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Department of Hydrobiology, Charles University, Praha

**STUDIES ON THE POPULATION DYNAMICS OF THE OLIGOCHAETS FAUNA  
IN A BOHEMIAN CARP-POND**

Shahadat ALI and Jan LELLÁK

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**Abstract.** Studies on the population dynamics and biomass of the benthic Oligochaeta collected during 1964 from the pond Velký Pálenec near Blatná was made. Maximum abundance of different species of the worms was found to occur, with a few exceptions, at different times of the year. 69.8% of the total abundance and 58% of total biomass was dominated by *Limnodrilus hoffmeisteri*. 70% of the total population aggregates within 1 m depth area. Maximum abundance of the oligochaetes was found to be 1,153 ind.  $0.1 \text{ m}^{-2}$  in February and minimum 247 ind.  $0.1 \text{ m}^{-2}$  in October while maximum biomass 2.97 g  $0.1 \text{ m}^{-2}$  in February and minimum 0.25 g  $0.1 \text{ m}^{-2}$  in October as well.

INTRODUCTION

Aquatic Oligochaeta are the pre dominant component of permanent part of bottom fauna of the water bodies and form an important secondary product in their trophic net. More recently it has been utilized to detect the organic pollution of waters. References on such studies are available (Hrabě 1941, 1981, Borodič 1962, Lellák 1961, 1965, 1966, 1969, Ertlová 1963, Brinkhurst 1964, 1965, 1966, Brinkhurst and Jamieson 1971, Wachs 1963, Poddubnaja 1965 etc.). An attempt has been made on the present occasion to find out the seasonal periodicity in the abundance and biomass of the oligochaetes population of carp pond Velký Pálenec during 1964.

MATERIAL AND METHODS

Between February and November in 1964 13 samplings of macroscopic bottom fauna from a typical mesotrophic carp pond located in a fish pond region in S. W. Bohemia near the town Blatná were carried out. The main hydrographical data of the pond studied are shown in Fig. 1. The quantitative samples of the benthos were taken in three weeks intervals (except in March when no samplings were made) from five different sampling areas distributed from the deepest part of the pond up to the shallow littoral zone:

- A — 3 m depth, pond bottom covered with 20–25 cm layer of soft muddy sediments.
- B — 2 m depth, bottom covered with 15 cm of soft muddy sediments.
- C — 1 m depth with sandy bottom covered with thin layer of detritus.
- D — 0.4 m depth with sandy bottom.
- E — 1.5 m depth with sandy bottom and a thin layer of organic sediments.

Lellák's modification of Ekman-Birge bottom quantitative sampler was used (Schubert and Lellák 1973).

For catch months the Roman numerical symbols (II–XI) were used.

For taxonomy authors followed Hrabě (1954, 1981), Sperber (1948) Brinkhurst and Jamieson (1971). Biomass of the worms was measured following Hrbáček and coll. (1972).

As most of the Tubificidae were noted broken, for determination of the biomass of the *Limnodrilus* species the samples were separated after Kennedy (1966 a, 1966 b) into three groups such as immature, mature, and breeding, while other Tubificidae into two groups, mature and immature, depending on the growth sexual characters. Only intact worms of each group and species having various length were weighed, from all the samplings. Mean weight of an individual worm of each group

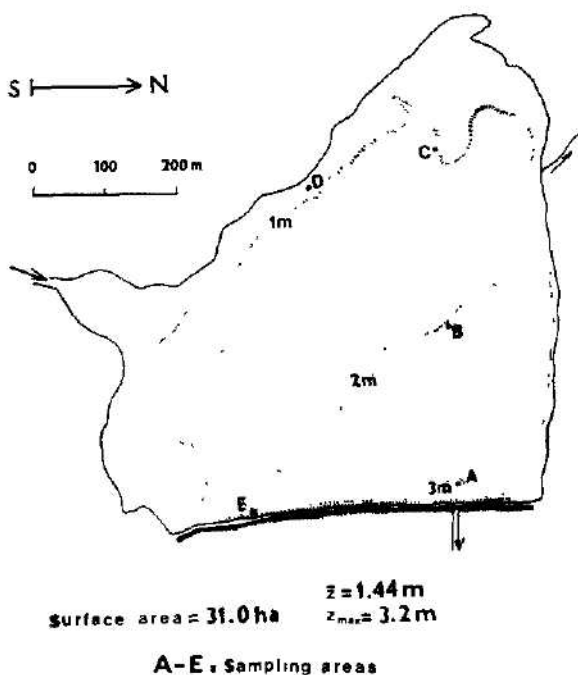


Fig. 1. Bathymetric map and basic data upon the water body studied, carp-pond Velký Pálenec in Blatná fish pond area of south - western Bohemia.

was thus determined. For Naididae all the worms were weighed in the same condition as they were found in the samplings. It might be added here that all the samples were transferred from 4% formalin to lactophenol through a wash in water for taxonomical studies which were again preserved in 4% formalin.

All quantitative data in Figs. 2-5 and Tabs. 1 and 2 represent the average values calculated from five sampling areas A-E (Fig. 1) in order to 0.1 m<sup>2</sup> of the pond area

## RESULTS

### Seasonal appearance and population dynamics of species found

Presence of six species of Naididae and five species of Tubificidae were noted in the collection (Fig. 3 and 5). Maximum abundance of Naididae was found to be 266 indiv. . 0.1 m<sup>-2</sup> during VI while minimum amounting 11 indiv. . 0.1 m<sup>-2</sup> during XI and for Tubificidae the same was represented as 146 indiv. . 0.1 m<sup>-2</sup> during II and 207 indiv. . 0.1 m<sup>-2</sup> during X, respectively (Fig 2)

Maximum biomass of Naididae was observed to be 0.123 g . 0.1 m<sup>-2</sup> during VI while minimum biomass was found to be 0.004 g . 0.1 m<sup>-2</sup> during X and

for Tubificidae the same was found to be 2.969 g. 0.1 m<sup>-2</sup> during II and 0.233 g. 0.1 m<sup>-2</sup> during X (Fig. 4).

The computed results indicate the maximum abundance and biomass of total oligochaets during II and minimum during X (Fig. 2 and 4). The range of individual species components, their abundance and biomass found in the present studies are indicated as follows (Fig. 3 and 5):

- a) *Uncinaiis uncinata* (Ørsted, 1842) was found in the population between V-VII with the maximum abundance of 26 indiv. 0.1 m<sup>-2</sup> during VI. The individual wet weight of the worm was found to be 0.7 mg while maximum biomass of the species population was seen to be 0.02 g. 0.1 m<sup>-2</sup>.
- b) *Ophidonais serpentina* (Müller, 1773) was found in the population throughout the period of observation. Maximum abundance of this species was found to be 90 indiv. 0.1 m<sup>-2</sup> during IV. Individual weight of the worm was noted to be 0.5 mg while maximum biomass of its population was seen to be 0.06 g. 0.1 m<sup>-2</sup>.
- c) *Arcteonais lomondi* (Martin, 1907) was observed in the population during VI, VII and IX. Its maximum abundance was noted to be 7 indiv. 0.1 m<sup>-2</sup> during IX. The biomass of an individual animal was found to be 0.6 mg while the maximum biomass of the species population was noted to be 0.004 g. 0.1 m<sup>-2</sup>.
- d) *Stylaria lacustris* (Linnaeus, 1767) was found in the population between IV-XI with maximum abundance of 16 indiv. 0.1 m<sup>-2</sup> during VI. The biomass of an individual animal was noted to be 0.6 mg and maximum biomass of the species was found to be 0.006 g. 0.1 m<sup>-2</sup>.
- e) *Dero digitata* (Müller, 1773) was noted in the population between IV-XI. Maximum of abundance of the species was seen to be 176 indiv. 0.1 m<sup>-2</sup>.

Table 1. Average abundance values of Oligochaeta in Velký Palenec pond during 1964

Species	Abundance ind. 0.1 m <sup>-2</sup>	% participation
<b>Naididae:</b>		
<i>Uncinaiis uncinata</i>	4	0.7
<i>Ophidonais serpentina</i>	26	4.2
<i>Arcteonais lomondi</i>	2	0.2
<i>Stylaria lacustris</i>	5	0.7
<i>Dero digitata</i>	40	6.5
<i>Dero nivea</i>	3	0.6
<b>Tubificidae:</b>		
<i>Tubifex tubifex</i>	91	15.0
<i>Tubifex ignotus</i>	2	0.2
<i>Limnodrilus hoffmeisteri</i>	423	69.8
<i>Limnodrilus udekemianus</i>	9	1.4
<i>Aulodrilus plurisetia</i>	3	0.5
<b>Naididae total</b>	<b>80</b>	<b>13.1</b>
<b>Tubificidae total</b>	<b>527</b>	<b>86.9</b>
<b>Oligochaeta total</b>	<b>607</b>	<b>100</b>

during VII while the weight of an individual animal was found to be 0.2 mg and maximum biomass of the population was noted to be  $0.037 \text{ g} \cdot 0.1 \text{ m}^{-2}$ .

f) *Dero nivea* (Aiyer, 1929) was noted in the population during VI and VII with the maximum abundance of 14 indiv.  $0.1 \text{ m}^{-2}$  during VI, the weight of an individual worm was noted to be 0.3 mg while the maximum biomass of species was found to be  $0.004 \text{ g} \cdot 0.1 \text{ m}^{-2}$ .

g) *Tubifex tubifex* (Müller, 1774) was represented in the bottom fauna popu-

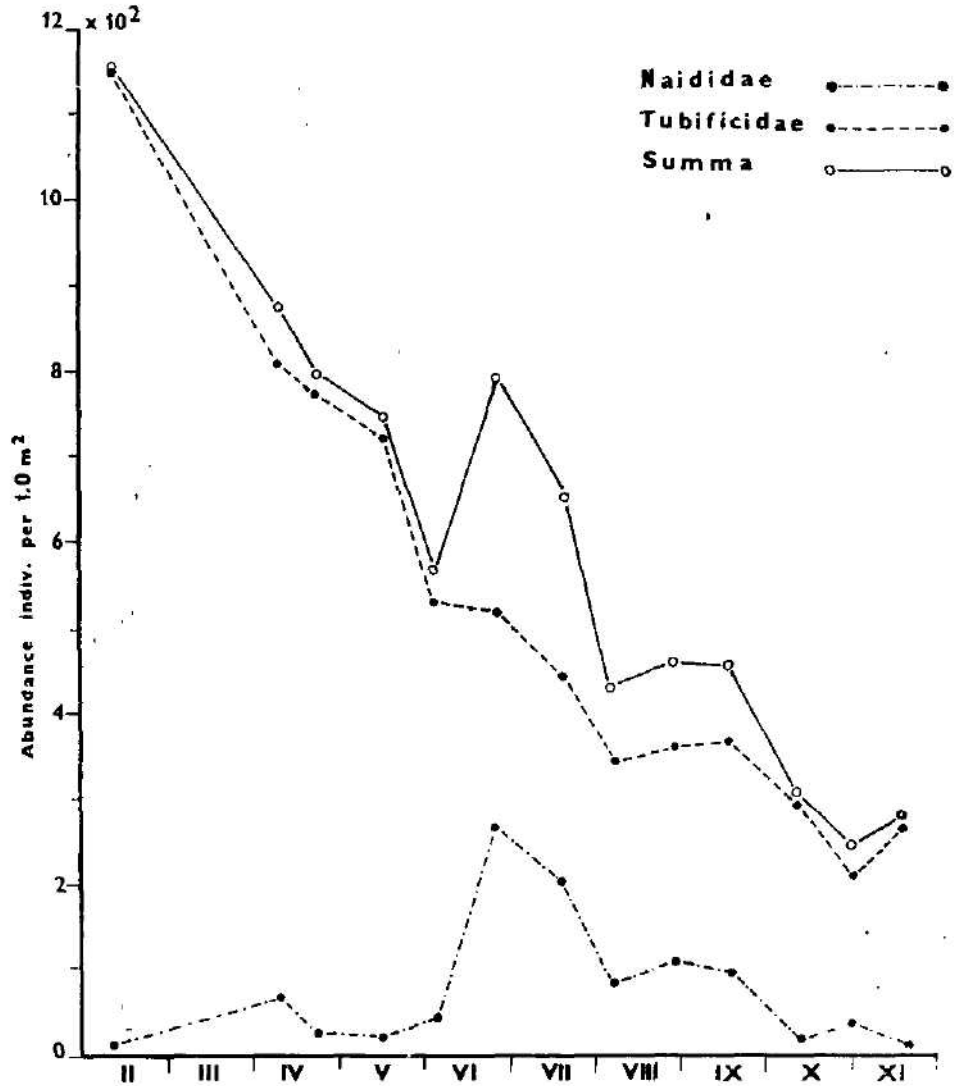


Fig. 2. Seasonal course of the abundance of Naididae, Tubificidae, and total Oligochaeta fauna using average numbers from quantitative bottom samples taken at the same time in five sampling areas distributed over the pond area.

