* was only found in these ponds.

The Pilis Biosphere Reserve is situated northwest to Budapest in the Pilis and the Szentendre-Visegrádi Mountains. Its area extends over 23,000 hectares. The two middle mountains (max. altitude 757 and 700 m, respectively) are of diverse geological and geographical origin. Pilis is mainly formed from Triassic limestone, the Szentendre-Visegrádi Mountains is volcanic, predominantly consisting of andesite.

The systematic survey of streams and small water bodies in the Pilis Biosphere Reserve started in 1982 (Berczik, 1984). The basic limnological investigations of small water bodies began in 1998. Our study included the determination of the most important water chemistry and environmental parameters and the species composition of the Crustacea (Cladocera, Ostracoda, Copepoda) fauna in twenty-one small waters. The general environmental description, the water chemistry field-work measurements, the presentation of the Crustacea fauna as well as the synthetic evaluation of former publications all were carried out by the author. The results of the water chemical laboratory analyses were derived from M. Gánti-Pap. In this paper we present our data on the adjacent Tólaki-láp and Csikóvári-tó. Former condition of these two ponds had been studied by several authors.

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General description of the study area

The Tólaki-láp and the Csikóvári-tó are temporary forest pools located north to Pomáz in the southern part of the Szentendre-Visegrádi Mountains (Fig. 1). Both are situated in a crater-like depression and fed by precipitation, snowmelt and possibly by seeping confined water, but no spring contributes their water volume.

The Tólaki-láp is located southwest from the Nagy-Csikóvár Peak at 354 m above sea-level. It is surrounded by a closed Querco petraeae-Carpinetum forest. The largest water surface of the pond was recorded in spring, 2000, when it reached 170 × 50 m with a water depth of 130 cm. In years with low precipitation it can completely dry out by the end of July, or beginning of September, but it did not happen in the rainy 1999-2000 period. In the middle of the pond there is a *Salix cinerea* stand, which became larger covering the period of study. In the vegetation period a considerable amount of the water surface is covered by a *Carex* species, *Lemna minor* and *Spirodela polyrrhiza*. In 1999 1–2 dm^3 large *Riccia fluitans* patches developed in the northern part of the pond.

The Csikóvári-tó is 120 m away from Tólaki-láp in the southeast, at 375 m above sea-level in an open oak forest (Quercetum petraeae-cerris). Its size reached 120 × 80 m with a 130 cm water depth during the period of study, but similarly to the Tólaki-láp, it occasionally dries out in dry years.

Human impact is moderate in the area due to its relative isolation.

Previous studies

The Tólaki-láp was first mentioned by Dégen (1922) when describing the Bryophyta flora of Budapest and its surroundings. *Sphagnum cymbifolium* Ehrh. and *Sphagnum cuspidatum* Ehrh. were recorded in the dry bottom of the pond. In spite of this, Dégen concluded that it was not a peat bog as no peat formation occurred there; the presence of *Sphagnum* species was explained by the special ecological conditions of the pond.

Palik (1940) studied the algae flora of Tólaki-láp in 1935-39. Fifty-five algae species were detected including a new Cyanophyta species from the Rivulariacea family, *Gloeotrichia tuzsoni*. Some of the species are acidophilic, characteristic for marshes with low pH, mainly belonging to the order Desmidiales, and to the genera *Cosmarium*, *Staurastrum* and *Closterium*. Besides the earlier mentioned *Sphagnum* species, *Sphagnum acutifolium* Russ & Warrnst was also found in the dry bottom of the pond.

Soós (1940) also reported *Sphagnum cuspidatum* from there. Since then no other *Sphagnum* data has been published from the Tólaki-láp.

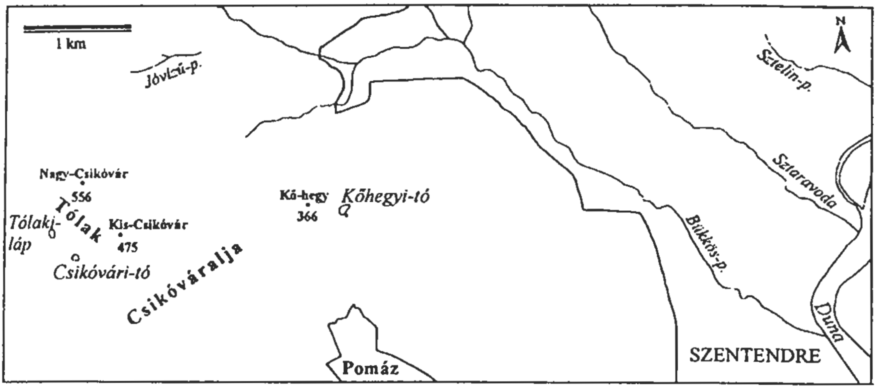

Fig. 1. Location of the sampling sites

According to Megyeri (1970), the special ecological conditions enable *Sphagnum* species to colonise the pond temporarily. In October, 1957 and May, 1958 he studied the microfauna (Testacea, Rotatoria, Cladocera, Ostracoda, Copepoda) and the water chemistry of the pond. Eight Testacea, twenty-two Rotatoria, eight Cladocera, three Ostracoda and seven Copepoda species were then detected. Three of the Testacea species (*Centropyxis aculeata, Lecquereusia spiralis, Euglypha strigosa*) are primarily known from *Sphagnum* bogs. After comparing the microfauna detected in a number of bogs and forest ponds, Megyeri concluded that its composition is basically determined by the chemical characteristics of the water (mainly by pH) and not by the vegetation.

No limnological articles have been published on the Csikóvári-tó, which lies only 120 m away from the Tólaki-láp, except for the thesis of Perendy (1981) dealing with the seasonal changes of its algae flora. He detected seventy species in the pond and concluded that with the exception of some species (*Eunotia lunaris, Schroederia setigera*) the species composition of algae communities changes seasonally. In March and April Dinophyta (*Gymnodinium albulum*), Chlorophyta (*Clamydomonas* spp.) and Chrysophyceae (*Dinobryon sertularia* and *D. sociale, Mallomonas allorgei*), from the end of April to end of May Cryptophyta (*Chroomonas acuta, Chroomonas reflexa, Cryptomonas rostratiformis*), from June Chlorophyta (*Oedogonium indonense, Ulothrix* spp.), Cyanophyta (*Oscillatoria tenuis, Anabaena oscillarioides, Microcystis firma*) and Euglenophyta (*Euglena proxima, Phacus acuminatus*) species dominated the communities. Palik

(1940) and Perendy (1981) only found three common species in the two ponds. Besides the different characteristics of the two water bodies, it could also be caused by the different sampling times and methods. Palik collected several samples between 1935 and 1939, but usually in spring and autumn, while Perendy sampled the Csikóvári-tó several times in a month from March to August. Also, Palik sampled the sediment and aquatic macrophytes for algae as well, while Perendy only had planktonic samples. In spite of all these sampling differences, the considerably higher species number of the acidophil Desmidiales order was characteristic for the Tólaki-láp.

Methods

Water chemistry measurements were carried out in the middle of the open water areas of the ponds, zoological samples were collected from different microhabitats (open water, floating macrophytes, reeds, weed, logs, roots, rocks, etc.). Five seasonal sampling was carried out between 1999 and 2000 (15. 04. 1999, 05. 08. 1999, 28. 10. 1999, 17. 04. 2000 and 03. 07. 2000). Water chemistry parameters were measured with a portable WTW Multiline-P4 multifunctional field equipment. Temperature, pH, conductivity, dissolved oxigen concentration and oxigen saturation were recorded. Qualitative samples were collected from all possible microhabitats with a 70 µm mesh size net to get a general overview of the Cladocera, Ostracoda and Copepoda fauna of the ponds. They were fixed in a 4 % formaldehyde solution on the site. Besides the species composition, the relative abundance of the three Crustacea groups was also estimated by counting 500-600 individuals in the laboratory.

Results and discussion

Water chemistry

Table 1 shows that the water of the Tólaki-láp is acidic with low conductivity and dark humic acids, it is similar to the water of bogs. PH is primarily determined by the amount of precipitation. In 1999-2000, pH increased during the spring and early June rainfall maxima and during possible autumn rains due to the neutrality of the rain water. According to Palik (1940), the pH was also very low (5.5) in September 1939, when there was only little water in the pond due to the lack of rain. In the drier summer months the pH of the water was always acidic (5.42–5.6). Conductivity fluctuated between 55.2 and 121 µS/cm. It decreased in the wet spring and

Table 1. Water surface and water chemistry data of the Tólaki-láp and Csikóvári-tó. (1935-39 and 1980 data were published by Palik (1940) and Perendy (1981), the 1999-2000 data are from the present author)

Characters	Measuring time	Tólaki-láp	Csikóvári-tó
Water surface (m)	1935-39 *	150x70	
	1980 *		70x50
	15. 04. 1999	165x50	120x80
	05. 08. 1999	70x35	55x60
	28. 10. 1999	160x40	120x70
	18. 04. 2000	170x50	130x80
	03. 07. 2000	140x35	100x50
pH	06. 05. 1936	5.6	
	02. 07. 1936	6.0	
	22. 09. 1936	5.5	
	15. 05. 1937	7.5	
	11. 10. 1938	6.8	
	07. 03. 1939	6.8	
	17. 10. 1939	6.2	
	15. 04. 1999	7.18	7.34
	05. 08. 1999	5.49	6.14
	28. 10. 1999	5.62	6.18
	18. 04. 2000	7.32	7.38
	03. 07. 2000	5.42	6.35
Conductivity (µS/cm)	21. 03. 1980		80
	28. 03. 1980		79
	11. 04. 1980		114
	25. 04. 1980		73
	09. 05. 1980		73
	29. 05. 1980		102
	15. 04. 1999	61.5	79
	05. 08. 1999	91	112.2
	28. 10. 1999	63.4	69
	18. 04. 2000	55.2	76.8
	03. 07. 2000	121	143
O_2 concentration (mg/l)	21. 03. 1980		23.82
	28. 03. 1980		11.16
	11. 04. 1980		8.62
	25. 04. 1980		9.27
	09. 05. 1980		11.69
	29. 05. 1980		6.29
	15. 04. 1999	10.18	9.28
	05. 08. 1999	5.20	2.37
	28. 10. 1999	0.36	2.52
	18. 04. 2000	9.05	8.55
	03. 07. 2000	8.95	3.53

* On one occasion measured data

Table 2. Water chemical characterization of the Tólaki-láp and the Csikóvári-tó. (Analyses were made by M. Gánti-Pap, Hungarian Danube Research Station of the Hungarian Academy of Sciences in April, 2000.)

Chemical characters	Tólaki-láp	Csikóvári-tó
Suspended matter (mg/l)	12.0	11.5
Total dissolved solids (mg/l)	14	18
Turbidity (mg/l)	36	30
Alkalinity (W^0)	0.57	0.69
Total hardness (nk^0)	2.15	2.46
Ca hardness (nk^0)	1.22	1.22
Mg hardness (nk^0)	0.93	1.24
HCO_3^- concentration (mg/l)	43.31	46.97
CO_3^{2-} concentration (mg/l)	0	0
Ca^{++} concentration (mg/l)	8.75	8.75
Mg^{++} concentration (mg/l)	4.05	5.4
NO_3^- concentration (mg/l)	0	0
PO_4^{3-} concentration (mg/l)	0.14	0.21
SO_4^{2-} concentration (mg/l)	0	1
Total chemical oxigen demand (mg O_2/l)	28.42	28.23
COD of dissolved matter (mg O_2/l)	25.01	23.72
COD of particuleted matter (mg O_2/l)	3.41	4.51

autumn months while in summer it was higher due to the concentration increase.

The pH of Csikóvári-tó was slightly acidic, the lowest value was 6.14. The conductivity of the water, similarly to the Tólaki-láp, was low though always higher than there, but it never exceeded 150 µS/cm. Conductivity and pH was again primarly governed by precipitation.

On the basis of the three authors' measurements (Palik: 1937-39, Perendy: 1980, Kiss: 1999-2000) there are no considerable differences between the water chemistry of the two pools probably due to the relative small ratio of the human impact.

According to the analysis of the sample from April, 2000, the Ca^{++}, Mg^{++} and HCO_3^- concentration of the two ponds was low due to the great quantity of inflowing water originating from rain and snowmelt (Table 2).

*Table 3. The Cladocera, Ostracoda and Copepoda fauna of the Tólaki-láp and Csikóvári-tó. (++ = abundant, + = intermediate, (+) = rare, * = species found by Megyeri, 1970)*

Species	Tólaki-láp	Csikóvári-tó
CLADOCERA		
Daphnia obtusa Kurz		++
Daphnia curvirostris Eylmann em. Johnson	(+)	+
Daphnia pulex Leydig em. Scourfield		+
Daphnia longispina O. F. Müller	(+)	
Simocephalus exspinosus (Koch)	+	++
Simocephalus vetulus (O. F. Müller)	*	+
Ceriodaphnia reticulata (Jurine)	(+)*	++
Ceriodaphnia laticaudata P. E. Müller	*	++
Ceriodaphnia quadrangula (O. F. Müller)	(+)	
Bunops serricaudata (Daday)	(+)*	(+)
Oxyurella tenuicaudis (Sars)	(+)*	
Alona intermedia Sars	(+)	++
Alona guttata Sars	(+)	
Alonella excisa (Fischer)	(+)*	+
Chydorus sphaericus (O. F. Müller)	++*	++
OSTRACODA		
Candonopsis kingsleii (Brady & Robertson)	(+)	
Pseudocandona compressa (Koch)		(+)
Pseudocandona pratensis (Hartwig)		(+)
Cypria ophtalmica (Jurine)	(+)*	
Cyclocypris ovum (Jurine)	(+)	
Bradleystrandesia fuscata (Jurine)	(+)	
Cypridopsis vidua (O. F. Müller)		++
Cypridopsis elongata (Kaufmann)		(+)
COPEPODA		
Eudiaptomus vulgaris (Schmeil)	(+)*	+
Macrocyclops albidus (Jurine)		+
Eucyclops serrulatus (Fischer)	++	
Paracyclops affinis (Sars)		(+)
Cyclops strenuus strenuus Fischer	++	++
Megacyclops viridis (Jurine)	++*	++

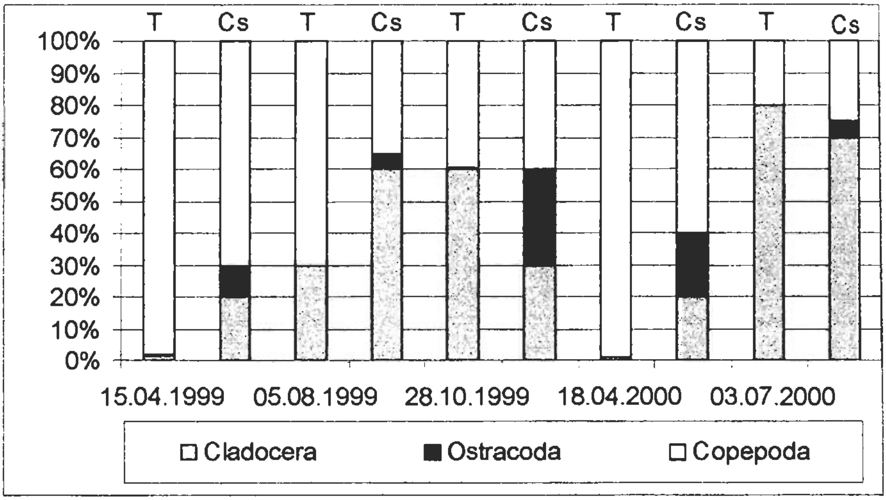

Fig. 2. Relative abundance of the three investigated Crustacea groups in the Tólaki-láp (T) and the Csikóvári-tó (Cs)

Cladocera, Ostracoda and Copepoda fauna

The presence of 29 species (15 Cladocera, 8 Ostracoda, 6 Copepoda) was recorded from the two ponds between April, 1999 and July, 2000 (Table 3).

	Tólaki-láp	Csikóvári-tó	Common
Cladocera	11	11	7
Ostracoda	4	4	0
Copepoda	4	5	3

One of the common species is *Bunops serricaudata,* which was only found in these ponds in the Pilis Mountains. Megyeri (1970) also detected it from the Tólaki-láp. On the other hand, he did not have any *Daphnia* species in his Tólaki-láp species list while all 1999–2000 samples contained that genus even if only with one or two individuals. On the contrary, *Daphnia* individual number was always high in the Csikóvári-tó samples.

With the exception of *Chydorus sphaericus,* Cladocera species were present in low individual number in the Tólaki-láp. It can be explained by the lower pH and the smaller macrophyton cover of the pond. Strikingly different Ostracoda species were found in the two ponds. In general, most ostracods can tolerate wide range of different environmental parameters and they are present in a great variety of water bodies. This phenomenon could probably be caused by the special geographical situation of the ponds. Both are located in depressions surrounded by steep sides covered by closed oak forests. They are also separated from the other small forest ponds (the nearest Kőhegyi-tó is approximately 2 kms away). In such a situation the effeciency of the most characteristic passive dispersal of ostracods (by wind or on amphibians, bird, etc.) is limited.

The relative abundance of the three Crustacea groups can be seen in Fig. 2. In spring copepods, *Cyclops strenuus strenuus, Megacyclops viridis* were predominantly abundant together with *Eucyclops serrulatus* in the Tólaki-láp. Several individuals of *Eudiaptomus vulgaris* were also found in both ponds. From spring to October there was a relative increase in Cladocera abundance. *Simocephalus exspinosus, Chydorus sphaericus, Ceriodaphnia reticulata, Alonella excisa* were present in both ponds, from April to October, they were abundant in the Csikóvári-tó. With the exception of the spring boom of *Cypridopsis vidua* in the Csikóvári-tó in 2000, Ostracoda species showed a very low individual number in both ponds.

Altogether sixty-four Crustacea (34 Cladocera, 17 Ostracoda, 13 Copepoda) species were recorded in the twenty-one investigated small water bodies of the Pilis Biosphere Reserve including the Tólaki-láp with nineteen and the Csikóvári-tó with twenty Crustacea species. Both are relatively high species numbers in comparison with the fauna of small water bodies (the highest species number was detected in the Kőhegyi-tó, which is situated approximately 2 kms away from the Tólaki-láp and the Csikóvári-tó.). The low pH of the Tólaki-láp did not reduce the species number, but the individual number of the species was always very low. Due to the relative isolation of the ponds, *Bunops serricaudata* was found only in these two water bodies. The composition of the microfauna in the twenty-one investigated small forest ponds was primarly determined by their geographical location, size and habitat diversity and the duration of the water cover.

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A comprehensive three-year herpetological survey in the Gemenc Region of the Duna–Dráva National Park, Hungary

By

M. PUKY*

Abstract. This study summarizes the results of the first general herpetological survey of the Gemenc Region of the Duna (=Danube)-Dráva National Park. Altogether nine amphibian and four reptile taxa were recorded in the diverse riparian habitats. The reproductive success of the common amphibian species was greatly influenced by the water level fluctuation of the Danube. The amphibian community size of Gemenc District was estimated to fluctuate between 16 and 238 million individuals. The occurrence of deformities in the protected area is a cause of concern.

The study of amphibians in protected areas is an important task of modern conservation as this class disappears faster than other vertebrate classes from temperate and tropical ecoystems (Griffith & Beebee, 1992) and they seem to be more endangered than e.g. birds or mammals. (As an example see Fig. 1 modified from Abramovitz, 1996.) Often, species disappear without any obvious natural or anthropogenic cause (Blaunstein & Wake, 1990; Wake, 1991; Wyman, 1990) and in general, there is an obvious and statistically significant amphibian decline in the Northern Hemisphere (Houlahan et al., 2000). In most documented cases the disappearance or considerable decline of amphibians is primarily caused by habitat destruction or degradation (Vial & Sailor, 1993), but other factors, such as water management, agriculture, forestry, tourism, the introduction of foreign species, acid rain, road mortality, collection, the introduction of fish into small water bodies as well as human brutality can also have a serious effect (Cooke, 1995; Corbett, 1989; Drost & Fellers, 1996; Petranka, 1994; Puky, 1991).

Several amphibian species are sensitive due to their basic biological characteristics (e.g. complex habitat reguirements and moderate colonisation capacity). As a result, even temporary adverse negative effects can lead to the disappearance or decline of populations (Young, 1981). Besides, amphibians are also characterized by a considerable population size fluctuation. Therefore

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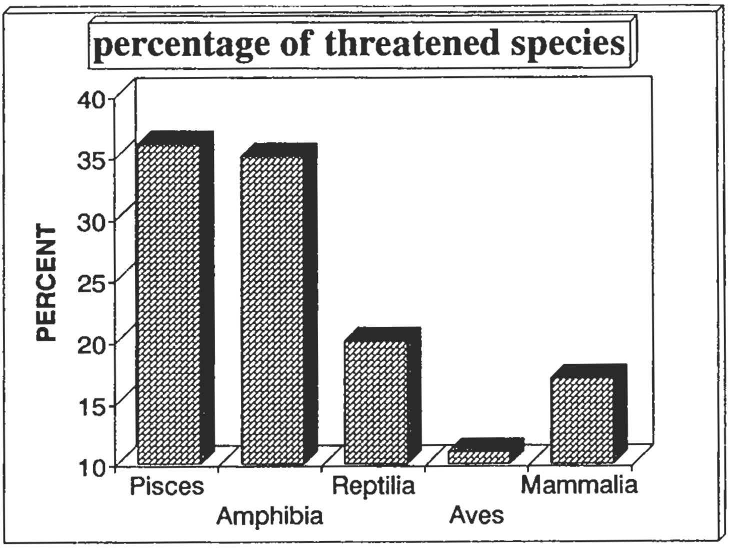


Fig. 1. The conservation status of vertebrate classes

several authors e.g. Grossenbacher (1995) and Pechman and Wilbur (1994) emphasize the importance of long-term herpetological studies in relatively undisturbed, protected areas.

In spite of these known facts, amphibians are rather badly studied, several species become extinct before they are described, especially in the tropics (but a new species, *Rana pyreneica* was also described in the 1990's even in Europe; Serra Cobo, 1993). The development of taxonomy changes the status of several taxa (including some living in Hungary), also affecting conservation needs due to the listing of new taxa in conservation treaties (IUCN, 1996). However, the lack of up-to-date information makes the effective use of these guidelines impossible. Besides, no special management plans are worked out for most amphibian species, which would be needed for the long-term conservation of amphibians (Gasc, 1997).

