

On helminths of rodents in Finland

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A total of 18 species of parasitic worms belonging to ten families and three classes (Trematoda, Cestoda and Nematoda) were recovered from the following species of terrestrial rodents in Finland: *Clethrionomys glareolus*, *C. rutilus*, *C. rufocanus*, *Microtus agrestis*, *M. oeconomus*, *Arvicola terrestris* and *Apodemus flavicollis*. The helminths found were determined as follows: Trematoda: *Plagiorchis elegans* (Rud., 1802), *Notocotylus* sp.; Cestoda: *Hydatigera taeniaeformis* (Batsch, 1786) larvae, *Taenia tenuicollis* Rud., 1829 larvae, *Cladotaenia globifera* (Batsch, 1786) larvae, *Anoplocephaloides* sp., *Paranoplocephala* spp., *Catenotaenia* spp.; Nematoda: *Heligmosomum mixtum* (Schulz, 1952), *H. costellatum* (Dujardin, 1845), *H. yamagutii* Chabaud, Rausch, Durette-Desset, 1963, *Boreostrongylus minutus* (Dujardin, 1845), *Syphacia stroma* (Linstow, 1884), *S. petrusewiczii* Bernard, 1960, *S. nigeriana* Baylis, 1929, *Angiostrongylus* (P.) *dujardini* Drozd & Doby, 1970, *Capillaria* sp., *Mastophorus muris* (Gmelin, 1790). With the exception of *H. taeniaeformis*, all species are recorded for the first time in Finland and with the exception of that species and all species of the genus *Syphacia*, these are first records in Fennoscandia.

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1. Introduction

The problems of parasitic helminths in rodents in Finland have not yet been dealt with using a large number of specimens: there are only a few fragmentary records (Lahtinen 1957, Rausch 1952, Wiger et al. 1976). In connection with extensive ecological studies in Finnish Lapland on microtine rodents, a collection of worms (helminths) was started in 1977. In addition, some material on microtine and murid rodents has been collected from southern Finland. Worms of the classes Trematoda, Cestoda and Nematoda were found. Here we present their specific and generic descriptions and notes, including their hosts, location in them and localities. Part of the material is documented with scanning electron and light microscope photographs. Most of the ecological aspects will be analysed elsewhere; the host specificity of rodent helminths in Finland is compared here with that in rodents of continental Europe.

2. Material and methods

Our material was collected in four localities, two of them in Finnish Lapland, two in southern Finland (Fig. 1). The following rodent species were examined: *Clethrionomys glareolus*

(185 specimens), *C. rutilus* (25), *C. rufocanus* (90), *Microtus agrestis* (59), *M. oeconomus* (33), *Arvicola terrestris* (4) and *Apodemus flavicollis* (3). The occurrence of the rodent species discussed in this study is presented in Table 1.

The majority of helminths were recovered from hosts which were frozen at -18°C during the field investigations. When rodents were defrosted and dissected for ecological information, the digestive tract, liver, lung and heart arteries, and body cavity were also examined for the presence of parasitic worms. The helminths were fixed in 70 % ethanol or 4 % formaldehyde. The scanning electron microscopy of selected species was carried out according to Wiger et al. (1978) using a Jeol JSM-1 microscope. The material was indentified during F. Tenora's visit to Helsinki. All measurements are in millimetres.

Table 1. The occurrence of rodents studied by us in different localities.

Species	Kilpis-järvi	Pallas-järvi	Jyväskylä	Lammi
<i>Clethrionomys glareolus</i>	-	+	+	+
<i>C. rutilus</i>	+	+	-	-
<i>C. rufocanus</i>	+	+	-	-
<i>Microtus agrestis</i>	+	+	+	+
<i>M. oeconomus</i>	+	+	-	-
<i>Arvicola terrestris</i>	+	+	+	+
<i>Apodemus flavicollis</i>	-	-	+	+

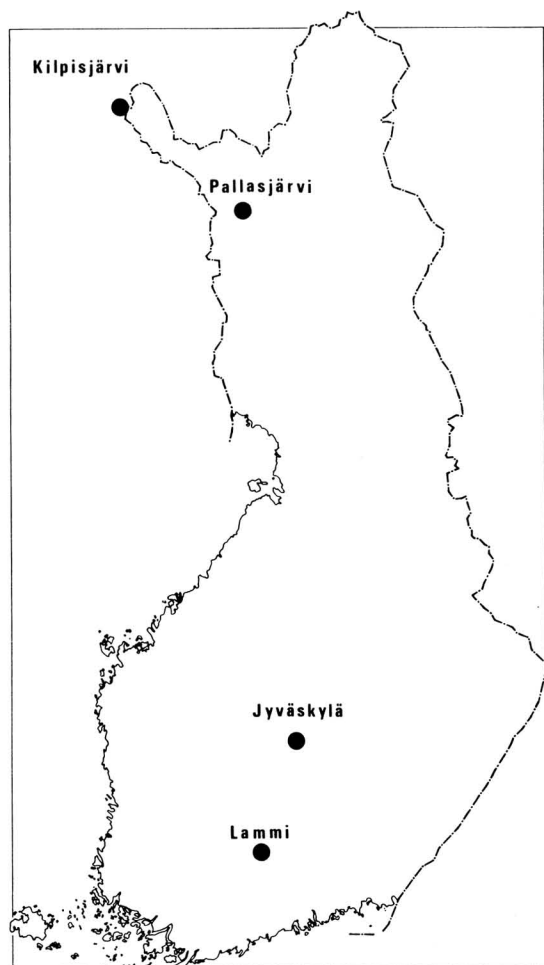


Fig. 1. The localities from which the helminth material was collected.