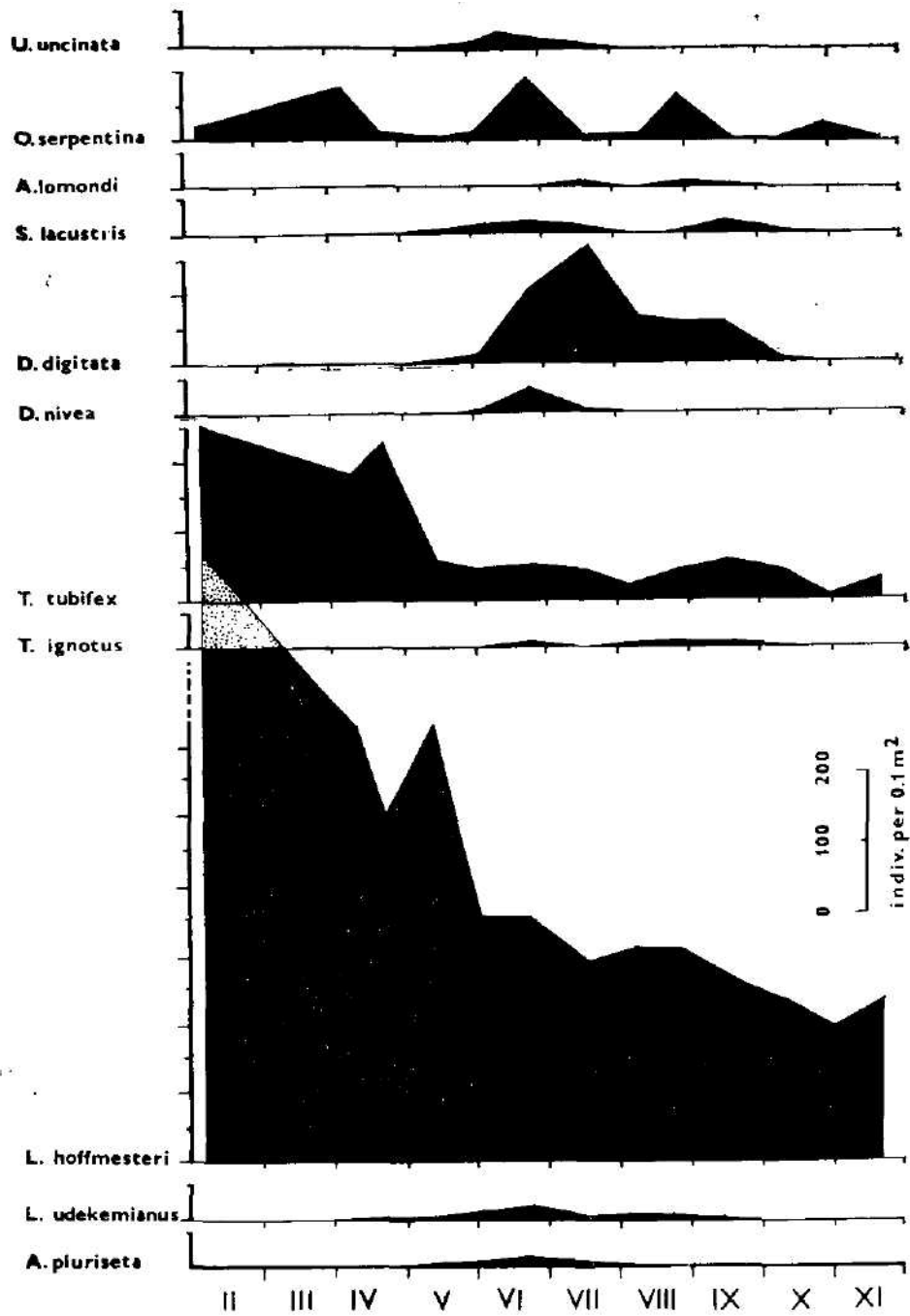


Fig. 3. Seasonal changes in the participation of all species found in the abundance of Naididae, Tubificidae and Oligochaeta total.



lation throughout the period of the investigation. Maximum abundance of this species was found to be 256 indiv.  $.0.1 \text{ m}^{-2}$  during II while the stated minimum was 6 indiv.  $.0.1 \text{ m}^{-2}$  during X. Average wet weight of an immature and a mature animal was noted to be 0.4 mg and 5.0 mg, respectively. Maximum biomass of the species population was found to be 1.306 g  $.0.1 \text{ m}^{-2}$  during II

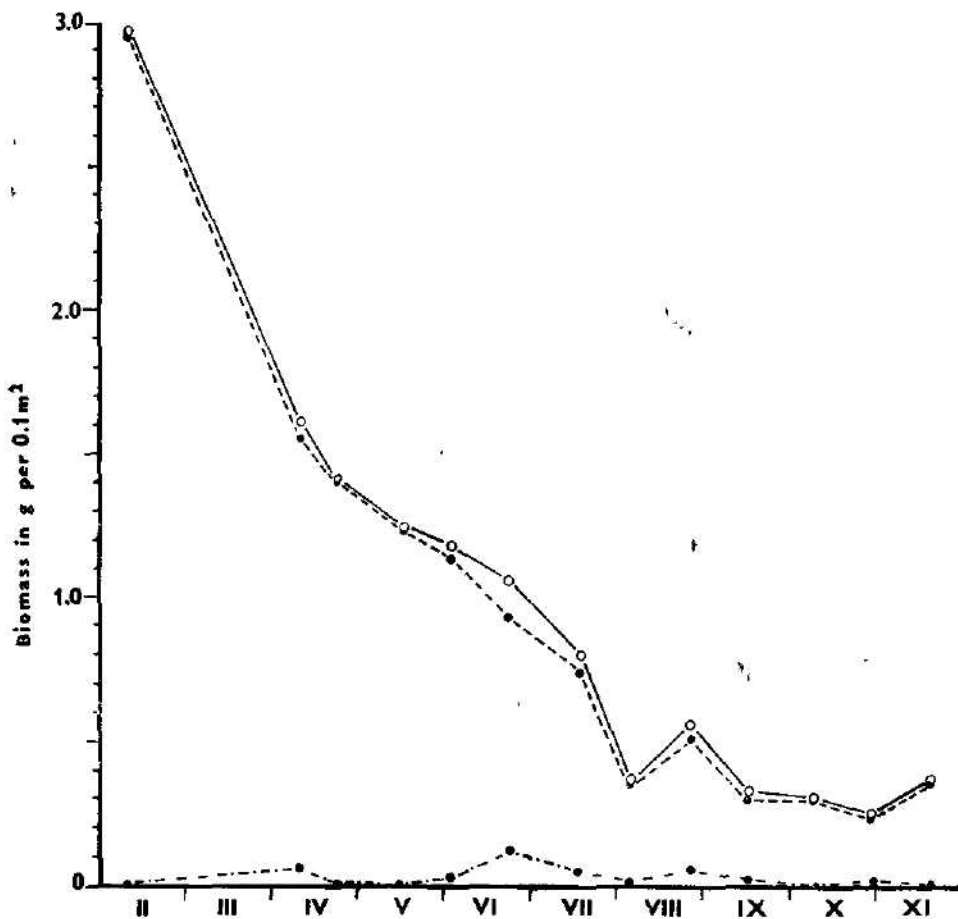


Fig. 4. Seasonal course of the biomass values of Naididae, Tubificidae and Oligochaeta fauna using average numbers from quantitative bottom samples similarly to Fig. 2.

h) *Tubifex ignotus* (Štolc, 1886) was noted in the oligochaets population during VI and IX. Average biomass of an immature and a mature worm was noted to be 0.5 mg and 8.0 mg. Maximum biomass of the species was noted to be 0.018 g  $.0.1 \text{ m}^{-2}$  during VI. The representatives of the species were found only at D sampling area.

i) *Limnodrilus hoffmeisteri* (Claparède, 1862) was found in the bottom samples

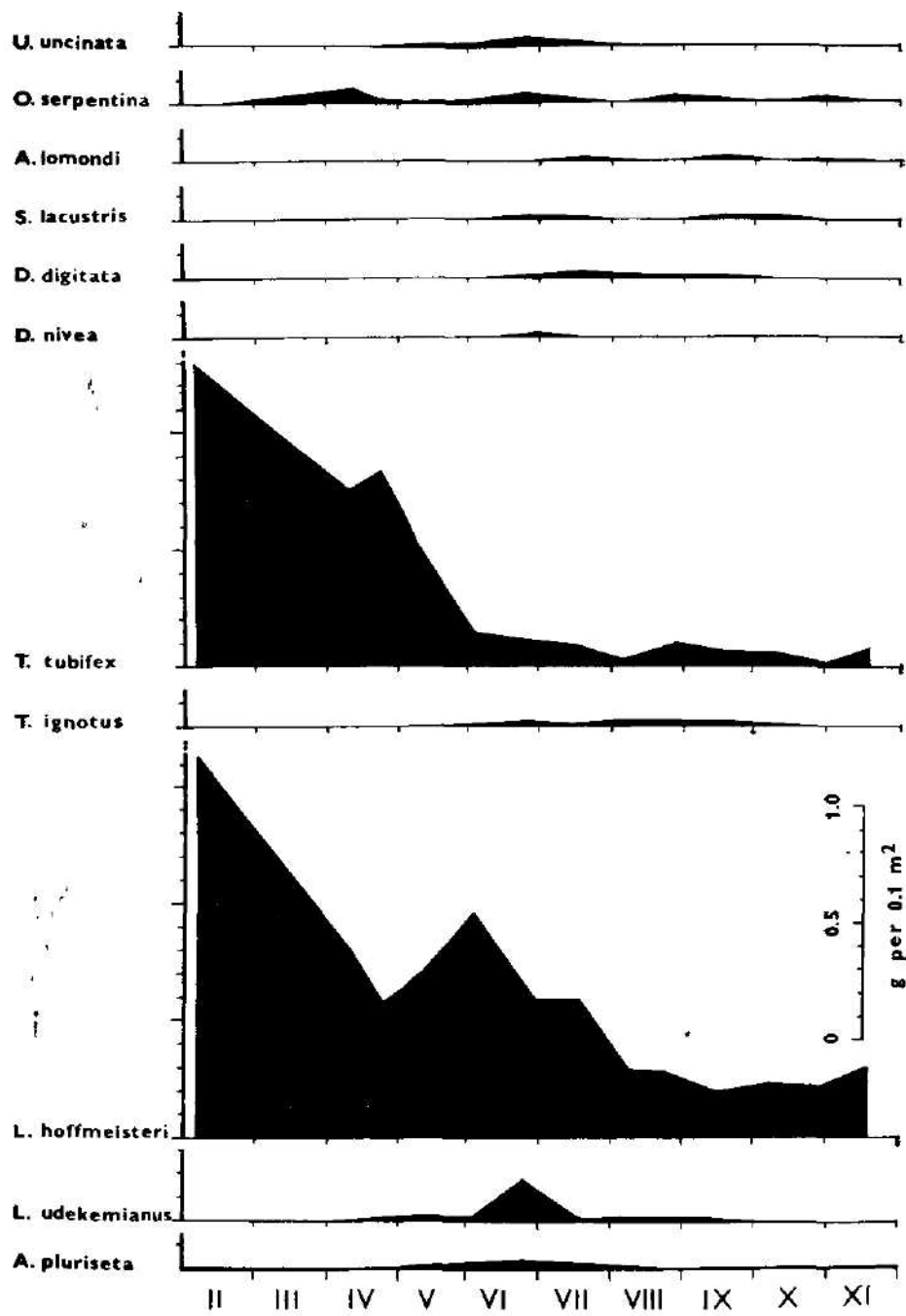


Fig. 5. Seasonal changes in the participation of all species found in the biomass of Naididae, Tubificidae and total Oligochaeta fauna.

Table 2. Average biomass values of Oligochaeta in Velký Pálenec pond during 1964

Species	Biomass g . 0.1 m <sup>-2</sup>	% participation
<b>Naididae:</b>		
<i>Uncinaiis uncinata</i>	0.003	0.3
<i>Ophidonais serpentina</i>	0.020	2.1
<i>Arctonais lomondi</i>	0.001	0.05
<i>Stylaria lacustris</i>	0.002	0.2
<i>Dero digitata</i>	0.009	1.0
<i>Dero nivea</i>	0.001	0.1
<b>Tubificidae:</b>		
<i>Tubifex tubifex</i>	0.340	35.3
<i>Tubifex ignotus</i>	0.004	0.4
<i>Limnodrilus hoffmeisteri</i>	0.560	58.0
<i>Limnodrilus udekemianus</i>	0.023	2.4
<i>Aulodrilus pluriseti</i>	0.003	0.3
Naididae total	0.036	3.7
Tubificidae total	0.928	96.2
Oligochaeta total	0.964	100.0

throughout the period of investigation. Nearly 70% of the total abundance of the oligochaets fauna was noted to be dominated by this species (see Tab. 1). The maximum and minimum abundance of the worm was found to be 876 indiv. . 0.1 m<sup>-2</sup> during II and 68 indiv. . 0.1 m<sup>-2</sup> during XI. Average biomass of an immature, a mature, and a breeding worm was noted to be 0.4 mg, 2.0 mg, and 4.0 mg, respectively. Maximum and minimum biomass of this species was noticed to be 1.638 g. 0.1 m<sup>-2</sup> and 0.101 g. 0.1 m<sup>-2</sup> during II and XI, respectively.

j) *Limnodrilus udekemianus* (Claparède, 1862) was noted in the oligochaets population between IV–X with the maximum abundance of 25 indiv. . 0.1 m<sup>-2</sup> during VI. Average biomass of an immature, a mature and a breeding animal was found to be 0.5 mg, 5.0 mg, and 9.0 mg, respectively. Maximum biomass of the species population was noted to be 0.178 g. 0.1 m<sup>-2</sup> during VI.

k) *Aulodrilus pluriseti* (Piguet, 1906) was present in the bottom samples between VI–VII with the maximum abundance of 6 indiv. . 0.1 m<sup>-2</sup> during VI. Average biomass of an immature and a mature worm was found to be 0.3 mg and 5.0 mg, respectively. The maximum biomass of the species population was noted to be 0.017 g. 0.1 m<sup>-2</sup> during VI.

#### Dispersion of oligochaets fauna over the pond area

Quantitative appearance of the Oligochaeta in the bottom samples collected from A–E sampling areas (Fig. 1) was compared in the abundance and biomass. It was found that:

At A locality, deepest muddy part of the pond bottom, Naididae appear only occasionally and in a small number of specimens while Tubificidae were found to dominate the oligochaets population throughout the period of observat-

ions achieving the maximum abundance of 286 indiv.  $.01\text{ m}^{-2}$  during X and maximum biomass with 0.352 g  $.01\text{ m}^{-2}$  during X as well.

At E area naidids were found to occur in the benthic population between IV–X while tubificids were noted to dominate the oligochaets population throughout the period of investigation. Maximum abundance of naidids found was 140 indiv.  $.01\text{ m}^{-2}$  during VII and that of tubificids 957 indiv.  $.01\text{ m}^{-2}$  during II, respectively.

Maximum biomass for naidids at this sampling area was found to be 0.030 g  $.01\text{ m}^{-2}$  during VII and for tubificids 2.753 g  $.01\text{ m}^{-2}$  during VI.

At B area naidids were found to occur in the benthic population between VI–IX with the maximum abundance of 208 indiv.  $.01\text{ m}^{-2}$  during VI. The abundance of tubificids was found to dominate in the population throughout the period of investigation. Maximum value was found to be 1,102 indiv.  $.01\text{ m}^{-2}$  during II.

Maximum and minimum biomasses of naidids were found to be 0.05 g  $.01\text{ m}^{-2}$  during VIII and 0.008 g  $.01\text{ m}^{-2}$  during II while the same for tubificids were noted to be 2.496 g  $.01\text{ m}^{-2}$  during II and 0.156 g  $.01\text{ m}^{-2}$  during IX, respectively.