The distribution of reptiles in Hungary is moderately known (Gasc, 1997). Most species are sparse, studies are relatively few and local (with the exception of those on *Vipera ursinii rakosiensis*). What is more, the processing of the available data is very inadequate given that reptiles in general are more threatened than birds or mammals.

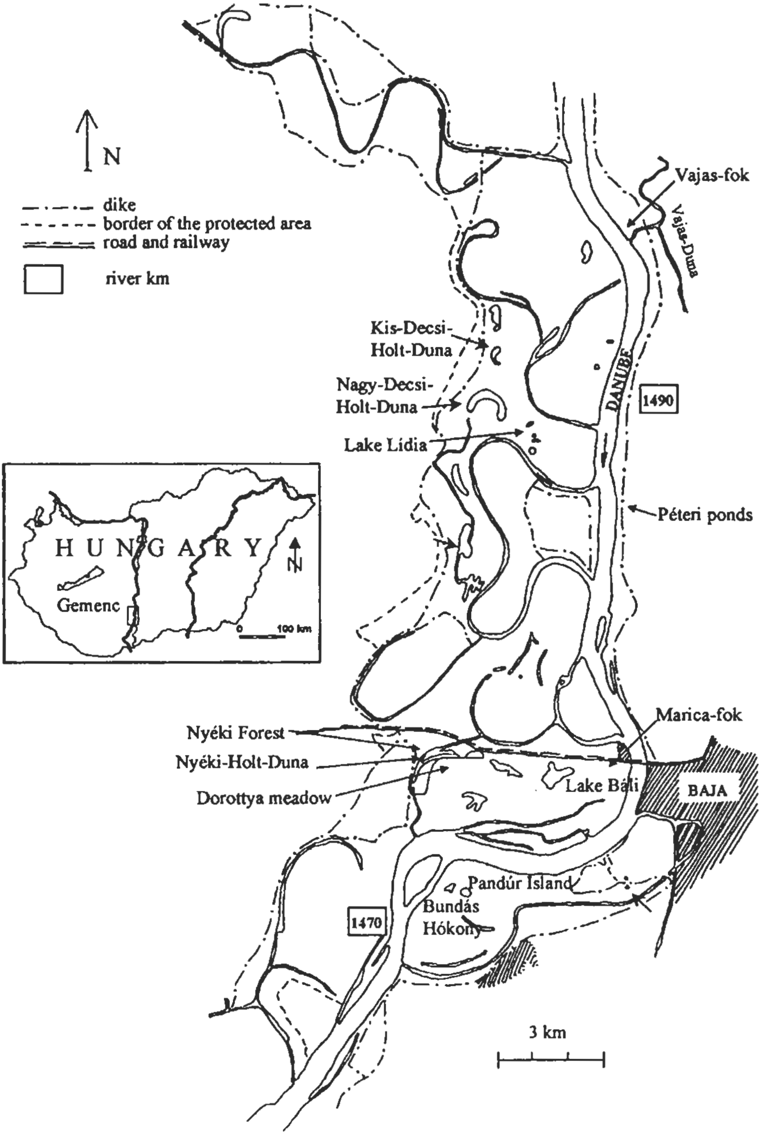


Fig. 2. Map of Gemenc

*Table 1. Main sampling sites in the Gemenc Region of the Duna-Dráva National Park**

Sampling site	Short characterization
Lake Báli	A temporarily water covered area south of the No. 55. public road. A long-term sampling site
Bárányfok	An area with several small water bodies at the northern destination of the forest railway, the northernmost sampling site on the right side of the Danube
Bundás Hókony	The outer, regularly flooded part of Pandúr Island opposite to Kádár Island. A long-term sampling site
Kis-Decsi Holt-Duna	A permanent oxbow lake near the forester's house at Szomfova
Marica-fok	An area with several small water bodies east of the forester's house at Felsőpörböly, south of the No. 55. public road
Lake Lídia	A permanent water body between the Gemenc Holt-Duna and the Rezéti Holt-Duna
Nyéki-Holt-Duna	A permanently water-covered oxbow lake south to the No. 55. public road, a natural water body also having been incorporated into the floodplain water supply system constructed during the study period. Two long-term sampling sites, Nyéki Forest and Dorottya meadow are situated on opposite sides of it
Pandúr Island	Danube and Sugovica surrounded this island on the left bank of the Danube
Péteri ponds	Permanent ponds between Érsekcsanád üdülőtelep and the Sámán farm on the left bank of the Danube
Vajas-fok	A protected area conserving diverse water types, the northernmost sampling site on the left bank of the Danube

* Several further samples were also collected from a number of small, temporary or permanent water bodies.

One of the most important purposes of the 49,479 hectare Duna–Dráva National Park is the conservation of riparian habitats. It consists of several separated units mainly along the River Danube and the River Dráva. Amphibians are one of the most characteristic animal group in those habitats so their conservation is especially important there. A precondition for this goal is to carry out a basic herpetological survey with modern methods. However, as in other protected areas in Hungary, this had not been done before the present survey started in 1997.

This study was carried out to survey the herpetofauna of Gemenc, record temporal changes and describe the regional importance of different threats.

Sites and methods

With its 17,800 hectares, Gemenc is the largest protected unit in the Duna –Dráva National Park. It is situated at the western edge of the Great Hungarian Plain. It is dominated by the Danube with its 2,260 m^3 s^{-1} water discharge and 5–7 m water level fluctuation mainly regulated by ice and snowmelting in the Alps (Bulla, 1962). Usually there is a moderate flood in March-April followed by another with the highest annual water level in June. Due to water management and its natural consequences in the last century the duration of floods is shortened and several water bodies were permanently or temporarily separated from the main arm of the Danube. However, Gemenc is still a most intact part of the Hungarian Danube section.

Samples were collected between 11th September, 1997 and 1st October, 1999. Four sampling sites (Bundás Hókony, Lake Báli, Nyéki Forest, Dorottya meadow, the latter two were situated on the opposite sides of Nyéki-Holt-Duna) were selected for long-term investigations but the whole protected area (Fig. 2) was sampled including habitats on the left side of the Danube. The main characteristics of the most important sampling sites can be found in Table 1.

Six internationally accepted methods were used to study amphibians (Fellers & Freel, 1995; Griffiths & Raper, 1994; Heyer et al, 1994; Olson et al, 1997).

Visual encounter surveys were carried out at each site. In spring mainly breeding sites were selected while in summer and autumn other habitats were also visited.

Audial surveys were always carried out when those were possible as a useful additional method. Certain species (e.g. *Hyla arborea*) are easier to detect with this method and distinguishing between the taxa in *Rana esculenta* „complex" is also possible on the basis of differerences in sounds.

Road transects (e.g. determining and counting living and dead amphibians on hard surface roads) are commonly used in Northern Europe and America. Though it can only be used in areas where the road network is developed it is especially useful to record species such as *Pelobates fuscus*. In Gemenc the Baja–Pörböly and the Érsekcsanád-Érsekcsanád Üdülőtelep public roads sections together with the right side (western) dikes were surveyed.

Torching and netting were done to collect newts in their aquatic phase by night and by day, respectively.

The transect method was used to estimate the number of individuals at the long-term sampling sites (Bundás Hókony, Lake Báli, Nyéki Forest, Dorottya meadow).

In autumn the growth characteristics of common species were also recorded together with the occurrence of development malformations. 51-101 individuals were studied at each site in every occasion. Length was measured with a spring balance, weight with KERN 462-41 digital scales.

Data were collected on standardised questionnaires, species and habitats were also documented by photography.

Table 2. Occurrence of amphibian and reptile species in Gemenc

Species	Right bank, northern part*	Right bank, southern part*	Left bank, north to Baja	Pandúr Island
AMPHIBIA				
Triturus vulgaris L.	+	+	+	
Triturus dobrogicus K.	+	+		
Bombina bombina L.	+	+	+	+
Bufo bufo L.	+	+	+	+
Bufo viridis L.	+	+	+	
Pelobates fuscus L.	+	+	+	
Hyla arborea L.	+	+	+	+
Rana dalmatina B.	+	+	+	+
Rana esculenta c.**	+	+	+	+
REPTILIA				
Lacerta agilis L.	+	+	+	+
Natrix natrix L.	+	+	+	+
Elaphe longissima L.		+		
Emys orbicularis L.				+

* Areas north or south of the No. 55. public road on the right side of the Danube

** Explanation see in the text

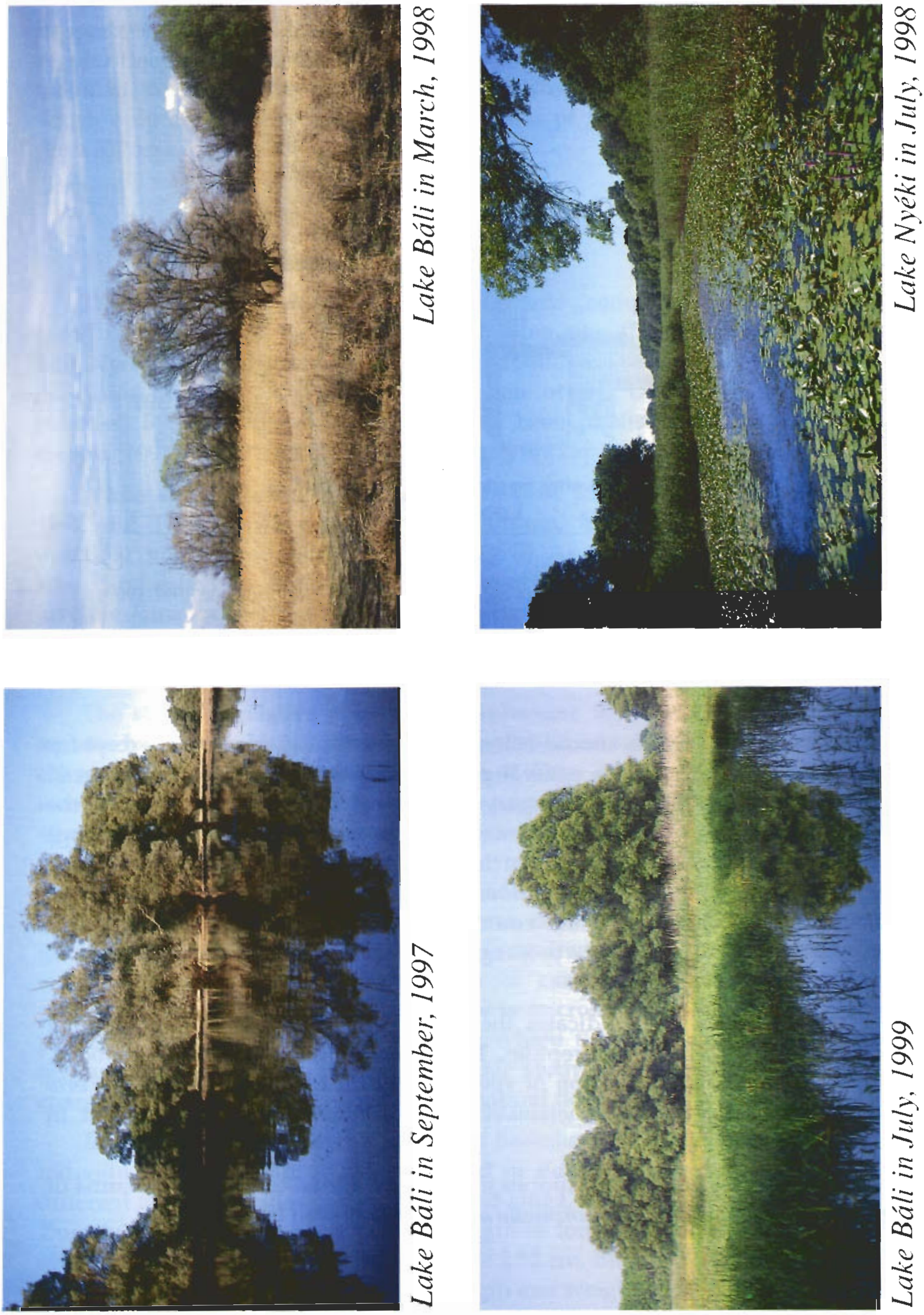
Results and discussion

Faunistic results

Altogether nine amphibian and four reptile taxa (species) were recorded in Gemenc. Their overall distribution can be found in Table 2. The water bodies in the protected area are functionally very well connected as floods enable amphibians to cover greater distances than in other habitats. Because of this phenomenon the data in Table 2. are from larger areas, which involve several different breeding sites (Figure 3).

Rana esculenta „complex" is the commonest of the amphibian taxa in the region. (Audial results indicated the presence of *Rana lessonae,* which was also supported by the study of Prof. Beebee, University of Sussex, who also proved the dominance of *Rana lessonae* by mitochondrial DNA analysis). *Hyla arborea* was also quite common.

From a conservation viewpoint, the presence of three International Red Data Book species (*Hyla arborea, Bombina bombina, Triturus dobrogicus*) is the most important feature (IUCN, 1996) so the ratio of internationally important, threatened species is high in Gemenc. Due to zoogeographical considerations, *T. dobrogicus* is the most valuable of the three internationally listed species in Gemenc (Nöllert & Nöllert, 1992). It is a member of the *Triturus cristatus* group and according to modern data (Arntzen et al., 1997),



Lake Báli in September, 1997

Lake Báli in March, 1998

Lake Báli in July, 1999

Lake Nyéki in July, 1998

Fig. 3. Key habitats and herpetofauna species in Gemenc

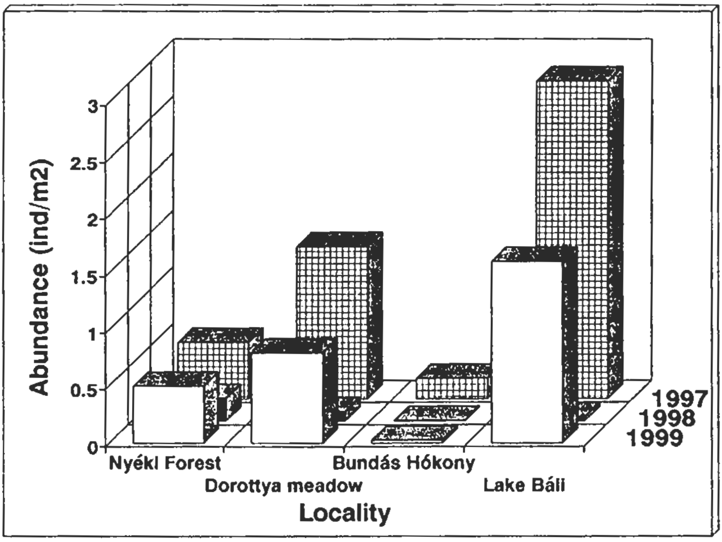


Fig. 4. Abundance of juvenile *Rana esculenta* „complex" individuals in 1997-1999

most Hungarian records should belong to *T. dobrogicus*. However, except for one Hungarian record in a general paper, there are no earlier studies on *T. dobrogicus* distribution in Hungary in spite of its central position in the distribution area. What is more, as a result of taxonomical misunderstandings and inadequate data a number of incorrect records were published. As a consequence, detailed investigations are urgently needed to clarify its distribution and status in the country. The present survey supports this hypothesis as all large newts caught so far in Gemenc belonged to *T. dobrogicus*.

As the species list indicates the Danube floodplain is not an optimal habitat for most Hungarian reptiles. This is mainly due to the regular floods. However, the colour variation of species is worth mentioning. Both *Lacerta agilis* var. *rubra* and the melanistic form of *Natrix natrix* are present in Gemenc.

In the future some other species may also be added to the herpetofauna of Gemenc. *Rana arvalis* and *Coronella austriaca* may well be present.

Similarity of the herpetofauna of the different areas (Table 2) also supports the hypothesis of exceptionally good functional connection due to regular floods between the different areas in Gemenc (when amphibians can travel in the flood). The exception is the distribution of *Emys orbicularis*, which only occasionally occurs in other parts of the region than indicated (Béla Kalocsa, pers. comm.).

The effect of water level fluctuation on amphibian populations

The reproductive success of *Rana esculenta* „complex", the commonest taxon, was studied at the long-term monitoring sites (Bundás Hókony, Lake Báli, Nyéki Forest, Dorottya meadow). The abundance of juveniles was closely correlated with the water level fluctuation of the Danube (Fig. 4). The recorded abundance was higher than had been published in the literature (Sebela, 1993), which indicates the great carrying capacity of the area.

While spring floods formed large, shallow, temporary water bodies in 1997 and 1999, which existed till the autumn, in 1998 the river did not overflow into its floodplain in Gemenc (Fig. 3). As a result, potential breeding sites diminished so there was a considerable decrease in the number of juvenile *Rana esculenta* „complex". individuals. An especially striking decline (of nearly a hundred times) was recorded at Lake Báli, where there is no permanent oxbow or side arm only temporary water bodies.

The study of relative abundance emphasizes the special importance of aquatic habitat diversity pattern for amphibians and their adaptation to its changes. The highest individual number of *Rana esculenta* „complex" was recorded around puddles especially if the adjacent vegetation was at least 30-40 cm high. Though these microhabitats are only temporarily available, they have two important characteristics for young *Rana esculenta* „complex" (which rapidly colonise shallow water bodies formed after floods or heavy rain). On the one hand they provide new, often large, additional feeding grounds, on the other hand by their size and separation from permanent waters they help avoid the predation of cannibalistic adults. *Bombina bombina* juveniles and adults also use these microhabitats, which were only proved to be important earlier in areas where the water supply was less favourable (Dodd, 1992). According to our study, this phenomenon is also characteristic in Gemenc, i.e. in the semi-natural floodplain of a large river.

In 1997 the length-weight ralation of juvenile *Rana esculenta* „complex" individuals was similar at Lake Báli and in Bundás Hókony but strikingly different at the two sides of the Nyéki-Holt-Duna, in the Nyéki Forest and the Dorottya meadow. Also, the avarage length of forest individuals was nearly identical (Nyéki Forest: 2.51 cm, Lake Báli: 2.52 cm, Bundás Hókony: 2.56 cm). At the Dorottya meadow the average length and weight was 9.2 % and 38.4%, smaller than in the Nyéki Forest. Several causes can be listed for this difference, the most probable is the different food supply but the presence of

Table 3. Local importance of different factors threatening amphibians in Gemenc (The evaluation is made according to the special needs of the amphibian fauna and not the general conservation importance of the individual factors)

Threat	Local importance
Collection	Perhaps occasionally damaging but its effect is diminished by natural recruitment
Human brutality	Present locally, not very important
Eutrofication	Mainly in shallow waters
Habitat destruction	Certain forestry management practices can harm the terrestrial habitats even in protected areas
Lack of information	It is one of the most important threats
Predation by domestic animals	Due to the distance of settlements from the protected area it is not considerable
Fish introduction	It does not occur, the diversity and extent of natural waters counter- balance the egg and tadpole predation of fish
Foreign amphibians	None
Isolation, fragmentation	It is not characteristic due to the structure and dynamics of the habitats
Desiccation	In years with no floods it affects valuable breeding sites but wet years compensate
Road mortality	Locally important on the No. 55 public road and on the dikes
Pollution	Usually not considerable, but pollution can not be excluded as the cause of the strikingly high deformity rate occurring in 1999
Ultraviolet radiation	No available data

different breeding areas and consequently of some isolation can not be exluded, either.

As in 1997, in 1998 the growth rate of juvenile *Rana esculenta* „complex" individuals was slower in the Dorottya meadow than in the Nyéki Forest. In 1998 the isolation of forest habitats could be seen on growth curve differences, too.

Figs. 5 and 6 show the length–weight relationship in two different habitat types. At Nyéki-Holt-Duna, which is permanently wet, although the individual number of *Rana esculenta* „complex" juveniles decreased in 1998, their growth and body condition was similar in the three years investigated. In contrast, at Lake Báli not only did the number of individuals drop but also the colonising individuals belonged to a different cohort, i.e. they metamorphosed a year earlier (they were significantly longer and heavier and could consequently migrate over greater distances).

The hydrological and meteorological conditions improved the reproductive success of *Bufo viridis* in 1998. The lack of floods and the fast drying out of several, usually water-covered areas favoured the fast colonising species. As a result, in July 1998, numbers never previously recorded (up to 50,000 individuals in a night) crossed the right dike of the Gemenc floodplain. Their average length and weight was 2.84 ± 0.22 cm és 2.1 ± 0.6 g, respectively, so newly metamorphosed individuals moved out from the floodplain. During the whole migration, a strikingly high, more than

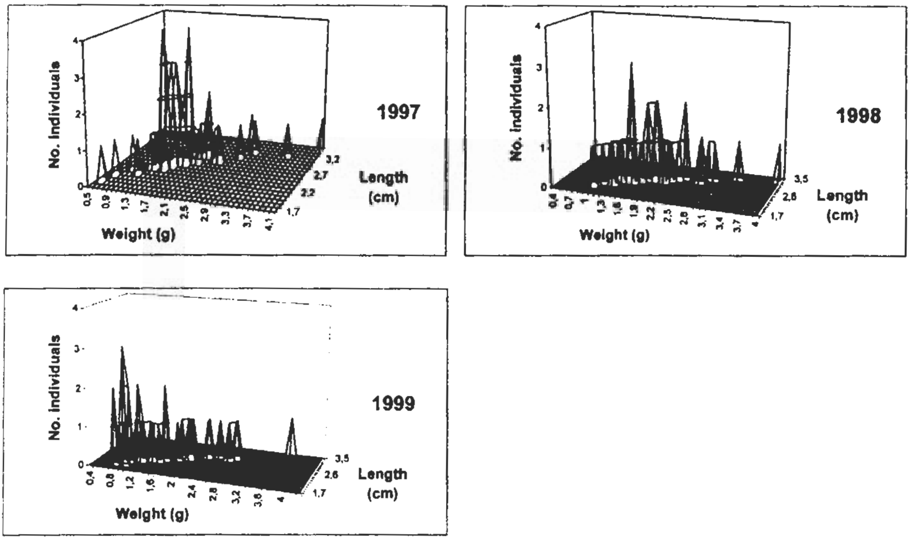


Fig. 5. Length-weight relationhip of juvenile *Rana esculenta* „complex" individuals in the Nyéki Forest in 1997-1999

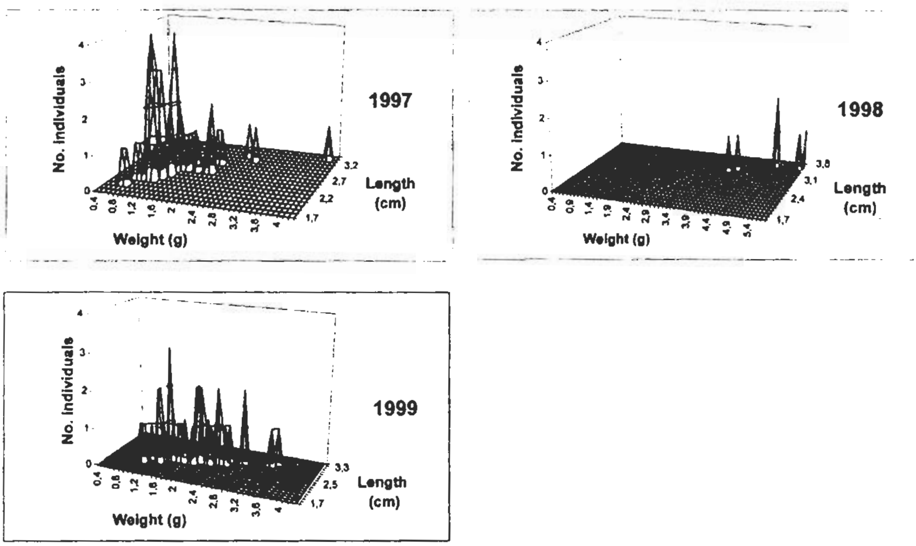


Fig. 6. Length-weight relationship of juvenile *Rana esculenta* „complex" individuals at Lake Báli in 1997-1999

100,000 (!) animals were estimated to be killed by the low traffic (less than five cars in an hour) on the dike. The road kill was especially high as approximately 6 % of the animals were also found feeding along ant paths on the hard surface. A nature conservation action plan should be worked out to avoid a similar mass mortality under similar circumstances.