3. Results

Plagiorchiidae

Plagiorchis elegans (Rudolphi, 1802)

Host and locality: *C. glareolus*, Pallasjärvi.

Location: small intestine.

Description (only one specimen found): Body length 2.8 and maximum body width 0.68. Oral sucker 0.21×0.20 , ventral sucker 0.26×0.21 . Ovary rounded, measuring 0.24×0.22 . Testes rounded, diagonal, measuring 0.24×0.22 and 0.28×0.23 , respectively. Vitellaria united above ventral sucker and in abdominal part of body. Body surface without spines. The genus *Plagiorchis* Lühe, 1899 is characterized by the following features: the suckers are almost the same size (the ventral sucker is only slightly larger), they are both situated in the anterior third of the body, testes are diagonal and vitellaria unite both above the ventral sucker and in the abdominal part of the body (Fig. 2).

Notes: The taxonomy of trematodes of the genus *Plagiorchis* parasitic in rodents has been studied by many authors (for a survey see Ryzhikov et al. 1978). However, the validity of the described species has not been generally recognized.

Krasnolobova (1971) demonstrated that *P. elegans* is a species with considerable morphological variation, with many synonyms, and is parasitic in various species of vertebrates. The main hosts of *P. elegans* are probably birds of the order Passeriformes, and our single finding also suggests that rodents are merely occasional hosts of this species.

Notocotylidae

Notocotylus sp.

Hosts and locality: *M. oeconomus*, *M. agrestis*, *C. glareolus*, Pallasjärvi.

Location: caecum.

Our material contained two forms differing from one another in measurements and hosts. The one parasitic in *M. oeconomus* was larger. The description given below concerns the trematodes from *M. oeconomus*, the values in parentheses concern those from *M. agrestis* and *C. glareolus*.

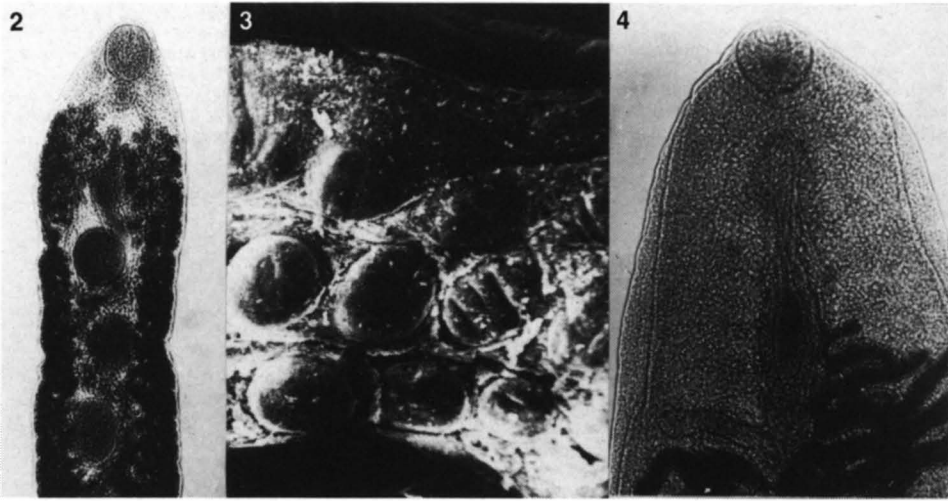
Description: Body elongated, slightly tapering towards anterior end and widely rounded posteriorly. Body surface without spines. Body length 4.2–4.4 (3.2–3.3), width 1.60–1.65 (1.1–1.2). Three rows of small glands, each consisting of 15 (15) glands, situated on ventral side of body (Fig. 3). Oral sucker rounded, measuring $0.29–0.30$ ($0.164–0.220$). Oesophagus short. Pharynx absent (Fig. 4). Intestinal branches with small processes, extending up to end of body. Length of genital bursa 1.3 (0.880–0.910). Cirrus without spines. Length of metraterm $0.350–0.420$ ($0.200–0.350$). Testes slightly elongated, situated in posterior part of body. Ovary intertesticular. Vitellaria situated laterally, beginning above testes and reaching a level of $0.400–0.800$ (0.400) from end of genital bursa. Uterus ribbon-like, consisting of 12–16 (13–16) branches. Uterine branches extending somewhat higher in that half of the body where metraterm is situated. Eggs with filaments, measuring 0.020×0.011 (0.020×0.011).

Notes: With regard to the presence of three rows of ventral glands, the trematodes belong to the genus *Notocotylus* Diesing, 1839. Three species of trematodes of the genus *Notocotylus*, namely *N. noyeri* Joyex, 1922, *N. neyræi* Gonzales, 1945 and *N. wetlugensis* Schaladybin, 1965, have been described from rodents from the European part of the Palaearctic region. The first two species were originally found in rodents of the genus *Arvicola*, whereas *N. wetlugensis* was recorded from *C. glareolus* (for comparison see Joyex 1922, Gonzalez 1945, Petrov & Tchertkova 1962, Schaladybin 1965, Groschaft & Tenora 1981).

