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## THE ESTONIAN *LUMBRICULIDAE*

The *Lumbriculidae* are a primitive family of the class *Oligochaeta*. They are treated as a separate order of *Lumbriculida* by D. G. Cook (1971). The family on the whole is holarctic, limnic, and prefers colder habitats. There are many endemic species in deep lakes, torrents and phreatic waters outside the area of the last glaciation. Rather uniform in their appearance, the *Lumbriculidae* vary considerably in the internal structure, especially in that of genitalia.

The present paper gives an account of all eight Estonian species known so far. Six of them were earlier mentioned in literature (Timm, 1970). Two more species are added here — a new one, and the other one first found in the USSR. Data on the ecology are given for all species, and for most of them descriptions of anatomy, unavoidable for their correct identification, have been added as well.

All available collections of *Oligochaeta* made by the Institute of Zoology and Botany and Tartu State University during the last 25 years in the Estonian fresh water bodies have been analyzed by the author. Among them recent (1973—1974) samples from the North Estonian limestone springs taken by Ado Seire, former student of the Tartu State University, were of special value.

The worms were studied mostly as whole mounts in glycerol. Series of histological sections were made from many mature animals. Some species were also bred in aquaria with mud (Тимм, 1974).

### *Lumbriculus variegatus* (Müller, 1774)

The most common and tolerant species, living in all sorts of freshwater habitats except the lake profundal. Due to the ability of encystment and rapid unsexual propagation, it can survive even in temporary pools and ditches. It also populates some acid waters in peat-bogs unsuitable for other oligochaetes. Architomy (fragmentation) is the main mode of reproduction. In aquaria, where the young were periodically removed, the age of the anterior ends left there reached up to three years. The most intensive architomy was observed in the first year of life. Sexual reproduction has become facultative in the genus *Lumbriculus*. Mature specimens appear very seldom, and they show a heavy degenerative variability, including that in the position of genitalia. Therefore it is rather difficult to define the various species in the genus.

Mature *Lumbriculus* were found five times in Estonia: two specimens with developing genitalia in L. Viitna Linajärv (15. III 1972) and

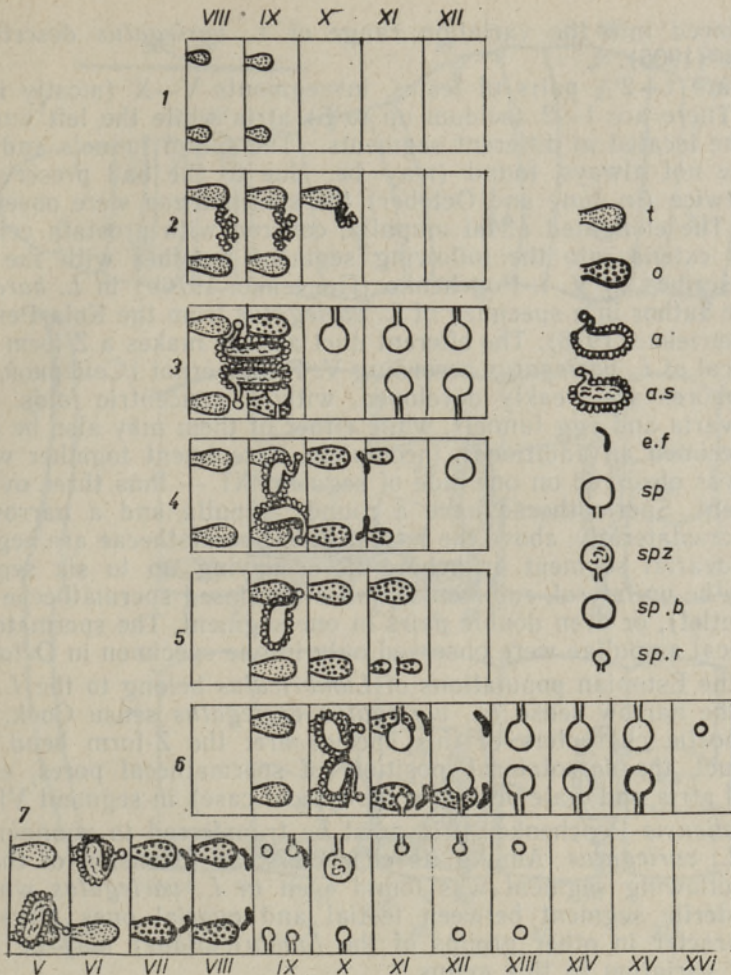


Fig. 1. *Lumbriculus variegatus*, scheme of the genital system of various specimens: 1 — from L. Saadjärv (23. V 1972); 2 — from L. Viitna Linajärv (15. III 1972); 3 — from L. Peipsi (18. VI 1967); and 4—7 — from the Roosna-Alliku spring pool (4. X 1958). V—XVI — numbers of segments. t — testis, o — ovary, a — atrium, a. s — atrium containing spermatozoa, e. f — egg funnel, sp — spermatheca, spz — spermatheca containing spermatozoa, sp. b — blind spermatheca, sp. r — rudimental spermatheca. The sperm funnels, sperm ducts, sperm sacs and egg sacs are not figured.

L. Saadjärv (23. V 1972); one mature worm without clitellum in the Nigula brook near the Võrtsjärv Limnological Station (20. V 1966; while in an aquarium, it lost its genitalia and resumed fragmentation); one clitellate specimen in L. Peipsi (18. VI 1967); eight mature specimens, partially with a degenerating genital system, in a spring pool at Roosna-Alliku, among the 135 immature ones (4. X 1958). It seems that sexual breeding takes place in summer months.

All in all seven mature specimens were studied as sections. Every specimen had its own combination of the number and position of testes, ovaria, genital ducts and spermathecae (Fig. 1). Nevertheless, they all

can be placed into the variation range of *L. variegatus* described by A. Mrázek (1906).