At C naidids were noted in the population throughout the period of studies. Maximum and minimum abundance of Naididae were found to be 424 indiv.  $.01\text{ m}^{-2}$  during VI and 4 indiv.  $.01\text{ m}^{-2}$  during IV. Maximum abundance of tubificids was found to be 896 indiv.  $.01\text{ m}^{-2}$  during IV. Abundance of tubificids was noted to dominate the total oligochaetes population throughout the period of studies except during XI. Maximum biomasses of naidids and tubificids at this area were found to be 0.215 g  $.01\text{ m}^{-2}$  during VIII and 1.458 g  $.01\text{ m}^{-2}$  during VI, respectively.

At D naidids appear in the population between IV and IX. Maximum abundance of the worms was noted to be 770 indiv.  $.01\text{ m}^{-2}$  during VIII. Tubificids were found to have maximum abundance of 2,300 indiv.  $.01\text{ m}^{-2}$  during IV and it was noted to dominate the oligochaetes population throughout the period of studies except during VI and VII. Maximum biomasses of naidids and tubificids were found to be 0.376 g  $.01\text{ m}^{-2}$  during VI and 6.696 g  $.01\text{ m}^{-2}$  during II.

At D total population of oligochaetes was found to be higher in number than those of other sampling areas throughout the period of studies except during VIII and IX. At C and D more than 70% of the total population of oligochaetes were found to aggregate. Biomasses of total oligochaetes at D was noted to be double than those of other sampling areas.

#### Maturing cycle of two dominant Tubificidae

Differences in abundance and biomasses of different age groups of two pre-dominant species, *Limnodrilus hoffmeisteri* and *Tubifex tubifex*, were studied (Fig. 6).

Mature individuals of *L. hoffmeisteri* were found to dominate in abundance during II, IV and XI while the immatures were found to dominate in the remaining periods. Breeding worms were found throughout the periods of studies and more intensively between II–V.

Abundance of mature *Tubifex tubifex* individuals was found to dominate in population during II, IV, V, VI and more intensively during II–V.

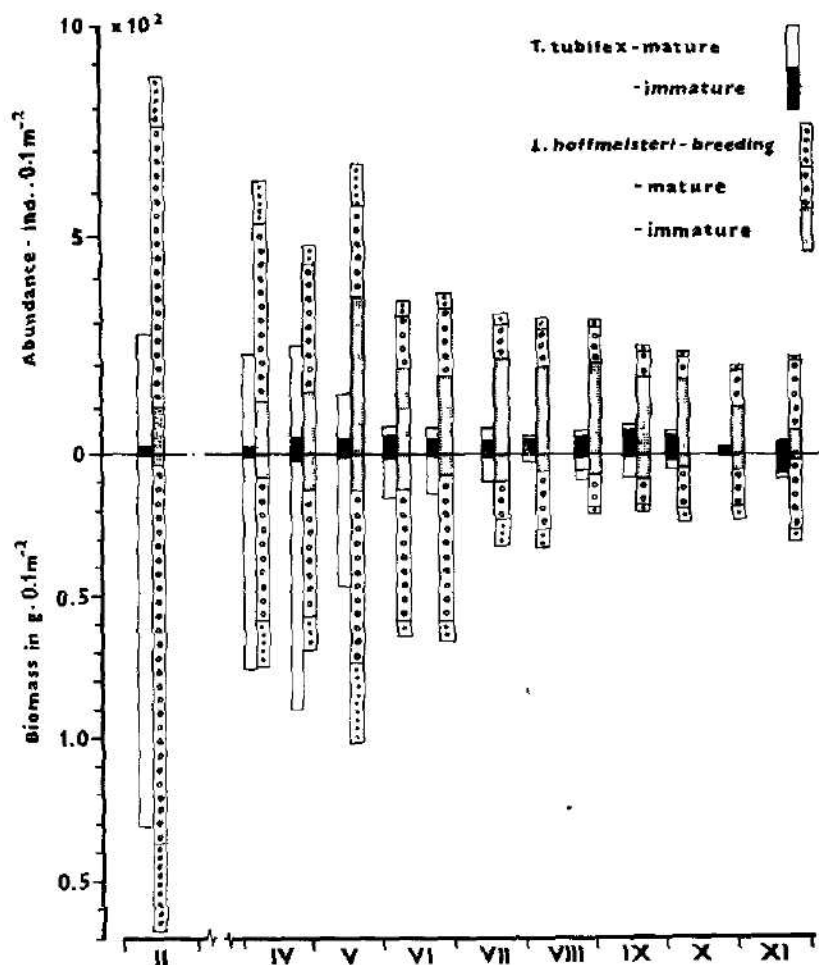


Fig 6. Ranges in abundance and biomass changes among the different age groups of two benthic dominant species *Lamnodrilus hoffmeisteri* and *Tubifex tubifex*.

#### DISCUSSION

Taxonomical structure, horizontal distribution and population dynamics of benthic Oligochaeta is influenced, in the first place, by the quality and the thickness of sedimentary layer, by the depth of the water column, the amount and the quality of the food and in the deepest parts of the ponds also by the amount of the dissolved oxygen in the water layers close to bottom during the summer or under the ice in winter. The decrease of the density of benthic oligochaets in spring and summer period may be caused by direct feeding activity of the predators, the intensity of which depends on the species composition, age structure and biomass of fish stock of the water body (Borodič 1965, Assman 1962, Sokolova 1965, Lellák 1961, 1966, 1969, 1974, Brinkhurst and Jamieson 1971). The maximum abundance of benthic oligochaets is usually found in early spring and autumn by most authors.

The present work agrees with the above findings. The authors found maximum abundance in February and minimum in November. However, high oligochaets abundance in autumn could not be confirmed. It might be correlated with the abundance of chironomid larvae (Lellák 1966, Barthelmes 1964, Brinkhurst and Kennedy 1965). Lellák's (1969) observation on the increase of biomasses of the chironomid larvae in the autumn of 1963 in Velký Pálenec points to that direction.

*L. hoffmeisteri* was found to be the dominant species and constitute over 69% of the total oligochaets fauna. Identical findings resulted from those of Brinkhurst and Kennedy (1965), Lišková (1967, 1976), Veal and Osmond (1969) and others. In the present work highest abundance of this species was found in D sampling area with sandy bottom. Similar observation was made by Wachs (1967) and Zahner (1967).

More than 70% of the total oligochaets fauna was found to be distributed within 1 m depth of pond area. Brinkhurst and Kennedy (1965) reported similar findings in Ditton Brook.

The authors noted the mature and breeding stages of *Tubifex tubifex* and *Limnodrilus hoffmeisteri* throughout the period of study Brinkhurst (1964, 1966), Cook (1969 in Brinkhurst and Jamieson 1971) also found similar results for those animals. Wachs (1963) found the peak of breeding period for *T. tubifex* and some *Limnodrilus* species from March to June. The authors achieve the similar results in the present studies.

It is indeed highly improbable to find out the correct biomass of oligochaets fauna. Lišková (1967) observed that biomass of the worms depended on the length, development of gonads and amount of food material in the digestive tract. She obtained different biomasses for the same species at different localities during different observations. The authors failed to achieve identical results in the present work. In the present study the biomasses of tubificids found were significant only *L. hoffmeisteri* population was found to have the maximum biomass among the oligochaetes and its biomass reached the peak in winter (Fig. 5). Lišková (1967) also observed that *L. hoffmeisteri* had maximum biomass in her materials but she found the highest peak in August and November.

Among the naidids the highest biomass was seen in *Ophidonais serpentina* while as regards abundance the species *Dero digitata* was found to dominate the population.

In the quantitative material of macroscopic benthic oligochaets fauna gathered during one year examination period the total amount of Tubificidae exceeds very expressively the amount of Naididae; in abundance by 86.9% towards 13.1% and in the wet weight biomass by 96.2% against 3.7%, respectively (Tab. 1 and 2).

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*Authors' addresses:* Prof. Shahadat Ali, MSc., Ph.D., Departement of Zoology, University of Dacca, Bangladesh. (Present address).  
 Doc. RNDr. Jan Lellák, C.Sc, Hydrobiologické oddělení, Přírodovědecká fakulta UK, Viničná 7, 128 44 Praha 2, Czechoslovakia.



Institute of Parasitology, Czechoslovak Academy of Sciences, Č. Budějovice<sup>1)</sup>  
Helminthological Laboratory of the USSR Academy of Sciences, Moscow<sup>2)</sup>

## HELMINTHS OF BIRDS OF THE FAMILY LARIDAE IN SOUTH BOHEMIA

Jan BUŠTA,<sup>1)</sup> Ludmila Michailovna TOLKACHEVA,<sup>2)</sup> Jan MICHÁLEK<sup>1)</sup>

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**Abstract.** Examination of 888 specimens of the family Laridae revealed the presence of 40 helminth species (19 trematode, 13 cestode and 8 nematode species). Nine species were found for the first time in the territory of Czechoslovakia: *Ligula intestinalis*, *Dilepis undula*, *Paricterotaenia porosa*, *P. sternina*, *Aploparaksis larina* and *Variolepis farcimiosa* in *Sterna hirundo* and *Dilepis undula*, *Pseudanomotaenia micracantha*, *Echinocotyle multiglandularis* and *Wardium filamentoovatum* in *Larus ridibundus*.

### INTRODUCTION

Members of the family Laridae are the most abundant and economically the most important representatives of our ornithological fauna. Their nests are bound to large water areas, mainly the pond systems of South and East Bohemia, South and central Moravia and East Slovakia. Attention has been paid both to some biological aspects (migration, habitat requirements, food habits) and to parasitoses of these gregarious birds. These problems have been studied mainly by Macko (1964a, b, c, d) in East Slovakia, Koubek (1979) in South Moravia and Sitko (1968), Baruš et al. (1978) in Moravia and Bohemia.

### MATERIAL AND METHODS

Between 1967 and 1981 a total of 888 specimens of the family Laridae (778 *Larus ridibundus*, 73 *Sterna hirundo* and 33 *Chlidonias nigra*) were dissected and examined for helminths.

The material was collected in 5 localities of the Třeboň basin — at Frahelž, Klec, Lomnice n/Luž., Lužnice nad Ponědraž throughout the year and fixed in 4% formaldehyde (nematodes) or 80% alcohol (cestodes and trematodes), the latter being stained with boraxcarmine.

Some material discussed herein has already been presented by Baruš et al. (1978), Bušta and Groschafft (in press).

### RESULTS

#### A. Trematodes

I. Family: Echinostomatidae Dietz, 1909

1. *Echinostoma revolutum* (Fröhlich, 1802)

Host: *Larus ridibundus* (3.8%, 1–3 specimens), *Chlidonias nigra* (2.7%, 3 specimens)

Location: intestine, bursa Fabricii

Locality: Klec, Lomnice n/Luž., Ponědraž

A common parasite of Anseriformes, Charadriiformes, Laridae and others.

In Czechoslovakia, the species has been found in *L. ridibundus* (Sitko, 1968; Koubek, 1979; Bušta and Groschafft, in press) and *Ch. nigra* (Bušta and Groschafft, in press). The trematode is one of the most frequently encountered parasite of a mallard, domestic duck and goose (Macko, 1963; Buša, 1962; Zajíček and Páv, 1963; Bušta, 1980c) in Czechoslovakia.

2. *Echinoparyphium recurvatum* (Linstow, 1873)

Host: *Larus ridibundus* (0.7%, 1–28 specimens)

Location: intestine

Locality: Lomnice n/Luž., Ponědraž

A common parasite of waterbirds; found occasionally in other bird species.

The fluke has been found in *L. ridibundus* by Kopriva (1959), Zajíček and Páv (1961), Páv and Zajíček (1963), Sitko (1968), Koubek (1979), Bušta and Groschafft (in press). The species is geopolitan in distribution and one of the most important parasites of a domestic duck.

3. *Mesorchis pseudoechinatus* (Olsson, 1876)

Host: *Larus ridibundus* (1.7%, 1–26 specimens)

Location: intestine

Locality: Klec, Lomnice n/Luž., Ponědraž

The trematode is frequent in Laridae and other fish-eating birds.

In Czechoslovakia, the parasite has been found by Macko (1964b), Sitko (1968), Koubek (1979), Bušta and Groschafft (in press).

The fluke has been reported from the USSR, Poland, GDR and Yugoslavia.

4. *Himasthla secunda* (Nicoll, 1906)

Host: *Larus ridibundus* (0.3%, 1–2 specimens), *Sterna hirundo* (1.3%, 1 specimen)

Location: intestine

Locality: Klec, Lomnice n/Luž.

An infrequent parasite of Laridae occurring more often in Charadriiformes and Anseriformes.

In Czechoslovakia, the species has been found in *L. ridibundus* (Sitko, 1968; Koubek, 1979; Bušta and Groschafft, in press), and *S. hirundo* (Bušta and Groschafft, in press).

The parasite was found in gulls in the territory of the European and Asian parts of the USSR and in GDR.

II. Family: Pachytrematidae Baer, 1943

5. *Pachytrema calculus* Looss, 1907

Host: *Larus ridibundus* (4.4%, 1–2 specimens), *Chlidonias nigra* (5.4%, 1 specimen)

Location: gall bladder

Locality: Frahelž, Klec, Lomnice n/Luž., Ponědraž

A common parasite of the Laridae, recorded also in Anseriformes, Charadriiformes and other orders of birds.

In Czechoslovakia, the species has been reported in *L. ridibundus* (Macko,

1964b: Sitko, 1968; Koubek, 1979; Bušta and Groschaft, in press) and *Ch. nigra* (Bušta and Groschaft, in press).

The fluke has been found in the European and Asian parts of the USSR, Japan, Scotland, Bulgaria and Yugoslavia.

6. *Pachytrema paniceum* Brinkmann, 1942

Host: *Larus ridibundus* (0.7%, 1–11 specimens), *Sterna hirundo* (1.3%, 2 specimens)

Location: gall bladder

Locality: Klec, Lužnice

The parasite occurs sporadically in Laridae.

In Czechoslovakia it has been recorded in *L. ridibundus* (Vojtek and Vojtková, 1961; Sitko, 1968; Bušta and Groschaft, in press), and *S. hirundo* (Bušta and Groschaft, in press).

It has so far been reported from Norway and the USSR.

III. Family: Galactosomatidae Morozov, 1950

7. *Cercarioides aharonii* Witenberg, 1929

Host: *Larus ridibundus* (0.1%, 1 specimen), *Sterna hirundo* (5.4%, 1 specimen)

Location: cloaca

Locality: Klec

A sporadically occurring parasite of Laridae.

In Czechoslovakia the fluke has been recorded in *L. ridibundus* (Bušta and Groschaft, in press) and *S. hirundo* (Sitko, 1968; Bušta and Groschaft, in press).

The trematode has been found in the USSR and Palestina.