Simon-Vincent et al. (1979) analysed the trematodes of the genus *Notocotylus* parasitic in rodents and came to the conclusion that the species occurring in the European part of the Palaearctic region are closely related and can be differentiated on the basis of the following characters: *N. noyeri* Joyex, 1922: Cirrus unarmed, metraterm and genital bursa of equal or almost equal length. *N. neyræi* Gonzalez, 1945: Cirrus armed with spines, metraterm short, reaching about 1/3 of length of genital bursa. *Notocotylus* sp.: Cirrus unarmed, metraterm short, reaching about 1/4–1/3 of length of genital bursa.

In our opinion it is possible that also *N. wetlugensis* Schaladybin, 1965 (regarded by Ryzhikov et al. (1978) as a synonym of *N. noyeri* Joyex, 1922) is a valid species. *N. wetlugensis* is very closely related to *N. noyeri*, particularly in the length of metraterm (more than 1/2 of length of genital bursa), but it differs from this species in the intestinal branches with processes and in the number of vitellaria.

The specimens found by us in rodents in Finland conform to the characterization of *Notocotylus* sp. by Simon-Vincent et al. (1979). It is possible that a new trematode species is concerned.



Figs 2-4. — 2. *Plagiorchis elegans*. Host *C. glareolus*. The anterior part of the body. $\times 60$. — 3. *Notocotylus* sp. Host *M. oeconomus*. Part of the body with ventral glands in three lines. SEM. $\times 100$. — 4. *Notocotylus* sp. Host *M. oeconomus*. The anterior part of the body. $\times 60$.

Taeniidae

Hydatigera taeniaeformis (Batsch, 1786) larvae

Hosts and localities: *A. flavicollis*, Jyväskylä and Lammi; *M. agrestis*, Jyväskylä.

Location: liver.

Description: Size of cysts 8.0-10.0. Strobilocercus lying freely in the cyst. Scolex well developed, with a diameter of 1.2 and bearing 30-34 hooks arranged in two circles (Fig. 5). Longer hooks measure 0.410-0.420, shorter ones 0.270-0.280. Sucker diameter 0.38-0.46.

Notes: The species was recorded only in localities where small rodents come into contact with cats, the definitive host of this species.

Taenia tenuicollis Rudolphi, 1829 larvae

Hosts and localities: *C. glareolus*, Pallasjärvi, Jyväskylä, Lammi; *C. rutilus* and *C. rufocanus*, Pallasjärvi, Kilpisjärvi; *M.*

agrestis, Pallasjärvi, Jyväskylä; *M. oeconomus*, Pallasjärvi.

Location: liver.

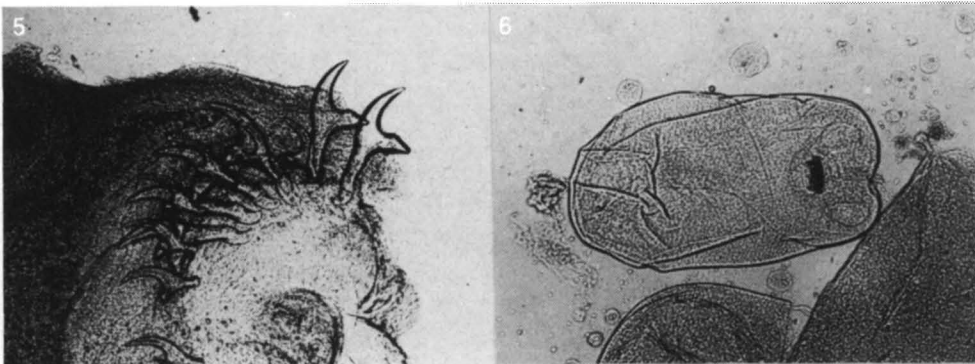
Description: The larva is enclosed in a cyst measuring 1.0-2.0. Scolex with 2 circles of hooks (44-48 in number), longer hooks measuring 0.020, shorter 0.017-0.019. The hooks have a characteristic shape: the larger hooks have manubrium, blade and guard of almost equal size, manubrium with a fine process at base. Smaller hooks do not have manubrial process and their blade is somewhat shorter. Suckers measure 0.158.

Notes: This species has been reported recently in the literature under the name *Taenia mustelae* Gmelin, 1790 (see Freeman 1956, Ryzhikov et al. 1979). The papers by Abuladze (1964), Tenora & Vaněk (1969) and Sadychov (1981) are considered in our description.

Cladotaenia globifera (Batsch, 1786) larvae

Host and locality: *C. glareolus*, Pallasjärvi.

Location: liver.



Figs 5-6. — 5. *Hydatigera taeniaeformis*, larva. Host *A. flavicollis*. Part of the hook circles. $\times 60$. — 6. *Cladotaenia globifera*, larva. Host *C. glareolus*. $\times 60$.