There are 1—2 $\frac{1}{2}$  pairs of testes, in segments V—X (mostly in VIII and IX). There are 1—2 (seldom up to 5) atria while the left and right one may be located in different segments. The sperm funnels and sperm ducts were not always found (may be, due to the bad preservation); however, twice (in June and October) the spermatozoa were observed in the atria. The elongated atrial ampulla, covered with prostata cells, can sometimes extend into the following segment together with the sperm sac, as described by V. I. Popchenko (Попченко, 1976b) in *L. kareliensis* and by the author in a specimen of *L. variegatus* from the Kola Peninsula (Тимм, Попченко, 1978). The efferent duct always makes a Z-form double bend, typical of *L. variegatus* according V. P. Semernoi (Семерной, 1971). The porophores are weakly developed, without concentric folds. 1—2 $\frac{1}{2}$  pairs of ovaria and egg funnels, while either of them may also be absent. In one specimen an additional, incomplete dissepiment together with an ovarium was observed on one side of segment XI — thus three ovaria in one segment. Spermathecae have a round ampulla and a narrow duct opening dorsolaterally, above the lateral line. Spermathecae are beginning with the ovarian segment or behind it, occupying up to six segments. There may be unilateral, rudimental and even closed spermathecae (without any outlet), or even double pairs in one segment. The spermatozoa in spermathecal ampullae were observed only in one specimen in October.

Thus, the Estonian populations of *Lumbriculus* belong to the *L. variegatus* in the narrow sense (*L. variegatus variegatus* sensu Cook, 1971). The diagnostic characters of this species are: the Z-form bend of the efferent duct, the dorsolateral position of spermathecal pores, and the location of atria and male pores (in the typical case) in segment VIII.

*L. kareliensis* Popchenko, 1976 must be transferred to younger synonyms of *L. variegatus*. Among its characters, an extension of the atria into the following segment was found even in *L. variegatus* while the peculiar sterile segment between testial and ovarian ones (treated as genus character in other groups of the *Lumbriculidae*) may be but an individual variation in this genus.

#### *Trichodrilus seirei* sp. n.

It is the first Estonian representative of this large genus, mostly connected with phreatic habitats. (About «*Trichodrilus* sp.» sensu Timm, 1970 see under *Tatriella slovenica*). The material consisting of 21 specimens originates mainly from the cold waters in the limestone Pandivere Hills: the Esna spring (11 specimens in seasonal samples by A. Seire), the Vetiku spring pool and the rivulets Valgejõgi and Soodla. It was also found in the littoral of eutrophic lakes: twice in the southern part of L. Võrtsjärv and once in L. Pangodi. Sexual maturity was observed in January, February, June, August, September and October, the water temperature being 0.9—10.2 °C in springs and 16.9° in L. Võrtsjärv. Six mature worms were studied as sections.

The majority of studied worms are fragments without tail, 4—10 mm long and consisting of 19—56 segments. The few undamaged specimens are not longer. The anteclitellar segments are 0.2—0.5 mm thick in various specimens, the following ones thicker, 0.3—0.6 mm respectively, on the clitellum sometimes even up to 0.7 mm. The prostomium is transparent, rounded or bluntly conical. All or most of the segments show

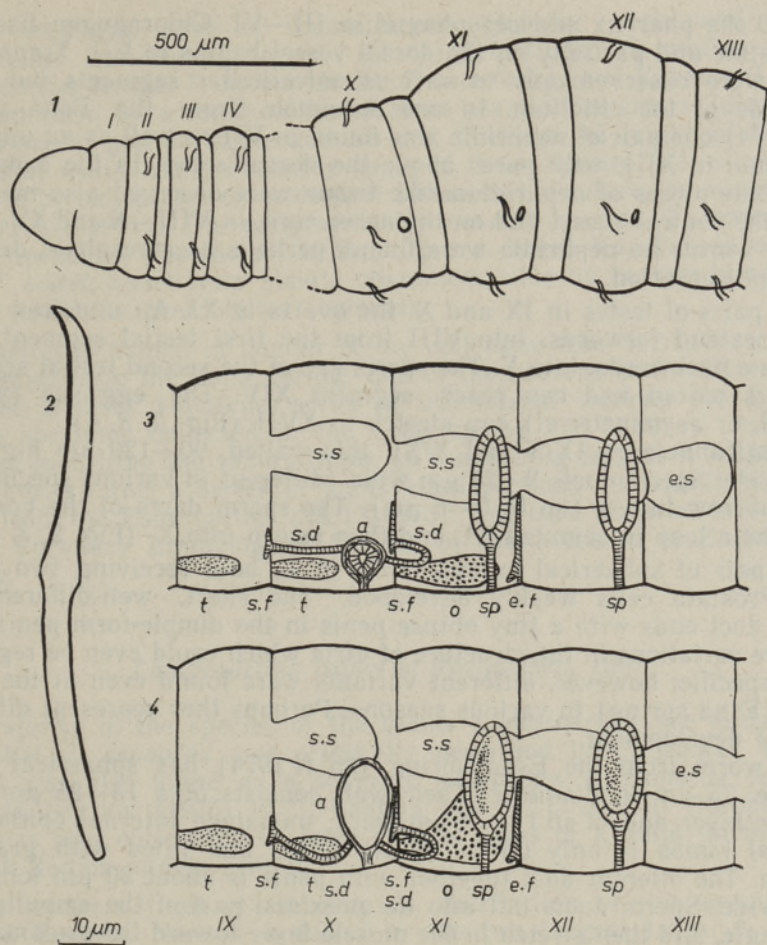


Fig. 2. *Trichodrilus seirei* sp. n., specimens from the Esna spring: 1 — external view; 2 — seta; 3 — scheme of the genital system of the one side, holotype (25. II 1974); 4 — the same of another worm (23. IX 1973). I—XIII — numbers of segments. a — atrium, e. f — egg funnel, e. s — egg sac, o — ovarium, s. d — sperm duct, s. f — sperm funnel, sp — spermatheca, s. s — sperm sac, t — testis.

secondary annulation: beginning with II two rings (the second being longer and with setae; Fig. 2, 1), in the middle part of the body sometimes three rings per segment. Setae paired, sigmoid, with simple sharp tip and with distal nodules (on  $2/3$  of the length), 3–5  $\mu\text{m}$  thick and 60–130  $\mu\text{m}$  long (Fig. 2, 2; anteriorly shorter, behind the clitellum longer). Clitellum on the segments X–XII (XIII). The paired genital apertures lie behind the ventral setal bundles. The round male pores without porophores on segment X, the oval spermathecal pores on XI and XII, remote female pores in the intersegmental furrow XI/XII.