8. *Tetracladium sterna*e Kulackova, 1952

Host: *Sterna hirundo* (4.1%, 2–4 specimens)

Location: cloaca

Locality: Lužnice

The species has been found only sporadically in gulls; besides Czechoslovakia where it has been found in *S. hirundo* (Sitko, 1968; Bušta and Groschaft, in press), it has been reported only from the territory of the USSR.

IV. Family: Heterophyidae Odhner, 1914

9. *Cryptocotyle lingua* (Creplin, 1825)

Host: *Larus ridibundus* (0.5%, 1–4 specimens)

Location: intestine

Locality: Fraheiž, Lomnice n/Luž.

The parasite occurs in Anseriformes, Ciconiiformes and in the family Laridae.

In Czechoslovakia, it has been recorded in the above host by Sitko (1968), Koubek (1979), Bušta and Groschaft (in press). As different marine fishes serve as a second intermediate host, the trematode is more abundant at the seaside, e. g. in Great Britain, the Netherlands, Denmark, Norway, GDR, USSR etc.

10. *Apophallus muehlingi* (Jägerskiöld, 1899)

Host: *Larus ridibundus* (7.9%, 1–257 specimens), *Sterna hirundo* (1.3%, 6 specimens)

Location: intestine  
Locality: Frahelž, Klec, Lomnice n/Luž., Ponědraž

A common species of fish-eating birds, the family Laridae included.

In Czechoslovakia, the fluke has been found in *L. ridibundus* (Vojtek, 1959; Vojtek and Vojtková, 1961; Zajíček and Páv, 1961; Páv and Zajíček, 1963; Macko, 1964b; Sitko, 1968; Koubek, 1979; Bušta and Groschaft, in press).

It has also been reported in gulls from the European and Asian parts of the USSR, Poland, Great Britain, GDR and Yugoslavia.

V. Family: Plagiorchiidae Lühe, 1901

11. *Plagiorchis laricola* Skryabin, 1924

Host: *Larus ridibundus* (54.3%, 1-828 specimens), *Sterna hirundo* (53.4%, 1-160 specimens), *Chlidonias nigra* (35.1%, 1-38 specimens)

Location: intestine

Locality: Frahelž, Klec, Lomnice n/Luž., Lužnice, Ponědraž

A common trematode of Laridae, occurring also in Charadriiformes, Ciconiiformes, Podicipediformes and other orders of birds.

In Czechoslovakia, it has been found in *L. ridibundus* (Kopřiva, 1959; Ryšavý, 1960; Vojtek and Vojtková, 1961; Zajíček and Páv, 1961; Páv and Zajíček, 1963; Sitko, 1968; Bušta and Groschaft, in press), and *Ch. nigra* (Macko, 1964b; Bušta and Groschaft, in press).

VI. Family: Prosthogonimidae Nicoll, 1924

12. *Prosthogonimus ovatus* (Rudolphi, 1803)

Host: *Larus ridibundus* (0.1%, 1 specimen)

Location: bursa Fabricii, oviduct

Locality: Lomnice n/Luž.

An infrequent parasite of gulls occurring more often in Anseriformes, Charadriiformes, songbirds etc.

In Czechoslovakia, the species has been reported from *L. ridibundus* (Vojtek and Vojtková, 1961; Sitko, 1968; Bušta and Groschaft, in press).

The trematode has been recorded in the European and Asian parts of the USSR, China, Egypt and Brazil.

VII. Family: Rencolidae Dollfus, 1939

13. *Rencicola lari* Timon-David, 1933

Host: *Larus ridibundus* (19%, 2-61 specimens), *Sterna hirundo* (9.5%, 2-72 specimens)

Location: kidneys

Locality: Klec, Lomnice n/Luž., Ponědraž

The trematode parasitizes in birds of the family Laridae and other fish-eaters.

In Czechoslovakia, it has been reported in *L. ridibundus* (Sitko, 1968; Koubek, 1979; Bušta and Groschaft, in press), and *S. hirundo* (Sitko, 1968; Bušta and Groschaft, in press).

The parasite has been recorded in the USSR, Bulgaria, Great Britain, GDR and Hungary.

VIII. Family: Eucotylidae Skryabin, 1924

14. *Tanaisia fedtschenkoi* Skryabin, 1924

Host: *Larus ridibundus* (4.6%, 1–64 specimens), *Chlidonias nigra* (2.7%, 75 specimens)  
Location: kidneys  
Locality: Klec, Lomnice n/Luž, Ponědraž

A common parasite of fish-eating birds, the gulls included.

In Czechoslovakia it has been found in *L. ridibundus* (Sitko, 1968; Bušta and Groschaf, in press) and *Ch. nigra* (Macko, 1964b; Bušta and Groschaf, in press).

The fluke has been reported from the European and Asian parts of the USSR.

IX. Family: Strigeidae Railliet, 1919

15. *Cardiocephalus longicollis* (Rudolphi, 1819)

Host: *Larus ridibundus* (1.3%, 1–55 specimens)  
Location: intestine  
Locality: Frahelž, Klec, Lomnice n/Luž.

An occasional parasite of gulls and other fish-eaters.

In Czechoslovakia, it has been reported in *L. ridibundus* (Sitko, 1968; Koubek, 1979; Bušta and Groschaf, in press).

The species has been recorded in gulls in the USSR, Bulgaria, GDR and Scotland.

16. *Cotylurus pileatus* Rudolphi, (1802)

Host: *Larus ridibundus* (0.1%, 2 specimens)  
Location: intestine  
Locality: Lomnice n/Luž.

A sporadic parasite in gulls. In Czechoslovakia, it has been found in *L. ridibundus* (Sitko, 1968; Bušta and Groschaf, in press).

The parasite has been reported from the USSR, Poland and the Netherlands.

17. *Cotylurus platycephalus* (Creplin, 1825)

Host: *Larus ridibundus* (0.5%, 3–21 specimens), *Sterna hirundo* (1.3%, 3 specimens), *Chlidonias nigra* (2.7%, 1 specimen)  
Location: intestine  
Locality: Lomnice n/Luž., Lužnice

A sporadic parasite of Laridae recorded also in other fish-eaters.

In Czechoslovakia, the fluke has been reported in *L. ridibundus* (Sitko, 1968; Bušta and Groschaf, in press), *S. hirundo* and *Ch. nigra* (Bušta and Groschaf, in press).

The trematode has also been recorded in the USSR and Poland.

X. Family: Diplostomatidae Poirier, 1886

18. *Diplostomum spathaceum* (Rudolphi, 1819)

Host: *Larus ridibundus* (50.6%, 1–252 specimens), *Sterna hirundo* (6.8%, 1–12 specimens)  
Location: intestine  
Locality: Frahelž, Klec, Lomnice n/Luž., Lužnice, Ponědraž

A common parasite of fish-eating birds the gulls included.

In Czechoslovakia, the parasite has been recorded in *L. ridibundus* (Ryšavý, 1960; Vojtek and Vojtková, 1961; Zajíček and Páv, 1961; Páv and Zajíček, 1963; Macko, 1964b; Sitko, 1968; Koubek, 1973, 1979; Bušta and Groschaft, in press) and *S. hirundo* (Bušta and Groschaft, in press).

The species has been reported from the European and Asian parts of the USSR, Bulgaria, Hungary, Poland, Norway, Great Britain and Canada.

XI. Family: Schistosomatidae Looss, 1899

19. *Ornithobilharzia canaliculata* (Rudolphi, 1819)

Host: *Sterna hirundo* (4.1%, 1–3 specimens)  
Location: blood system  
Locality: Klec

A sporadic parasite of Laridae and other birds.

In Czechoslovakia, the species has been reported by Sitko (1968), Bušta and Groschaft (in press).

Further it has been found in western Siberia.

## B. Cestodes

I. Family: Ligulidae Claus, 1867

1. *Ligula intestinalis* (Linné, 1758)

Host: *Larus ridibundus* (0.5%, 1 specimen), *Sterna hirundo* (1.3%, 1 specimen)  
Location: intestine  
Locality: Lomnice n/Luž., Lužnice, Ponědraž

A common and widely distributed parasite of fish-eating birds.

This is the first finding in *S. hirundo* in Czechoslovakia.

It has been recorded in *L. ridibundus* (Macko, 1959b, 1964a; Škarda, 1964) and in other fish-eaters — *Podiceps cristatus*, *P. griseigena* and *P. nigricollis* (Sommer, 1954; Ryšavý, 1957, 1962; Macko, 1959a, 1964a).

II. Family: Tetrabothriidae Linton, 1981

2. *Tetrabothrium cylindraceum* (Rudolphi, 1819)

Host: *Larus ridibundus* (0.5%, 3–5 specimens), *Sterna hirundo* (1.3%, 1 specimen)  
Location: intestine  
Locality: Lomnice n/Luž., Lužnice, Ponědraž

A tapeworm of birds of the order Lariformes.

In Czechoslovakia, the species has been recorded in *L. ridibundus* in the territory of Slovakia (Koubek, 1979), *L. minutus* and *Hydroprogne tsche-grava* (Macko, 1964a).

III. Family: Dilepididae Fuhrmann, 1907

3. *Dilepis undula* (Schränk, 1788)

Host: *Larus ridibundus* (0.7%, 1–21 specimens), *Sterna hirundo* (1.3%, 1 specimen)  
Location: intestine  
Locality: Lomnice n/Luž., Lužnice, Ponědraž

A common parasite of birds of the order Passeriformes in the Palaearctic region.

In Czechoslovakia, the species has been reported in songbirds (Ryšavý, 1957; Bušta, 1980a etc.), in the atypical hosts — *Fulica atra* (Baruš and Lelek, 1961) and *A. anser* f. *dom.* (Bušta, 1980b). The presence of this species in the above atypical hosts, in several species of mammals (Prokopič, 1958, 1959) and in the two Laridae individuals might be connected with the collection of earthworms — intermediate hosts of the species — in the fields after ploughing. This parasite does not mature in these atypical hosts.

All the parasites found were juvenile; bursa cirri anlagen were located at the same site within all segments. The scolex possesses a rostellum armed with two rows of 20–25 hooks each. The hooks of the first row are 0.080–0.084 mm long, those of the second row measure 0.086–0.100 mm. The hooks are identical in shape with those in *D. undula*.

4. *Pseudanomotaenia micracantha* (Krabbe, 1869)

Host: *Larus ridibundus* (0.3%, 9–17 specimens)  
Location: intestine  
Locality: Klec

A parasite of Laridae which has been reported from the European and Asian parts of the USSR, Iceland, Greenland, North America (Alaska) and New Zealand.

This is the first record of the species in *L. ridibundus* in Czechoslovakia.

5. *Paricterotaenia porosa* (Rudolphi, 1810)

Host: *Larus ridibundus* (16.1%, 1–32 specimens), *Sterna hirundo* (2.7%, 3–4 specimens)  
Location: intestine  
Locality: Frahelž, Klec, Lomnice n/Luž., Ponědraž

A common parasite in birds of the family Laridae. In *S. hirundo*, the cestode has been recorded for the first time in the territory of Czechoslovakia. In *L. ridibundus* and *L. canus* it has been found by Zajíček and Páv (1961), Ryšavý (1962), Páv and Zajíček (1963), Macko (1964a), Neradová (1966) and Valkounová (1983).

The species has been reported from GDR, Poland, from the European and Asian parts of the USSR, Africa (Egypt) and America (California).

6. *Paricterotaenia sternina* (Krabbe, 1869)

Host: *Sterna hirundo* (8.2%, 1–6 specimens)  
Location: intestine  
Locality: Lužnice

A less frequent parasite of Laridae. This is the first record of the species in this host in Czechoslovakia. It has been recorded in the USSR, Iceland and Greenland.

IV. Family: Hymenolepididae (Aricola, 1899)

7. *Aploparaksis larina* (Fuhrmann, 1921)

Host: *Larus ridibundus* (2.9%, 2–10 specimens), *Sterna hirundo* (1.3%, 4 specimens)  
Location: intestine  
Locality: Frahelž, Klec, Lomnice n/Luž., Lužnice, Ponědraž

A common parasite of Laridae. In Czechoslovakia, the species has been reported in *L. ridibundus* (Koubek, 1979). Our findings in the localities studied demonstrate the cestode is not scarce.

The parasite is likely to be more frequent than it was to be expected and the sporadic findings may be due to the incorrect identification. The species has been found in many parts of the USSR, Poland, France, Antarctica, North America and Australia.

8. *Echinocotyle multiglandularis* (Baczynska, 1914)

Host: *Larus ridibundus* (0.1%, 13 specimens)  
Location: intestine  
Locality: Klec

The parasite has been reported in *L. fuscus* in western parts of the USSR (Estonia) and in Africa.

This is the first record of the species in *L. ridibundus* in Czechoslovakia.

All specimens found were small. The length of bursa cirri (its extension to the aporal excretory canals) and the general topography of all segments of the strobila correspond in full to those of *E. multiglandularis*. The length of the rostellar hooks is 0.0256 mm which is less than that reported by Spasskaya (1966) — 0.0286 mm. Nevertheless, the difference is within the morphological variability of the species.

9. *Microsomacanthus paracompressa* (Czaplinski, 1956)

Host: *Larus ridibundus* (0.5%, 2 specimens)  
Location: intestine  
Locality: Frahelž, Klec, Lomnice n Luž.

A typical parasite in Anseriformes, widely distributed in Poland and the USSR.

In Czechoslovakia, the species has been found in *L. ridibundus* (Ryšavý 1961), and in several species of Anseriformes (Ryšavý, 1961; Páv and Zajíček, 1963; Macko, 1970; Neradová-Valkounová, 1971; Ryšavý et al., 1982).

The cestode has been found also in *Larus ichthyaetus* in the Asian part of the USSR (Polkacheva, 1975).

10. *Variolopsis farciminosa* (Goeze, 1782)

Host: *Sterna hirundo* (1.3%, 15 specimens)  
Location: intestine  
Locality: Lužnice

A common parasite of songbirds, widely distributed in the Palaearctic region. It parasitises also in other birds — *Gallus gallus f. dom.* and *Aythya ferina* (Spasskaya, 1966).

This is the first record of this parasite in *S. hirundo* in Czechoslovakia. The segments of the specimens found correspond in morphology to those of *V. farciminosa*. Bursa cirri measures 0.17–0.19 mm, not exceeding by much the poral excretory canals in the male segments and not reaching them in the female ones. The scolex is 0.18 × 0.25 mm long, the suckers measure 0.105–0.115 × 0.070–0.084 mm. The rostellum is invaginated, armed with 10 hooks of fraternoid type. The hooks are 0.020 mm long, the blade measures 0.007 mm.