Description: The larva is situated in a cyst measuring about 1.0 (Fig. 6). Body of larva measures 1.0×1.6 . Rostellum measuring 0.15 in diameter, invaginated in body and bearing 2 circles of hooks (total number 42). Larger hooks measure 0.020–0.021, smaller ones 0.017–0.019. Shape of hooks characteristic: manubrium and blade elongated, guard strikingly shorter. Suckers measure 0.075.

Notes: Adult specimens of the genus *Cladotaenia* Cohn, 1901 parasitize birds of the orders Accipitriformes and Strigiformes. The intermediate hosts for many species of *Cladotaenia* are unknown. Rodents are reported as intermediate hosts of two species, *C. globifera* (Batsch, 1786) and *C. circi* Yamaguti, 1935 (see Abuladze 1964, Ryzhikov et al. 1978).

Various forms of *C. globifera* larvae have been reported in the literature. Our material contained specimens conforming with those recorded by Rybaltkowskii & Ovchinnikova (1960) (compare Abuladze 1964).

Anoplocephalidae

Anoplocephaloides sp.

Hosts and localities: *M. oeconomus*, Pallasjärvi; *M. agrestis*, Pallasjärvi; *C. rufocanus*, Pallasjärvi and Kilpisjärvi.

Location: caecum.

We have found only a few specimens with gravid proglottides corresponding to the characteristics of the genus *Anoplocephaloides* Baer, 1923, sensu Rausch, 1976. They most probably belong to the species *Anoplocephaloides dentata* (Galli-Valerio, 1905). Since the material was somewhat damaged, the number of testes and some other characters could not be discerned, and no exact specific determination was possible.

Paranoplocephala spp.

Hosts and localities: *C. glareolus*, Pallasjärvi, Lammi; *C. rufocanus*, *M. oeconomus*, Pallasjärvi; *M. agrestis*, Pallasjärvi, Kilpisjärvi; *A. terrestris*, Lammi.

Location: small intestine.

Because the original rodent material was not collected for

helminthological studies in particular, the material was somewhat damaged due to freezing and the specimens found could not be determined precisely. The cestodes recovered from *A. terrestris* resemble *Paranoplocephala omphalodes* Hermann, 1783, those from other rodents resemble *Paranoplocephala cracilis* Tenora & Murai, 1980. Since not all the characters could be discerned, no exact specific determination was possible.

Catenotaeniidae

Catenotaenia spp.

Hosts and locality: *C. glareolus*, *C. rutilus*, *C. rufocanus*, Pallasjärvi.

Location: small intestine.

Two different groups of cestodes of the genus *Catenotaenia* Janicki, 1906, were identified in our material. One of them resembles *C. cricetorum* f. *glareolica* Tenora, 1959 in its morphological characters, such as size of body and particularly the shape of proglottides (triangular). The other group comprises smaller and finer cestodes not possessing triangular proglottides and evidently belonging to another species. No exact specific determination was possible because of the damage to the material.

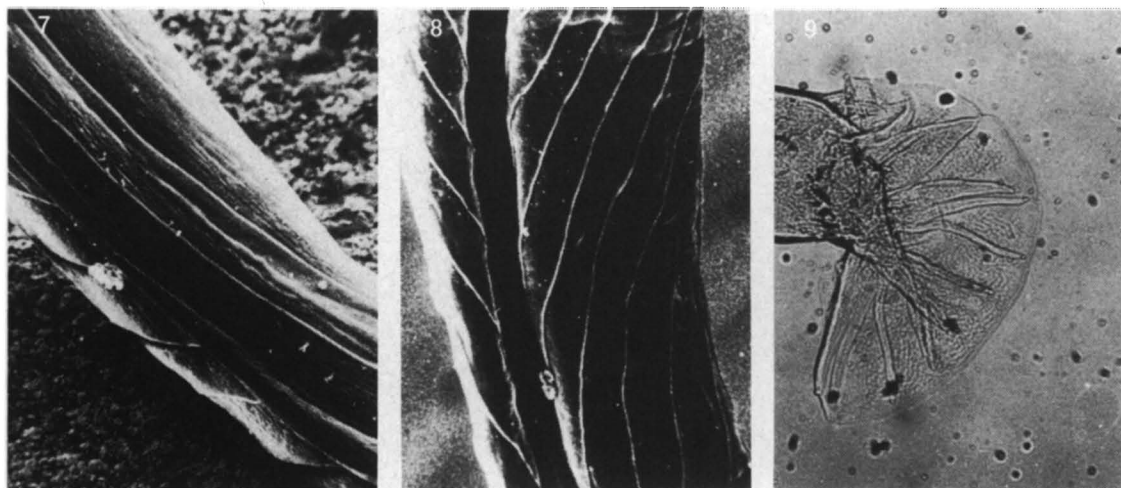
Heligmosomidae

Heligmosomum mixtum (Schulz, 1952)

Hosts and localities: *C. glareolus*, Pallasjärvi, Lammi; *C. rutilus*, Pallasjärvi; *M. agrestis*, Pallasjärvi.

Location: small intestine.