The body wall hypodermis is 6–8  $\mu\text{m}$  thick (14–23  $\mu\text{m}$  on the clitellum), the circular musculature 1–6  $\mu\text{m}$ , the longitudinal one 24–32  $\mu\text{m}$ . In segment II the upper portion of the pharyngeal wall is thickened up to 32  $\mu\text{m}$ , the other parts being only 5  $\mu\text{m}$  thick. In segment III the pharyngeal wall is totally thickened. In IV–V the pharynx gradually narrows into the oesophagus. Chromophilous cells (pharyngeal glands)

surround the pharynx and oesophagus in III—VI. Chloragogen tissue on the intestine and partially on the dorsal vessel begins in VII. Transversal vessels were observed only in various anteclellular segments but never backwards of the clitellum. In one specimen (from the Esna spring, 25. II 1974) one pair of nephridia was found in VII as well as an unpaired nephridium in XIII, with pores above the dorsal setae. In the same specimen some pieces of nephridium-like tissue were observed also medially, around the ventral vessel and on the nerve cord, in VIII—X and XV—XVI. In other worms no nephridia were found, perhaps as a result of dissatisfactory preservation.

Two pairs of testes in IX and X, the ovaria in XI. An unpaired sperm sac can extend forwards, into VIII from the first testial segment, or a paired one backwards, into X. The sperm sac of the second testial segment is always paired and can reach segment XIV. The egg sac (paired, unpaired, or asymmetrical) can stretch to XVII (Fig. 2, 3, 4).

Sperm funnels on IX/X and X/XI, thin-walled, 90—120  $\mu\text{m}$  high and 65  $\mu\text{m}$  wide. Sperm ducts 9—24  $\mu\text{m}$  wide (different in various specimens), with a narrow lumen (up to 5—6  $\mu\text{m}$ ). The sperm ducts of the posterior pair make a loop in segment XI, and then return into X (Fig. 2, 3, 4).

One pair of sphaerical or oval atria in X, both receiving two sperm ducts. Prostata cells weakly developed. The short, well-differentiated efferent duct ends with a tiny obtuse penis in the dimple-form penial sac. There are variations in the structure of atria which could even be regarded as interspecific; however, different variants were found even at the same station (Esna spring) in various seasons. Perhaps they represent different stages of development.

One worm from the Esna spring (25. II 1974) has sphaerical atrial ampullae, 75  $\mu\text{m}$  in diameter. Their wall consists of a 13—25  $\mu\text{m}$  thick muscular layer and of an 11—18  $\mu\text{m}$  thick, unstained internal epithelium; the atrial lumen is only up to 18  $\mu\text{m}$  broad and filled with granular secretion. The efferent duct together with penis is about 30  $\mu\text{m}$  long and 27  $\mu\text{m}$  wide. Sperm ducts fall into the proximal part of the ampulla at a sharp angle, and then stretch in the muscle layer toward the proximal end of the atrium (Fig. 2, 3). Another specimen has similar atria, but with a thinner wall (both layers being 6  $\mu\text{m}$  thick), sampled in L. Vörtsjärv (9. VIII 1965).

Two worms from the Esna spring (23. IX 1973) have noticeably bigger atria. The ampulla is oval, 100—113  $\mu\text{m}$  long and 60—97  $\mu\text{m}$  broad, empty, with muscular layer being 4—10  $\mu\text{m}$  thick and without any epithelial lining. The sperm ducts discharge into the middle part of the ampulla. The efferent duct is about 60  $\mu\text{m}$  long and 20—25  $\mu\text{m}$  wide. It seems as if the atria were already degenerating after their functioning (Fig. 2, 4). The worms sampled in Vetiku spring pool have similar atria (30. VI 1968). Egg funnels on the dissepiment XI/XII are large, up to 180  $\mu\text{m}$  high and 80  $\mu\text{m}$  wide.

Two pairs of spermathecae lie in XI (the ovarial segment) and XII. They consist of an oval thick-walled ampulla and a well-distinguished stiff duct, being sometimes partially pushed into the ampulla by mounting. The ampulla is 120—230  $\mu\text{m}$  long and 65—120  $\mu\text{m}$  broad, its epithelial wall is 6—40  $\mu\text{m}$  thick. Sometimes (in the specimens of the second type of atria only) some granular or reticular matter was observed in the spermathecal ampullae. The spermathecal duct is 75—105  $\mu\text{m}$  long, the widest part (17—23  $\mu\text{m}$ ) is often situated in its middle; the width of the narrow lumen can reach up to 9  $\mu\text{m}$  (Fig. 2, 3, 4).

*T. seirei* belongs to a group of closely related Central European

species with two pairs of spermathecae, globular atria and without postclitellar transversal vessels (*T. hrabei* Cook, *T. medius* Hrabě, *T. moravicus* Hrabě, *T. tenuis* Hrabě, *T. montenegrinus* Karaman), differing from them by a combination of some plastic characters (dimensions of pharyngeal glands, setae and atrium, thickness of layers of the body and atrial walls, etc.). Probably some of these species will show themselves to be subspecies or ecological forms in the future, as supposed by Cook (1967, 1971). The geographically nearest species, *T. aporophorus* V. I. Popchenko (Попченко, 1976a) from a South Karelian lake differs from *T. seirei*, apart from plastic characters, also by having blind transversal vessels in postclitellar segments.