11. *Wardium cirrosa* (Krabbe, 1869)

Host: *Larus ridibundus* (0.1%, 2 specimens)  
Location: intestine  
Locality: Frahelž

A common parasite in birds of the order Lariformes, widespread in gulls throughout Europe (Great Britain, France, Denmark, USSR), in the Asian part of the USSR and North America.

In Czechoslovakia, the species has been recorded in *L. ridibundus* (Ryšavý, 1961; Valkounová, 1983) under the name *Aploparaksis cirrosa* (Krabbe, 1969), the synonym of *W. cirrosa* (Spasskaya, 1966). In Slovakia, the species has been found in *L. canus* by Macko (1964a).

12. *Wardium filamentoovatum* Macko, 1962

Host: *Larus ridibundus* (0.1%, 6 specimens)  
Location: intestine  
Locality: Ponědraž

The parasite has been described by Macko (1962) based on the specimens recovered from *L. minutus* captured in Slovakia.

This is the first record in *L. ridibundus* in Czechoslovakia. Except Czechoslovakia, the cestode has been found only in *L. minutus* and *S. hirundo* in the Asian part of the USSR (Northern Kulunda). These data were presented by Tolkacheva (1975) who considered this species valid, denying its synonymy with the species *Wardium spasskii* Schigin, 1961 as established by Spasskaya (1966).

13. *Wardium fusa* (Krabbe, 1869)

Host: *Larus ridibundus* (2.7%, 1–9 specimens)  
Location: intestine  
Locality: Frahelž, Klec, Lomnice n/Luž., Ponědraž

A typical parasite of Laridae.

In Czechoslovakia, it has been found in *L. ridibundus* and *L. minutus* (Koubek, 1979; Macko, 1964a). Some authors (Ryšavý, 1957, 1961; Zajíček and Páv, 1961; Páv and Zajíček, 1963) have reported the species *Aploparaksis fusus* (Krabbe, 1869) to occur in gulls. Among the synonyms of *A. fusus* Ryšavý (1957) ranks *Taenia fusus* Krabbe, 1869 and *Hymenolepis fusus* Fuhrmann, 1908. Spasskaya (1966) considers all the above names to be the synonyms of the species *Wardium fusa* (Krabbe, 1869) in her monograph. Therefore, the tapeworms reported as *Aploparaksis fusus* (Krabbe, 1869) (nec. *Aploparaksis fusus* Skryabin et Mathevossian, 1945) are to be regarded as *W. fusa*.

Except Czechoslovakia, the tapeworm has been reported from the European and Asian parts of the USSR and Greenland.

### C. Nematodes

#### I. Family: Capillariidae Neveu-Lemaire, 1936

##### 1. *Eucoleus contortus* (Creplin, 1839)

Host: *Larus ridibundus* (20.4%, 1–10 specimens), *Sterna hirundo* (4.1%, 1–2 specimens), *Chlidonias nigra* (8.1%, 1–2 specimens)

Location: esophagus, small intestine  
Locality: Frahelž, Klec, Lomnice n/Luž., Lužnice, Poněradž

The species is cosmopolitan in distribution and parasitizes in a wide range of birds.

In Czechoslovakia, it has been recorded in Anseriformes, Charadriiformes, Passeriformes etc. It has been reported in Laridae (Macko, 1964c, d; Baruš, 1974; Baruš et al., 1978; Koubek, 1979).

To place the species in the genus a paper by Moravec (1982) has been considered.

II. Family: Syngamidae Leiper, 1912

2. *Cyathostoma lari* (Blanchard, 1849)

Host: *Larus ridibundus* (17.6%, 4–22 specimens)  
Location: oral and nasal cavities, trachea  
Locality: Frahelž, Klec, Lomnice n/Luž., Lužnice, Poněradž

A common parasite of Laridae in the Palaearctic region — Euroasia and North America.

In Czechoslovakia, the species was reported in *L. ridibundus* for the first time in South Moravia (Zavádil, 1961). The parasite has been found by Koubek (1979) and Baruš et al. (1978) in the same region and at Lomnice n/Luž. Exogenous phase of the parasite's development was studied by Baruš (1970).

Based on our material, this species can be, next to *E. contortus*, considered the most frequent nematode in gulls.

III. Family: Toxocaridae Hartwich, 1954

3. *Porrocaecum ensicaudatum* (Zeder, 1800) — (larvae)

Host: *Larus ridibundus* (3.5%, 1–9 specimens)  
Location: under stomach cuticle, small intestine  
Locality: Frahelž, Klec, Lomnice n/Luž., Poněradž

A typical parasite of Passeriformes (mainly Turdidae, Sturnidae and Corvidae).

The species is widespread throughout Czechoslovakia. In the area studied, it has been found in *Sturnus vulgaris*, *Turdus merula* and *Garrulus glandarius* (Bušta, 1980c). In region studied we have found the species in *T. philomelos* and *V. vanellus*, the parasite was found also in gulls (Baruš et al., 1978; Koubek, 1979). The parasite develops in Lumbricidae (Ryšavý, 1959; Levine, 1961; Jogis, 1970) and thus it may enter the digestive tract of birds together with the food (Osche, 1959; Jogis, 1974; Bakke and Baruš, 1975). Similarly as Baruš et al. (1978) and Koubek (1979) we have not succeeded in finding the adult specimens in *L. ridibundus*. As only the larval stages have been found, this nematode does not appear to mature in gulls (atypical hosts).

4. *Porrocaecum crassum* (Deslongchamps, 1824) (larvae)

Host: *Larus ridibundus* (0.2%, 1 specimen)  
Location: small intestine  
Locality: Klec

A parasite of Anseriformes — mainly of ducks.

It has been reported from Czechoslovakia by Bušta (1962), Zajíček and

Páv (1963). *P. crassum* larvae have been found in *Vanellus vanellus* (Macko, 1961–1962) and *L. ridibundus* (Baruš et al., 1978). Since the parasite is found sporadically and the larvae occur only in Laridae, these hosts are considered atypical as well.

5: *Porrocaecum semiteres* (Zeder, 1800)

Host: *Larus ridibundus* (2.9%, 1–5 specimens)  
Location: small intestine  
Locality: Frahelž, Klec, Lomnice n/Luž.

Hartwich (1959, 1975) regarded the species as a typical parasite of Charadriiformes. The parasite has been recorded in the same hosts in Czechoslovakia (e. g. Vojtěchovská-Mayerová, 1952; Ryšavý, 1957; Macko, 1961–1962). It has been also reported in Corvidae and Sturnidae (Hanák and Vojtek, 1973; Koubek and Vojtek, 1973) and in *L. ridibundus* (Baruš et al., 1978; Koubek, 1979). A natural infection of *Eisenia tetraedra* with *P. semiteres* larvae has been recorded in Czechoslovakia (Moravec, 1971).

IV. Family: Tetrameridae Travassos, 1914

6. *Tetrameres skrbabini* Panova, 1926

Host: *Larus ridibundus* (1.1%, 1–5 specimens), *Sterna hirundo* (2.8%, 2–14 specimens), *Chlidonias nigra* (3.7%, 12 specimens)  
Location: proventriculus  
Locality: Lomnice n/Luž., Lužnice

The parasite has been reported in several species of Laridae and Charadriiformes in the territory of the USSR and in *Larus delawarensis* in the USA (Mollhagen, 1976).

In Czechoslovakia (East Slovakia), the parasite has been found in *L. ridibundus*, *Ch. hybrida* and *Ch. leucoptera* (Macko, 1964b, c), the females being recorded as *Tetrameres* sp. Further findings have been reported in *L. ridibundus*, *Ch. nigra* and *S. hirundo* (Baruš et al., 1978) and *L. ridibundus* (Koubek, 1979).

V. Family: Acuariidae Seurat, 1913

7. *Cosmocephalus obvelatus* (Creplin, 1825)

Host: *Larus ridibundus* (1.2%, 1–3 specimens), *Sterna hirundo* (1.1%, 2 specimens), *Chlidonias nigra* (3.7%, 1 specimen)  
Location: esophagus, small intestine  
Locality: Klec, Lomnice n/Luž., Lužnice

A parasite of fish-eating birds, geopolitan in distribution.

In Czechoslovakia, it was recorded for the first time in *L. ridibundus* and *Ch. nigra* in East Slovakia (Macko, 1964c, d).

The species has been recorded in *L. ridibundus*, *Ch. nigra* and *S. hirundo* (Baruš et al., 1978) and *L. ridibundus* (Koubek, 1979).

8. *Rusguniella elongata* (Rudolphi, 1819)

Host: *Larus ridibundus* (0.4%, 1–2 specimens), *Chlidonias nigra* (8.1%, 1–3 specimens)  
Location: under the stomach cuticle, small intestine  
Locality: Klec, Lomnice n/Luž., Lužnice

A parasite of fish-eating birds, mainly of Laridae in the Palaearctic region. In Czechoslovakia, the nematode has been found in *Chlidonias nigra* (Baruš et al., 1978) and *L. ridibundus* (Koubek, 1979).

#### SUMMARY

The most frequently encountered helminths in Laridae of South Bohemia were trematodes. A total of 19 species belonging to 11 families were found. The most abundant were four species of the family Echinostomatidae.

*L. ridibundus*, *S. hirundo* and *Ch. nigra* were found to harbour 17, 10 and 5 trematode species, respectively.

*C. platycephalus* and *P. laticola* were recorded in the three birds species examined, 9 trematodes were found in two hosts and 8 trematodes were recorded in a single host species.

*P. laticola* and *D. spathaceum* were the most common trematodes in Laridae in the localities under study.

The cestode fauna in Laridae of South Bohemia was constituted by 13 species of four families. The most abundant were the species of the family Hymenolepididae (7 species).

Four cestodes in the family Dilepididae and one cestode species of the family Ligulidae and Tetrabothriidae were recorded.

Six tapeworm species were revealed to occur both in *L. ridibundus* and *S. hirundo*. Four and three tapeworm species were found in a single host, *L. ridibundus* and *S. hirundo*, respectively. The most common parasites in gulls of South Bohemia are *P. porosa* and *A. larina*; in terns — *P. sternina*.

Three tapeworm species — *P. micracantha*, *P. sternina* and *E. multiglandularis* were recorded for the first time in Laridae in Czechoslovakia.

In addition, 8 nematode species (three species of the family Toxocaridae, 2 species of the family Acuariidae, one species of the family Capillariidae, Syngamidae and Tetrameridae) were recorded.

Three nematode species are common for *L. ridibundus*, *Ch. nigra* and *S. hirundo*, one nematode was recorded both in *L. ridibundus* and *Ch. nigra* and four nematodes were recorded in a single host — *L. ridibundus*.

The most frequent nematodes were *E. contortus* and *C. lari*, the latter occurring in gulls only.

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*Authors' address:* J. Bušta and J. Michálek, Institute of Parasitology, Czechoslovak Academy of Sciences, Na sádkách 702, Č. Budějovice 370 05, Czechoslovakia;  
L. M. Tolkacheva, Helminthological Laboratory of the USSR Academy of Sciences, Mytnaia 28, 11 70 71 Moscow B-71, USSR

Institute of Hygiene and Epidemiology, Prague

**QUANTITATIVE STRUCTURE OF INTESTINAL HELMINTH FAUNA OF SMALL  
RODENTS IN SUCCESSIVE STAGES OF SPOIL BANKS IN THE MOST BASIN  
(Northern Bohemia) AND IN THEIR SURROUNDINGS**

Jan JIROUŠ

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**Abstract.** A total of 1497 small rodents were trapped on three spoil banks formed as a result of surface lignite mining and at five near-by sites and were examined for presence of intestinal helminths. The rodents belonged to three species *Clethrionomys glareolus*, *Microtus arvalis* and *Apodemus sylvaticus*. The penetration of rodents onto spoil banks and the development of these spoil banks were attended by changes in the quantitative characteristics of their invasion by helminths. A naturally developing and an afforested spoil bank displayed lower values of extensity of invasion (invasion rate), mean intensity of invasion and relative density of invasion of rodents by helminths than did other localities from where the rodents had apparently migrated to the spoil banks. Quantitative characteristics of invasion by helminths tapeworms were higher in all the host species on 25–25 years old spoil banks than at localities other than banks. The reverse is true of invasion by nematodes. The results suggested that the development of communities of some organisms on Most-basin dumps proceeds in a somewhat different direction than in the surrounding areas.

INTRODUCTION

The following quantitative relations rank among topical components of ecological evaluation. A number of authors have dealt with this problem during the last ten years. In the 1970's were proposed some methods for quantitative investigation of the small rodents helminth invasion (Kisielewska, 1970 b). Differences in the helminth fauna of rodents have been observed in different biotopes (Kisielewska 1970a, Tenora et al. 1973, Prokopič 1972b, 1973, Tenora 1976, etc.) and under different geographic conditions (Prokopič and Genov 1974). The quantitative structure of the helminth fauna has also been studied in relation to the condition of the host population (Kisielewska 1971, Kisielewska and Zubczewska 1973, Kisielewska et al. 1973, Tenora and Zejda 1974, Tenora et al. 1979). However, nobody has so far investigated changes in quantitative characteristics of helminth invasion on transition of their small rodent hosts from their original biotopes on to spoil banks formed after lignite mining. Investigation along this line could contribute to our knowledge of the changes in living conditions that occur on these spoil banks as compared with the surrounding areas and suggest the direction of development of communities of some organisms upon these newly forming landscape elements.