Description: The body surface has a characteristic structure, longitudinal and diagonal striation (Fig. 7). There are no cuticular processes on the head portion. Males do not have processes on the externo-dorsal ray. Bursa copulatrix slightly asymmetrical. Antero-lateral ray shorter than medio-lateral. Male: Body length 9.6–12.4 and maximum body



Figs 7–9. — 7. *Heligmosomum mixtum*. Host *C. glareolus*. Part of the body with longitudinal and diagonal striation. SEM. $\times 300$. — 8. *H. costellatum*. Host *M. agrestis*. Part of the body with diagonal striation. SEM. $\times 300$. — 9. *H. yamagutii*. Host *C. rutilus*. Bursa copulatrix. $\times 60$.

width 0.28. Rays in bursa copulatrix situated as follows: dorsal ray very short, well visible, splitting into four branches; externo-dorsal ray long, originating from a separate trunk, as well as three lateral rays; postero-lateral ray narrowest, moderately diverted from two other lateral rays. Medio-lateral and antero-lateral rays close to one another. Two ventral rays originating from separate trunks on each side, ventro-ventral ray being shorter. Prebursal papillae present. Female: Body length 16.3–19.8, maximum body width 0.36. Vulva 0.420–0.500 from end of body. End of body armed with a spine. Eggs measure $0.068\text{--}0.072 \times 0.024\text{--}0.032$.

Notes: In continental Europe *H. mixtum* parasitizes *C. glareolus* in particular (see Tenora & Mészáros 1971). The specimens in our material were recovered mainly from *C. glareolus*, but also from *C. rutilus*. *H. mixtum* has not been found by us in *C. rufocanus*, not even in localities and habitats where the populations of *C. rufocanus* were sympatric with those of *C. glareolus* and *C. rutilus*.

Heligmosomum costellatum (Dujardin, 1845)

Host and locality: *M. agrestis*, Pallasjärvi.

Location: small intestine.

Description: Body surface with a characteristic structure consisting of diagonal striation only (Fig. 8). Bursa copulatrix of males symmetrical. Externo-dorsal ray without processes at base. Male: Body length 9.3 and maximum body width 0.196. Oesophagus 0.48 long. Dorsal ray short, with four small processes. Externo-dorsal ray long and thin. Postero-lateral ray narrowest of the lateral rays, deviating slightly from medio-lateral and antero-lateral rays. Ventral rays originating from a separate base, ventro-ventral ray smaller than latero-ventral. Female: Body length 16.0–18.0 and maximum body width 0.27. Length of oesophagus 0.53–0.61. Vulva situated 0.52–0.58 from end of body. Eggs measure $0.053\text{--}0.096 \times 0.049\text{--}0.087$.

Notes: This species has been reported in continental Europe as a typical parasite of rodents of the genus *Microtus* (see Tenora & Mészáros 1971). On the other hand it has been found in many rodent species, e.g. in the U.S.S.R. (Ryzhikov et al. 1979). In our material *H. costellatum* was recovered only from *M. agrestis*, even in the localities where the population of *M. agrestis* was sympatric with the populations of other species (e.g., of the genus *Clethrionomys*).

H. costellatum is closely related to *H. borealis* Schulz, 1930, which is a characteristic parasite of rodents of the genus *Clethrionomys*. It differs from *H. costellatum* in having a small process at the base of the externo-dorsal rays. It has not been recorded in continental Europe and was also absent from our material from Finland, though its presence was expected there.

Heligmosomum yamagutii Chabaud, Rausch, Durette-Desset, 1963

Hosts and locality: *C. glareolus*, *C. rutilus*, Pallasjärvi.

Location: small intestine.

Description: Body surface with diagonal and longitudinal striation (as in *H. mixtum*). Males with a symmetrical bursa copulatrix. Postero-lateral ray almost twice as wide as mediolateral (Fig. 9). Female with markedly narrowed body behind vulva. Cuticular spine at end of body. Male (description based on fragments): Width of bursa copulatrix 0.656, symmetrical, its left part larger. Dorsal ray and prebursal papillae not observed. Externo-dorsal ray thin and long. Lateral rays originating from a separate trunk. Antero-lateral ray deviating slightly from two other lateral rays. Medio-lateral ray narrow (about 0.012–0.016) and postero-lateral ray wide (about 0.040). Latero-ventral ray also wide (0.072–0.076) and more stout than ventro-ventral ray. Spicules 0.075 long. Female: Body length 19.0–21.0 and

maximum body width 0.44. Vulva 0.48–0.49 from end of body. Body behind vulva markedly narrowed, end of body with cuticular spine. Eggs measure $0.078\text{--}0.080 \times 0.040\text{--}0.044$.

Notes: *H. yamagutii* was originally described in Japan from *C. rufocanus* and *Microtus* sp. In the U.S.S.R. it was recorded in *C. glareolus* and *C. rufocanus* (Ryzhikov et al. 1979). It is closely related to three other species of the genus *Heligmosomum* Railliet & Henry, 1909, from which it differs as follows: From *H. petrovii* Krotov, 1959: different arrangement of cuticular striation in both male and female. From *H. asiaticum* Nadtochij, 1970: less conspicuous dorsal ray in male and markedly narrowed body behind vulva in female. From *H. mixtum* (Schulz, 1952): less conspicuous dorsal ray, striking width of postero-lateral ray, distinctly asymmetrical bursa in male and narrowed part of body behind vulva in female.

Boreostrongylus minutus (Dujardin, 1845)

Host and locality: *A. terrestris*, Lammi.

Location: small intestine.