*T. seirei* is named in honour of my colleague Ado Seire, the collector of material from the Esna spring, one of the sources of the River Pärnu in Paide District. Holotype: series of transversal sections (on 2 slides) from a specimen collected in the Esna spring (25. II 1974). Paratypes: one specimen from the same sample (a 8 mm long fragment without tail, 35 segments) and a series of transversal sections (3 slides) of a specimen from the Esna spring (23. IX 1973). The type material is deposited at the Võrtsjärv Limnological Station of the Institute of Zoology and Botany.

#### *Lamprodrilus isoporus* Michaelsen, 1901

The majority of the species of the genus *Lamprodrilus* are endemic for L. Baikal. *L. isoporus* was originally described in L. Baikal, too, but then it was also found as a separate subspecies *L. isoporus variabilis* by P. G. Svetlov (1936) in L. Ladoga and L. Onega in Europe. Later on it was also discovered in some smaller lakes of Karelia, in the Arkhangelsk Region and in Finland.

The southern limit of the area of distribution of this species runs through Estonia. Here it is found in the two largest lakes: L. Peipsi-Pihkva and L. Võrtsjärv (Июффе, 1939; Timm, 1970). In the former it is the dominant species everywhere on sand and muddy sand areas while in the latter it occurs rarely in the sandy littoral zone of the north-eastern part. It prefers lower temperatures, a fact demonstrated by its breeding exceptionally in winter here. The cocoons contain usually two embryos, sometimes one or three (Timm, 1970; Саватеева, 1976). The adult worms gathered in the lake can survive in aquaria sometimes more than a year, and, held in cold in winter, can even breed. Young worms are more sensitive and die after some months. As *L. isoporus* is lacking in running water, its populations in local lakes must be regarded as relics, possibly those of the periglacial lakes.

P. G. Svetlov (1936) has mentioned as characters of the European *variabilis* subspecies: smaller dimensions in comparison with the nominate form (11—20 mm instead of 30—40), the presence of a loop of the sperm duct in the postatrial segment (however, its absence in the nominate form has never been directly declared), and the variable number of spermathecae (in addition to one pair in segment XIII sometimes an extra spermatheca in XIV). The above-mentioned character was not observed in the author's material but sperm ducts really penetrate the subsequent dissepiments while the length of the worms here is (due to the size of lakes?) still smaller than that in the L. Ladoga and L. Onega, 9—13 mm, seldom up to 15 mm.

*Stylodrilus heringianus* Claparède, 1862

This Boreomontaneous species is common in the northernmost part of Europe, beginning with Karelia. In Estonia its distribution has almost acquired a relic nature. Thus, it occurs in masses in cold springs, especially in North Estonia. It is also common in the stony and gravelly sections of rivers and brooks. As for lakes, *S. heringianus* is typical of the sandy littoral of the oligotrophic meres (the so-called *Lobelia*-lakes) only, rather rare in Estonia now. As a relic, it occurs in some former oligotrophic lakes that have recently eutrophized (L. Peta). In ordinary eutrophic lakes it is lacking. In our biggest eutrophic lakes, L. Peipsi-Pihkva and L. Võrtsjärv, it can be found in the lotic, stony littoral of the north-eastern corner (probably undulation plays the role of current for rheobionts here), and seldom also on the peat bottom. There are also scarce finds on the solid peat bottom in dyseutrophic lakes (L. Koigi and L. Tooma Männikjärv). An abnormal specimen with two pairs of penes (as described also by J. K. Hiltunen, 1967 from L. Michigan) was observed in the torrential Oostriku River.

*S. heringianus* breeds in Estonian springs the year round, but in our rivers and lakes mostly in summer. As a comparatively eurythermic animal, it can live and propagate in aquaria even at room temperature, and still more successfully in the case of hibernation in cold. Some specimens can reach an age of over 11 years in aquaria. The number of embryos per cocoon is 1—3, most often 2 in nature and 1 in aquaria.

*Stylodrilus brachystylus* Hrabě, 1929

This rare species was known only in Central and West Europe so far. Recently it has been collected for the first time in the USSR by A. Seire in two big springs of the Pandivere Hills: Esna (23. VII 1973, +7.4°) and Pransu (28. VIII 1974, +6.5°), as well as by the author in L. Lüüsjärv (with bottom springs, 23. VII 1976) and in a spring in Kargopol, Arkhangelsk Region (16. VII 1973).

The Estonian specimens are mature but damaged: a fragment with 20 segments measures 4 mm, another one with 65 segments — 15 mm, and the third one with 25 segments — 5 mm. The Kargopol specimen consists of 55 segments and measures 13 mm. The specimens are up to 0.8 mm thick. One of the fragments has a crippled head end, and this is why its reproductive system is as if placed forward, with male pores on VI. Virtually they lie on X. Penes are not visible externally, or they are visible as small protuberances only, surrounded by a collar of thickened hypodermis (Fig. 3, 1, 4). Setae are approximately 125  $\mu\text{m}$  long and 5—6  $\mu\text{m}$  thick, with distal nodulus, simple or with a short distal tooth (Fig. 3, 2). Clitellum on segments X—XI, extending on IX and XII as fully developed.

The layers of the body wall: hypodermis 11—18  $\mu\text{m}$ , the circular musculature 3—8  $\mu\text{m}$ , the longitudinal one 50—60  $\mu\text{m}$ . The brain is globular. The lower and lateral walls of the pharynx in I—II are thin, the upper wall being thick and muscular, covered by a fine layer of glandular cells. Oesophagus in III—VI (VII), narrow, but thick-walled, surrounded by masses of chromophilous cells. The chloragogen tissue begins in VII. Nephridia in VII, with pores in front of the ventral setae. The vascular system was not studied.