The aims of our work were accordingly as follows:

- (1) To ascertain some quantitative characteristics of intestinal helminth in-

Table 1a, b. Comparison of quantitative characteristics of invasions calculated for individual localities

<i>Clethrionomys glareolus</i>	No ani- mals		No invaded		No helminths		EI		MI		RD				
	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat			
Locality I	57	—	38	38	—	1032	—	67	67	—	27.2	27.2	—	18.1	18.1
Locality II	54	3	16	17	6	109	115	6	30	31	2.0	6.8	0.1	2.0	2.1
Locality V	106	34	18	46	75	68	143	32	17	43	2.2	3.8	3.1	0.7	0.6
Total	217	37	72	101	81	1209	1290	17	33	47	2.2	16.8	12.8	0.4	5.6

Table 1b	That year's subadults														
	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat			
Locality I	34	—	20	20	—	228	228	—	59	59	—	11.4	11.4	—	6.7
Locality II	28	—	7	7	—	23	23	—	25	25	—	3.3	3.3	—	0.8
Locality V	47	16	3	18	38	4	43	34	6	38	2.4	1.3	2.3	0.8	0.1
Total	109	16	30	45	38	255	293	15	28	41	2.4	8.5	6.5	0.3	2.3



Table 1c, d. Comparison of quantitative characteristics of invasion calculated for individual localities

<i>Clethrionomys glareolus</i>	No ani-		No invaded		No helminths		EI		MI		RD		
	mals	Tapew	Nemat	total	Tapew	Nemat	total	Tapew	Nemat	total	Tapew	Nemat	total
Locality I	5	—	4	4	—	53	53	—	80	80	—	13.3	13.3
Locality II	6	1	3	4	4	4	5	17	50	67	1.0	1.2	1.3
Locality V	30	4	10	13	5	18	23	13	33	43	1.3	1.8	1.8
Total	41	5	17	21	6	75	81	12	41	51	1.2	4.4	3.9

	Previous year's animals	
	MI	RD
Locality I	—	—
Locality II	2.6	41.7
Locality V	2.3	4.1
Total	2.3	1.6

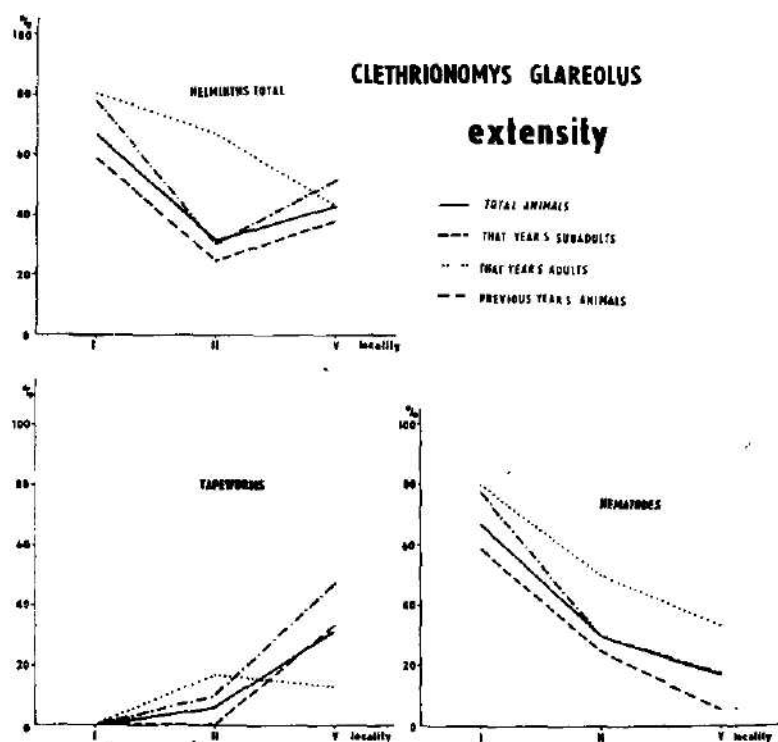
vasion of small rodents at the successive stages of spoil bank development and in the surrounding biotopes from which the rodents had apparently migrated, and (2) to investigate in these biotopes the tapeworm-to-nematodes ratio in the helminth fauna of the individual hosts.

#### MATERIAL AND METHODS

The material described in Jirouš 1985 was used in this study (see Materials, methods).

The 1979 and 1980 results were evaluated together. Development of the helminth fauna of small rodents in the process of their migration from their natural biotopes to the spoil banks was followed. The following migration patterns were observed: *C. glareolus* migrated from natural forest (Locality I) along the brook (Locality II) to the afforested spoil bank (Locality V); *M. arvalis* migrated from the meadow biotopes and vicinity of the brook (Locality II) to the newly formed spoil bank (Locality III), its populations then developing on the spoil bank with natural succession (Locality IV) or the afforested spoil bank (Locality V); *A. sylvaticus* migrated from natural forest (Locality I) and vicinity of brook (Locality II) to the newly formed spoil bank (Locality III), its populations subsequently developing on the spoil bank with natural (spontaneous) succession (Locality IV) or afforested spoil bank (Locality V).

To compare the helminth fauna of hosts at the different localities, the following quantitative characteristics of invasion were used: (1) extensity of invasion (EI), or the percentage of infested host individuals out of the total captured; (2) mean intensity of invasion (MI), or the mean helminth count per invaded host; (3)



Graph 1. Extensity of helminths invasion in *Clethrionomys glareolus*.

relative density of invasion (RD), or the mean helminth count per host trapped; (4) the ratio of individuals invaded by tapeworms to individuals invaded by nematodes.

## RESULTS

### Development of quantitative characteristics of helminths:

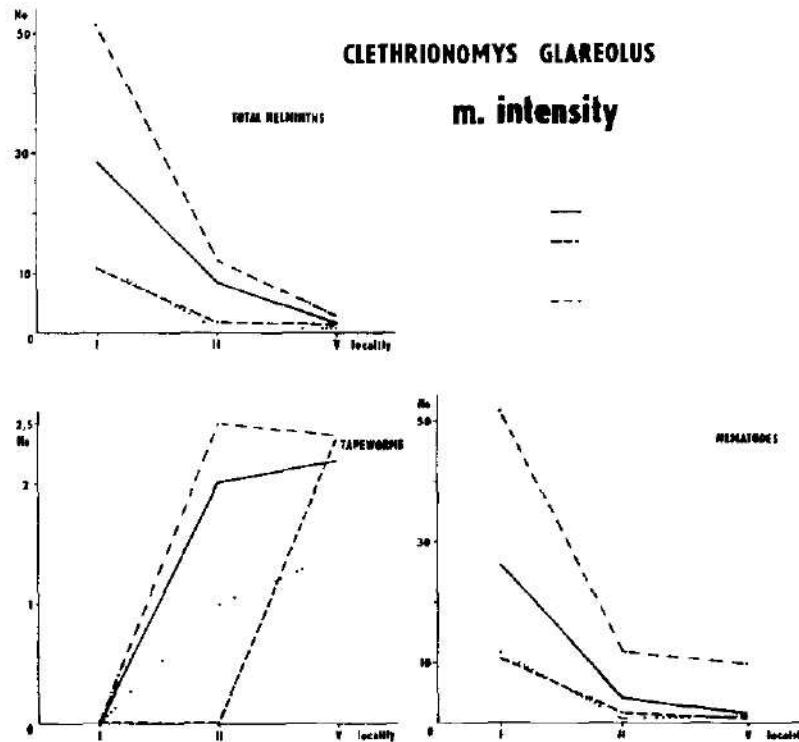
#### *Clethrionomys glareolus* (Tables 1a—1d)

This species was studied in three localities:

natural forest (Locality I), banks of brook (Locality II), and afforested spoil bank (Locality V).

Extensivity of invasion (EI): (Graph 1a)

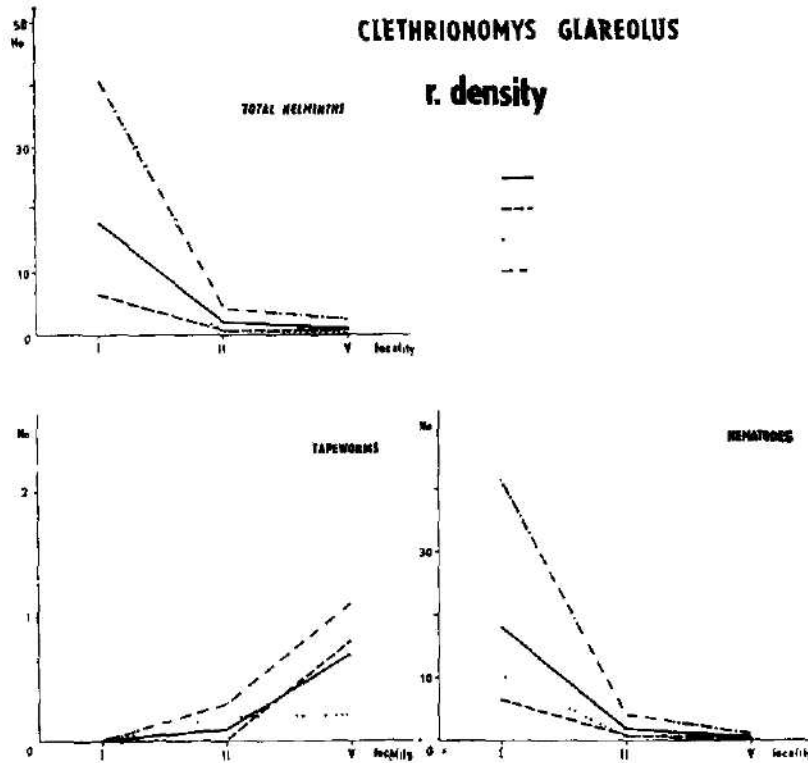
The highest EI value for intestinal helminths (67%) was found at the natural-forest locality. The EI dropped to one half (31%) on the banks of the brook. The afforested spoil bank again exhibited a higher EI value (43%). Similar trends were observed in the individual age categories. The only exception was the EI value for adults born in the year of observation ("that year's adults") on the afforested spoil bank, being lower than at the other two localities.



Graph 2. Mean intensity of helminths invasion in *Clethrionomys glareolus*.

Mean intensity of invasion (MI): (Graph 2a)

The highest MI values were found in natural forest (27.2 helminths). At the near-brook locality, the MI value dropped abruptly to one fourth of the previous MI value (6.8 specimens), to drop again to one half of the near brook value (3.1) at the afforested spoil bank. The same trends was observed in all age categories.



Graph 3 Relative density of helminth invasion in *Clethrionomys glareolus*.

Relative density of invasion (RD): (Graph 3a)

This characteristics showed the same trend as MI. The highest RD value was obtained for natural forest (18.1 helminths), a substantially lower value (2.1) for banks of brook and a still lower value (1.3) for afforested spoil bank. Again, all age categories showed a similar trend.

Evaluation of all the localities in sum showed age related differences in all the quantitative characteristics of invasion followed. The EI value was highest in previous year's animals (52%), one percent lower (51) in that year's adults and lowest (41%) in that year's subadults. The highest MI and RD values were found in previous year's individuals (26.2 and 13.7 helminths, respectively), lower in that year's subadults (6.5 and 2.7, respectively) and lowest in that year's adults (3.9 and 2.0, respectively).

Table 2c, d. Comparison of quantitative characteristics of invasions calculated for individual localities

<i>Microtus arvalis</i>	No ani- mals		No invaded		No helminths		EI		MI		That year's adults		RD			
	Tapew	Nemat	total	Tapew	Nemat	total	Tapew	Nemat	total	Tapew	Nemat	total	Tapew	Nemat	total	
Locality II	19	6	11	14	9	87	96	32	58	74	1.5	7.9	6.9	0.5	4.6	5.1
Locality III	6	1	6	6	7	118	125	17	100	100	7.0	19.7	20.8	0.2	19.7	19.7
Locality IV	23	13	5	16	40	29	69	57	22	70	3.1	5.8	4.3	1.7	1.3	3.0
Locality V	14	12	1	12	31	1	32	86	7	86	2.6	1.0	2.7	2.2	0.07	2.3
Total	62	32	23	48	87	235	322	52	37	77	2.7	10.2	6.7	1.4	3.8	5.2

Table 2d	Previous year's animals	
	Tapew	Nemat
Locality II	123	56
Locality III	12	6
Locality IV	51	43
Locality V	20	18
Total	206	123

Table 2d	Previous year's animals	
	Tapew	Nemat
Locality II	139	80
Locality III	16	10
Locality IV	240	22
Locality V	122	6
Total	517	118

Table 2a, b. Comparison of quantitative characteristics of invasions calculated for individual localities

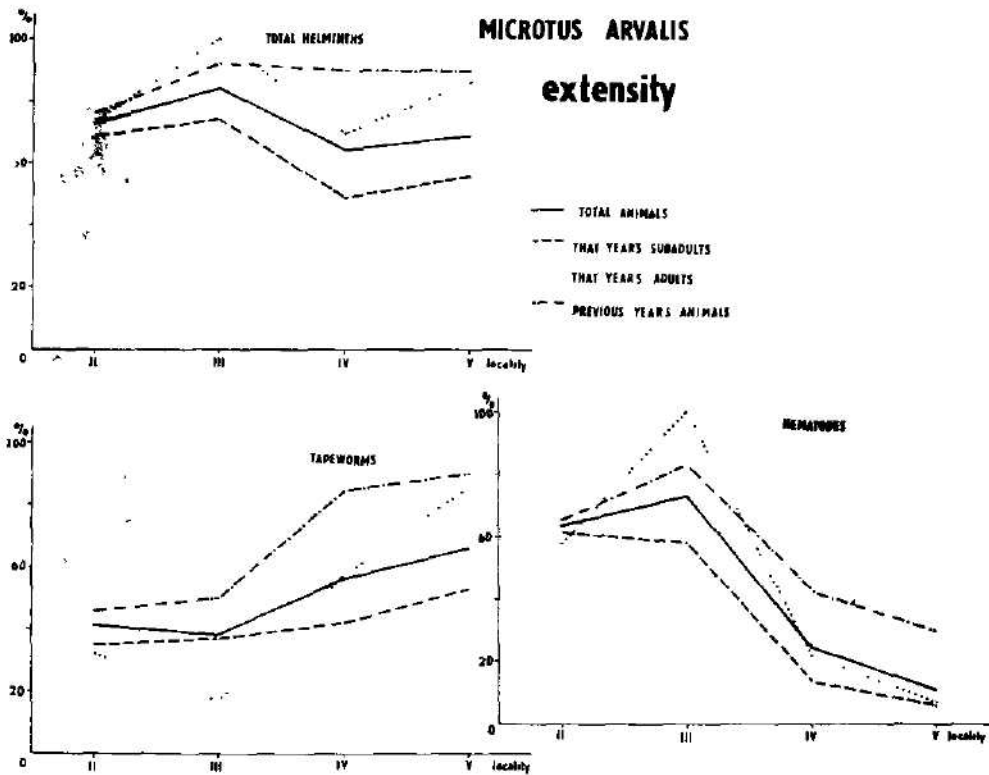
<i>Microtus arvalis</i>	No amimals		No invaded		No helminths		EI		MI		RD					
	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat				
Locality II	213	87	134	156	191	1641	1832	41	63	73	2.2	12.2	11.7	0.9	7.7	8.6
Locality III	37	14	27	31	32	289	321	38	73	94	2.3	10.7	10.4	0.9	7.8	8.7
Locality IV	174	89	41	111	375	142	517	56	24	64	3.8	3.5	4.7	2.2	0.8	3.0
Locality V	89	59	10	61	243	12	255	66	11	69	4.1	1.2	4.2	2.7	0.1	2.9
Total	513	258	212	359	841	2084	2925	50	41	70	3.3	9.8	8.1	1.6	4.1	5.7

	That year's subadults	
	Tapew	Nemat
Locality II	71	25
Locality III	19	7
Locality IV	100	42
Locality V	55	29
Total	245	103

*Microtus arvalis* (Tables 2a—2d)

This species was studied at four locality types: meadows (Locality II), newly formed spoil bank (Locality III), spoil bank after 25 years of natural development (Locality V).