Amphibian community size estimation for Gemenc

Considering the individual number, the amphibian populations greatly fluctuate even under relatively stable environmental conditions (Grossenbacher, 1995). The amphibian community, its size and biomass was estimated from the individual numbers, abundance and weights recorded in 1997-99. The following preconditions were used:

1. The floodplain amphibian community is mostly (90%) *Rana esculenta* „complex". The proportion of other species is calculated as 10%.
2. The number of juveniles greatly exceeds adults. The total individual number contains 95% juvenile amphibians.
3. The selected sampling sites are representative and just two main habitat types are distinguished (forest, meadow), 95% of the total area is assumed to be forest, the remaining 5 % meadows. The abundance of amphibians is considered uniform within the habitat types.
4. The biomass of *Rana esculenta* c. is 90% of the total amphibian biomass.
5. The weight of juveniles is 52% of the total biomass of the species.

In the given conditions the total amphibian community size of Gemenc was estimated to be 238 million individuals in 1997, 16 million in 1998 and 145 million in 1999. The total amphibian biomass in the last third of September was calculated to be 654 tons in 1997, 67 tons in 1998 and 497 tons in 1999.

The 1997 data proved that the amphibian abundance was outstandingly high at the sampling sites. In 1998 a 90% decrease was detected while in 1999 it considerably increased (Fig. 3). The processes described above were closely correlated with the annual water level fluctuation of the Danube especially with the occurrence of floods, and the formation and duration of temporary waters in the floodplain.

The particular floodplain conditions that under special circumstances (e.g. during floods) threaten the survival of even amphibians (Bosman et al., 1997), also make the Gemenc floodplain an unfavourable habitat for reptiles in general. The characteristics discussed previously, i.e. the great diversity and variability of water cover not only provide an unpredictable environment for the terrestrial species but also threaten aquatic species, which also lay their eggs on land (e.g. by the flooding of eggs). As a consequence, reptiles are present in low numbers, which could not be accurately estimated.

Occurrence of amphibian deformities in Gemenc

Amphibians are good indicators (Khangarot et al., 1985) of environmental changes. One of the reasons is their complex development, which can react fast and with easily detectable deformities to unusual conditions. Deformities also occur under natural or semi-natural conditions e.g. following unsuccessful attacks of predators (Viertel & Veith, 1993), but in the Northern Hemisphere amphibian deformities are recorded increasingly frequently (Dubois, 1979; Gardiner & Hoppe, 1999; Quellet et al., 1997). 1–2% deformity with some variation between species is considered to be the natural background value (Vershinin, 1989, Hoppe, 1999), but today values of 10-30% are also quite common. In certain conditions, e.g. after water pollution with pesticides, this proportion can reach even 69-80% (Dubois, 1979; Quellet et al., 1997; Vershinin, 1989). The first discovery of mass deformity (30%) in North America was followed by extremely extensive research in the last decade. However, the cause of only one type of deformity was detected so far (Sessions & Ruth, 1990; Johnson et al., 1999), unless the pollution source was obvious.

In Gemenc mass amphibian deformities were first described by Jászberényi (1995). In September, 1999 an extremely high deformity level was detected in two semi-aquatic species. At Bundás Hókony 70% of *Bombina bombina* juveniles had eye, hind or front leg deformities. With *Rana esculenta* "complex" this proportion was 30% in the same habitat. To a lesser extent this phenomenon was also present in other parts of the protected area in Gemenc (Béla Kalocsa, pers. comm.).

Threats for amphibians in Gemenc

Table 3 summarizes the importance of different threats for amphibians in Gemenc. At present the most important practical tasks seem to be to carry out further general studies, and to describe in detail the occurrence of deformities and its possible causes.

Summary

The Gemenc floodplain of the Danube provides a unique habitat mosaic for amphibians in Hungary. It is mainly due to its semi-natural condition, size, special aquatic conditions, habitat diversity and sophisticated ecological relationships. Haslam (1997) suggests a 200 m wide riparian corridor as an optimal habitat size around the breeding site for amphibians. In Gemenc it is often more than ten times wider. However, the local herpetofauna was poorly studied and known, the European Herpetological Atlas (Gasc, 1997) only mentions one species (*Hyla arborea*) from a 50 × 50 km unit overlapping the area.

The herpetological study of the Gemenc Region of the Duna–Dráva National Park recorded valuable fauna in the area. Altogether nine amphibian and four reptile taxa were recorded. With the exception of *Rana arvalis*, all typical Hungarian lowland amphibians (Dely, 1967) are present. Three "International Red Data Book"-amphibians live in the area, the most important was the new record of *Triturus dobrogicus*. The further study of its distribution in Hungary is an internationally important conservation task.

The reptile fauna of Gemenc is also mainly determined by the water level fluctuation of the Danube and the resulting water cover pattern. As their individual number is lower by several orders of magnitude than amphibian individual number and the effect of water level fluctuations is more dramatic, no reliable qualitative estimations could be made at this group.

Amphibian individual number and biomass estimations were made on the basis of three-year-data sets. Under strikingly different hydrological conditions the individual number and biomass at Gemenc fluctuated between 16 and 238 million and 67 and 654 tons, respectively.

The reproductive success of *Rana esculenta* "complex" is greatly influenced by the presence of floods and the consequent temporary waters. In 1998, due to the lack of floods, the individual number greatly declined and the length and weight values were also smaller than in 1997 and 1999 (usually significantly).

The especially successful reproduction of *Bufo viridis* in 1998 led to a very high road mortality calculated to reach a total of 100,000 individuals (when juveniles crossed the dikes). A conservation action plan should be worked out to avoid a similar situation.

Parallel to the general survey of amphibians and reptiles, possible threats were also listed, investigated and ranked. On the basis of our 1997-99 studies it is important to continue the survey of the herpetofauna in Gemenc with special emphasis on the occurrence of amphibian deformities and the herpetological investigation of the total Danubian section of the Duna–Dráva National Park.

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Estimated biomass of Ciliata (Protozoa) communities in alkaline soils of the Hortobágy National Park, Hungary

By

A. SZABÓ*

Abstract. Studies have been carried out in different subtypes of solonetz soils, forming a mosaic pattern. In the soils of the HNP the estimated biomass values are higher in the upper layers (0-5 cm) than in the lower ones (5-10-20 cm). Extremely high values (11-16 kg/ha) were experienced in the sampling sites with humous-rich upper soil-horizon. A 30-40% volume decrease has been recorded in the deeper soil layers. The estimated biomass of Ciliata in the sampling sites with eroded A-horizon is 1-3 kg/ha. Based on the biomass values, soils of the HNP can be ordered in the same way (I, VII, V, IV, III, VI sampling sites) as they have been in case of he species-individuals relations. Because of the mosaic pattern of solonetz soils, the estimated average Ciliata biomass, calculated on the basis of actual (not cultured) numbers of individuals, is estimated to be 6.6 kg/ha in the 0-5 cm layer. Although this value is lower than that calculated in other (e.g. chernozem, forest, pasture) soil types, our data demonstrate the importance of Ciliata populations even in the alkaline soils, and one has to take them into consideration while studying food chains and flow of nutrients.

Function and importance of organisms and their communities living in various biotopes can only be measured if one has information about their activities, role and position in the food-chain, and also if there are data on their biomass within the given ecosystem. Protozoa (Ciliata) usually appear in the biotopes in great numbers. It is not simply their presence, but also the biomass they represent, which gives them an important role in a biological community (e.g. in the edaphon).

Determination the biomass of Protozoa (Ciliata) is not a simple task. There have been already some measures to calculate their volume (Sebestyén, 1958) mainly by comparing them to geometric bodies. There are also some recent publications (Buitkamp, 1979; Foissner, 1981, 1995, 1998) giving some guidelines (sometimes concrete values) for the measurement of the biomass of Ciliata. There are several difficulties while calculating the biomass of Ciliata living in soils. One of the most important of these is that the size or volume of Protozoa living in alkaline soils is many times much smaller than that in water bodies, because of troglodytism. In addition, other characteristics of the biotope could influence the volume (cubic measure) of Ciliata. For this reason

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one can only very carefully apply exactly the same methods and values published by other authors. This was emphasised by Gellért (1957), Varga (1960), Buitkamp (1979) and Foissner (1981) as well.

In this study there are estimations on the biomass of Ciliata communities living in different subtypes of solonetz soils, forming a mosaic pattern in the area of the Hortobágy National Park (HNP), Hungary. It is hoped that this study can contribute to have a more objective view on the function of Protozoa (Ciliata) in a given community.

Materials and methods

Plant associations and soil types

Studies have been carried out in one of the strictly protected areas of the HNP in different subtypes of solonetz soils, forming a mosaic pattern and each can be characterised by a specific plant association. Sampling sites were directly neighbouring with alkaline depressions, and they have been assigned in the halophytic plant associations of a mosaic pattern, characterising the erosional succession series and the different subtypes of solonetz soils as well.

On the higher surfaces there are deep or medium layer meadow solonetz soils covered by Achilleo-Festucetum pseudovinae (I) plant association. The A-horizon of the soil is thick (15-30 cm) with a 3-4 % humus content. The A-horizon does not contain Na-salts and the pH is slightly acidic.

Going down to lower parts - parallel with the gradual thinning of the A-horizon - one can found the Artemisio-Festucetum pseudovinae (II) association on medium meadow solonetz soil. In the sloping direction a discontinuous type of this plant association develops (in Hungarian called "alkaline tussocks disposed by hand"). The high intensity drop-erosion leads to the development of the typical alkaline soil "shoulders" (small surface elevations), supported by the precipitation of amorphous silicate (SiO_2) in the B-horizon. Because of the complete erosion of the A-horizon, Na-salts get closer to the surface, which can be tolerated only the Camphorosmetum annue (IV) plant association.

The wetter crusted solonetz soil with precipitated silicate is covered by Puccinellietum limosae (V). Here the a-horizon of the soil is missing and the B-horizon is of a column structure. There is precipitated silicate (SiO_2) on the surface. Because of the erosion process, the upper humic soil is getting together on lower parts, where the Pholiuro-Plantaginetum tenuiflorae (VI) plant association develops. The soil here is brownish black with a 2.6% humus content and accumulation of Na-ions. The border of the wet depression, being the base level, is covered by the Agrosti-Beckmannietum eruciformis (VII) plant association. Here the A-horizon is considerably leached, the B-horizon is often with no structure. Na-salts are found only in deeper parts of the soil.

Plant associations indicate the different subtypes of the solonetz soil as follows.

I. Achilleo-Festucetum pseudovinae (Magyar) So6	Deep layer meadow solonetz
II. Artemisio-Festucetum pseudovinae So6	Medium meadow solonetz
III. Artemisio-Festucetum pseudovinae So6	Meadow solonetz with degraded A-layer
IV. Camphorosmetum annuae (Rapaics) So6	Crusted meadow solonetz
V. Pholiuro-Plantaginetum tenuiflorae (Rapaics) So6	Crusted meadow solonetz
VI. Puccinellietumlimosae (Klika) Wendelbg.	Crusted solonetz with precipitated silicate
VII. Agrosti-Beckmannietum eruciformis (Rapaics) So6	Meadow like solonetz with humic upper soil layer

Collection and processing of samples

Samples were taken in the sites described above with sterile tools from 1.5 × 1.5 m quadrats. Part-samples were taken from three points of each quadrat, from depths of 0-5, 5-10 and 10-20 cm-s. After a careful mixing of the part-samples taken from the same depth, they (altogether about 1 kg each) were carried to the laboratory in sterile boxes. The homogenised samples were dried on room-temperature for 8-10 days.

During the quantitative analysis of soil samples the culture-dilution method was used. Our method is based on the dilution technique of Varga and Telegdy-Kovács (1953), and also that of Singh (1955) with certain modifications, but incorporates several elements of modifications introduced by Brunberg-Nielsen (1968) and Buitkamp (1979). During our studies this method was used consistently. In our opinion this method can be successfully used in biological analysis of other (not alkaline) soil types.

In the course of the quantitative analysis of soil samples, the culture method has been modified, by which the starting mass of the dry soil used was increased to 5 × 10 g (Buitkamp, 1979; Foissner, 1981, used 8 × 3 g soil to start). To wet the soil samples 1:5, Protozoon-free soil extractum was used, by which the drastic destroying influence of distilled water can eliminated. Levels of dilution (1/5-1/640) and repetitions within the levels (10) were optimalised.

During the analysis the volume of the samples processed has been increased from 0.05 ml to 1 ml. These modifications have significantly increased the objectivity of the statistical method used, and errors deriving from the aggregated appearance of cysts could be avoided (Gellért, 1957; Stout, 1962). 5 × 80 cultures were set up from each sample. Culture tubes were incubated on 21 °C for 6 days (Buitkamp, 1979). Processing of data was based on the VIII/2. Table of Fisher-Yates (1963) and on the formula (ind/g) of Brunberg-Nielsen (1968).

After heat treatment – on 58 °C for 45 minutes – the number of cysts has been determined from the soil samples, making the determination of the actual number of species and individuals possible.

For the qualitative analysis of the samples, cultures were set up in every case (Foissner, 1981, 1987). 50 g of the air-dry soil sample was put into a crystallizing cup in a step-like pattern. To wet the soil samples Protozoon-free, 1:5 soil extractum was used. Samples were examined in 2,4,6,10,14 and 21 days, when the appearing species were recorded.

In order to support the identification if species, the wet silvering method of Klein (1926), the core staining method of Feulgen, the silvering method of Chatton-Lwoff (1936) and the protargol method modified by Wilbert (1975) were used.

The estimated biomass of Ciliata in the soils was calculated by the formula of Pussard (1967, 1971) and given in g/ha. The average mass of solonetz soils was considered to be 1.45 g/cm^3. Volume of Ciliata has been calculated by the Simpson-formula (Czorik, 1968) and using the method of Buitkamp (1979, and also pers. comm.). The body of the organisms has been compared to simple geometric bodies. The density of the protoplasm has been considered to be 1.

The Simpson-formula is as follows:

$$V = h/6 \times (b_1+4b_2+b_3)$$

(where: V = body volume, h = body length, b_1 = area of the lower segment, b_2 = area or diameter of the middle segment, b_3 = area of the upper segment..)

The estimated biomass of Ciliata in the soils to an area unit (ha) was calculated by the formula of Pussard (1967, 1971):

$$S\ (g/ha) = V \times N \times \delta \times c\ 10^8$$

(where: S = estimated biomass of a species (g/ha)V = volume of the species in 10^{-8} cm^3, δ = volume weight of the soil (g/cm^3), c = thickness of the soil layer examined (cm), δ x c 10^8 = weight of 1 ha soil (g).)

The average mass of solonetz soils was considered to be 1.45 g/cm^3. Results are give in g/ha.

Results and discussion

Based on our studies, there are diverse Ciliata communities in the solonetz soils of the HNP, where altogether 35 species have been found. Most

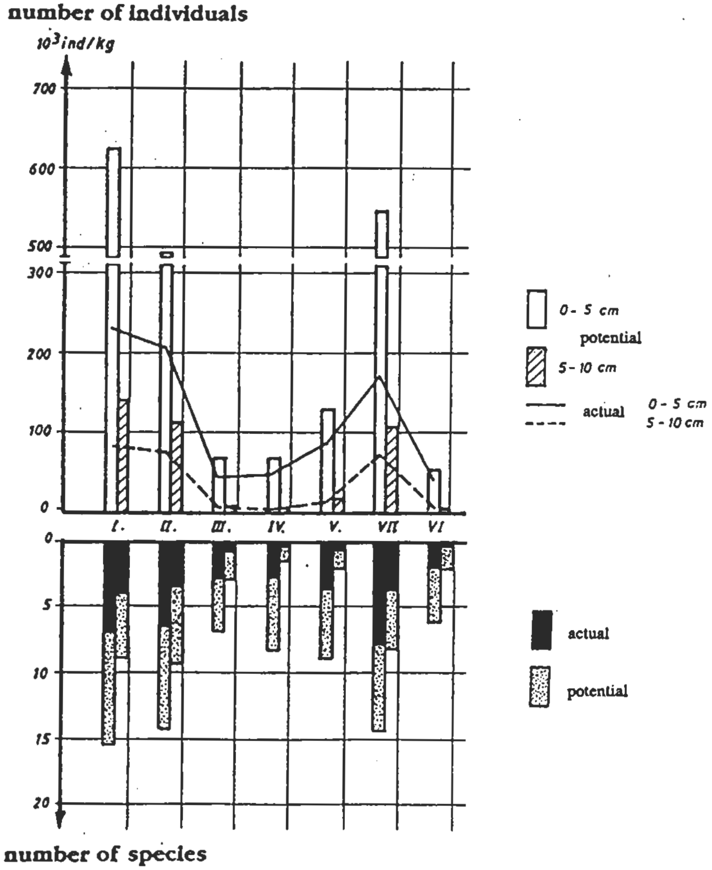

Fig. 1. Number of species and individuals in the sampling sites. (I = deep layer meadow solonetz; II = medium meadow solonetz; III = degraded A-layer crusty solonetz; IV = crusty solonetz; V = crusty solonetz; VI = crusty solodized solonetz; VII = meadow solonetz with humus upper layer)

of the species are well-known, cosmopolitan organisms with wide ecological tolerance spectrum. A lot of species are known from wetlands as well which supports findings of Varga (1936, 1953) based on the ecological classification of whom the Protozoon fauna of the soils is of a limnic origin (hydrobiont edaphon).

In the soils of the HNP the highest numbers of individuals were found in the upper (0-5 cm) layer of the soils of high humous-content (I, II, VI), where it is around 500-600 10^3 ind/kg. This value is only 50% of those coming from the same layer of chernozem soils. In sampling sites with eroded upper layers, abundance of species is rather low (40-60 10^3 ind/kg) in each of the layers studied (Fig. 1).

It was found that in alkaline (solonetz) soils the volume decrease (troglodytism) of Ciliata is significant. Decrease of big organisms reached 30-70%, while that of smallers 20-25%. Calculations on the biomass of Ciliata in the area of the HNP had to be done in each biotope, hence the different subtypes of solonetz soils formulate a mosaic-like pattern.

Because of the difficulties in determining the number of individuals and the mass of the certain species, it was not our aim to calculate the absolute value of the Ciliata biomass, only estimations can be given.

The values of the estimated biomass (kg/ha) show that there is more living material in the upper soil-layers (0-5 cm) than in the lower ones. The estimated biomass is particularly high in those sampling sites (I, II, VII) with a humous-rich upper layer which are more favourable for Ciliata populations than the other (III, IV, V, VI), eroded soil types.

In the soil types with a humous-rich upper layer (A-horizon), covered by Achilleo-Festucetum pseudovinae, Artemisio-Festucetum pseudovinae and Agrosti-Beckmannietum eruciformis plant associations, the estimated biomass is 11-16 kg/ha, based on the cultured population sizes.

In the lower layers of these soils, the decrease in the mass of living material can reach 30-40%.

This significant decrease derives from the unfavourable physical conditions of soils (lack of air, high colloid content, increase of salt concentration, lack of food and water).

In other subtypes and varieties of solonetz soils (crusted, with precipitated silicate) the biomass values are low. Here in absence of a humus-rich A-horizon, the B-horizon comes up to the soil surface and conditions for Ciliata become less favourable, thus the number of species and population sizes are found to be low. The estimated biomass is 1-3 kg/ha in the 0-5 cm layer. In the 5-10 cm layers biomass represented by Ciliata is on the minimum (1.4-0.03 kg/ha).

These data show that there is a positive correlation between the population size of Ciliata and their biomass, which is well-proved by Fig. 1. Because of the small volume of the occurring species, in some sampling sites (III, IV, VI), however, this correlation is not linear!