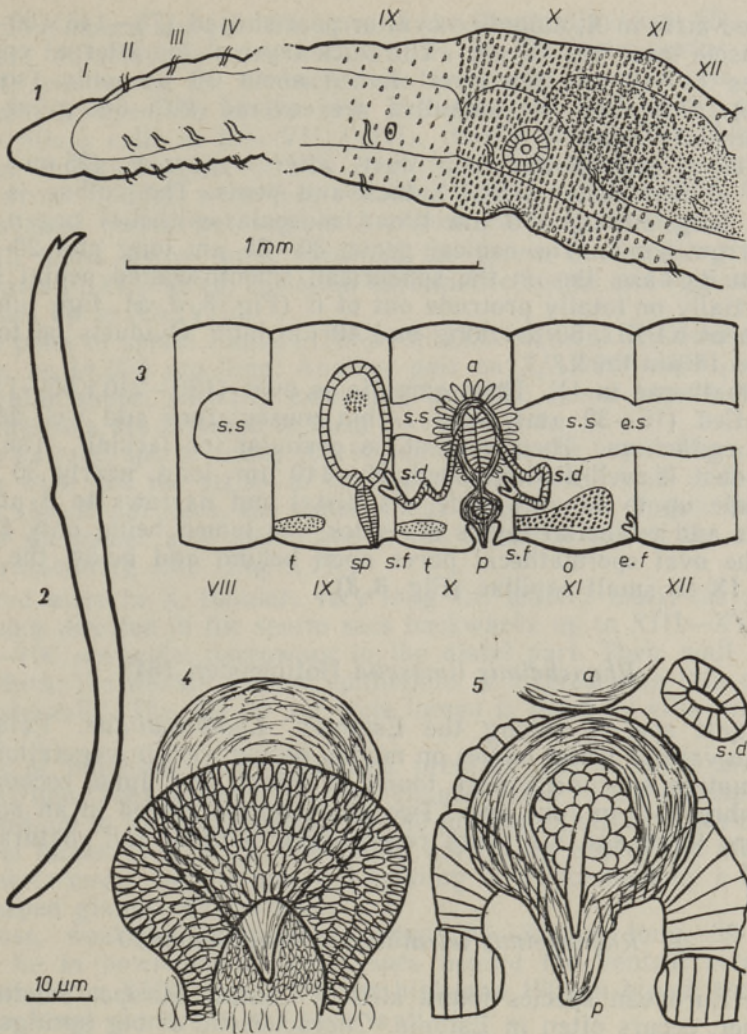


Fig. 3. *Stylo-drilus brachystylus*: 1 — external view of the specimen from Kargopol; 2 — seta of the specimen from L. Lüüsjärvi; 3 — compiled scheme of the genital system of the one side; 4 — male pore of the specimen from L. Lüüsjärvi; 5 — longitudinal section of the penial apparatus of the specimen from Kargopol. I—XII — numbers of segments. a — atrium, e. f — egg funnel, e. s — egg sac, o — ovary, p — penis with the penial bulb, s. d — sperm duct, s. f — sperm funnel, sp — spermatheca, s. s — sperm sac, t — testis.

Testes in IX and X, ovaria in XI. The sperm sacs in VIII, X and XI—XII as well as the egg sac in XII—XIV are unpaired.

Sperm funnels on IX/X and X/XI are 40—70  $\mu\text{m}$  high, 30—40  $\mu\text{m}$  broad and 65—90  $\mu\text{m}$  long, their wall being 6—13  $\mu\text{m}$  thick. Sperm ducts 15—30  $\mu\text{m}$  thick, internally ciliated, while the lumen measures up to a half of their diameter. Sperm ducts penetrate the corresponding dissepiments while those of the second pair return from XI to the X again. They fall into the middle portion of the atrium with a sharp angle and then go to the proximal end of the atrium between its muscular layers.



Paired atria in X, ampullae oval or pear-shaped ( $75-145 \times 60-90 \mu\text{m}$ , with muscle layer  $10-23 \mu\text{m}$ ). The thick layer of the internal epithelium measures  $14-18 \mu\text{m}$ , the atrial lumen about  $10 \mu\text{m}$  only (sometimes invisible). Externally the ampullae are covered with unregular masses of the prostata cells.

The distal part of the male duct, after a narrow ( $25 \mu\text{m}$ ) collar, consists of two parts: penial bulbus and penis. The bulbus is a  $70-105 \mu\text{m}$  long and  $55-75 \mu\text{m}$  broad muscular-epithelial organ with a very narrow lumen. The conical penis,  $30-35 \mu\text{m}$  long and  $20-28 \mu\text{m}$  broad on its base, lies in the sphaerical, smooth-walled penial sac, but may partially or totally protrude out of it (Fig. 3, 3, 5). Egg funnels on dissepiment XI/XII,  $50 \mu\text{m}$  long and  $40 \mu\text{m}$  high. Oviducts up to  $50 \mu\text{m}$  long and  $15 \mu\text{m}$  thick.

Spermathecae in IX. Their ampulla is oval ( $160-240 \times 65-110 \mu\text{m}$ ), thick-walled ( $15-32 \mu\text{m}$ ), with a thin musculature and well-developed internal epithelium. Their content is granular or lacking. The spermathecal duct is well-distinguished,  $80-140 \mu\text{m}$  long, nearly  $30 \mu\text{m}$  (in the middle up to  $53 \mu\text{m}$ ) wide. Its distal end narrows to  $9 \mu\text{m}$ . Both muscular and epithelial layers are thick, the lumen being only  $2-5 \mu\text{m}$  wide. The oval spermathecal pores open behind and below the ventral setae of IX on small papillae (Fig. 3, 3).

#### *Rhynchelmis limosella* Hoffmeister, 1843

The biggest species among the Estonian *Lumbriculidae*. Palaearctic. Occurs in various water bodies on muddy bottom rich in vegetation. Rare. Single mature specimens were found in March and June, cocoons with eight embryos — in June only. Two adult worms placed in an aquarium lived here three and six years respectively, without full maturation or breeding.