Description: Very fine, minute worms. Body surface with fine longitudinal striation. Well developed alae reaching above vulva opening in females. Male: Body length 1.8–2.1, maximum body width 0.078–0.080. Bursa copulatrix slightly asymmetrical. All rays almost reach the margin of the bursa. Externo-dorsal rays above the division of dorsal ray. Lateral and ventral ray originating from a common trunk. Length of spicules 0.36–0.37. Length of gubernaculum 0.028. Female: Body length 2.1–2.5 and maximum body width 0.120. Posterior part of body with three minute processes. Vulva 0.060 and anus 0.040, respectively, from end of body. Eggs measure 0.070–0.090.

Notes: This species is known in the literature under the name *Longistriata wolgensis* (Schulz, 1926). Durette-Desset (1968) demonstrated that *L. wolgensis* is a synonym of *L. minuta* (Dujardin, 1845). In 1971 the same author created a new genus *Boreostrongylus*, in which she placed the above-mentioned species. Ryzhikov et al. (1979) recorded this species as a parasite of many rodent species. In our material, however, it was recorded only from *A. terrestris*.

Syphaciidae

Syphacia stroma (Linstow, 1884)

Host and locality: *A. flavicollis*, Lammi.

Location: small intestine.

Description: Minute white worms with a small, short vesicle. Lateral alae very short, not reaching the level of the nerve ring. Mouth opening triangular (Fig. 10). Female: Body length 2.5–3.8 and maximum body width 0.38. Length of oesophagus 0.280–0.316. Length of bulb 0.85–0.92. Vulva situated 0.520–0.640 from anterior end of body. Eggs measure $0.128\text{--}0.139 \times 0.032\text{--}0.038$.

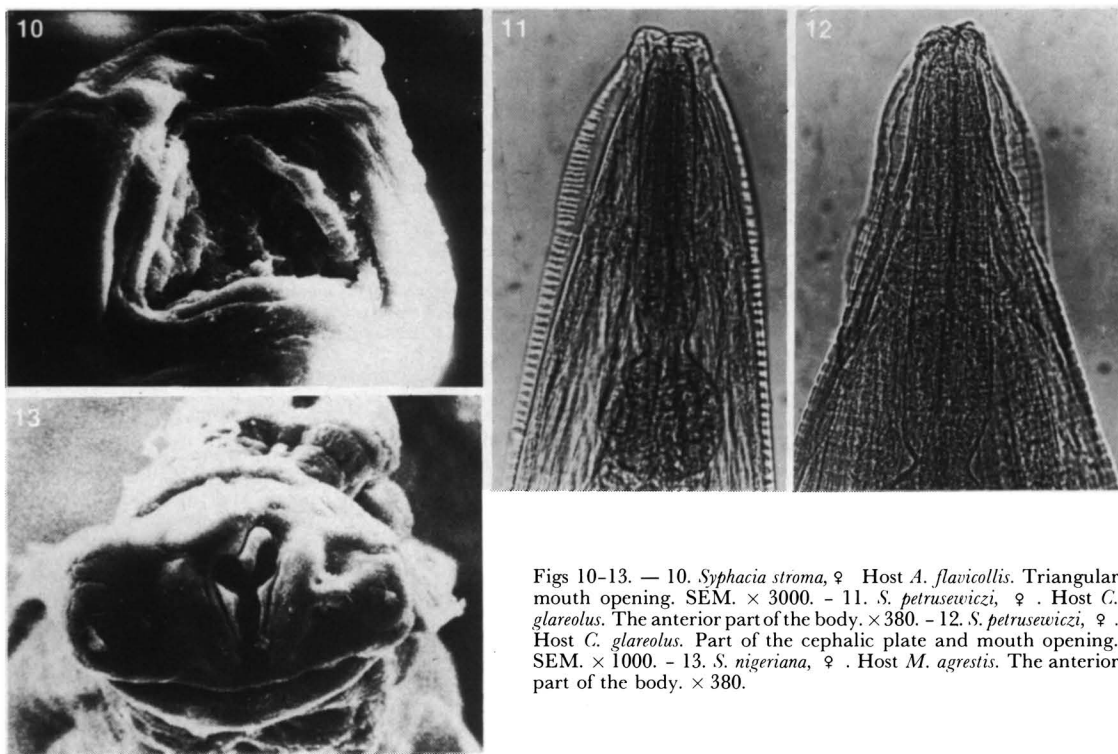
Notes: This species is a characteristic parasite of rodents of the genus *Apodemus*, located in the small intestine. The morphology of the species found by us fully conforms to the descriptions published by Quentin (1971), Tenora & Mészáros (1975), Ryzhikov et al. (1979) and Genov & Jancev (1980).

Syphacia petrusewiczii Bernard, 1960

Host and locality: *C. glareolus*, Pallasjärvi.

Location: caecum.