Graph 4. Extensity of helminths invasion in *Microtus arvalis*

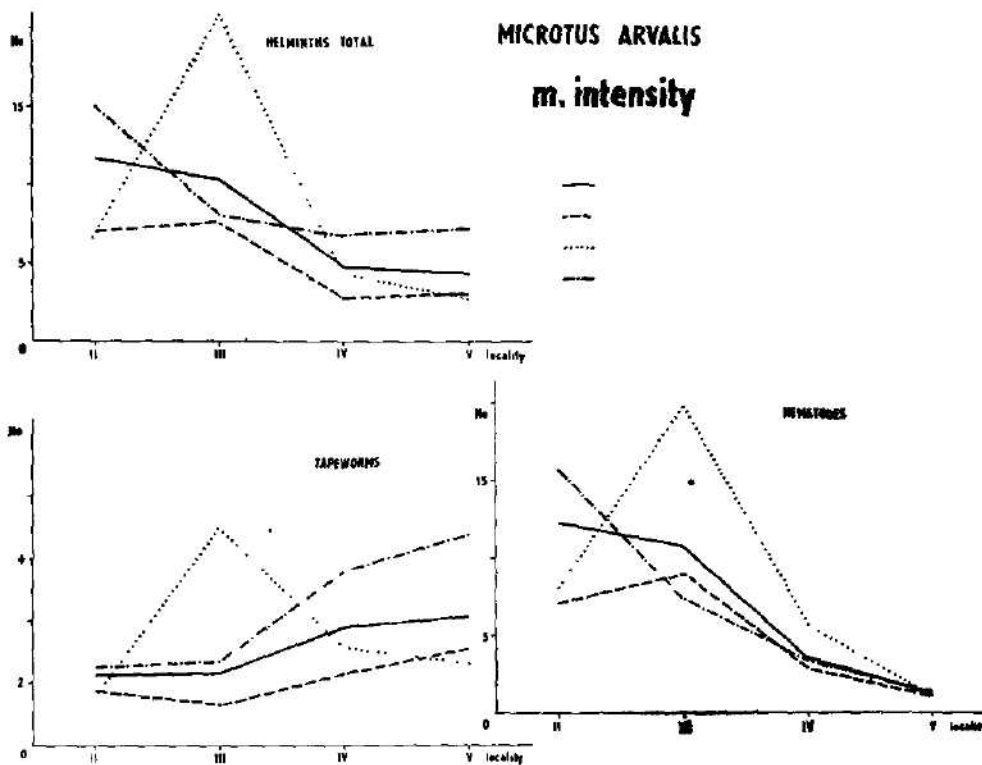
Extensity of invasion (EI): Graph 4a)

The meadow biotopes displayed the second highest EI value (73%). A higher percentage was found on the new dump (84%). The naturally developing spoil bank had a much lower EI value (64%); the EI value for the afforested spoil bank was moderately higher (69%). All age categories exhibited a similar trend as the group as a whole. The only exception were previous year's animals on the naturally developing spoil bank; their EI value was on roughly the same level as those on the new and the afforested spoil banks instead of being lower as in the other age categories.

Mean intensity of invasion (MI): (Graph 5a)

The highest MI value (11.7 helminths) was found at the meadow biotopes. A slightly lower MI value was found on the new spoil bank (10.4 helminths), half this value on the naturally developing spoil bank (4.7 helminths) and the affo-

rested spoil bank (4.2 helminths). These separate age categories also showed a decrease in MI values running from the meadow biotopes down to the afforested spoil bank. This general trend was only different in that year's adult hosts on the new formed spoil bank.



Graph 5. Mean intensity of helminths invasion in *Microtus arvalis*.

Relative density of invasion (RD): (Graph 6a)

This quantitative characteristic had a similar trend as MI. The RD values were on comparable levels in hosts from the meadow biotopes (8.6 helminths) and the new spoil bank (8.7), but dropped to 1/3 on the naturally developing spoil bank (3.0) and the afforested spoil bank (2.9). The individual age categories displayed similar tendencies, again with the exception of that year's adults.

Evaluation of all the localities as a whole showed age-related differences in the quantitative characteristics. The highest EI, MI and RD values were found in previous year's animals (82%, 11.5 and 9.3 helminths, respectively). Lower values were obtained for that year's adults (77%, 6.7 and 5.2 helminths, respectively) and the lowest values for that year's subadults (58%, 4.7 and 2.8 helminths, respectively).

*Apodemus sylvaticus* (Tables 3a-3d)

This species was studied on five types of locality: natural forest (Locality I),



Table 3c, d. Comparison of quantitative characteristics of invasions calculated for individual localities

<i>Apodemus sylvaticus</i>	No anti-mals		No invaded		No helminths		EI		MI		RD	
	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat
Locality I	5	—	5	5	—	141	—	100	—	28.2	—	28.2
Locality II	22	6	20	20	83	1393	27	91	13.8	69.7	67.1	63.3
Locality III	58	3	48	48	4	1892	5	83	1.3	39.4	39.6	32.6
Locality IV	13	2	8	9	4	235	15	62	2.0	29.4	26.5	18.1
Locality V	29	2	23	23	4	568	7	79	1.5	24.7	24.8	19.7
Total	127	13	104	105	94	4229	10	82	7.2	40.7	41.2	33.3

	Previous year's animals	
	Tapew	Nemat
Locality I	—	—
Locality II	9.2	127.6
Locality III	1.7	127.1
Locality IV	1.0	65.6
Locality V	2.0	80.4
Total	4.5	80.2

+1 = + 4 *Plagiorchis* sp.  
+3 = + 12 *Plagiorchis* sp.

Table 3a, b. Comparison of quantitative characteristics of invasions calculated for individual localities

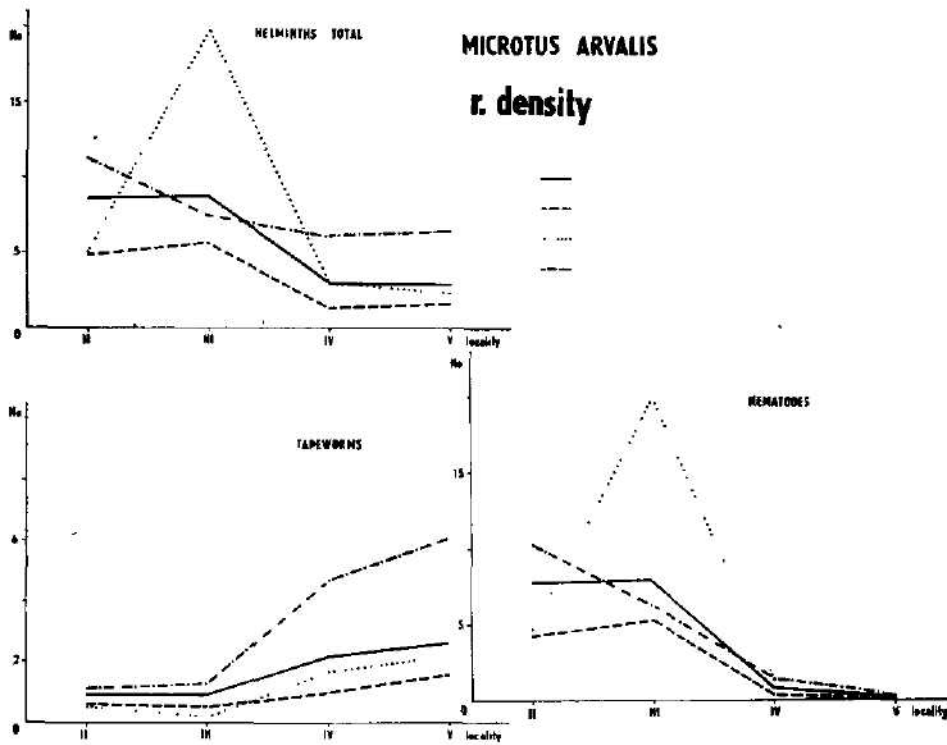
<i>Apordeus sylvaticus</i>	No ani- mals		No invaded		No helminths		EI		MI		RD				
	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat			
Locality I	31	22	22	22	—	1266	—	71	71	—	57.5	57.5	—	40.8	40.8
Locality II	117	108	108	108	145	9136	9281	15	92	8.5	84.6	85.9	1.2	78.0	79.3
Locality III	320	270	272	272	19	13669	13692 <sup>+1</sup>	3	84	2.4	50.6	50.3	0.06	42.7	42.8
Locality IV	71	49	52	52	18	2113	2131	14	69	1.8	43.1	41.0	0.3	29.8	30.0
Locality V	228	193	196	196	15	11592	11619 <sup>+2</sup>	5	85	1.4	60.1	59.3	0.06	50.8	51.0
Total	767	642	650	650	197	37776	37989	6	84	4.3	58.8	58.4	0.3	49.3	49.5

Table 3b

Locality	That year's subadults														
	No ani- mals	No invaded	No helminths	EI	MI	RD	Tapew	Nemat	Tapew	Nemat	Tapew	Nemat			
Locality I	17	9	104	53	11.6	11.6	—	53	53	—	11.6	11.6	—	6.1	6.1
Locality II	59	54	3482	92	64.2	64.5	10	92	92	2.7	64.2	64.5	0.3	58.7	59.0
Locality III	89	67	1561	75	23.1	23.0	2	75	76	5.0	23.1	23.0	0.1	17.4	17.5
Locality IV	34	23	273	68	11.9	12.4	18	68	68	2.0	11.9	12.4	0.4	8.0	8.4
Locality V;	72	40	804	64	17.5	16.5	8	64	68	1.0	17.5	16.5	0.1	11.2	11.3
Total	271	203	6198	73	31.1	30.7	7	73	75	2.2	31.1	30.7	0.2	22.9	23.0
Total	271	199	6198	73	31.1	30.7	7	73	75	2.2	31.1	30.7	0.2	22.9	23.0

<sup>+1</sup> = + 4 *Plagiorchus* sp.<sup>+2</sup> = + 12 *Plagiorchus* sp.

banks of brook (Locality II), newly formed spoil bank (Locality III), spoil bank after 25 years of natural development (Locality IV) and afforested spoil bank (Locality V).



Graph 6. Relative density of helminths invasion in *Microtus arvalis*.

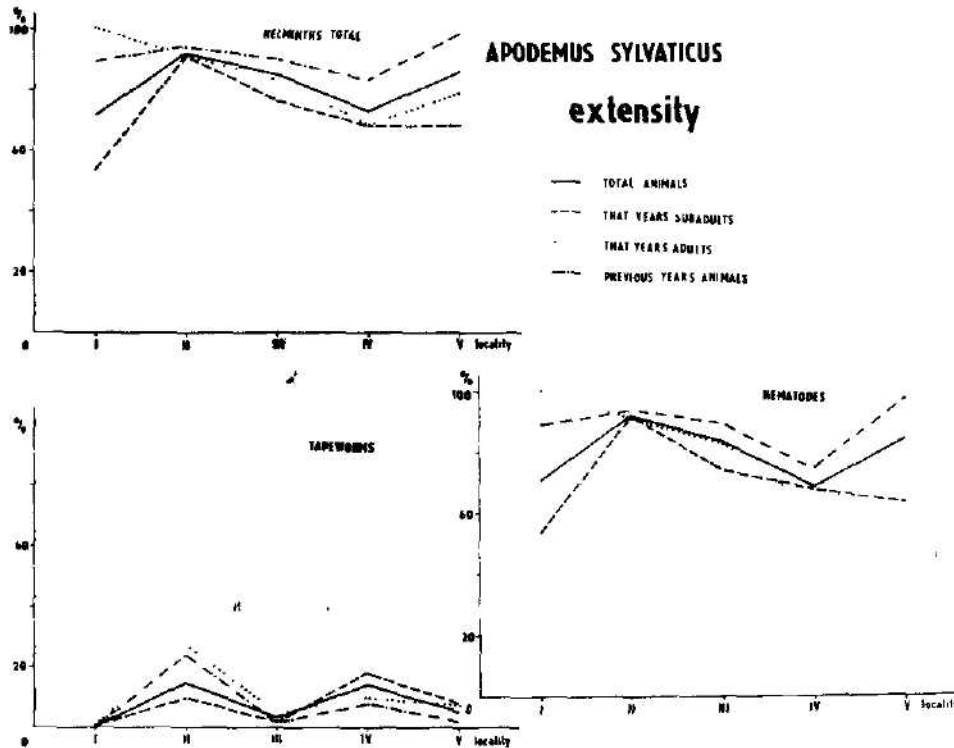
Extensity of invasion (EI): (Graph 7a)

The lowest percentage of invaded individuals (71%) was found in natural forest, the highest (92%) near the brook and on the meadow biotopes. The EI value on the new spoil bank was somewhat lower (85%) and natural spoil bank development appeared to be attended by a further decrease in EI value, which after 25 years amounted to 73%. The afforested spoil bank had the same level of EI (86%) as the new spoil bank. All age categories of the hosts showed similar trends.

Mean intensity of invasion (MI): (Graph 8a)

Natural forest displayed an intermediate MI value (57.5 helminths), brook banks and meadows biotopes the highest MI value (85.9 helminths), the new spoil bank a lower MI value than natural forest (50.3 helminths), the naturally developing spoil bank the lowest MI value of all the environments (41.0 helminths), whereas the MI value of the afforested spoil bank (59.3 helminths) was comparable to that of the natural forest. That year's animals had MI

values similar to the overall (age-nonrelated) values. Previous year's animals showed two deviations from the general trend. While that year's animals had the MI values substantially lower in natural forest than on brook banks and meadows biotopes, previous year's animals had these values almost equal. Moreover, previous year's animals had the MI value higher on the naturally developing spoil banks, than on the new spoil bank, whereas in that year's individuals this relationship was reversed.