#### *Rhynchelmis tetratheca* Michaelsen, 1920

A North European species found also in Central Europe. Smaller than the former, occurs often in Estonia. Characteristic of big springs, found also in brooks, rivers and in the sandy littoral of some lakes. Breeds in the coldest season, in aquaria only at water temperature not exceeding  $11-12^\circ$ . There are two embryos per cocoon in natural conditions,  $1-10$  (often  $4-6$ ) in cultures. In spite of the very easy autotomy, only the head end can regenerate itself into a complete animal. The worms can live  $3-10$  years or even more in aquaria.

The anatomy was studied on cultivated specimens. They are approximately  $50 \text{ mm}$  long (but those in freedom only  $15-32 \text{ mm}$ ),  $0.8 \text{ mm}$  thick at the head end and  $1.3 \text{ mm}$  beginning from the clitellum. There are about 160 segments. The round, swollen prostomium bears a  $1 \text{ mm}$  long tentacle. All the segments except the I are biannulate; the first, longer ring bears the setae. Those are  $110-260 \mu\text{m}$  long and  $5-9 \mu\text{m}$  thick, with a rudimental distal tooth. The dorsal setae are smaller than the ventral ones, and those at the head end smaller than in the middle part of the body. Clitellum indistinctly delineated, extends from VIII approximately up to XXI. The paired male pores behind the ventral setae of X, two pairs of spermathecal pores on VIII and IX, the female pores in the intersegmental furrow XI/XII.

The hypodermis is about  $30 \mu\text{m}$  thick ( $50-80 \mu\text{m}$  on the clitellum),

the circular musculature 8—25  $\mu\text{m}$  and the longitudinal one 65—105  $\mu\text{m}$ . There are dorsolateral muscular bundles in the body cavity of every segment, leading to the characteristic four-lobed form of the body in cross-section, especially in the tail. The pharynx wall hardly modified. Chromophilous cells in III—VII (VIII), mostly dorsal. The chloragogen tissue on intestine starts in VII. Nephridia, consisting of a funnel and a little ovoid bladder, were observed on XII/XIII and XIII/XIV. One pair of transversal vessels per segment, without blind appendages.

Small lobed testes in X surround the sperm duct coming from IX. Tiny ovaria in XI. Paired, but often asymmetric sperm and egg sacs reach sometimes up to XXXVII.

Two pairs of sperm funnels. Those on IX/X without any function, very delicate, up to 250  $\mu\text{m}$  long. Another pair on X/XI 200—300  $\mu\text{m}$  broad, of irregular shape, partially extending into the sperm sac in XI. A lot of spermatozoa are fastened to them by their heads.

Two pairs of sperm ducts, 40—65  $\mu\text{m}$  wide in the beginning and up to 100  $\mu\text{m}$  wide (as the atria) in the distal part. Their wall is 5—15  $\mu\text{m}$ , distally 15—30  $\mu\text{m}$  thick, the lumen about 15  $\mu\text{m}$  wide. Sperm ducts pass into the sperm sac and open there at the proximal end of the atrium of the corresponding side (Fig 4, 1).

Paired atria in X, tubular, very long (at least 2 mm), the proximal ends being directed in the sperm sacs backwards up to XIII—XVII. They are 60—100  $\mu\text{m}$  wide, narrowing in the distal part. Their wall is about 30  $\mu\text{m}$  thick; the weakly stained epithelium is covered by a thin muscular layer externally. The 25—30  $\mu\text{m}$  wide lumen is filled by cilia and mucus (Fig. 4, 1).

Tens or hundreds of multicellular prostata glands cover almost the whole atrium. They are pear- or club-shaped, fixed to the atrium by their sharp end, up to 150  $\mu\text{m}$  long and 30—40  $\mu\text{m}$  broad, strongly stained, with a central lumen (Fig. 4, 1). The distal, narrowing end of the atrium has no prostata cover, but its external opening is surrounded by a crown of pear-shaped glands, 80  $\mu\text{m}$  long.

Obtuse, weakly distinguished penes (65—80  $\mu\text{m}$  long, 30—50  $\mu\text{m}$  broad) lie in bowl-shaped penial sacs behind the ventral setae of X. Egg funnels on XI/XII up to 210  $\mu\text{m}$  high and 170  $\mu\text{m}$  broad; the oviduct (110  $\mu\text{m}$  long) penetrates the body wall.

Two pairs of spermathecae, in VIII and IX. The sac-shaped ampulla (260—280  $\mu\text{m}$  long and 130—150  $\mu\text{m}$  broad, the wall 15  $\mu\text{m}$  thick) gradually turns into a narrower (100—130  $\mu\text{m}$ ), thick-walled (15—25  $\mu\text{m}$ ) blind diverticulum, directed downwards. The heads of spermatozoa lie mostly in the diverticulum, their tails in the ampulla. Two well-distinguished ducts emerge from each ampulla, both 40—65  $\mu\text{m}$  broad, the lumen about 5  $\mu\text{m}$  wide. The shorter duct (120  $\mu\text{m}$ ) begins from the upper part of the ampulla and opens into the intestine from below. Another duct emerges from the border between the ampulla and the diverticulum and opens externally on the shorter ring of the corresponding segment behind the ventral setae, on the tip of a penis-like tubercle lying in a small depression (Fig. 4, 3).