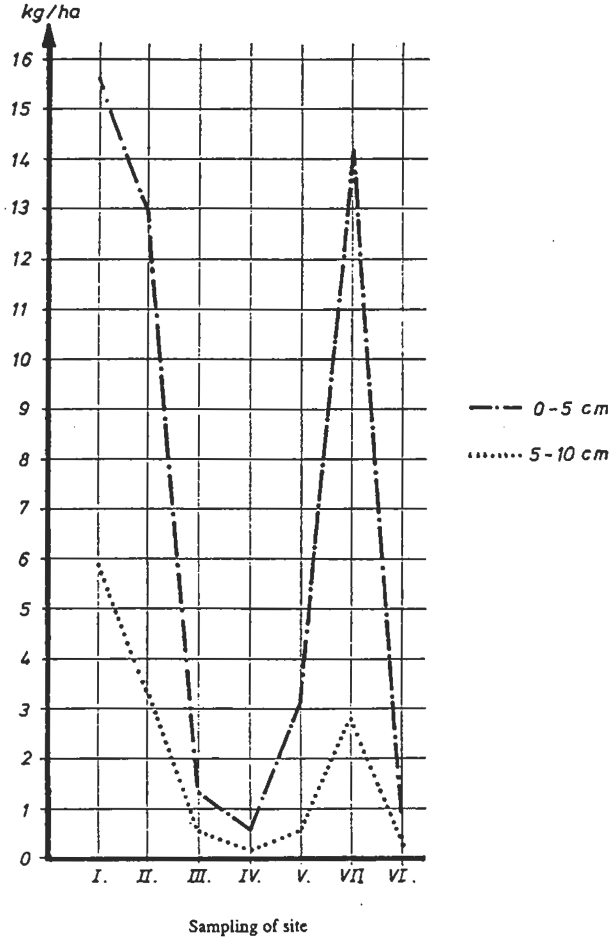

Fig. 2. Changes of the estimated biomass in the different subtypes of solonetz soils

Based on these data, the studied soils can be ordered in a similar way as done by the numbers of species and individuals. Values of the estimated biomass are the highest (Table 1) in the upper (0-5 cm) layer of the deep and medium meadow solonetz soils (I, VII, II).

Table 1. Main characteristics of the Ciliata fauna living in the soils of the Hortobágy National Park with the indication of the estimated biomass (based on average data)

Sampling sites	I.		II.		III.		IV.		V.		VI.		VII.	
Main characteristics	0-5	5-10	0-5	5-10	0-5	5-10	0-5	5-10	0-5	5-10	0-5	5-10	0-5	5-10
Cult. number of indiv. (T) 10^3/kg	663	251	455	139	58	14	61	4	117,8	11	554	203	43	10
Cultiv. number of species	15	8	14	9	7	3	8	1	9	2	14	9	6	2
Actual nr. of ind. (T-C) 10^3/kg	425,0	169,4	257,0	76,5	25,0	8,4	26,0	1,2	60,8	3,3	381,5	152,2	16	4,3
Actual number of species	7	4	7	3	2,5	0,5	2,6	0,08	3,5	0,7	7,8	3,4	1,8	0,3
Number of cysts (C) 10^3/kg	238	1,6	198	62,5	33	5,6	35	2,8	57	7,7	172	50,8	27	5,7
Cyst %	36	33	44	45	57	40	57	70	48	70	31	25	63	57
Hypotrichida %	52	68	53	42	60	100	65	0	64	0	47	41	57	33
Other taxonomic category %	48	32	47	57	40	0	35	85	36	100	53	59	43	66
Biomass kg/ha	16,04	6,84	11,29	3,27	1,24	0,01	0,65	0,03	2,88	0,32	13,6	3,03	0,7	0,0

There is significantly less biomass in the 5–10 cm layer, and in both (0–5, 5–10 cm) layers of the crusted solonetz soils with eroded upper horizon (III, IV, V, VI).

Comparing the estimated biomass values of Ciliata in the soils of the Hortobágy National Park with that of Table 2, it turns out that other authors have only studied the uppermost (0–5 cm) layer of soils. Biomass values given in these publication show an extremely significant deviation. Analysing data of Table 2, it is believed that the extremely high values given by Bick (1972) and Foissner (1981) can be accepted only with reservations.

It comes also from the comparison that in the well-structured chernozem soils the number of individuals, and the closely related biomass values are higher in the 5–10 cm layer than in the upper, 0–5 cm one. This can be explained by the more intensive exposition of the upper layer to the physical effects (radiation, heat, wind) and also by the more favourable water-supply of the lower layers.

In the soil samples studied the cultured number of Ciliata is higher by 30–50% than the actual population sizes of soils. Taking into account this data, the estimated biomass in the alkaline soils with humous-rich upper layer is only 5–8 kg/ha in the upper (0–5 cm) soil-horizon. This value decreases to 0.05–0.3 kg/ha in the 5–10 cm layer.

Because of the mosaic pattern of the studied solonetz soils of the Hortobágy National Park, the estimated average Ciliata biomass calculated on the basis of actual numbers of individuals is 6.6 kg/ha in the upper layers. This value is relatively low, but cannot be neglected while studying food chains and flow of nutrients.

Table 2. Amount and biomass of Protozoa in different soil types

Author's name	Name of the soil	Amoeba	Protozoa n 10^3 Flagell.	Ind/kg Ciliata	Protozoa n 10^3 ind/kg	Biomas s g/ha	Dept h cm
CUTLER (1920)	Arable land	10-60.000	1.000- 10.000	1.000	1.100- 170.000		
CUTLER (1920)	Pasture				5-35.000		
ALLISON	Fertilized soil	1.492	10.314	77-110	11.883		
PERÉY (1925)	Garden soil	446.400	1.030.000	200	1.476.600		
SANDON (1928)	Fertilized soil			15-186	480.000		
BRODSKY (1929)	Desert clay				10-3.000		
TELEGDY-K. (1934)	Arable land	500.000	250.000	5.000	305.000		
DIXON (1936)	Steppe	121.938	443.159	86	565.183		
RUSSEL (1936)	Fertilized soil	150.000	350.000	100	500.100		
HEINIS (1937)		280.000	770.000	1.000	1.071.000		
HEINIS (1937)				26			
SINGH (1946)	Soil from Rothamsted	41.400	70.500	377	112.277		
BREZINKA-D. (1954)	Rice soil	64.500					
BREZINKA-D. (1954)	Very humic soil	1.690.000					
VARGA (1954)	Arable land				150.000		
VARGA (1954)	Forest soil				50.000		
GELLÉRT (1957)	Broad-leaved forest soil			6.450			
GELLÉRT (1957)	Coniferous forest soil			18.500			
RUSSEL (1957)						16.700	
BRUNBERG-N. (1968)	Beech forest soil			300.000			
PRASAD (1968)	Tropical soil				8.873.000		
BICK (1972)	Soil from Matador	20.000	15.000	2.700	37.000	930	0-0,5
		5.500	500	65		2.530	0,5-10
BUITKAMP (1979)	Pasture			1862		16.682	0-5
	Mixed forest soil			2.029		43.723	0-5
	Tropical sav. forest soil			2.935		16.716	0-5
	Tropical savanna			844		9.964	0-5
	Gallery forest			1.191		9.763	
FOISSNER (1981)	High mountain soil			8.839		66.950	0-5
SZABÓ A. (1991)	Deep layer solonetz			1.549		5200	0-5
	Solonetz			663		16.040	0-5
				251		6.840	5-10
	Crusted meadow solonetz			43		0.700	0-5
				10		0.030	5-10
	Chernozem soil			1.323		24.380	0-5
				2.206		42.400	5-10

It is not possible to compare our data with those of other authors, hence there are no similar results, based on the analysis of alkaline soils neither among Hungarian nor in foreign references.

By the comparison, however, it is remarkable that the estimated biomass of alkaline soils is far behind the values measured in other soil types.

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Revision der Untergattung *Martiodrilus* (*Martiodrilus* Michaelsen, 1936) (Oligochaeta: Glossoscolecidae)

Regenwürmer aus Südamerika, 29

Von

A. ZICSI*

Abstract. „Revision of the subgenus *Martiodrilus* (*Martiodrilus* Michaelsen, 1936) (Oligochaeta: Glossoscolecidae). Earthworms from South-America, 29". Based on examination of type material, 14 species/subspecies of the 15 known ones belonging to the subgenus *M.* (*Martiodrilus*), are revised. Furthermore, ten species and one subspecies new to science are described: *M.* (*M.*) *cayambensis, M.* (*M.*) *cosanganensis, M.* (*M.*) *nonniorum, M.* (*M.*) *papillatus, M.* (*M.*) *pseudotuberculatus, M.* (*M.*) *nemoraloides, M.* (*M.*) *szekelyi, M.* (*M.*) *loksai, M.* (*M.*) *interandinus, M.* (*M.*) *robustus* spp. n., and *M.* (*M.*) *robustus chilesensis* subsp. n.

Bei der Revision der Gattung *Thamnodrilus* Beddard, 1887 durch Michaelsen (1936) wurde die artenreiche Gattung *Martiodrilus* errichtet, die nur Arten umfasst, die über 6-8 Kompositenschlauch- bzw. Wabentaschen verfügen. Seither sind innerhalb dieser Gattung weitere Artengruppen abgegrenzt worden, die in neue Gattungen bzw. Untergattungen zusammengefasst wurden (Righi, 1995; Zicsi & Csuzdi, 1997).

Michaelsen (1918) hat bereits in der tabellarischen Zusammenstellung der damals zur Gattung *Thamnodrilus* gestellten Taxa die Arten in verschiedene Gruppen eingeteilt. Vor allem wurden Arten mit verdickten Dissepimenten hinter dem Muskelmagen und solche, bei denen sie sehr zart sind oder gänzlich fehlen, unterschieden. Weiterhin wurde auch die Zahl der Samentaschen und die Form der Testikelblasen berücksichtigt. Der Zahl der Chylustaschen wurde ebenfalls Beachtung geschenkt; die mit 7 Chylustaschen versehenen Spezies sind am Ende der Tabelle gemeinsam angeführt worden.

In der vorliegenden Arbeit befasse ich mich mit Arten, bei denen dem Muskelmagen folgend die Dissepimente stark verdickt sind, die über 2 bzw. 3 Paar Samentaschen verfügen und die kein rosettenartiges (büschelförmiges) Nephrostom besitzen. Erwähnt sei, dass die Verdickung der Dissepimente hinter dem Muskelmagen eindeutig auf eine erhöhte Grabtätigkeit dieser

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Formen hinweist, so dass man allein aufgrund dieses Kennzeichens auf unpigmentierte, meistens weisse, in verschiedenen Bodentiefen lebende Arten folgern kann. Dieses konnte auch beim Sammeln dieser Regenwürmer bestätigt werden.

Da bei der Bearbeitung dieser Artengruppe, die nachfolgend als typische Untergattung der Gattung *Martiodrilus* Michaelsen, 1936 zusammengefasst wird, das Identifizieren einiger Taxa Schwierigkeiten bereitete und die Beschreibung neuer Arten erschwerte, wurde zuerst das Typenmaterial der bisher beschriebenen spezifischen Taxa überprüft.

Martiodrilus (Martiodrilus) Michaelsen, 1936 emend.

Hypogaeon partim, Schmarda, 1861:12.
Rhinodrilus partim, Benham, 1890:254.
Rhinodrilus partim, Beddard, 1895:636.
Anteus partim, Beddard, 1895: 652; Rosa, 1896:90.
Rhinodrilus (Thamnodrilus) partim, Cognetti, 1906:170.
Thamnodrilus (Th.) partim, Michaelsen, 1918:86; Stephenson, 1930:892; Cordero, 1945:8.
Martiodrilus partim, Michaelsen, 1936:1172.
Martiodrilus partim Brinkhurst&Jamieson, 1971:735; Zicsi, 1988a:436, 1988b:954, 1990:367
Thamnodriloides Gates, 1968:14.

Diagnose: Verschieden grosse, unpigmentierte, weisse oder grüne Formen. Borsten am ganzen Körper in 8 Längslinien angeordnet, selten am Körperende in unregelmässiger Anordnung. Männliche Poren interclitellial. Chylustaschen 8 Paar im 7.-14. Segment, Kompositenschlauch- bis Wabentaschen. Geschlechtsapparat holoandrisch und metagyn. Samensäcke kurz. 2-3 Paar Samentaschen. Dissepimente hinter dem Gürtel verdickt. Meganephridien ohne rosettenförmiges Nephrostom.

Typusart: *Hypogaeon heterostichon* Schmarda, 1861 = *Martiodrilus (Martiodrilus) heterostichon* (Schmarda, 1861).

23 Arten und 3 Unterarten lassen sich in die Untergattung einreihen:

M. (M.) acanthinurus (Cognetti, 1904)
M. (M.) acanthinurus heterophina (Cognetti, 1904)
M. (M.) agilis (Cognetti, 1904)
M. (M.) cayambensis sp. n.
M. (M.) cosanganensis sp. n.
M. (M.) devriesi Zicsi, 1988
M. (M.) heterostichon (Schmarda, 1861)
M. (M.) heterostichon colpochaeta (Cognetti, 1906)
M. (M.) interandinus sp. n.
M. (M.) kuehnelti Zicsi, 1990
M. (M.) lojaensis (Michaelsen, 1918)
M. (M.) loksai sp. n.
M. (M.) menai Zicsi & Csuzdi, 1999
M. (M.) michaelseni Zicsi, 1990
M. (M.) monticola (Michaelsen, 1900)

M. (M.) nemoralis (Cognetti, 1904)
M. (M.) nemoraloides sp. n.
M. (M.) nonniorum sp. n.
M. (M.) papillatus sp. n.
M. (M.) pseudotuberculatus sp. n.
M. (M.) psikakao Righi, 1995
M. (M.) purino (Michaelsen, 1900)
M. (M.) robustus sp. n.
M. (M.) robustus chilesensis subsp. n.
M. (M.) szekelyi sp. n.
M. (M.) tuberculatus (Cognetti, 1904),

Martiodrilus (Martiodrilus) heterostichon heterostichon (Schmarda, 1861)

Hypogaeon heterostichon Schmarda, 1861:12.
Anteus heterostichon, Beddard, 1892:114.
Thamnodrilus heterostichon, Michaelsen, 1900:437.
Thamnodrilus heterostichon partim, Cognetti, 1904:5; Cognetti, 1906:182.
Thamnodrilus heterostichon, Michaelsen, 1910:145.
Thamnodrilus heterostichon, Michaelsen, 1918:92.
Martiodrilus heterostichon, Michaelsen, 1936:172.
Martiodrilus heterostichon, Zicsi, 1988a:954.

In einer vorausgehenden Arbeit (Zicsi, 1988a) wurde bereits erwähnt, dass die Identifizierung dieser Art den älteren Autoren (Beddard, 1892; Michaelsen, 1900, 1910, 1918; Cognetti, 1904, 1906) Schwierigkeiten bereitete. Allein aufgrund der Überprüfung eines Typenexemplars aus dem Naturhistorischen Museum, Wien (Inv. Nr. 4799, *T. heterostichon* (Schmarda), Ecuador, Cordilleren, coll. Schmarda) habe ich mich aufgrund der 3 Paar Samentaschen der Meinung Michaelsens angeschlossen, die von Cognetti als *T. colpochaeta* beschriebene Art als Synonyme von *heterostichon* zu betrachten. Obwohl seinerzeit (Zicsi, 1988a) das Typenmaterial von *colpochaeta* nicht eingesehen werden konnte, ist aufgrund der zahlreichen Exemplare, die in der Prov. Pichincha und vom *Locus typicus*, in der Umgebung von Quito, gesammelten Tiere (vergl. Zicsi, 1988a, p. 956), die alle drei Paar Samentaschen besassen, dieser Entschluss gefasst worden. Die hauptsächliche Ursache zur Aufstellung von *colpochaeta* waren nämlich die von Beddard (1892) nicht erkannten Samentaschen (Cognetti, 1906). Inzwischen ist es gelungen, das Typenmaterial von *Th. colpochaeta* aus der Sammlung von Torino einzusehen. Wie aus der Überprüfung des Typenmaterials hervorgeht, lagen Cognetti von verschiedenen Fundorten Tiere vor (OL 381, Quito, 2810 m; OL 382, Azienda di Verde Cruz bei Quito, 2700 m; OL 384, Lloja, 3070 m; OL 383, Tulcan, 2977 m; OL 385 El Troje Huaca, 2980 m).

In einer unlängst erschienenen Arbeit von Righi (1995) wird angenommen, dass meine Beschreibung von *M. (M.) heterostichon* mit der von Cognetti für *colpochaeta* gegebenen nicht übereinstimmt, da die männlichen Poren bei *colpochaeta* auf Intersegmentalfurche 19/20 liegen und Unterschiede in der Lage der Pubertätsstreifen, wenn auch nur um ein halbes

Segment, bestehen. Da inzwischen zahlreiche weitere Tiere von *M. (M.) hererostichon* erbeutet wurden, und, wie erwähnt, die Typen von Cognetti eingesehen werden konnten, kann bezüglich dieser Frage Stellung genommen werden. Eindeutig konnte festgestellt werden, dass bei allen aus der Prov. Pichincha stammenden Exemplaren sowie auch bei denen aus der Prov. Carchi die männlichen Poren auf Intersegmentalfurche 20/21 liegen. Die Angaben von Cognetti beruhen auf einem Irrtum. Die Lage der Pubertätsstreifen vom 9.-24. Segment ist allein bei den Exemplaren aus der Prov. Carchi erkannt worden. In meiner Beschreibung von *heterostichon* (Zicsi, 1988a, p. 956) heisst es „breiten etwas die benachbarten Segmente aus".

Da ich seinerzeit nur eine kurze Ergänzungsbeschreibung von *M. (M.) heterostichon* gab, soll jetzt eine ausführliche, auf dem Vergleich zahlreicher Exemplare beruhende Beschreibung erfolgen. Bei dieser Beschreibung werden nur Exemplare aus den Provinzen Pichincha und Imbabura berücksichtig. Für die von Cognetti aus der Prov. Carchi stammenden Exemplare, von denen ebenfalls viele neugesammelte Tiere vorliegen, wird *colpochaeta* als Unterart von *heterostichon* abgetrennt.

Fundorte: Ekuador: Prov. Imbabura: 28 km von Otavalo in Richtung Selva Alegre, 3500 m, 21.4.1989 leg. Zicsi, Loksa & Troja. (AF/1687 2+1 juv. Ex.);- AF/1688 2 Ex., 39 km von Otavalo in Richtung Selva Alegre, 3400 m, 20. 4. 1989 leg. Zicsi & Loksa & Troja.- AF/1692 1+2 juv. Ex., 36 km von Otavalo in Richtung Selva Alegre, 3300 m, 20. 4. 1989 leg. Zicsi & Loksa & Troja.- AF/ 1693 1 Ex., Mirador de Pijal, 2960 m, Wiese, 27. 4. 1989 leg. Zicsi & Loksa & Troja.- AF/1762 5+12 juv. Ex., Ibarra, Hosteria Chorlavi, 2200 m, Wiese, 14. 5. 1988 leg. Zicsi & Csuzdi.- AF/3905 16 Ex., zwischen Cayambe u. Otavalo, vor Cajas, 13. 5. 1993 leg. Zicsi & Csuzdi.- Prov. Pichincha.- AF/1667 9 Ex., Antisana, 3500 m, Paramo Schwarzerde, 15. 4. 1989 leg. Zicsi & Loksa.- AF/1704 6 Ex., Fundort wie zuvor, 17. 5. 1988, leg. Zicsi & Csuzdi.- AF/1706 18+6 juv. Ex., Antisana, Finca Lopez, Eukalyptus-Plantage, 3 km von Pintag entfernt, 17. 5. 1988 leg. Zicsi & Csuzdi.- AF/1690 7 Ex., Urbanisations Ludres, 13 km südlich von Quito, 3100 m, 13. 4. 1989 leg. Zicsi & Loksa & Troja.- AF/1691 7 juv. Ex., AF/1713 2+3 juv. Ex., 10 km von Quito entfernt, neben der Autobahn Gen. Ruminahui, Eukalyptus-Wald, 2800 m, 22. 4. 1988 leg. Zicsi & Csuzdi.- AF/1694 16+28 juv. Ex.,AF/1710 1+7 juv. Ex., 2-10 km hinter Lloa in Richtung Rio Blanco, 2900-3100 m, 29. 4. 1989 leg. Zicsi & Loksa & de Vries.- AF/1711 1 Ex., 2 km hinter Cayambe, Wiese 19. 4. 1989 leg. Zicsi & Loksa & Troja.- AF/1024 1+6 juv. Ex., unterhalb Olmedo, 3000 m, 13. 4. 1988 leg. Zicsi & Csuzdi.- AF/ 1716 1. Ex., Cayambe oberhalb Ayora, 3000 m, 13. 4. 1988 leg. Zicsi & Csuzdi.- AF/1712 3+ 1 Ex., hinter Machachi, El Chaupi, Wiese, 2800 m, 13. 5. 1988 leg. Zicsi & Csuzdi.- AF/ 3907 10+6 juv. Ex., zwischen Pifo und Papallacta, 3000 m, 4. 5. 1990 leg. Zicsi & Csuzdi.

Äussere Organisation. Länge 150-350 mm, Breite 7-15 mm, Segmentzahl 180-320. Farbe weiss, unpigmentiert. Kopf eingezogen. 1.-2. Segment verwachsen, 3. gefurcht. Segmente 6 oder 7 bis 10 in der Mitte, von der Konservierungsweise abhängend, verschieden stark wallförmig hervortretend, sehr kennzeichnend im abgetöteten Zustand (Zicsi, 1988a: 955). Segmente von 11-14 und hinter dem Gürtel mehrfach geringelt.

Borsten vom 5., 6. oder 7. Segment zu erkennen. Borsten eng gepaart, nur am Körperende gehen die Reihen etwas auseinander und verlaufen unregelmässig. Borsten *ab* vom 5. bis zum 10. Segment auf kleinen hervorstehenden Höckern, nicht zu Geschlechtsborsten verwandelt. Borsten vom 18.-24. Segment von Papillen umgeben zu Geschlechtsborsten verwandelt. Länge der Geschlechtsborsten 0,4-0,6 mm, Breite 0,030-0,035 mm, mit 8-12 Kerben versehen. Im Körperinneren stecken die Borsten in grossen Bündeln, die tief in die Körperhöhle hineinreichen. Nephridialporen in der Borstenlinie *cd*. Samentaschenporus auf Intersegmentalfurche 6/7-8/9, kleine Öffnungen.

Gürtel sattelförmig vom 15.-25. Segment, bei einigen Tieren auf der Dorsalseite etwas auch auf das 26. Segment übergehend. Pubertätsstreifen auf dem 20.-24. Segment, bei einigen Exemplaren auch auf 25 übergehend. Männliche Poren auf Intersegmentalfurche 20/21. Weibliche Poren auf dem hinteren Rand des 14. Segments.