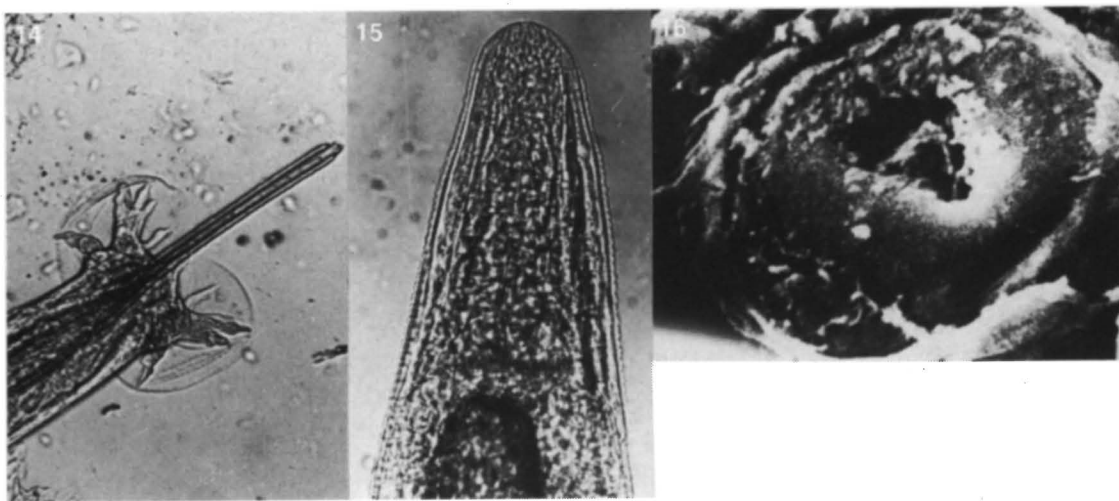
Description: Anterior end of body provided with vesicle. Cervical alae with characteristic transverse ornamentation. One pair of cervical papillae situated at the level of the nerve ring (Figs 11 and 12). Female: Body length 2.7–4.3 and maximum body width 0.22. End of body narrowed. Length of



Figs 10-13. — 10. *Syphacia stroma*, ♀. Host *A. flavicollis*. Triangular mouth opening. SEM. $\times 3000$. — 11. *S. petrusewiczii*, ♀. Host *C. glareolus*. The anterior part of the body. $\times 380$. — 12. *S. petrusewiczii*, ♀. Host *C. glareolus*. Part of the cephalic plate and mouth opening. SEM. $\times 1000$. — 13. *S. nigeriana*, ♀. Host *M. agrestis*. The anterior part of the body. $\times 380$.

bulb 0.067–0.076. Length of oesophagus 0.180–0.292. Nerve ring 0.128–0.131, vulva 0.50–0.81 and excretory pore 0.35–0.45, respectively, from anterior end. Length of lateral alae 0.328–0.330, reaching below bulb (0.16). Eggs measure 0.090–0.115 \times 0.027–0.039.

Notes: In Scandinavia this species was recorded as a parasite of *C. glareolus* and *M. agrestis* (Wiger et al. 1976). In another paper (Tenora et al. 1979) these findings were corrected and *S. petrusewiczii* was reported to parasitize only *C. glareolus* in Scandinavia. In the present material *S. petrusewiczii* was also



Figs 14-16. *Angiostrongylus dujardini*. — 14. ♂. Host *C. glareolus*. Bursa copulatrix. $\times 75$. — 15. ♀. Host *C. glareolus*. The anterior part of the body. $\times 95$. — 16. ♀. Host *C. glareolus*. The mouth opening with a massive ring. SEM. $\times 10000$.

recovered only from *C. glareolus*, which is its specific host in Europe (Quentin 1971, Tenora & Mészáros 1975, Genov & Jancev 1980).

Syphacia nigeriana Baylis, 1928

Host and locality: *M. agrestis*, Pallasjärvi.

Location: caecum.

Description: Head end of body provided with a vesicle. Lateral alae wide in anterior portion, then rapidly tapering (Fig. 13). Transverse pseudostriation visible in their widened part. Female: Body length 3.1–5.6 and maximum body width 0.36. Lateral alae mostly extending up to opening of excretory organs. Nerve ring 0.12–0.16, and vulva 0.42–0.63, respectively, from anterior end of body. Eggs measure 0.094–0.124 × 0.030–0.040.

Note: This species is a typical parasite of microtine rodents in Europe (Tenora & Mészáros 1975).

Filaroididae

Angiostrongylus (*P.*) *dujardini* Drozd & Doby, 1970

Host and locality: *C. glareolus*, Pallasjärvi.

Location: lung and heart arteries.

Description: Male: Body length 8.3 and maximum body width 0.23. Bursa very well developed, symmetrical (Fig. 14). Bursal rays arranged as follows: Dorsal ray short, measuring 0.027 and terminating in two hemispherical appendages. Externo-dorsal ray arising separately, slightly longer than dorsal ray. Lateral rays originating from a common trunk, giving rise to first antero-lateral ray. Medio-lateral ray longest, measuring about 0.045, postero-lateral ray shortest. Ventral ray originating from a common trunk and splitting into ventro-ventral and latero-ventral rays, latero-ventral ray being larger. Length of spicules 0.36. Length of gubernaculum 0.040. Telamon absent. Female: Body length 14.8–16.0 and maximum body width 0.30. Length of oesophagus 0.26–0.30. Vulva 0.016–0.020, and anus 0.030–0.042, respectively, from body end. Eggs measure 0.038–0.042.