The so-called rudimental atrium in IX is a single, unpaired organ. It is tubular, blind, 750  $\mu\text{m}$  long and 90—100  $\mu\text{m}$  broad. The wall consists of an external muscular layer and of an internal epithelium, both about 15  $\mu\text{m}$  thick. The lumen is 25  $\mu\text{m}$  wide. The organ is covered by a dense, 40—80  $\mu\text{m}$  thick layer of unstained glandular cells, similar to the prostata cells of *Tatriella*. The distal end of the organ narrows into a duct, 15  $\mu\text{m}$  broad, penetrating the longitudinal musculature of the body wall at the

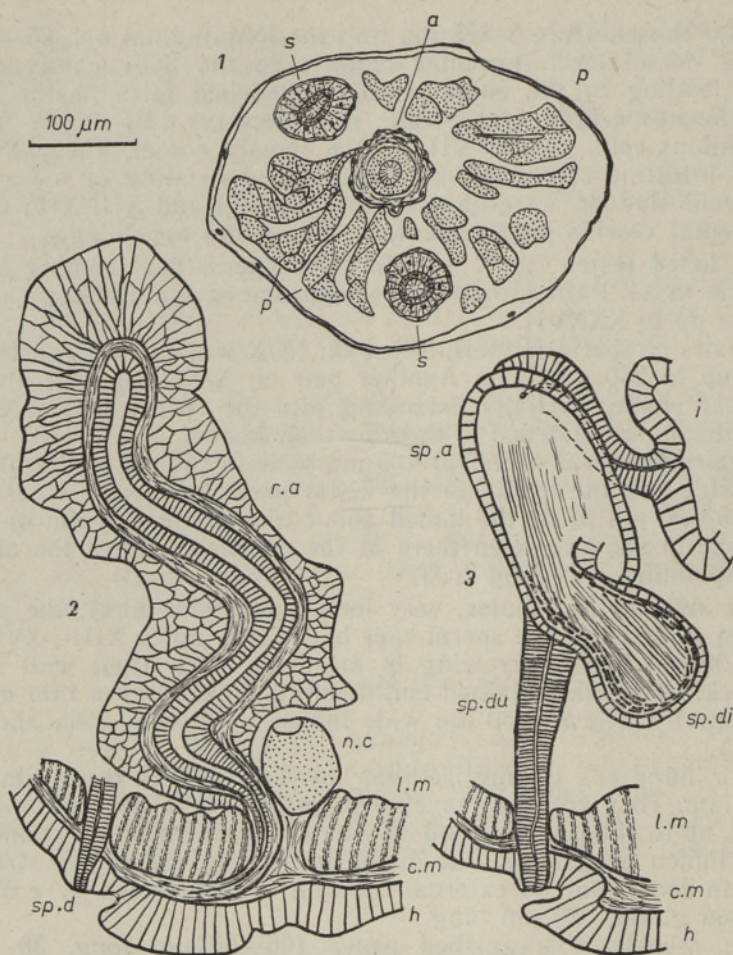


Fig. 4. *Rhynchelmis tetratheca*, internal organs of a cross-sectioned specimen from an aquarium: 1 — section of a sperm sac with atrium and sperm ducts from segment XIII; 2 — reconstruction of the «rudimental atrium» from segment IX; 3 — reconstruction of a spermatheca from segment VIII. a — atrium, c. m — circular musculature, h — hypodermis, i — intestine, l. m — longitudinal musculature, n. c — nerve cord, p — prostata, r. a — «rudimental atrium», s — sperm duct, sp. a — spermathecal ampulla, sp. di — spermathecal diverticulum, sp. du — spermathecal duct.

side of the nerve cord. It reaches the circular musculature at the median line, then proceeds in this layer either to the opposite side of the body or back to the same side, and opens as a tiny pore behind and laterally of one of the spermathecal pores of segment IX (Fig. 4, 2).

*Tatriella slovenica* Hrabě, 1939

Syn.: *Trichodrilus* sp. sensu Timm (1970), p. 71, Fig. 18

Found in the sandy littoral of some small lakes: repeatedly (23.V 1957 and 14.V 1969) and in sexually mature condition in the dystrophic L. Meelva, single juvenile specimens also in L. Piigandi and L. Jõuga

Linajärv. Apparently it breeds in spring. Since the known area of distribution of this species is Boreomontaneous (the Tatra Mountains and the north of Russia), the Estonian populations must be interpreted as relics.

Seven mature specimens were studied in sections. The worm is 8—18 mm long (8—11 when mature), up to 0.6 mm thick and consists of 50—79 segments. Pink and very lively, it neither swims nor coils when agitated. The preserved animals are bent at the dorsal side, and the pharynx often is protruded from the mouth. Prostomium bluntly triangular. The secondary annulation weak; the first, longer ring bears setae. Two setae per bundle, simple, sharp, sigmoid, 82—100  $\mu\text{m}$  long and 5  $\mu\text{m}$  thick. Clitellum with large glandular cells, begins behind the setae of IX and ends indistinctly on XIV or  $1/2$  XV.

Layers of the body wall: hypodermis 5  $\mu\text{m}$ , circular musculature 5  $\mu\text{m}$ , longitudinal one 30  $\mu\text{m}$  (on the clitellum 30, 2 and 13  $\mu\text{m}$ , respectively). The dorsal wall of the pharynx thickened, extends as an appendage backward in III. The chromophilous glands, proceeding from this appendage, extend to VIII. The chloragogen tissue on the intestine begins in IX.

Two pairs of testes, in IX and X; ovaria in XI. The paired sperm sacs and ovisacs can extend to XIV and XX, respectively. Sperm funnels 25—40  $\mu\text{m}$  broad, on IX/X and X/XI, can be stretched backward in the sperm sacs with corresponding dissepiments. Sperm ducts 12  $\mu\text{m}$  wide, their course is not clear.

The single, unpaired atrium in X consists of an oblong ampulla (230—260  $\mu\text{m}$  long, 75—90  $\mu\text{m}$  broad, the wall 5  $\mu\text{m}$  thick) and of an about 150  $\mu\text{m}$  long duct, fluently bound with the latter. The proximal, a little wider (25  $\mu\text{m}$ ) portion of this duct is covered by irregular masses of very long, transparent, unstained prostata cells. The distal portion of the duct (23  $\mu\text{m}$  wide) opens on the median line, under the nerve cord behind the ventral setae with a small conical penis. Spermatozoa were observed in the atrial ampulla. Paired egg funnels on XI/XII about 120  $\mu\text{m}$  high.