Innere Organisation. Dissepimente 6/7-8/9 sehr stark, 9/10-10/11 schwächer, 11/12–14/15 hautförmig verdickt. Muskelmagen im 6. Segment, von den Dissepimenten vollkommen überdeckt. Schlund bis ins 4. Segment reichend, Peptonephridien am Oesophagus vor dem Muskelmagen. Nephridien mit Nephridalblasen vom 18. Segment (Abb. 1). Lateralherzen im 7.-9., Intestinalherzen im 10 und 11. Segment. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit abgeschnürtem Kopf. Hoden und Samentrichter im 10. und 11. Segment in typische oesophageale Testikelblasen eingeschlossen (vergl. auch Zicsi &. Csuzdi, 1997: 95), die an den Oesophagus angeschmiegt sind, Herzen und Chylustaschen umgeben, Samensäcke des 11. Segments nicht einschliessen. Samensäcke im 11. und 12. Segment, frei, kleine regelmässige, runde Gebilde, die auf die Segmente beschränkt sind. Ovarien im 13. Segment, fächerförmig. Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend. Samentaschen im 7.-9. Segment, lange, fadenförmige oder am Ende etwas gebogene und geschwollene Gebilde.

Martiodrilus (Martiodrilus) heterostichon colpochaeta (Cognetti, 1906) gr. n.

Thamnodrilus heterostichon partim, Cognetti, 1904: 5
Rhinodrilus (Thamnodrilus) colpochaeta Cognetti, 1906: 183
Thamnodrilus heterostichon partim, Michaelsen, 1910:145
Thamnodrilus heterostichon parim, Michaelsen, 1918: 92
Martiodrilus heterostichon partim, Righi, 1995: 513

Alle Exemplare aus der Prov. Carchi weichen in gewissen Merkmalen von der Stammform *heterostichon* ab, und da diese Populationen auch durch den interandinen Trockenstreifen im Norden des Landes isoliert voneinander vorkommen, wird die von Cognetti (1906) beschriebene und von Michaelsen eingezogene *Rh. (Th) colpochaeta* als Unterart von *M. (M.) heterostichon* zurückgestellt.

Fundorte. Ekuador. Prov. Carchi. Lectotypus OL 385 El. Troja Huaca Ecuador interandina. II. 1897 leg. Festa. - Paralectotypus OL 383 1-2 juv. Ex., Tulcan Ecuador interandina I. 1897 leg. Festa.- AF/1068 3+16 juv. Ex., Rumichaca, 2800 m, Wiese, 16. 5. 1988 leg. Zicsi & Csuzdi.- AF/1686 9+8 juv. Ex., bei der Verzweigung La Libertad, 3300 m, Paramo, Schwarzerde, Wiese, 25. 4. 1989 Leg. Zicsi & Loksa & Lopez.- AF/1689 15+2 juv. Ex., hinter El Angel bei St. Antonio Chambayan, 3080 m, 25. 4. 1989 leg. Zicsi & Loksa & Lopez.-AF/3913 9 praead. Ex., AF/3917 1 Ex., zwischen El Angel und Las Juntas, 3300-3500 m, 12. 5. 1993 leg. Zicsi & Csuzdi & Florenzo.- AF/3910 11+3 juv Ex., + 4 Eier zwischen Mira u. El Angel, 2900 m, 12. 5. 1993. leg Zicsi & Csuzdi & Florenzo.

Da es sich im Originaltext von Cognetti um eine Beschreibung von Exemplaren verschiedener Fundorte handelt, von denen ein Teil zur Stammform gestellt wurde, soll aufgrund des designierten sowie der neugesammelten, gut konservierten Tiere eine Beschreibung erfolgen.

Länge 140-170 mm, Breite 10-14 mm, Segmentzahl 179 –198.

Äussere Organisation: Farbe weiss, unpigmentiert. Kopf eingezogen. 1.-2. Segment verwachsen, 3. gefurcht. Segmente von 7-10 in der Mitte etwas gewölbt, vom 11.-14. sowie hinter dem Gürtel mehrfach geringelt. Erste *ab* und *cd* Borstenpaare vom 7. bzw. 8. Segment zu erkennen. Borsten eng gepaart, nur am Körperende etwas weitläufiger gepaart. Borsten *ab* vom 10.-13. Segment auf kleinen Erhebungen, nicht zu Geschlechtsborsten verwandelt. Borsten vom 15.-24. Segment von Borstenpapillen umgeben, zu Geschlechtsborsten verwandelt. Länge der Geschlechtsborsten 0,96-1,10 mm, Breite 0,04-0,05 mm, mit 7-8 Kerben versehen. Nephridialporen zwischen der Borstenlinie *cd.*

Gürtel sattelförmig vom 15.-25. Segment. Pubertätsstreifen vom 20.-24. Segment, breite weisse Streifen, die bei einigen Exemplaren auch auf das 19.–25. Segment übergehen können. Weibliche Poren auf dem hinteren Rand des 14. Segments in der Borstenlinie *b.* Männliche Poren auf Intersegmentalfurche 20/21 in Höhe der Pubertätsstreifen. Samentaschenporen auf Intersegmentalfurche 6/7-8/9, von aussen schwer zu erkennen.

Innere Organisation: Dissepimente 6/7–9/10 stark, 10/11–14/15 nach hinten zu immer schwächer verdickt. Muskelmagen im 6. Segment, wird von den Dissepimenten vollkommen überdeckt. Vor dem Muskelmagen mächtige Peptonephridien, die sich an den Oesophagus anschmiegen. Lateralherzen im 7.-9., Intestinalherzen im 10. und 11. Segment. Schlingenherzen im 12. Segment. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit abgeschnürtem Kopf. Hoden und Samentrichter in oesophageale Testikelblasen eingeschlossen, ziehen sich am Oesophagus entlang hoch, ohne die Herzen und Chylustaschen der entsprechenden Segmente einzuschliessen. Samensäcke im 11. und 12. Segment, frei, runde Gebilde, die auf die Segmente beschränkt sind. Ovarien im 13. Segment, fächerförmig, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend.

Samentaschen drei Paar im 7., 8., 9. Segment, nicht fadenförmige Gebilde, sondern schlauchförmiger, langer Ausführungsgang mit zurückgebogener Ampulle, die mit Samenkämmerchen prall gefüllt sind (Abb. 2).

M. (M.) heterostichon colpochaeta unterscheidet sich von der Stammart in der Form des vorderen Körperteiles, in der Form und Länge der Pubertätsstreifen und in der Form der Samentaschen.

Martiodrilus (Martiodrilus) cayambensis sp. n.

Fundorte: Ekuador: Prov. Napo. Oberhalb der Lagune San Marcos am Cayambe Vulkan, 4000 m, 6.5.1988 leg. Zicsi & Csuzdi; (Holotypus. AF/3951); Paratypen: Fundort wie beim Holotypus, 4200 m, (AF/3848 3+1 juv. Ex., AF/3844 1 Ex.).

Länge des Holotypus 130 mm, Breite 6 mm, Segmentzahl 170. Paratypen: Länge 112-175 mm, Breite 5,6 – 6,7 mm, Segmentzahl 156–187.

Äussere Organisation: Farbe weiss, unpigmentiert. Kopf eingezogen. 1.-2. Segment verwachsen, 3. längsgefurcht, 4.-9. ungeringelt, 10.-14. Segment mehrfach geringelt. Borsten *ab* und *cd* vom 5. Segment beginnend zu erkennen. Borsten gepaart, am hinteren Teil des Körpers stark hakenförmig gebogen. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 4:1,5:4:1:12. Borsten 9-13 von kleinen Papillen umgeben, von 17-27 ebenfalls von Papillen umgeben. Die vorderen besitzen einen Nodulus, sind 1,00 mm lang, 0,12 mm breit und besitzen 6-7 Kerben, die auf dem Gürtel sind sehr kurz, z.T. zu Geschlechtsborsten verwandelt, 1,2 mm lang, 0,07 mm breit und ebenfalls mit 6-7 Kerben versehen. Nephridialporen vor dem Gürtel oberhalb der Borstenlinie *d*, hinter dem Gürtel zwischen der Borstenlinie *cd*. Samentaschenporen auf Intersegmentalfurche 6/7-8/9, von aussen nicht zu erkennen.

Gürtel sattelförmig vom 15.-26. Segment. Pubertätsstreifen vom 20., 20.-27. Segment. Weibliche Poren auf dem 14. Segment am inneren Rand, zwischen der Borstenlinie *ab*. Männliche Poren auf Intersegmentalfurche 21/22 (Abb. 3).

Innere Organisation. Dissepimente 6/7-11/12 stark verdickt, 12/13-16/17 nach hinten zu an Verdickung abnehmend, nur noch hautförmig verdickt. Schlund kurz, Muskelmagen im 6. Segment, zwiebelförmig, von den Dissepimenten, die bis zum Schlund reichen, überdeckt. Am Oesophagus vor dem Muskelmagen grosse Peptonephridien. Lateralherzen im 7.-9., Intestinalherzen im 10.-11. Segment. Schlingenförmige Herzen im 12. Segment fehlen. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen, auf der Innenseite des oberen Drittels ein abgeschnürtes, kopfförmiges Gebilde (Abb. 4). Hoden und Samentrichter in perioesophageale Testikelblasen eingeschlossen, die des 10. kleiner, die des 11. Segments grösser, schliessen ausser den Herzen und Chylustaschen auch die Samensäcke des 11. Segments ein. Samenleiter treten etwas gewunden hervor, verlaufen gerade und unvereint an der Innenwand entlang und treten in der Intersegmentalfurche 21/22 aus. Samensäcke im 11. und 12. Segment, die des 11. sehr klein, die des 12. Segments gross und kugelrund. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend.

Samentaschen 3 Paar im 7-9. Segment, gleichgrosse Gebilde mit langem Ausführungsgang und löffelförmiger Ampulle (Abb. 5).

Die neue Art erinnert an *M. (M.) loksai* sp. n., unterscheidet sich von dieser in der Lage des Gürtels und der der Pubertätsstreifen.

Martiodrilus (Martiodrilus) cosanganensis sp. n.

In der Umgebung des Fundortes der Riesenform *Martiodrilus (Cordilleroscolex) ischuros* Zicsi & Csuzdi, 1998 wurde bei Cosanga eine weitere für die Wissenschaft neue Art entdeckt, von der mehrere adulte Tiere zur Beschreibung vorliegen.

Material: Ekuador: Prov. Napo, 7 km von Cosanga in Richtung Rio Aliso, Regenwald, 10.4.1987 leg. Zicsi, Loksa & Ponce; (Holotypus AF/3939; Paratypen. AF/1718 21+7 juv. Ex.).

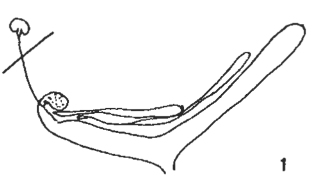
Länge des Holotypus 159 mm, Breite 5 mm, Segmentzahl 176. Paratypen: Länge 142-163, Breite 5-5,2 mm, Segmentzahl 156 –181.

Äussere Organisation: Farbe weiss, unpigmentiert. Kopf eingezogen, rüsselförmig. 1. und 2. Segment verwachsen, 3. gefurcht, bis zum 10. Segment ungeringelt, vom 11.-14. Segment und hinter dem Gürtel mehrfach geringelt. Borsten *ab* vom 6., Borsten *cd* vom 7. Segment zu erkennen. Borsten gepaart, Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 8:1:12:1:24. Borsten am Hinterkörper nicht unregelmässig angeordnet. Borsten *ab* des 11. und 12. Segments stehen auf kleinen Erhebungen, sind nicht in Geschlechtsborsten verwandelt. Borsten vom 18.-26. Segment von Papillen umgeben, in Geschlechtsborsten verwandelt; Länge 2,1 mm, Breite 0,1 mm, mit 6-9 Kerben versehen. Borsten vom 12.-15. Segment nach vorne stehend. Nephridialporen in der Borstenlinie *cd*. Samentaschenporen auf Intersegmentalfurche 6/7-8/9, kleine Öffnungen.

Gürtel sattelförmig vom 15.- 27., Pubertätsstreifen vom 21.-26. Segment. Auf dem 25. und 26. Segment ein breites Pubertätsfeld welches auch auf einen Teil des 27. Segments ventral übergeht (Abb. 6). Weibliche Poren auf dem hinteren Rand des 14. Segments. Männliche Poren auf Intersegmentalfurche 21/22 in Höhe der Pubertätsstreifen.

Innere Organisation. Dissepimente 6/7-10/11 stark, 11/12-14/15 hautförmig verdickt. Dissepimente überdecken den Muskelmagen bis zum Schlund. Muskelmagen im 6. Segment. Schlund durch zahlreiche Querbinden an die Innenwand des Körpers befestigt. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit abgeschnürtem Kopf. Lateralherzen im 7.-9., Intestinalherzen im 10.-11. Segment. Dorsales Rückengefäss knotenförmig bis ins 18. Segment reichend. Hoden und Samentrichter im 10. und 11. Segment von perioesophagealen Testikelblasen umgeben, schliessen die Herzen, Chylustaschen und Samensäcke des 11. Segments ein. Samensäcke im 11. und 12. Segment, runde kleine Gebilde, die auf die Segmente beschränkt sind. Samenrinnen treten gewunden hervor und verlaufen ebenfalls stark gewunden bis zum 16. Segment. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 17. Segment, Thyphlosolis im 27. Segment beginnend. Nephridien vom 16. Segment mit Nephridialblasen (Abb. 7).

Samentaschen 3 Paar im 7.-9. Segment, sehr langer dünner Ausführungsgang mit löffelartiger Ampulle (Abb. 8).



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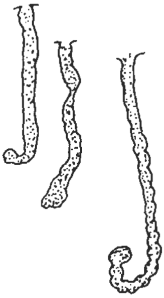

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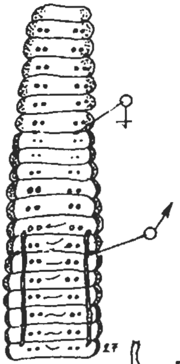

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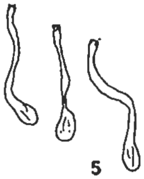

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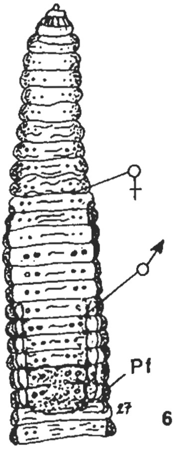

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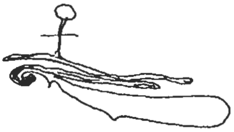

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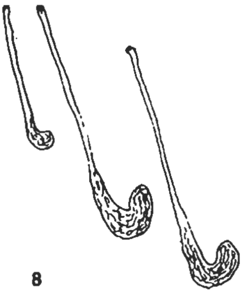

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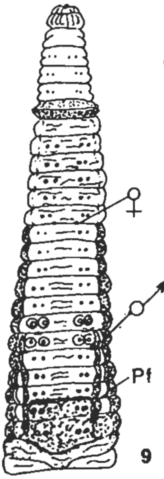

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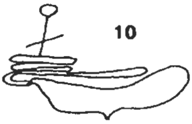

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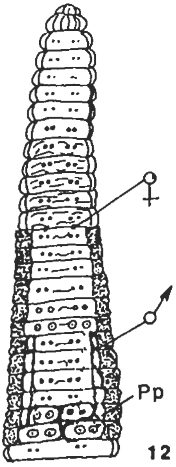

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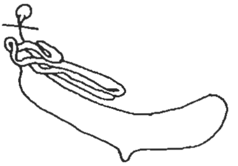

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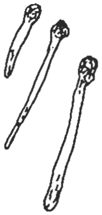

14

Abb. 1. *Martiodrilus (Martiodrilus) heterostichon heterostichon* (Schmarda, 1861). Form der Nephridien. **Abb. 2.** *Martodrilus (Martiodrilus) heterostichon colpochaeta* (Cognetti, 1906). Form der Samentaschen. **Abb. 3-5.** *Martiodrilus (Martiodrilus) cayambensis* sp. n. 3: Ventralseite. 4: Chylustasche mit seitlich abgeschnürtem Kopf. 5: Form der Samentaschen. **Abb. 6-8.** *Martiodrilus (Martiodrilus) cosanganensis* sp. n. 6: Ventralseite (Pf = Pubertätsfeld). 7: Form der Nephridien. 8: Form der Samentaschen. **Abb. 9-11.** *Martiodrilus (Martiodrilus) nonniorum* sp. n. 9: Ventralseite (Pf = Pubertätsfeld). 10: Form der Nephridien. 11: Form der Samentaschen. **Abb. 12-14.** *Martiodrilus (Martiodrilus) papillatus* sp. n. 12: Ventralseite (Pp = Pubertätspapillen). 13: Form der Nephridien. 14: Form der Samentaschen

Die neue Art steht *M. nonniorum* sp. n. und *M. papillatus* sp. n. am nächsten, unterscheidet sich von beiden in der Lage des Gürtels und der Pubertätsstreifen und in der Form der Samentaschen.

Martiodrilus (Martiodrilus) nonniorum sp. n.

Material: Ekuador: Prov. Napo. Bei der Verzweigung zur Lagune San Marcos am Cayambe Vulkan, 4100 m, 28.4.1990 leg. Zicsi, Csuzdi & Nonn; (Holotypus AF/3930 2 Ex., Paratypen AF/3935 2+5 juv. Ex.) Cayambe Vulkan, 4000-4200 m, 6. 5. 1988 leg. Zicsi & Csuzdi.- AF/1701 9 Ex., AF/1702 3 Ex., oberhalb der San Marcus Lagune, 4200 m, Cayambe Vulkan, sehr feuchte Wiese, 24. 4. 1988 leg. Zicsi & Csuzdi.- AF/1019 2+2 juv. Ex., CayambeVulkan, Fundort wie zuvor, 4300 m, 24. 4. 1988 leg Zicsi & Csuzdi.

Länge des Holotypus 230 mm, Breite 6 mm, Segmentzahl 181. Paratypen: Länge 170 -250 mm, Breite 5-7 mm, Segmentzahl 160-202.

Äussere Organisation: Farbe grauweiss, unpigmentiert. Kopf eingezogen. 1.-2. Segment verwachsen, 3. gefurcht, bis zum 7. Segment ungeringelt. 8. Segment in der Mitte kragenförmig hervorstehend, sehr kennzeichnend für die Art (Abb. 9). 9.-14. Segment und hinter dem Gürtel ebenfalls mehrfach geringelt. Nephridialporen auf dem vorderen Drittel des Segments, in der Borstenlinie *cd*. Borsten gepaart, Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 3:1:7:1:16. Samentaschenporen 3 Paar auf Intersegmentalfurche 6/7-8/9.

Gürtel sattelförmig vom 15.-26. Segment. Pubertätsstreifen vom 21.-26. Segment. Weibliche Poren auf dem hinteren Rand des 14. Segments. Männliche Poren auf Intersegmentalfurche 21/22. Borsten *ab* des 11. und 12. Segments auf kleinen Drüsenpölstern, sind nicht in Geschlechtsborsten verwandelt. Borsten vom 19., 20.-24. Segment von Papillen umgeben und in Geschlechtsborsten verwandelt. Länge 2 mm, Breite 0,08 mm, Borsten mit 13 Kerben versehen. Ein hervorstehendes Drüsenfeld bedeckt ventral das 25.- 27. Segment.

Innere Organisation. Dissepimente 6/7-8/9 sehr stark, 9/10 weniger stark, 10/11-14/15 hautförmig verdickt. Schlund bis ins 4. Segment reichend. Muskelmagen im 6. Segment, von den Dissepimenten überdeckt. Mächtige Peptonephridien vor dem Muskelmagen. Weitere Peptonephridien mit sehr langem Stiel bis ins 15. Segment reichend. Lateralherzen im 7.-9., Intestinalherzen im 10., 11. Segment. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit abgeschnürtem Kopf. Hoden und Samentrichter im 10. und 11. Segment in perioesophagealen Testikelblasen, die Herzen und Chylustaschen der entsprechenden Segmente sowie die Samensäcke des 11. Segments einschliessen. Samensäcke im 11. und 12. Segment, runde Gebilde, die auf ihre Segmente beschränkt sind. Ovarien im 13. Segment, fächerförmig, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18. Segment, Typhlosolis vom 27. Segment vorhanden. Nephridien vom 15. Segment mit Nephridialblasen versehen (Abb. 10).

Samentaschen drei Paar im 7., 8., 9. Segment, gleichlange, fadenförmige Gebilde, Ampulle nur am Ende etwas verbreitet (Abb. 11).

Die neue Art steht *M. cosanganensis* sp. n. und *M. papillatus* sp. n. am nächsten, unterscheidet sich von diesen in der Lage des Gürtels und der Pubertätsstreifen, in der Form des Pubertätsfeldes und in der Form der Samentaschen.

Die neue Art wird nach der Familie Nonn aus Quito benannt, die uns bei der Verwirklichung unserer Sammeltätigkeit weitgehend behilflich war.

Martiodrilus (Martiodrilus) papillatus sp. n.

Fundorte. Holotypus, Ekuador Prov. Napo. AF/3940 zwischen Pifo und Papallacta, 3900 m, unterhalb dem Denkmal der Madonna, 11. 5. 1988 leg. Zicsi & Csuzdi.- Paratypen. AF/1700 6+1juv. Ex., Fundort wie beim Holotypus.- AF/1699 3+1 juv. Ex., Fundort wie zuvor, 4150 m, 14. 4. 1989 leg. Zicsi & Loksa.- AF/3927 4 Ex., Fundort wie zuvor, 4200 m, 4. 5. 1990 leg. Zicsi & Csuzdi & Paredes.

Länge des Holotypus 220 mm, Breite 10 mm, Segmentzahl 167. Paratypen: Länge 190-230 mm, Breite 8-11 mm, Segmentzahl 167-245.

Äussere Organisation: Farbe unpigmentiert, grau. Kopf rüsselförmig eingezogen. 1.-2. Segment verwachsen, 3. längsgefurcht. Segmente 4-9 ungeringelt, 10-14 und hinter dem Gürtel dreifach geringelt. Borsten *ab* vom 4., *cd* vom 5. Segment beginnend zu erkenen. Borsten gepaart. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 5:1:5:1:17,5. Nephridialporen in der Borstenlinie *cd.* Samentaschenporen auf Intersegmentalfurche 6/7, 7/8, 8/9, kleine Öffnungen.