Notes: The specimens found by us fully conform to the description by Drozd & Doby (1970) and Mészáros (1972), with the exception of the ventro-ventral ray, which is somewhat shorter in our specimens. Observations under scanning electron microscope revealed that the anterior part of the body of *A. dujardini* consists of a cephalic plate in the centre of which is a triangular mouth bordered by a massive ring (Figs 15 and 16). The species was found in Finland in *C. glareolus* more than 500 km north of the distribution range of *A. flavicollis*, thus confirming that *C. glareolus*, at least, is an essential host for this species; Drozd & Doby (1970) found this species in the sympatric *C. glareolus* and *A. flavicollis* in France.

Capillariidae

Capillaria sp.

Hosts and locality: *C. glareolus*, *G. rutilus*, Pallasjärvi.

Location: small intestine.

The hosts harboured specimens of the genus *Capillaria*. No specific determination was possible.

Spiruridae

Mastophorus muris (Gmelin, 1790)

Hosts and localities: *C. glareolus*, Pallasjärvi; *C. rutilus*, *C.*

Table 2. Host and microhabitat selection of helminths of rodents in Finland. l = larva, si = small intestine, ca = caecum, st = stomach, li = liver, lu = lung and heart arteries.

	<i>C.gla.</i>	<i>C.ruf.</i>	<i>C.rut.</i>	<i>M.agr.</i>	<i>M.oec.</i>	<i>A.ter.</i>	<i>A.fl.</i>
Trematoda							
<i>Plagiorchis elegans</i> ¹	si						
<i>Notocotylus</i> sp. ¹	ca			ca		ca	
Cestoda							
<i>Hydatigera taeniaeformis</i> (1) ³				li			li
<i>Taenia tenuicollis</i> (1) ¹	li		li	li	li		li
<i>Cladotaenia globifera</i> (1) ¹	li						
<i>Anoplocephaloides</i> sp. ¹		ca			ca	ca	
<i>Paranoplocephala</i> spp. ¹	si	si			si	si	si
<i>Catenotaenia</i> spp. ¹	si	si	si				
Nematoda							
<i>Heligmosomum mixtum</i> ¹	si		si	si			
<i>H. yamagutii</i> ¹	si		si				
<i>H. costellatum</i> ¹				si			
<i>Boreostrongylus minutus</i> ¹						si	
<i>Syphacia stroma</i> ²							si
<i>S. petrusewiczii</i> ²	ca						
<i>S. nigeriana</i> ²				ca			
<i>Angiostrongylus dujardini</i> ¹	lu						
<i>Capillaria</i> sp. ¹	si		si				
<i>Mastophorus muris</i> ²	st	st	st				

¹ First observation in Fennoscandia

² First observation in Finland

³ Recorded earlier in Finland

rufocanus, Pallasjärvi and Kilpisjärvi.

Location: stomach.

Both adult specimens and larvae were found. Their morphology and measurements are within the ranges reported for this species by Ryzhikov et al. (1979).

4. Discussion

A total of 18 species of parasitic worms belonging to 10 families of the classes Trematoda (2 species), Cestoda (6 species) and Nematoda (10 species) were found in Finland during the examination of 392 rodents of the genera *Microtus*, *Clethrionomys*, *Arvicola* and *Apodemus* (Table 2). With the exception of *H. taeniaeformis*, all the species are recorded for the first time in Finland, and except for *H. yamagutii*, all the species are known to parasitize rodents in the European part of the Palearctic region.

Many helminths recovered in Finland show considerable host specificity. In continental Europe the host specificity of many species discussed here is wider (for references see e.g. Tenora & Zejda 1974). For example, in Finland *B. minutus* was found only in *A. terrestris*, *S. stroma* only in *A. flavicollis*, *S. petrusewiczii* only in *C. glareolus*, and *S. nigeriana* only in *M. agrestis*. *H. mixtum* parasitized *C. glareolus* and *C. rutilus*, but not sympatric *C. rufocanus*, and only exceptionally *M. agrestis*. The two latter rodent species are clearly more herbivorous than the two mentioned first. With regard to host specificity, *H. yamagutii* greatly resembles *H. mixtum*.

Microhabitat selection was also quite distinct in most species. Trematodes of the genus *Notocotylus* occur only in the caeca of rodents belonging to the genera *Microtus* and *Clethrionomys*. On the other hand, *P. elegans* was recovered from the small intestine. The nematode *A. dujardini* was found only in a single *C. glareolus*, but the lung arteries of this individual were full of these nematodes. *M. muris* was in the present material found only in the stomach of voles.

The larvae of *H. taeniaeformis* were found only in the two southern study localities with feral cats. There are a lot fewer cats in Lapland, and consequently no larvae of *H. taeniaeformis* were recovered from the two sparsely populated localities studied by us in Finnish Lapland. Larvae of *T. tenuicollis* (definitive hosts mustelids) were found in every locality. Instead, we found no larvae of cestodes inhabiting the body cavity of

rodents (definitive hosts usually canids).

In future studies we shall try to obtain more trematodes of the genus *Notocotylus* and cestodes of the genera *Paranoplocephala*, *Anoplocephaloides* and *Catenotaenia* for exact specific determination. It is possible that a new species is concerned in the case of *Notocotylus* sp.

In spite of our expectations, we found neither a single specimen of *H. borealis* nor parasites reported from rodents in the Nearctic subregion.

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