Unpaired spermatheca in VIII consists of a sacciform, thick-walled, internally bulged ampulla (250  $\mu\text{m}$  long, 120  $\mu\text{m}$  broad) and of a well-distinguished vertical duct (300  $\mu\text{m}$  long, 20  $\mu\text{m}$  wide). The duct opens with unpaired median pore behind the ventral setae of VIII. The ampulla was empty.

### Zoogeography and protection

*Lumbriculidae* are rather poorly represented in Estonia, in comparison with Central Europe or Karelia, due to the scarcity of permanently cold, oxygen-rich water bodies. Several species reach their limit of distribution here. Moreover, they are seriously endangered by the modern tendency of a rapid eutrophization of water bodies. Our eight species can be divided into the following zoogeographical-ecological groups:

1) Widely distributed, eurythermic species, not endangered so far: the Holarctic *Lumbriculus variegatus* and the Palaearctic *Rhynchelmis limosella*.

2) Rheophilous Boreomontaneous species: *Stylodrilus heringianus* and probably *Rhynchelmis tetratheca*. In case of a successive eutrophization of water systems, various springs and torrents will serve them as a refuge.

3) Limnophilous species: the Boreal *Lamprodrilus isoporus* and the Boreomontaneous *Tatriella slovenica*. Both are living here at the southern edge of the North-European portion of their distribution area. Their relic

populations are endangered by eutrophization of the corresponding lakes in future. For keeping them safe, the protection of *L. Peipsi-Pihkva* and *L. Meelva* is necessary.

4) Mainly phreatic species of Central European origin, apparently having their northern limit of distribution here: *Stylodrilus brachystylus* and (as the representative of a species group) *Trichodrilus seirei*. They belong to the spring fauna of the limestone Pandivere Hills, urgently needing complex measures for protection of local underground waters.

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## EESTI RABELIIMUKLASED

Artiklis on kirjeldatud Eesti NSV veekogudest leitud kaheksa rabeliimuklaste (*Lumbriculidae*, *Oligochaeta*) liigi anatoomiat ja eluviisi. Kõikjal esinev *Lumbricus variegatus* sigib peamiselt sugutult. On kirjeldatud tema harva ilmuvat, väga muutlikku suguelundkonda. Eesti populatsioonid kuuluvad samasse liiki, Karjalast leitud *L. kareliensis* tunnistatakse *L. variegatus*e sünonüümiks. *Trichodrilus seirei* sp. n. kuulub Kesk-Euroopas levinud *T. moravicus*e-le lähedaste liikide rühma. Ta asustab peamiselt Pandivere kõrgustiku allikaid ja jõekesi, kuid teda on leitud ka mõnest Lõuna-Eesti eutroofsest järvest. *Lamprodrilus isoporus* on massiline Peipsi-Pihkva järve liivapõhjal, haruldasem Võrtsjärves. *Stylodrilus heringianus* on iseloomulik allikatele, jõgedele ja oligotroofsetele järvedele. *S. brachystylus*t leiti esmakordselt Nõukogude Liidus Pandivere kõrgustiku allikaist, põhjaallikatega Lüüsjärvest ja ühest allikast Kargopolis Arhangelski oblastis. *Rhynchelmis limosella* eelistab taimestikurikkaid biotoope. *R. tetratheca* on külmalembene, elab allikais ja ojades, harva mõne järve litoraalis. *Tatriella slovenica* on teada kolme

oligotroofse või düstroofse väikejärve litoraalist. Meie 8 liiki jagunevad nelja ökoloogilis-zoogeograafilise rühma: laia levikuga eurütermsed (*L. variegatus*, *R. limosella*), reofiilsed boreomontaansed (*S. heringianus*, *R. tetratheca*), limnofiilid (boreaalne *L. isoporus*, boreomontaanne *T. slovenica*) ja lõunapoolse päritoluga põhjaveeloomad (*S. brachystylus*, *T. seirei*). Kolm viimast rühma on inimõjude eest taandumas ja vajaksid kaitset.

Тармо ТИММ

### ЛЮМБРИКУЛИДЫ ЭСТОНИИ

В водоемах Эстонской ССР найдено 8 видов *Lumbriculidae* (*Oligochaeta*). Вездесущий *Lumbriculus variegatus* размножается бесполом способом. На основе изучения редких половозрелых особей с крайне изменчивой половой системой подтверждается принадлежность местных популяций к этому виду, уточняются признаки последнего, а карельский вид *L. kareliensis* переводится в его синонимы. *Trichodrilus seirei* sp. n. относится к группе средневропейских видов, близких к *T. moravicus*. Обитает он главным образом в источниках и речках Пандивереской возвышенности, но найден также в некоторых эвтрофных озерах Южной Эстонии. *Lamprodrilus isoporus* является массовым на песчаном грунте в Псковско-Чудском озере и редким в оз. Виртсыярв. *Stylodrilus heringianus* характерен для источников, рек и олиготрофных озер. *S. brachystylus* найден впервые для СССР в источниках Пандивереской возвышенности, в оз. Люзъярв с донными источниками и в одном роднике в Каргополе (Архангельская область). *Rhynchelmiss limosella* предпочитает сильно заросшие биотопы. *R. tetratheca* — холодолюбивый вид, который обитает в источниках и ручьях, редко и на литорали некоторых озер. *Tatriella slovenica* известен на литорали трех малых олиготрофных или дистрофных озер. Описанные 8 видов можно разделить на 4 эколого-зоогеографические группы: широкораспространенные эвритермные (*L. variegatus*, *R. limosella*), реофильные бореомонтанные (*S. heringianus*, *R. tetratheca*), лимнофильные (бореальный *L. isoporus*, бореомонтанный *T. slovenica*) и обитатели грунтовых вод южного происхождения (*S. brachystylus*, *T. seirei*). Три последние группы постепенно вымирают в результате деятельности человека и нуждаются в охране.