Gürtel sattelförmig vom 15.-26., Pubertätsstreifen vom 21.-25. Segment, Pubertätsfeld auf dem 25. und 26. Segment in Form von 4 grossen Papillen, die miteinander verschmolzen sind. Borsten *ab* des 8.-12. Segments hervorstehend, sind nicht in Geschlechtsborsten verwandelt, Länge 1,25 mm Breite 0,1 mm, mit, 7-8 Kerben versehen. Borsten des 19., 20. und 25., 26 sowie vom 21.-24. Segment von verschieden grossen Papillen umgeben, die in Geschlechtsborsten verwandelt sind. Die Borsten sind 1,85 mm lang, 0,15 mm breit und mit 11 Kerben versehen. Weibliche Poren auf dem hinteren Rand des 14. Segments in der Borstenlinie *b.* Männliche Poren auf Intersegmentalfurche 21/22 in Höhe der Pubertätsstreifen (Abb. 12).

Innere Organisation. Dissepimente 6/7-9/10 sehr stark, 10/11-14/15 hautförmig verdickt. Schlund bis ins 4. Segment reichend. Muskelmagen im 6. Segment von den Dissepimenten überdeckt. Mächtige Peptonephridien beginnen vor dem Muskelmagen und verlaufen bis ins 15. Segment, von da Nephridien mit Nephridialblasen (Abb. 13). Lateralherzen im 7.-9., Intestinalherzen im 10. und 11. Segment. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit stark gebogenem Körperteil und abgeschnürtem Kopf. Hoden und Samentrichter im 10. und 11. Segment von perioesophagealen Testikelblasen umgeben, die Herzen und Chylustaschen sowie die Samensäcke des 11. Segments einschliessen. Samensäcke im 11. und 12.

Segment. Samenrinnen verlaufen stark gewunden an der inneren Körperwand entlang und treten in Höhe des 21./22. Segments aus. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend.

Samentaschen im 7., 8. und 9. Segment, von vorne nach hinten zu grösser werdende längliche sackförmige Ampulle. An der Basis des Ausführungsganges Samenkämmerchen vorhanden (Abb. 14).

Die neue Art steht *M. cosanganensis* sp. n und *M. nonniorum* sp. n. am nächsten, unterscheidet sich von diesen in der Lage des Gürtels und der Pubertätsstreifen, in der Form des Pubertätsfeldes und der Samentaschen.

Martiodrilus (Martiodrilus) agilis (Cognetti, 1904)

Thamnodrilus agilis Cognetti; 1904:14
Rhinodrilus (Thamnodrilus) agilis, Cognetti, 1906:196
Thamnodrilus agilis, Michaelsen, 1918:88

Von dieser Art, die in unseren Aufsammlungen in Ecuador bisher nicht angetroffen werden konnte, liegen in der Sammlung von Torino von einem Fundort 2 Exemplare vor (OL 421, *Thamnodrilus agilis*, Valle del Rio Peripa, XI. 1897, leg. Festa). Aufgrund der verdickten Dissepimente hinter dem Muskelmagen und des Fehlens eines rosettenförmigen Nephrostoms, wird diese Art in die Untergattung *Martiodrilus* gestellt.

Eine Nachbestimmung der beiden Exemplare lässt, wenn auch nicht mit vollkommener Sicherheit, erkennen, dass der Gürtel bis ins 27. Segment reicht und wahrscheinlich am 15. Segment beginnt. Die weiblichen Poren liegen auf der hinteren Kante des 14. Segments, die männlichen Poren auf Intersegmentalfurche 21/22. Die Samentaschen des von mir geöffneten Tieres scheinen viel stärker entwickelt zu sein, besitzen einen muskulösen Stiel und eine plattgedrückte Ampulle. Das von Cognetti geöffnete Exemplar wird als Lectotypus designiert (OL 421a).

Martiodrilus (Martiodrilus) acanthinurus acanthinurus (Cognetti, 1904)

Thamnodrilus acanthinurus acanthinurus Cognetti, 1904:10
Rhinodrilus (Thamnodrilus) acanthinurus acanthinurus, Cognetti, 1906:211
Thamnodrilus (Thamnodrilus) acanthinurus acanthinurus, Michaelsen, 1918:106

M. a. acanthinurus wurde anhand zahlreicher Exemplare vorwiegend aus den südlichsten Teilen Ecuadors beschrieben (OL 414 Sigsig, 2550 m, 1895, leg. Festa; OL 417, Valle del Santiagom, II/III 1896, leg. Festa; OL 418, Gualaquiza, 800 m, IV. 1895; OL 419, S. José, V. 1896, 1100 m, leg. Festa; OL. 420, Valle del Rio Zamore, XI. 1895, leg. Festa). Ein einziger Fundort stammt aus dem nördlichen Teil des Landes, aus Ibarra (OL. 416, 2550 m, III. 1897, leg. Festa, interandine Region).

Die Nachbestimmung der aus Ibarra vorliegenden beiden Tiere, die auch nicht ganz adult sind, können nicht zu dieser Unterart gezählt werden, sie werden zu *M. (M.) loksai* sp. n. gestellt.

Unter den Tieren aus Gualaquiza konnte ein Exemplar als *M. (M.) tuberculatus* (Cognetti, 1904) bestimmt werden.

Von mehreren Fundorten, ebenfalls aus den südlichen Teilen Ecuadors, sind zahlreiche Tiere mit *acanthinurus acanthinurus* einwandfrei identifiziert worden.

Fundorte. Ekuador. Prov. Loja. AF/1600 1 Ex., AF/3820 1+3 juv. Ex., 18 km von Loja entfernt, unterhalb der Kirche in Richtung Zamora, Wiese, 1. 5. 1988 leg. Zicsi & Csuzdi.- AF/3780 2 Ex., 5 km hinter Saraguro, 2500 m, 26. 4. 1988 leg. Zicsi & Csuzdi.- AF/3806 5+4 praead.+2 juv. Ex., 3 km von der Hacienda el Cortijo entfernt, Wiese, 2200 m, 27. 4. 1988 leg. Zicsi & Csuzdi.- AF/3814 3 Ex., 50 km von Loja in Richtung Cuenca Wiese, 2400 m, 30. 4. 1988 leg. Zicsi & Csuzdi.- AF/3817 3+2 juv. Ex., 76 km von Loja in Richtung Cuenca, 2800 m, Wiese, 30. 4. 1988 leg. Zicsi & Csuzdi.- AF/3818 13+15 juv. Ex., 24 km vor Saraguro, 3500 m, 30. 4. 1988 leg. Zicsi & Csuzdi.- Prov. Zamora-Chinchipe. AF/1556 17 Ex., AF/3809 5 Ex., 41 km von Loja in Richtung Zamora, 1200 m, 29. 4. 1988 leg. Zicsi &Csuzdi. AF/1558 6 Ex.,AF/3812 6Ex., 16 km von Zamora in Richtung Loja, 1000 m, 29. 4. 1988 leg. Zicsi & Csuzdi. AF/3822 4 Ex., Zamora Wiese, 900 m, 29. 4. 1988 leg. Zicsi & Csuzdi. AF/1560 17 Ex., AF3808 25 Ex., 30 km von Loja in Richtung Zamora, 1300 m, 29.4. 1988 leg. Zicsi & Csuzdi. Prov. Azuay. AF/3832 2+3 juv. Ex., zwischen Giron und Victoria de El Portete, 2000 m, Wiese, 2. 5. 1988 leg. Zicsi & Csuzdi. AF/3839 15+14 juv. Ex., oberhalb Sigsig, 3100 m, 3. 5. 1988 leg. Zicsi & Csuzdi. AF/3777 7 Ex, zwischen Cuenca und Loja, 52 km von Cuenca entfernt, 4000 m, 26. 4. 1988 leg. Zicsi & Csuzdi.- Prov. Napo. AF/341 3 Ex., Puerto Misahuali Regenwald, 250 m, 14. 2. 1986 leg. Zicsi & Loksa & Benavides. AF/350 2 Ex., Teniente, Hugo Ortiz , 14. 2. 1986 leg. Zicsi & Loksa & Benavides. AF/496 8+3 juv. Ex., Piatua, am Ufer des Rio Anzu, 14. 2. 1987 leg. Zicsi & Loksa & Benavides.

Da der Originaltext Cognettis sehr ausführlich ist, verzichte ich auf eine Wiedergabe der Beschreibung. Es sei nur erwähnt, dass die Gürtelorgane der revidierten Tiere nicht ganz mit der Originalbeschreibung übereinstimmen (S. José : Gürtel 15., 1/2 15., 16.– 26. Segment, Pubertätsstreifen 20.–24., 25. Segment. Gualaguiza: Gürtel 15.–25. Segment, Pubertätstreifen 20.–25. Segment. Valle del Zamora: Gürtel 15.– 26. Segment, Pubertätsstreifen 20.–24. Segment. Valle del Santiago: Gürtel 15.– 26. Segment, Pubertätsstreifen 20.–24, 25. Segment. Sigsig: Gürtel 15.–26. Segment, Pubertätssreifen 20.–25. Segment). Diese Unterschiede konnten auch bei den von uns gesammelten Tieren der verschiedenen Fundorte nachgewiesen werden. Sie sind z.T. auf die verschieden fortgeschrittene Geschlechtsreife der einzelnen Exemplare zurückzuführen, oder wie bei den Exemplaren aus der Prov. Zamora-Chinchipe, wo der Gürtel konstant auf dem 16. Segment beginnt und bis zur Hälfte des 26. Segments reicht, vielleicht auch als artbegrenzendes Merkmal betrachtet werden könnte. Da im Typenmaterial aus S. José innerhalb einer Population beide Formen vorkommen, habe ich mich nicht zu diesem Schritt entschlossen.

Eine Nachbestimmung der Geschlechtsborsten erbrachte den Nachweis, dass die des 18. bzw. 19. und 25. Segments mehr als 10 Kerben besitzen und nur die der Pubertätsstreifen-Region (20.–24. Segment) verfügen über 4-5, wie dies in der Originalbeschreibung angeführt wurde.

Martiodrilus (Martiodrilus) acanthinurus heterophyma (Cognetti, 1904) gr. n.

Thamnodrilus acanthinurus forma *heterophyma* Cognetti, 1904:11
Rhinodrilus (Thamnodrilus) acanthinurus forma *heterophyma*, Cognetti, 1906:213
Thamnodrilus (Thamnodrilus) acanthinurus forma *heterophyma*, Michaelsen, 1918: 109

In der Sammlung von Torino liegen zahlreiche Exemplare von einem Fundort vor (OL 415, Valle del Santiago Ecu. orientale, II/III. 1896, leg. Festa, 25 Ex.). Unter Inv. Nr. OL 415a wird ein von Cognetti geöffnetes Exemplar als Lectotypus designiert.

Im vorliegenden Material sind einige Exemplare aus der Prov. Napo als diese Unterart bestimmt worden. Die kennzeichnende Ausbildung der Pubertätsstreifen ermöglichte ein sicheres Erkennen der Tiere.

Fundorte. Ekuador. Prov. Napo AF/352 1 Ex., 2 km von Puyo entfernt, Regenwald, 870 m, leg. Zicsi & Loksa & Benavides.- AF/1449 3 Ex., AF/1450 1 Ex., hinter Madre de Tierra in Richtung Puyo, Regenwald, 800 m, 2. 5. 1989 leg. Zicsi & Loksa & Ponce.- AF/1451 1 Ex., hinter Madre de Tierra in Richtung Puyo bei der Brücke, Regenwald, 2. 5. 1989 leg. Zicsi & Loksa & Ponce.

Martiodrilus (Martiodrilus) tuberculatus (Cognetti, 1904)

Thamnodrilus tuberculatus Cognetti, 1904:9
Thamnodrilus acanthinurus partim, Cognetti, 1904:10
Rhinodrilus (Thamnodrilus) tuberculatus Cognetti, 1906:208
Thamnodrilus (Thamnodrilus) tuberculatus, Michaelsen, 1918:105

Diese von einem Fundort (OL. 442, Valle del Rio Santiago, Ecuador orientale, leg. Festa) beschriebene Art liegt in 5 Exemplaren vor, bei denen die Pubertätsstreifen entwickelt, der Gürtel z.T. nur undeutlich erkennbar ist. Bei einem Tier konnte mit Sicherheit erkannt werden, dass er am 18. Segment beginnt, bei den übrigen liess sich dies nicht genau feststellen. Die Pubertätsstreifen sind hervorspringende Gebilde, die auf das 21.-24. Segment begrenzt sind. Kein rosettenförmiges Nephrostom vorhanden. Unter Inv. Nr. OL. 442/a wird ein Exemplar als Lectotypus designiert.

Martiodrilus (Martiodrilus) pseudotuberculatus sp. n.

Fundorte: Ekuador. Prov. Napo. Holotypus. AF/3969 82 km von Loreto, 17 km vor der Abzweigung Tena, 1250 m, 2. 5. 1990 leg. Zicsi & Csuzdi & Paredes.- Paratypen. AF/2288 1+3 Ex., Fundort wie beim Holotypus. - AF/2277 4 Ex., 55 km vor Loreto, Regenwald, 1200 m, 2. 5. 1990 leg. Zicsi & Csuzdi & Paredes.- AF/2286 3 Ex., 2 km hinter Coca, 1200 m, 4. 5. 1990 leg. Zicsi & Csuzdi & Paredes. - AF/2293 1 Ex., 44 km vor Loreto, 1100 m, 2. 5. 1990 leg. Zicsi & Csuzdi & Paredes. - AF/641, AF/1758 12+6 juv. Ex., zwischen Baeza und Cosanga, Wiese mit vereinzelten Bäumen, 2200 m, 10. 4.1987. leg. Zicsi & Loksa & Paredes. - AF/2209 1 Ex., zwischen Baeza und Tena, 40 km vor Tena, 1250 m, 4. 5. 1990 leg. Zicsi & Csuzdi. - AF/2276 1+2 juv. Ex., 53 km von Baeza, hinter der Verzweigung nach Coca, Regenwald, 1220 m, 2. 5. 1990 leg. Zicsi & Csuzdi & Paredes. - AF/2212 1 Ex., 5 km vor Baeza, 1950 m, 1. 5. 1990 leg. Zicsi & Csuzdi & Paredes. AF/1760 2Ex., 7 km vor Lumbaqui, 700 m, 11. 5. 1988 leg. Zicsi &

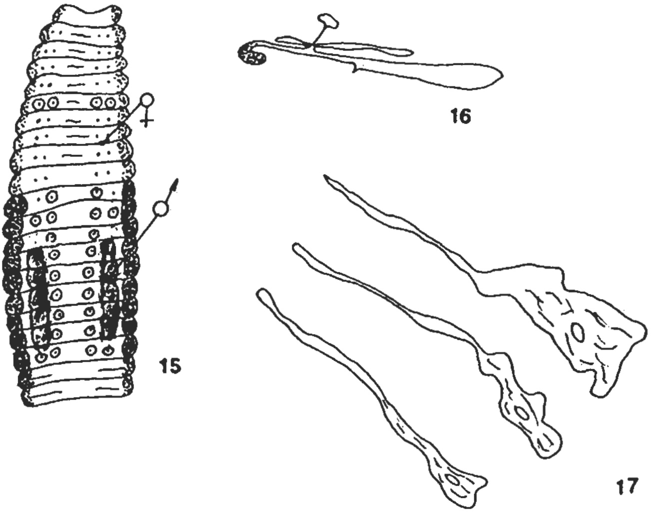

Abb. 15-17. *Martiodrilus (Martiodrilus) pseudotuberculatus* sp. n. 15: Ventralseite. 16: Form der Nephridien. 17: Form der Samentaschen

Csuzdi. - AF/2233 1 Ex., 25 km von Lago Agrio in Richtung Dureno, 300 m, 10. 5. 1988 leg. Zicsi & Csuzdi.

Holotypus. Länge 100 mm, Breite 5 mm, Segmentzahl 154. Paratypen: Länge 42-98 mm, Breite 2,8-3,7 mm, Segmentzahl 95-134.

Äussere Organisation: Farbe weiss, unpigmentiert. Kopf eingezogen, 1.-2. Segment verwachsen, längsgefurcht. 3.-12. Segment ungeringelt, vom 13. Segment und hinter dem Gürtel mehrfach geringelt. Borsten weitläufig gepaart. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 3,7:1,2:2,5:1:18,7. Borstenreihe *cd* vom 70., sämtliche Borstenreihen vom 100 Segment beginnend zerfallen, in Quinkunxstellung angeordnet. Borsten *ab* des 12.,18. und 25., Borsten *a* des 17., 19. und 20.-24. Segments von kleinen Papillen umgeben, in Geschlechtsborsten verwandelt. Länge der Geschlechtsborsten 0,75-77 mm, Breite 0,05 mm, Zahl der Kerben 6-8. Nephridialporen in der Borstenlinie *d*. Samentaschenporen auf Intersegmentalfurche 6/7-8/9.

Gürtel sattelförmig vom 16.,17.- 26. Segment, Pubertätsstreifen vom 20., 1/2 20.-24., 25. Segment. Weibliche Poren auf dem 14. Segment in der Borstenlinie *b*. Männliche Poren auf Intersegmentalfurche 20/21 (Abb. 15).

Innere Organisation. Dissepimente 6/7-10/11 stark, 11/12-15/16 hautförmig verdickt. Verdickte Dissepimente reichen bis zum Schlund und überdecken den Muskelmagen im 6. Segment. Lateralherzen im 7.-9., Intestinalherzen im 10. und 11. Segment. Schlingenförmige Herzen im 12. Segment fehlen. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit abgeschnürtem Kopf. Hoden und Samentrichter im 10. und 11. Segment in perioesophageale Testikelblasen eingeschlossen, die dorsal miteinander verbunden sind und die Herzen, Chylustaschen sowie die Samensäcke des 11. Segments einschliessen. Samensäcke im 11. und 12. Segment, kleine, auf die Segmente beschränkte, runde Gebilde. Ovarien im 13. Segment, fächerförmig. Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Thyphlosolis im 27. Segment beginnend. Nephridien vom 16. Segment mit Nephridialblasen versehen (Abb. 16).

Samentaschen im 7.-9. Segment, sehr langer Ausführungsgang mit plattgedrückter, formloser Ampulle (Abb. 17).

Die neue Art steht *M. (M.) tuberculatus* am nächsten. Unterscheidet sich von ihr in der Lage der Pubertätsstreifen und durch die zerfallenen Borstenreihen des Hinterkörpers (Quinkunxanordnung).

Martiodrilus nemoralis (Cognetti, 1904)

Thamnodrilus nemoralis Cognetti, 1904:7
Rhinodrilus (Thamnodrilus) nemoralis Cognetti, 1906:203
Thamnodrilus (Thamnodrilus) nemoralis, Michaelsen, 1918:104
Thamnodrilus (Thamnodrilus) validus partim, Michaelsen, 1918:88

Nach Überprüfung des Typenmaterials (OL 437, Valle del Rio Zamore, 1896, leg. Festa; OL. 438, Valle Santiago, 1896, leg. Festa) sowie der von Michaelsen aus Loja zu *M. validus* gestellten Exemplare konnten einige von uns gesammelte Tiere mit dieser Art identifiziert werden. Unter Inv. Nr. OL 437/a wird ein von Cognetti geöffnetes Exemplar als Lectotypus designiert.

Fundorte. Ekuador. Prov. Loja. AF/1597 2 Ex., AF/3821 2 juv. Ex., 85 km hinter Loja bei Zambi, Bachufer, 1600 m, 1. 5. 1988 leg. Zicsi & Csuzdi .- AF/1599 1 Ex., 18 km hinter Loja in Richtung Zamora, unterhalb der Kirche, Wiese, 1. 5. 1988 leg. Zicsi & Csuzdi. - AF/1603 8 Ex., 6 km hinter Jangana in Richtung Zambi, 1100 m, 28. 4. 1988 leg. Zicsi & Csuzdi. AF/3779 2+8 juv. Ex., Hacienda El Cortijo, Wiese, 27. 4. 1988 leg. Zicsi & Csuzdi.

Die neu untersuchten Tiere stimmen mit der Originalbeschreibung vollkommen überein. Es sei bemerkt, dass alle Tiere, die konserviert grau waren, im Leben grün sind. Die von Ohaus in Loja gesammelten Exemplare, die von Michaelsen (1918, p. 89) zu *validus* gestellt wurden, sind jetzt endgültig als *M. nemoralis* bestimmt worden (Zicsi, 1990; Zicsi & Csuzdi, 1999).

Martiodrilus (Martiodrilus) nemoraloides sp. n.

Fundorte. Ekuador. Prov. Loja. Holotypus AF/1598, 18 km hinter Loja in Richtung Zamora, unterhalb der Kirche, Wiese, 2200 m, 1. 5. 1988 leg. Zicsi & Csuzdi. - Paratypen. AF/1602 3 Ex., 46 km von Loja in Richtung Cuenca, Wiese, 30. 4. 1988 leg. Zicsi & Csuzdi.

Holotypus: Länge 91 mm, Breite 6 mm, Segmentzahl 149. Paratypen: Länge 87-110 mm, Breite 5,6-6,1 mm, Segmentzahl 134-154.

Äusserte Organisation: Farbe weiss, lebend grün. Die grüne Farbe der Tiere geht, so wie auch bei *M. nemoralis*, nach der Konservierung in Alkohol gänzlich verloren. Kopf eingezogen, 1.-2. Segment verwachsen, 3. längsgefurcht, die übrigen Segmente ungeringelt. Borsten gepaart, Borsten *ab* vom 7., *cd* vom 12. Segment zu erkennen. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 10:1:9,5:1:20. Nephridialporen in der Borstenlinie *cd*. 3 Paar Samentaschenporen auf Intersegmentalfurche 6/7-8/9 auf kleinen Erhebungen.

Gürtel sattelförmig vom 15.-25. Segment, Pubertätsstreifen vom 20.-25. Segment, kleine Furche von einem dünnen Wall umgeben (Abb. 18). Borsten *ab* vom 15.-25. Segment von kleinen Papillen umgeben, Borsten zu Geschlechtsborsten verwandelt; Länge 2 mm, Breite 0,05 mm. Die Borsten sind mit 18-20 Kerben versehen. Im Körperinneren stecken sie in länglichen Borstensäcken, die von flachen Geschlechtsdrüsen umgeben sind. Männliche Poren auf Intersegmentalfurche 20/21, von aussen nicht zu erkennen. Weibliche Poren auf dem 14. Segment in der Borstelinie *ab*.

Innere Organisation. Dissepiment 6/7- 14/15 hautförmig verdickt, vorne stärker, nach hinten zu schwächer werdend. Hinter dem Schlund mächtige Peptonephridien an den Oesophagus geschmiegt. Muskelmagen im 6. Segment, von den Dissepimenten vollkommen umhüllt. Lateralherzen im 7.-9., Intestinalherzen im 10. und 11. Segment, im 12. Segment schlingenförmige Herzen vorhanden. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen, gebogene Gebilde mit abgeschnürtem Kopf (Abb. 19 und 20). Hoden und Samentrichter im 10. und 11. Segment in perioesophageale Testikelblasen eingeschlossen, die die Herzen, Chylustaschen und die Samensäcke des 11. Segmentes einschliessen. Samensäcke im 11. und 12. Segment, klein, auf die Segmente beschränkt. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Samenrinnen verlaufen etwas gewunden, nicht verschmolzen auf der Innenwand entlang und treten im 20/21 Intersegment aus. Mitteldarm im 18., Typhlosolis im 27. beginnend. Nephridien vom 18. Segment mit Nephridialblasen versehen (Abb. 21).

Samentaschen im 7., 8., 9. Segment, plattgedrückte Ampulle mit einem tropfenförmigen Anhang. Die Samentaschen sind von mächtigen Geschlechtsdrüsen umgeben (Abb. 22).

Die neue Art erinnert an *M. nemoralis*, unterscheidet sich von dieser in der Lage des Gürtels, in der Form der Pubertätsstreifen, vor allem in der Form der Samentaschen und der nur schwach verdickten Dissepimente hinter dem Muskelmagen.

Martiodrilus (Martiodrilus) michaelseni Zicsi, 1990

Martiodrilus michaelseni Zicsi, 1990:375

Fundorte. Ekuador. Prov. Imbabura. AF/1696 2 Ex., 30 km von Otavalo entfernt in Richtung Apuella, 3250 m, 20. 4. 1989 leg. Zicsi & Loksa & Troya. - Prov. Pichincha. AF/1697 1 Ex., hinter Pingtag, 3000 m, 15. 4. 1987 leg. Zicsi & Loksa. - AF/1707 4 Ex., 3 km von Pintag entfernt, Finca Lopez, Eukalyptus-Wald, 17. 5. 1988 leg. Zicsi & Csuzdi. - AF/3737 1. Ex., Nationalpark Pasochoa, 2880 m, 15. 4. 1987 leg. Zicsi & Loksa & Benavides. - AF/3744 3 juv. Ex., Antisana Vulkan, 3300-3500 m, 16. 4. 1987 leg. Zicsi & Loksa. - AF/3772 4 Ex., 52 km von Quito entfernt in Richtung St. Domingo, Wiese, 3600 m, 24. 4. 1988 leg. Zicsi & Csuzdi.- AF/3861 5 juv. Ex., zwischen Pifo und Papallacta, 3900 m, 11. 5. 1988 leg. Zicsi & Csuzdi.

Die Überprüfung des Typenmaterials erbrachte den Nachweis, dass auch diese Art kein rosettenförmiges Nephrostom besitzt, und die Nephridien ähnlich denen der übrigen Arten dieser Untergattung sind.

M. (M.) michaelseni, die ebenfalls plattgedrückte, birnenförmige Samentaschen besitzt und so der *M. (M.) nemoralis* nahesteht, unterscheidet sich eindeutig von dieser durch die Lage der männlichen Poren auf Intersegmentalfurche 21/22, durch das Fehlen der perioesophagealen Testikelblasen und der Schlingenherzen im 12. Segment sowie durch die Form der Pubertätsstreifen und deren Länge. Während die zahlreichen Fundorte (vergl. auch Originalbeschreibung, Zicsi, 1990, p. 377) sozusagen auf die Prov. Pichincha beschränkt sind, kommt *nemoralis* nur im südlichsten Teil, in der Prov. Loja vor. Wie bereits bei *M. (M.) heterostichon colpochaeta* erwähnt, werden die Fundorte bei diesen nahe verwandten, trotzdem deutlich verschiedenen Arten durch breite Trockenstreifen in den interandinen und den beiderseits davon liegenden Regionen voneinander getrennt. Es kann angenommen werden, dass die Isolierung der Populationen unter verschiedenen Verhältnissen zu diesen Unterschieden geführt haben können.

Martiodrilus (Martiodrilus) lojaensis (Michaelsen, 1918)

Thamnodrilus (Thamnodrilus) lojaensis Michaelsen, 1918:97
Martiodrilus lojaensis, Righi, 1995:513

Diese Art wurde anhand von je 1 Exemplar (V 6983, Ecuador, Tal von Loja, 2200 m, leg. Ohaus, 29.6.1905; V 6969, Sabanilla, 1800 m, 11.5.9. 1905, leg. Ohaus) aus der Prov. Loja und Zamora beschrieben. Die Originalbeschreibung erfolgte anhand des aus dem Tal von Loja stammenden Exemplars, da das aus Sabanilla nicht geöffnet wurde. Das unter Inv. Nr. V 6983 vorliegende Tier wird als Lectotypus designiert. Aufgrund der von uns gesammelten Tiere aus der Umgebung von Loja und des von mir geöffneten Paralectotypus aus Sabanilla wird nachstehend die Originalbeschreibung mit den fehlenden Angaben ergänzt.

Fundort. Ekuador. AF/3782 16+10 juv. Ex.,+ 6 Eier, hinter Loja, 5 km von Vilcabamba entfernt, 2000 m, Bachufer, 27. 4. 1988 leg Zicsi & Csuzdi.

Äussere Organisation: Der Gürtel konnte auch beim ungeöffneten Tier erkannt werden, er liegt, wie auch bei den neuerbeuteten Tieren, auf dem 15.-25., 26. Segment, Pubertätsstreifen erstrecken sich vom 20., 2/3 20.-24. Segment. Weibliche Poren auf dem hinteren Rand des 14. Segments. Männliche Poren auf Intersegmentalfurche 21/22.

Innere Organisation. Lateralherzen im 7.-9., Intestinalherzen im 10. und 11. Segment. Oesophageale Testikelblasen im 10. und 11. Segment, die auf der Dorsalseite zu in einen an die Vorderseite der Dissepimente angelegten Anhang übergehen, der die Hoden und Samentrichter einschliesst, die Herzen und Chylustaschen und die Samensäcke des 11. Segments bleiben frei. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14.

Michaelsen (1918) ist der Meinung, dass *M. (M.) lojaensis* der *M. (M.) purnio* am nächsten steht. Ich selbst bin der Meinung, dass sie *M. (M.) acanthinurus acanthinurus* am nächsten steht, von der sie sich nur durch die oesophagealen Testikelblasen unterscheidet.

Martiodrilus (Martiodrilus) szekelyi sp. n.

Fundorte. Holotypus: Ekuador, Prov. Chimborazo. AF/3945 Juan de Velasco, 3200 m, Wiese Schwarzerde, 4. 4. 1987 leg. Zicsi & Loksa & Coloma. - Paratypen. AF/3725 14 +1 juv. Ex., Fundort wie beim Holotypus. - Prov. Bolivar. AF/3727 4 Ex., Cashca Totoras, Grenze der Wald- und Grasvegetation, 3200 m, 3. 4. 1987 leg. Zicsi & Loksa & Coloma.

Holotypus: Länge 125 mm, Breite 6 mm, Segmentzahl 165. Paratypen: Länge 121-129 mm, Breite 5,9-6,3 mm, Segmentzahl 154 - 167.

Äussere Organisation: Farbe grau, unpigmentiert. Kopf daumenförmig eingezogen. 1.-2. Segment verwachsen, 3. längsgefurcht. Segmente 4-11 ungeringelt, 12-14 geringelt. Borsten gepaart. Vor dem Gürtel *cd* sehr eng, hinter dem Gürtel etwas weiter gepaart. Borsten *ab* vom 6., *cd* vom 10. Segment vorhanden. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 7:1,6:6:1:12. Borsten des 17.-26. Segments zu Geschlechtsborsten verwandelt, am Gürtel nur äussere Reihe von Papillen umgeben. Länge der Geschlechtsborsten 1 mm, Breite 0,1 mm. Zahl der Kerben 5-7. Nephridialporen auf dem vorderen Teil der Segmente in der Borstenlinie *d*. Samentaschenporen auf Intersegmentalfurche 6/7-8/9, auf deutlichen kleinen Erhebungen.

Gürtel sattelförmig vom 15.-26., 26. Segment, Pubertätsstreifen vom 19.-24. Segment, Pubertätsfeld mit Längsstreifen versehen (Abb. 23). Männliche Poren auf Intersegmentalfurche 20/21. Weibliche Poren auf dem hinteren, inneren Rand des 14. Segments.

Innere Organisation. Dissepimente 6/7-15/16 verdickt, die von 6/7-8/9 sehr stark, die übrigen nach hinten zu dünner werdend. Schlund gross, zwischen ihm und dem Muskelmagen im 6. Segment mächtige Peptonephridien, die von den Dissepimenten überdeckt werden. Lateralherzen im 7.-9., Intestinalherzen im 10. und 11. Segment. Keine Schlingenherzen im 12. Segment. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit doppellappig abgeschnürtem Kopfteil (Abb. 24). Perioesophageale Testikelblasen im

10. und 11. Segment, sie schliessen die Herzen und Chylustaschen sowie die Samensäcke der entsprechenden Segmente ein. Samensäcke im 11. und 12. Segment, die des 11. Segments sehr klein. Ovarien im 13. Segment, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend. Nephridien vom 18. Segment mit Nephridialblasen versehen (Abb. 25).

Samentaschen 3 Paar im 7.-9. Segment, lange fadenförmige Gebilde mit kleinem plattgedrückten Kopf (Abb. 23).

Die neue Art steht *M. (M.) acanthinurus* nahe, unterscheidet sich von ihr in der Lage des Gürtels und der Pubertätsstreifen und in der Form des doppellappigen Chylustaschenkopfes.

Die neue Art wird mit bestem Dank nach Herrn L. Székely, Quito, benannt, der uns bei der Verwirklichung unserer Expedition von 1988 weitgehend so behilflich war.

Martiodrilus (Martiodrilus) loksai sp. n.

Thamnodrilus acanthinurus partim, Cognetti, 1904:10
Rhinodrilus (Thamnodrilus) acanthinurus partim, Cognetti, 1906:211

Fundorte. Holotypus. Ekuador Prov. Napo. AF/3944 28 km von St. Barbara auf dem Weg nach Julio Andrade, 3150 m, 26. 4. 1987 leg. Zicsi & Loksa & Lopez. - Paratypen. AF/3938 13 Ex., Fundort wie beim Holotypus. - Prov. Carchi. AF/1101 3+3 juv. Ex., 15 km von Tulcan, vor der Abzweigung Carmelo, 3800 m, 15. 5. 1988 leg. Zicsi & Csuzdi. - AF/996 5+6 juv. Ex., 22 km von Tulcan, oberhalb Tufino, Wiese, 15. 5. 1988 leg. Zicsi & Csuzdi. - AF/3918 3 Ex., zwischen EL Angel und Las Yuntas, 15 km von El Angel entfernt, Espeletien Vegetation, 12. 5. 1993 leg Zicsi & Csuzdi. - AF/3914 3 Ex., Fundort wie zuvor, 11 km von El Angel entfernt, 3300 m, 12. 5. 1993 leg. Zicsi & Csuzdi.- OL. 416 2 praead. Ex., Ibarra, 2225 m, III. 1897 leg. Festa.

Holotypus: Länge 9 mm, Breite 6,4 mm, Segmentzahl 112. Paratypen: Länge 8-12 mm Breite 6-7 mm, Segmentzahl 108-134.

Äussere Organisation: Farbe grau, unpigmentiert. Kopf eingezogen. 1.-2. Segment verwachsen, 3. längsgefurcht, 4.-11. Segment ungeringelt, 11.-14. Segment geringelt. Borsten gepaart, Borsten *ab* und *cd* vom 5. Segment beginnend zu erkennen. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 6:1:8:1:24. Borsten *ab* des 12. und 13. Segments auf kleinen Erhebungen, auf dem 17.-20. Segment von grossen Papillen umgeben, auf dem Gürtel vom 21.-25. Segment wieder auf kleineren Papillen stehend und zu Geschlechtsborsten verwandelt. Länge der Geschlechtsborsten 1,3 mm, Breite 0,06 mm, mit 7 Kerben ornamentiert. Borsten am Hinterkörper stark hakenförmig gebogen. Nephridialporen in der Borstenlinie *d*. Samentaschen-poren auf Intersegmentalfurche 6/7-8/9, deutlich zu erkennen.

Gürtel sattelförmig vom 15., 1/2 15.-25., 25. Segment, Pubertätsstreifen vom 21.-1/2 26., 26. Segment. Weibliche Poren auf dem 14. Segment. Männliche Poren auf Intersegmentalfurche 21/22 (Abb. 27).

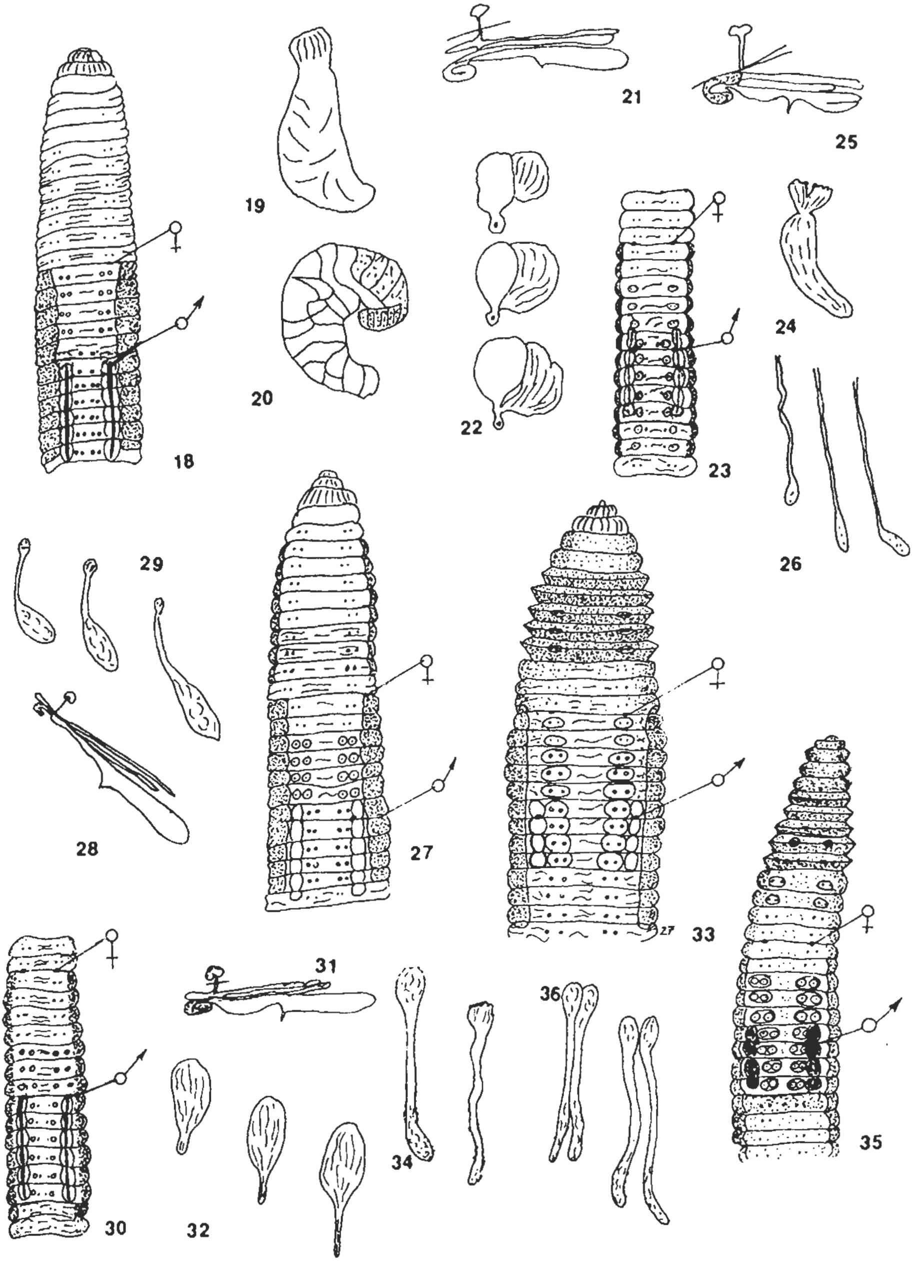

Abb. 18-22. *Martiodrilus (Martiodrilus) nemoraloides* sp. n. 18: Ventralseite. 19-20: Chylustaschen mit verschieden abgeschnürtem Kopf. 21: Form der Nephridien. 22: Form der Samentschen mit Geschlechtsdrüsen. **Abb. 23-26.** *Martiodrilus (Martiodrilus) szekelyi* sp. n. 23: Ventralseite. 24: Chylustasche mit doppellappig abgeschnürtem Kopf. 25: Form der Nephridialporen. 26: Form der Samentaschen. **Abb. 27-29.** *Martiodrilus (Martiodrilus) loksai* sp. n. 27: Ventralseite. 28: Form der Nephridien. 29: Form der Samentaschen. **Abb. 30-32.** *Martiodrilus (Martiodrilus) interandinus* sp. n. 30: Ventralseite. 31: Form der Nephridien. 32: Form der Samentaschen. **Abb. 33-34.** *Martiodrilus (Martiodrilus) robustus* sp. n. 33: Ventralseite. 34: Form der Samentaschen. **Abb. 35-36.** *Martiodrilus (Martiodrilus) robustus chilesensis* ssp. n. 35: Ventralseite. 36: Form der verschiedenen Samentaschen

Innere Organisation. Dissepimente 6/7-8/9 sehr stark, 9/10-10/11 schwächer, bis zum 14/15 hautförmig verdickt. Schlund kurz, am Oesophagus, vor dem Muskelmagen grosse Peptonephridien. Muskelmagen zwiebelförmig im 6. Segment. Lateralherzen im 7.-9., Intestinalherzen im 10.-11. Segment. Schlingenherzen im 12. Segment fehlen. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit abgeschnürtem Kopf und gebogenem Hauptteil. Hoden und Samentrichter im 10. und 11. Segment von perioesophagealen Testikelblasen umgeben, die die Herzen, Chylustaschen und die Samensäcke des 11. Segmentes einschliessen. 2 Paar Samensäcke im 11. und 12. Segment, kleine runde Säcke, die auf ihre Segmente beschränkt sind. Ovarien im 13. Segment, fächerförmig, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend. Nephridien vom 15. Segment mit Nephridialblase versehen (Abb. 28).

Samentaschen im 7.-9. Segment, fast gleichlange Gebilde mit schmal löffelförmiger Ampulle (Abb. 29).

M. (M). loksai sp. n. steht ebenfalls *M. (M.) acanthinurus* am nächsten, unterscheidet sich von ihr in der Lage des Gürtels, der Pubertätsstreifen und der männlichen Poren.

Die neue Art wird in Erinnerung an Doz. Dr. Imre Loksa, meinen lieben Freund und Begleiter auf mehreren Expeditionen, ihm zu Ehren benannt.

Martiodrilus (Martiodrilus) interandinus sp. n.

Fundort. Ekuador. Prov Azuay. Holotypus AF/3946 zwischen Loja und Cuenca, 52 km von Cuenca entfernt, 4000 m, Wiese, 26. 4. 1988 leg. Zicsi & Csuzdi. - Paratypen AF/3778 3 Ex., Fundort wie beim Holotypus.

Länge des Holotypus 152 mm, Breite 8 mm, Segmentzahl 171. Paratypen: Länge 132-148 mm, Breite 7-8 mm, Segmentzahl 162-183.

Äussere Organisation: Farbe lebend grün, abgetötet grau, gestreift. Kopf rüsselförmig eingezogen. 1.-2. Segment verwachsen, 3. längsgefurcht. 4.-10. Segment ungeringelt, 11.-14. Segment geringelt. Borsten *ab* und *cd* vom 4. Segment an zu erkennen. Borsten gepaart, am Hinterkörper nicht so stark hakenförmig. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 11:2,4:8,4:1:26. Borsten vom 19.-27. Segment von Papillen umgeben, in Geschlechtsborsten verwandelt, die innen in grossen Borstensäcken stecken. Länge der Borsten 2,1 mm, Breite 0,07 mm, Zahl der Kerben 13. Nephridialporen in der Borstenlinie *d*. Samentaschenporen auf Intersegmentalfurche 6/7–8/9, zwischen der Borstenlinie *cd*.

Gürtel vom 15.–28. Segment, sattelförmig, Pubertätsstreifen vom 22.–27. Segment, in einer Furche liegend (Abb. 30). Weibliche Poren auf dem 14. Segment, zwischen der Borstenlinie *ab*, am hinteren Rand des Segments. Männliche Poren auf Intersegmentalfurche 21/22.

Innere Organisation. Dissepimente 6/7–9/10 stark, trichterförmig, 10/11–15/16 hautförmig verdickt. Muskelmagen im 6. Segment von den

Dissepimenten überdeckt. Schlund kurz, Oesophagus vor dem Muskelmagen von Peptonephridien umgeben. Lateralherzen im 7.–9. Segment, Intestinalherzen im 10. und 11. Segment, schlingenförmige Herzen im 12. Segment. Chylustaschen im 7.–14. Segment, 8 Paar Wabentaschen mit abgeschnürtem Kopf. Hoden und Samentrichter im 10. und 11. Segment, in oesophageale Testikelblasen eingeschlossen. 2 Paar Samensäcke im 11. und 12. Segment. Ovarien im 13. Segment, fächerförmig, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 18., Typhlosolis im 27. Segment beginnend. Nephridien vom 16. Segment mit Nephridialblasen (Abb. 31).

Samentaschen 3 Paar im 7.-9. Segment, eiszapfenförmige Gebilde, bei denen die kolbenförmige Ampulle in eine ausgezogene Spitze übergeht. Grösse der Samentaschen von vorne nach hinten zunehmend (Abb. 32).

M. (M) interandinus sp. n. steht der *M. (M.) kuehnelti* am nächsten, unterscheidet sich von dieser in der Lage des Gürtels, der Pubertätsstreifen und männlichen Poren sowie in der Form der Samentaschen und in der Kerbenzahl der Geschlechtsborsten.

Martiodrilus (Martiodrilus) kuehnelti Zicsi, 1990

Martiodrilus kuehnelti Zicsi, 1990:377

Fundorte. Ekuador. Prov. Pichincha. AF/1609 1 praead. Ex., hinter Machachi bei der Verzweigung El Chaupi, 2800 m 13. 5. 1988 leg. Zicsi & Csuzdi. - AF/1709 2+ 4 juv. Ex., AF/3867 3 Ex Antisana Vulkan, 3600 m, 17.5. 1988 leg. Zicsi & Csuzdi. - AF/3743 15+11 juv. Ex., Antisana Vulkan, 3300-3500 m, 16. 4. 1987 leg. Zicsi & Loksa. - AF/3738 6 Ex., Nationalpark Pasochoa, 15. 4. 1987 leg. Zicsi & Loksa & Benavides. - AF/3746 1 Ex., Pichincha Gebirge, 2900 m, 19. 4. 1987 leg. Zicsi & Loksa. - AF/3747 13 Ex., Fundort wie zuvor, 3100 m, leg. Zicsi & Loksa. - AF/3752 2+12 juv. Ex., zwischen Nono und Quito, 3250 m, 8. 4. 1987 leg. Zicsi & Loksa. - AF/3769 2 praead. Ex., oberhalb Olmedo, 3000 m, 23. 4. 1988 leg. Zicsi & Csuzdi & Székely. - AF/3771 4 Ex., 58 km von Quito in Richtung St. Domingo, 3600 m., Wiese, 23. 4. 1988 leg. Zicsi & Csuzdi. – Pro. Napo. AF/3736 1 Ex., beim Rio Aliso in der Umgebung von Cosanga, 2250 m, 10. 4. 1987 leg. Zicsi & Loksa & Ponce. - AF/3933 1 Ex., San Marcus Lagune, Cayambe Vulkan, 3822 m., 28. 4. 1990 leg. Zicsi & Csuzdi & Nonn.

Die Arten *M. (M.) kuehnelti* und *M. (M.) intermedianus* sp. n., die durch weiter nach hinten verlagerte Gürtel und Pubertätsorgane gekennzeichnet sind, haben eine verschiedene Verbreitung. Auch die Fundorte der Originalbeschreibung berücksichtigend kommt *M. (M.) kuehnelti* nur in der Prov. Pichincha und Napo vor, während die neue Art nur südlich davon, hinter dem bereits erwähnten interandinen Trockenstreifen anzutreffen ist.

Martiodrilus (Martiodrilus) monticola (Michaelsen, 1900)

Anteus monticola Michaelsen, 1900:240
Rhinodrilus (Thamnodrilus) monticola Cognetti,1906:188
Thamnodrilus (Thamnodrilus) monticola Michaelsen, 1918:86

Von dieser aus Kolumbien beschriebenen Art (Zoologisches Museum

Berlin, Inv. Nr. 7385, *Thamnodrilus monticola,* Holotypus, leg. Bürger, 1896) konnte der Holotypus überprüft werden. Die Originalbeschreibung gibt 7 Chylustaschen an, die im 7.-14. Segment liegen sollen. Obwohl die inneren Organe vom Muskelmagen bis zum Mitteldarm entfernt sind und gesondert im Fläschchen lagen, konnten 8 Chylustaschen, wenigstens auf einer Seite, gezählt werden, wodurch die dubiose Angabe von Michaelsen geklärt ist. Mit Sicherheit liess sich feststellen, dass die Nephridien kein rosettenförmiges Nephrostom besitzen. Diese Art wurde bisher nicht wieder gesammelt.

Martiodrilus (Martiodrilus) purnio (Michaelsen, 1900)

Anteus purnio Michaelsen, 1900:238
Rhinodrilus (Thamnodrilus) purnio, Cognetti, 1906:188
Thamnodrilus (Thamnodrilus) purnio Michaelsen, 1918:96

Unter Inv. Nr. V. 5447 liegen im Zoologischen Institut und Museum von Hamburg (Goldmine Purnio bei Honda, 28.Okt.-21. Nov. 1986, leg. Bürger) 3 Exemplare vor. Aus dem Zoologischen Museum von Berlin konnten 5 Syntypen vom gleichen Fundort überprüft werden. (Inv. Nr. 7299, Purnio, Mina, leg. Bürger). Von den 5 Tieren waren nur 2 ganz geschlechtsreif, die übrigen praeadult. Eine Überprüfung des Typenmaterials erbrachte den Nachweis, dass die Nephridien kein rosettenförmiges Nephrostom besitzen, wie dies irrtümlicherweise von uns (Zicsi & Csuzdi, 1997) angeführt wurde. Das gut erhaltene Syntypenmaterial, welches nur jetzt eingesehen werden konnte, ermöglichte auch die Erkennung der männlichen Poren auf Intersegmentalfurche 20/21, die der weiblichen Poren auf dem hinteren Rand des 14. Segments in der Borstenlinie *b*.

Unter Inv. Nr.V. 5447/a wird ein Exemplar der Sammlung von Hamburg als Lectotypus designiert.

Martiodrilus (Martiodrilus) menai Zicsi & Csuzdi, 1998

Martiodrilus menai Zicsi & Csuzdi, 1998.

Fundorte. Ekuador. Prov. Bolivar. AF/3726 4 Ex., Cashca Totoras, Paramo Schwarzerde, 3. 4. 1987 leg. Zicsi & Loksa & Coloma. - Prov. Chimborazo. AF/3729-30 3 praead. Ex., Chagmala, 1750 m, leg. Zicsi & Loksa & Coloma. - Prov. Canar. AF/3776 1 juv. Ex., vor El Tambo, 3100 m, 25. 4. 1988 leg. Zicsi & Csuzdi. - AF/3841 1+2 juv. Ex., 36 km hinter Cuenca in Richtung Biblian, 2600 m, 3. 5. 1988 leg. Zicsi & Csuzdi. - AF/3852 1+2 praead. + 2 juv. Ex., zwischen El Tambo und Zhud, 3000 m, Wiese, 4. 5. 1988 leg Zicsi & Csuzdi. - Prov. Pichincha. AF/354 1 Ex., Centro Cientifico Rio Palenque, 225 m, 21. 2. 1986 leg. De Vries.

Es ist die einzige Art dieser Untergattung, die über einen Blindsack verfügt.

Martiodrilus (Martiodrilus) devriesi Zicsi, 1988

Martiodrilus devriesi Zicsi, 1988:956

Diese bisher nur aus der Prov. Pichincha erwähnte Art besitzt, im Gegensatz zu den bisher angeführten Taxa, nur 2 Paar Samentaschen im 8. und 9. Segment.

Die Überprüfung des Typenmaterials erbrachte den Nachweis, dass das Nephrostom der Nephridien nicht rosettenförmig ist, die Zahl der Rillen bei normalen Borsten 9-10, die Zahl der Kerben bei Geschlechtsborsten 11 beträgt. Im vorliegenden Material sind keine Exemplare dieser Art angetroffen worden.

Weitere Tiere mit 2 Paar Samentaschen sind in der subnivalen Region des Cayambe und Chiles Vulkans gesammelt worden. Es handelt sich um grosse, robuste Regenwürmer, die in stark durchfeuchteten Hochgebirgsböden angetroffen wurden. Obwohl zahlreiche Exemplare erbeutet werden konnten, ist die Zahl der vollkommen geschlechtsreifen Tiere sehr spärlich, so dass trotz der Unterschiede, die innerhalb der Populationen vom Cayambe bzw. Chiles Vulkan und innerhalb der beiden Hochgebirgsregionen erkannt wurden, mit Sicherheit nur eine neue Art und Unterart für die Wissenschaft beschrieben werden können.

Martiodrilus (Martiodrilus) robustus sp. n.

Fundorte. Holotypus. Ekuador Prov. Carchi, Chiles Vulkan. AF/3949 oberhalb Tufino, 30 km von der Schranke entfern, 4200 m, 8. 5. 1990 leg. Zicsi & Csuzdi & Paz. - Paratypen. AF/3895 2+2 juv. Ex., AF/3896 6. praead. Ex., AF/3899 25 praead. Ex., AF/3900 7 praead. Ex., AF/3901 3 praead. Ex., Fundort wie zuvor, 4200-4300 m. - AF/3901 2+7 praead. Ex., Fundort wie zuvor, 33 km von der Schranke, 4000 m. - AF/3898 2+3 juv Ex., Fundort wie zuvor, 17 km von der Schranke entfernt, 3900 m. - AF/1002 3+2 juv Ex., oberhalb Tufino, 4100 m, 15. 5. 1988 leg. Zicsi & Csuzdi .- AF/1006 10 praead. Ex., Fundort wie zuvor, 4200 m. - Prov. Napo. Cayambe Vulkan. AF/1703 4+11 juv. Ex., oberhalb der Lagune San Marcos, 4200 m, 6. 5. 1988 leg. Zicsi & Csuzdi. - AF/1017 1+5 juv. Ex., Fundort wie zuvor, 4200 m, 23. 4. 1988 leg. Zicsi & Csuzdi.- AF/1022 2 Ex., Fundort wie zuvor.-AF/3931 1+9 juv. Ex., oberhalb der Verzweigung zur Lagune San Marcos, 4000 m, 28. 4. 1990 leg. Zicsi & Csuzdi.- AF/3936 1+4 praead. Ex., Fundort wie zuvor.

Schon beim Sammeln 1988 sind diese robusten Tiere aufgefallen, da sie sich von *M. (M.) nonniorum* sp. n., mit der sie gemeinsam am Cayambe Vulkan angetroffen wurden, unterschieden, so dass die Fundorte noch im gleichen Jahr und in den nachfolgenden wieder aufgesucht wurden, um weiteres, geschlechtsreifes Material zur Lösung der taxonomischen Probleme zu erhalten. Trotz wiederholter Bemühungen ist dies nicht zur Genüge gelungen.

Länge des Holotypus 320 mm, Breite 10 mm, Segmentzahl 218. Paratypen: Länge 182-332 mm, Breite 8-11 mm, Segmentzahl 198-322.

Äussere Orgasnisation: Farbe grau, unpigmentiert. Kopf eingezogen. 1.-2.

Segment verwachsen. 3.-4 längsgefurcht, 5.-9 ungeringelt, 10.-11. Segment 3-4fach geringelt. Segmente von 7-11 in der Mitte gewölbt, erinnern so an die Wölbungen von *M. (M.) heterostichon*. Segmente hinter dem Gürtel ebenfalls mehrfach geringelt. Borsten gepaart, am Vorderkörper *cd* enger als *ab*. Borsten *ab* vom 9., *cd* vom 10. zu erkennen. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 13,3:1,3:12,6:1:30. Borsten *ab* vom 9.-11. Segment auf kleinen Erhebungen, ohne in Geschlechtsborsten verwandelt zu sein. Borsten *ab* vom 15. oder 16.-23. Segment stehen auf breiten Papillen und sind von einem kleinen runden Kreis umgeben. Diese Borsten sind zu Geschlechtsborsten verwandelt. Innen konnten keine Borstenbündel erkannt werden. Länge der Geschlechtsborsten 1,3-1,6 mm, Breite 0,6-0,7 mm. Zahl der Kerben 13. Die Zahl der Kerben ist bei den einzelnen Populationen verschieden, es können auch 9-15 vorkommen. Nephridialporen in der Borstenlinie *cd*. 2 Paar Samentaschenporen auf Intersegmentalfurche 7/8 und 8/9 in der Borstenlinie *cd*, bei den meisten Exemplaren deutlich zu erkennen.

Stark drüsiger Gürtel sattelförmig vom 1/2 14.,14., 15.-1/2 26., 26., 27. Segment, ausnahmsweise auch nur bis zum 25. Segment reichend. Pubertätsstreifen vom 1/2 20., 20.-1/2 23., 23. Segment. Männliche Poren auf Intersegmentalfurche 20/21. Weibliche Poren auf dem hinteren inneren Rand des 14. Segments in der Borstenlinie *b* (Abb. 33).

Innere Organisation. Dissepimente 6/7-9/10 sehr stark verdickt, trichterförmig, die übrigen bis 15/16 hautförmig verdickt. Schlund kurz, sehr kräftig, durch zahlreiche Querbinden an die Innenwand befestigt. Muskelmagen mit einem deutlichen Kragen im 6. Segment, von den Dissepimenten vollkommen überdeckt. Vor dem Muskelmagen am Oesphagus mächtige Peptonephridien angeschmiegt, die bis ins 16. Segment fortlaufend vorkommen. Lateralherzen im 7.-9., Intestinalherzen im 10. und 11. Segment. Keine Herzschlingen im 12. Segment. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit kleinem, abgeschürtem Kopf. Hoden und Samentrichter im 10. und 11. Segment von perioesophagealen Testikelblasen umgeben, die die Herzen, Chylustaschen und die Samensäcke der entsprechenden Segmente einschliessen. Samensäcke 2 Paar im 11. und 12. Segment, runde Gebilde, die auf die Segmente beschränkt sind. Ovarien im 13. Segment, fächerförmig, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 17., Typhlosolis im 27. Segment beginnend. Nephridien vom 18. Segment mit Nephridialblase versehen.

Samentaschen 2 Paar im 8. und 9. Segment, längliche Gebilde, die an der Basis beim Ausführungsgang angeschwollen und mit kleinen Samenkämmerchen versehen sind. Bei einigen Exemplaren ist die Ampulle kurz und glatt oder länglicher, fadenförmig mit warzenförmiger Struktur, am Ende etwas angeschwollen. Die Form der Samentaschen ist bei den Tieren der einzelnen Fundorte verschieden, aber eine längliche, schlauchförmige Ampulle ist bei allen gleicherweise vorhanden (Abb. 34).

Die mächtigen Eier dieser Art sind 62 mm lang und 25 mm breit.

Die neue Art steht *M. (M) devriesi* am nächsten, unterscheidet sich von dieser durch die Lage des Gürtels und durch die perioesophagealen Testikelblasen.

Martiodrilus (Martiodrilus) robustus chilesensis subsp. n.

Fundort. Ekuador. Prov. Carchi. Holotypus. AF/3950 Chiles Vulkan, Südseite, 4500 m, 15. 5. 1988 leg. Zicsi & Csuzdi. - Paratypen. AF/1012 1+6 juv. Ex., Fundort wie beim Holotypus.

Länge des Holotypus 310 mm, Breite 11 mm, Segmentzahl 222 Paratypen: Länge 295-322 mm Breite 9-11 mm, Segmentzahl 198-232.

Äussere Organisation: Farbe dunkelgrau, unpigmentiert. Kopf eingezogen, 1.-2. Segment verwachsen, 3. längsgefurcht, 4.-10. ungeringelt, 11.-14. Segment, hinter dem Gürtel ebenfalls mehrfach geringelt. Segmente 6-10 in der Mitte gewölbt, wie bei der Stammform. Borsten *ab* vom 10., *cd* vom 12. Segment zu erkennen. Borstenverhältnis hinter dem Gürtel *aa:ab:bc:cd:dd* wie 6:1:5:1:18. Borsten *ab* vom 9.-12. Segment auf kleinen Erhebungen, die vom 17.-23. Segment auf breiten Papillen und in Geschlechtsborsten verwandelt sind. Länge der Borsten 1,5 mm, Breite 0,18 mm, Zahl der Kerben 15. Nephridialporen in der Borstenlinie *cd*. Samentaschenporen auf Intersegmentalfurche 7/8, 8/9, zwei dicht nebeneinander liegende deutliche Öffnungen in der mutmasslichen Borstenlinie *cd*.

Gürtel sattelförmig vom 15.- 1/2 26., 26. Segment, Pubertätsstreifen vom 20.- 23., 23. Segment. Weibliche Poren auf dem 14. Segment, am hinteren inneren Rand, in der Borstenlinie *b*. Männliche Poren auf Intersegmentalfurche 20/21 (Abb. 35).

Innere Organisation. Dissepimente 6/7–9/10 stark verdickt, trichterförmig, 10/11–15/16 hautförmig. Schlund durch Querbinden an der Innenwand befestigt. Muskelmagen mit deutlichem Kragen im 6. Segment, von den Dissepimenten bedeckt. Oesophagus vor dem Muskelmagen von Peptonephridien umgeben. Weitere Peptonephridien reichen bis ins 16. Segment. Lateralherzen im 7.-9., Intestinalherzen im 10.-11. Segment. Herzschlingen im 12. Segment fehlen. Chylustaschen im 7.-14. Segment, 8 Paar Wabentaschen mit abgeschnürtem Kopf. Hoden und Samentrichter im 10. und 11. Segment von perioesophagealen Testikelblasen umgeben, die die Herzen, Chylustaschen und Samensäcke der entsprechenden Segmente einschliessen.

Zwei Paar Samensäcke im 11. und 12. Segment, kleine runde Gebilde, die auf die Segmente beschränkt sind. Ovarien im 13. Segment, fächerförmig, Ovarientrichter auf Dissepiment 13/14. Mitteldarm im 17., Typhlosolis im 27. Segment beginnend. Form der Nephridien wie bei der Stammform.

Samentaschen 2 Doppelpaare im 8. und 9. Segment, schlauchförmige Ampulle, beim Ausführungsgang angeschwollen, mit Samenmassen gefüllt, am Ende etwas warzenförmig mit Samenmassen in der Wand (Abb. 36). Bei einem Exemplar nur eine Seite mit verdoppelten Samentaschen.

Die neue Unterart unterscheidet sich von der Stammform durch die Verdoppelung der Samentaschen.

Martiodrilus (Martiodrilus) psikakao Righi, 1995

Martiodrilus psikakao Righi, 1995:528

Fundort: Kolumbien. Dept. del Cauca, AF/3481 1+1 juv. Ex., Muncipio de Puerto Tejada, Vereda de Perico Negra, 980 m, 2. 11. 1993, leg. Feijoo. - AF/3472 2 Ex., Dept. del Valle, Muncipio de Yotoco, Reserva de Yotoco, 1600 m, 3. 2. 1995, leg. Feijoo.

Allein von dieser Art konnte der Typus nicht überprüft werden. Die vorliegenden Exemplare stimmen in allen Kennzeichen mit der Originalbeschreibung überein. Da dieses kein rosettenförmiges Nephrostom besitzt, wird diese Art ebenfalls zur Untergattung *Martiodrilus* gestellt.

Zusammenfassung

Die bisher beschriebenen und jetzt zur Untergattung *Martiodrilus* gestellten Arten sind, mit Ausnahme von *M. (M.) psikakao,* anhand des Typenmaterials überprüft und revidiert worden. Wo dies erforderlich war, wurde auch ein Lectotypus designiert. Von den 15 bekannten und 11 als neu beschriebenen Arten bzw. Unterarten kommen 3 nur in Kolumbien, 23 in verschiedenen Teilen Ekuadors vor. Die interandinen Trockenstreifen sind auf die Verbreitung der einzelnen Arten von ausschlaggebendem Einfluss.

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Communicatio Brevis

A water strider species new to the fauna of Afghanistan, *Gerris asper* (Fieber, 1860) (Heteroptera: Gerromorpha)

By

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Abstract. Two *Gerris* species (Heteroptera, Gerromorpha, Gerridae) are recorded from Afghanistan, one of which, *Gerris asper* (Fieber, 1860), is new to the country.

During a zoological expedition in Afghanistan in 1974, Dr. L. Papp collected numerous bug species from wetlands. The material has been deposited in the Heteroptera Collection of the Hungarian Natural History Museum, Budapest. The following two species belonging to the family Gerridae have been identified:

Gerris (Gerriselloides) asper (Fieber, 1860): one adult female, with long wings.

Gerris (Gerris) thoracicus Schummel, 1832: two adult males, with long wings.

All the three specimens may be characterized by the same collecting parameters: Paghman River, Prov. Kabul, Afghanistan, 16 km west from Kabul, 1850 m above sea-level, 05. 10. 1974, coll.: L. Papp, No. 90.

On the basis of the „Catalogue of the Heteroptera of the Palaearctic Region" (Aukema and Rieger, 1995), *Gerris asper* proved to be new to the fauna of Afghanistan. This species was known hitherto from South and Central Europe, the Middle East and North Africa. In Asia it was found in Israel and Syria, furthermore there was a dubious detection in Turkey. Its recent occurrence in Afghanistan is the most remote one in the East so far.

Distribution of *Gerris asper*: Afghanistan, Algeria, Austria, Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Israel, Italy, Macedonia,

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Morocco, Poland, Russia, Slovakia, Slovenia, Spain, Switzerland, Syria, Turkey, Ukraine, Yugoslavia.

Regarding its size and colour, *Gerris asper* is very similar to *Gerris (Gerriselloides) lateralis* Schummel, 1832 (the latter one is well known from Afghanistan), however, the shape of the apophysis of the abdominal connexivum and the orientation of the female's last sternit are markedly different (Andersen, 1994; Schuster, 1983; Wagner and Zimmermann, 1955). The larvae of *G. asper* were described by Hufnagel and Vásárhelyi (1999).

Gerris thoracicus is a widespread and frequent species in both the Palearctic and the Oriental Region.

Distribution of *G. thoracicus*: Afghanistan, Algeria, Armenia, Austria, Azerbaijan, Belgium, Bulgaria, Canary Isles, Croatia, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Great Britain, Germany, Georgia, Greece, Hungary, India, Iran, Iraq, Ireland, Israel, Italy, Kazakhstan, Latvia, Lebanon, Liechtenstein, Lithuania, Luxembourg, Malta, Macedonian, Madeira, Moldavia, Morocco, The Netherlands, Norway, Poland, Portugal, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Syria, Tadzhikistan, Tunisia, Turkey, Turkmenistan, Ukraine, Uzbekistan, Yugoslavia.

Species names are given according to Aukema and Rieger (1995). Identifications were based on the papers of Hedicke (1938), Benedek (1969) and Savage (1989).

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