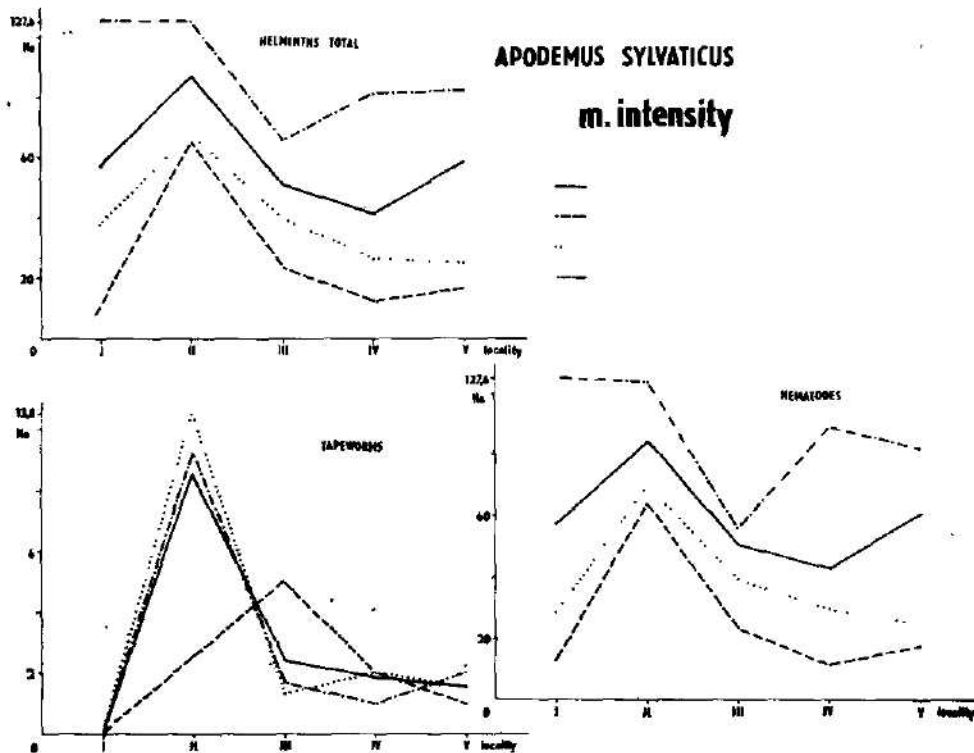
Graph 7. Extensivity of helminths invasion in *Apodemus sylvaticus*.

Relative density of invasion (RD): (Graph 9a)

This quantitative characteristics showed a similar trend as MI: natural forest had an intermediate RD value (40.8 helminths), brook banks and meadows biotopes the highest (73.9 helminths), the new spoil bank 42.7 helminths, the naturally developing spoil bank the lowest RD value (30.0 helminths) and the afforested spoil bank a value of 51.0 helminths. As in the case of MI, two age related values diverged from the general trend: previous year's animals exhibited high values in natural forest and the naturally developing spoil bank.

Similar to the preceding two host species, *A. sylvaticus* taken as a summary collection from all the localities studied showed age-related differences in quantitative-characteristic value. The EI value was highest in previous year's animals (93%), lower in that year's adults (83%) and lowest in that year's

subadults (75%). The MI and RD values were also highest in previous year's animals (80.2 and 74.3 helminths, respectively), lower in that year's adults (41.2 and 34.1 helminths, respectively) and lowest in that year's subadults (30.7 and 23.0 helminths, respectively).



Graph 8. Mean intensity of helminths invasion in *Apodemus sylvaticus*.

Quantitative representations of tapeworms in relation to nematodes in the helminth faunas of the individual host species

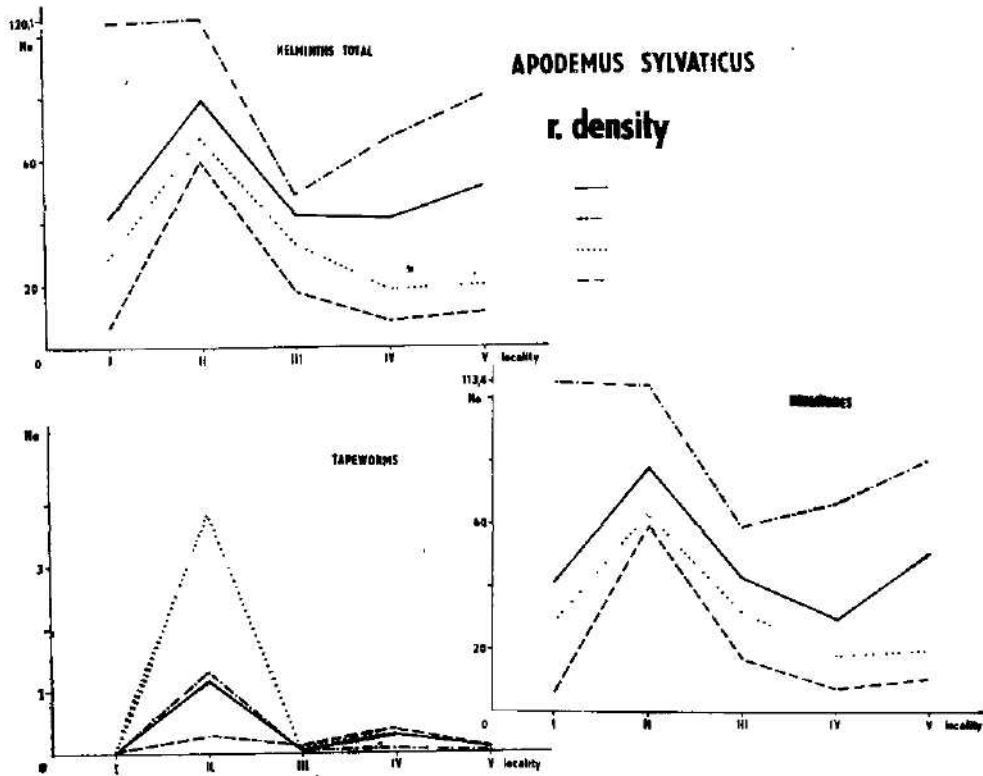
*Clethrionomys glareolus*:

Extensity of invasion (EI): (Graphs 1b, c)

Tapeworms were not encountered at all in natural forest, at a 6% EI near the brook and a 32% EI on the afforested spoil bank. On the other hand, natural forest showed the highest EI value for nematodes (67%). The EI value for nematodes dropped to a half (30%) near the brook and a more 17% on the afforested spoil bank. All age categories showed the same trends in EI values both for tapeworms and nematodes. The only deviation was the EI value for that year's adult rodents invaded by tapeworms on the afforested spoil bank. This value was comparable to that for the banks of the brook, while in the other age categories it was much higher.

Mean intensity of invasion (MI): (Graphs 2b, c)

Tapeworms were not found in natural forest. The MI values for the site lining the brook and the afforested dump were, respectively, 2.0 and 2.2 tapeworms per animal. Natural forest, on the contrary, displayed the highest mean nematode invasion value (27.2 nematodes), whereas the MI for the banks of the brook equalled one fourth of this (6.8 nematodes) and the MI for the afforested spoil bank was lower still (3.8 nematodes). All age categories displayed the



Graph 9. Relative density of helminths invasion in *Apodemus sylvaticus*.

same trends in tapeworm and nematode invasion, except that, on the banks of the brook the mean tapeworm invasion value was somewhat higher in previous year's animals than what would correspond with the general trend in the other age categories.

Relative density of invasion (RD): (Graphs 3b, c)

This quantitative characteristic exhibited the same trends as MI. The tapeworm RD value for the site near the brook was 0.1 and for the afforested spoil bank 0.7 tapeworms. The highest nematode RD value was found in natural forest (18.1 nematodes), a much lower value was found along the brook (2.0 nematodes) and the lowest on the afforested spoil bank (0.3 nematode). All age categories of this host showed a similar trend.

The ratio between individuals invaded by tapeworms and nematodes was in favour of nematodes on the sites other than spoil banks (natural forest and banks of brook 0:38 and 1:5.3, respectively) and in favour of tapeworms on the afforested spoil bank (1.9:1). That year's subadults and all age categories of previous-year's animals showed the same relationship, while that year's adults displayed a ratio in favour of nematodes in all three localities (0:4, 1:3, 1:2.5).

*Microtus arvalis:*

Extensivity of invasion (EI): (Graphs 4b, c)

After colonization of the new spoil bank by *M. arvalis*, its EI by tapeworms decreased somewhat, from 41% (meadow biotopes and banks of brook) to 38%. However, the EI by tapeworms rose to 56% on the naturally developing spoil bank and 66% on the afforested spoil bank. On the other hand, the EI by nematodes rose somewhat on colonization of the new spoil bank, viz. from an original 63% (meadow biotopes and banks of brook) to 73%. The naturally developing spoil bank and the forest-recultivated spoil bank displayed EI by nematodes equal to only 24% and 11%, respectively. The same trends were seen in all age categories.

Mean intensity of invasion (MI): (Graphs 5b, c)

The MI by tapeworms was on the same level in meadow biotopes and on the new spoil bank (2.2 and 2.3 tapeworms, respectively). The naturally developing spoil bank and the afforested spoil bank displayed higher MI values: 3.8 and 4.1, respectively. The MI by nematodes was somewhat lower (10.7 nematodes) on the new spoil bank than on the meadow biotopes and along the brook (12.2 nematodes), and decreased during dump development to a value of 3.5 nematodes on the naturally developing spoil bank and 1.2 nematode on the afforested spoil bank. As regards age-related MI values, the only exception from the overall trend were high values for intensity of invasion of that year's adults by both tapeworms and nematodes on the new spoil bank.

Relative density of invasion (RD): (Graphs 6b, c)

The RD values for tapeworms were the same on meadow biotopes along the brook and on the new dump (0.9 tapeworms), but the values had risen in the course of spoil bank development to 2.2 and 2.7 on the naturally developing and the afforested spoil bank, respectively. The RD values for nematodes were also equal on the meadow biotopes, along the brook and on the new spoil bank (7.7, 7.8), but, in contrast to tapeworms, they had decreased during dump development and reached 0.8 nematode on the naturally developing spoil bank and 0.1 nematode on the afforested one. All age categories of the host exhibited similar trends. The only exception was a high RD value for nematodes in that year's adults on the new spoil bank.

It was thus found that the ratio of tapeworm-invaded to nematode-invaded animals was in favour of nematodes at the other-than-spoil bank localities and on the new spoil bank (1:1.5 and 1:1.9) but that it was in favour of tapeworms on the older spoil banks (2.4:1, and 5.9:1 on the naturally developing and the afforested spoil bank, respectively). This phenomenon was observed without exception also for each age category of the host.

*Apodemus sylvaticus:*

Extensivity of invasion (EI): (Graphs 7b,c)

The EI by tapeworms was highest along the brook and on the meadow biotopes (15<sup>0</sup>/<sub>0</sub>). The EI value was lower on the new dump (3<sup>0</sup>/<sub>0</sub>) and again rose to the original level (14<sup>0</sup>/<sub>0</sub>) following natural spoil bank development. It was lower (5<sup>0</sup>/<sub>0</sub>) on the afforested dump. The EI by nematodes was 71<sup>0</sup>/<sub>0</sub> in the natural forest, was highest (92<sup>0</sup>/<sub>0</sub>) on the meadow biotopes, decreased somewhat (to 84<sup>0</sup>/<sub>0</sub>) following migration of the host to the new spoil bank, was lower still (68<sup>0</sup>/<sub>0</sub>) on the naturally developing spoil bank but not so on the afforested spoil bank (85<sup>0</sup>/<sub>0</sub>). The same trends were observed in all host age categories, with the exception of that year's nematode invaded subadults on the afforested spoil bank, this EI value being somewhat lower than on the naturally developing spoil bank.

Mean intensity of invasion (MI): (Graphs 8b,c)

The highest MI value for tapeworms was found on meadow biotopes and on the banks of the brook (8.5 tapeworms). This value decreased to 1.4 (2.4 tapeworms) on the new spoil bank and even more so on the naturally developing spoil bank (1.8) and the afforested spoil bank (1.4). The MI value for nematodes was 57.5 in the natural forest, rising highest (84.6 nematodes) on the meadow biotopes and along the brook and decreasing to 50.6 nematodes on the newly formed spoil bank and 43.1 nematodes on the naturally developing spoil bank, to rise again (60.1 nematodes) on the afforested spoil bank. Some host age categories showed exceptions from the general trends. These relate to that year's subadults invaded by tapeworms on the new and the afforested spoil bank, the previous year's animals invaded by tapeworms on the afforested spoil bank, the previous year's animals invaded by nematodes on the naturally developing spoil bank, and that year's adults invaded by nematodes on the afforested spoil bank.

Relative density of invasion (RD): (Graphs 9b,c)

This quantitative characteristics of invasion displayed the same trend as MI. Accordingly, the highest RD value for tapeworms was found along the brook and on the meadow biotopes (1.2 tapeworm), lower values were found on the new spoil bank (0.06 tapeworm), the naturally developing spoil bank (0.3 tapeworm) and the afforested spoil bank (0.06 tapeworm). The RD values for nematodes were 40.8 in natural forest, 78.0 along the brook and on meadow biotopes, 42.7 on the new spoil bank, 29.8 on the naturally developing dump and 50.8 on the afforested spoil bank. The only age-related exception from the general trends was the RD value for nematodes in previous year's animals on the naturally developing spoil bank; this value was higher than the corresponding value for the species in general.

DISCUSSION

The penetration of small rodents onto spoil banks is accompanied by changes in the quantitative characteristics of their invasion by intestinal helminths. In all the host species, the extensivity of invasion (invasion rate) EI was lower on the older spoil banks investigated (one after 25 years of natural



development and one afforested) than on biotopes beyond the spoil bank area. In *C. glareolus*, a decrease in EI was observable even on migration from natural forest to the banks of a brook. Kisielewska observed a similar decrease in *C. glareolus* EI by helminths following introduction of specimens from the Bialowieska primeval forest onto a lake island of the Mazury system (Kisielewska 1970a). The EI values was lower in both introduced individuals and their island-born-progeny. In both her and our case a population had migrated or had been transferred from a natural forest into another, less favourable biotope. The difference in EI value was apparently in both instances due to the different conditions for both helminth and host development in the new locality.

The level of parasitism in relation to the age composition of the host population has been studied by many authors. Adult individuals always displayed a higher extensity of invasion than did subadult or juvenile animals (Kisielewska 1971; Prokopič et al., 1973; Feliu 1980; etc.). In our materials, the highest quantitative characteristics of helminth invasion were also found in previous year's animals, lower values being found in that year's adults and the lowest in that year's subadults. It is thus probable that the intensity of invasion by helminths is largely due to the period for which the host has been exposed to the risk of invasion. This probably explains why younger animals are first invaded by nematodes (a greater number of infectious stages in the environment) and only later by tapeworms (smaller number of infectious stages in the environment; Tenora 1976. However this mutual relation between age of host and invasion by nematodes or tapeworms is probably not absoluted. In our material this relation was found in *C. glareolus* and *M. arvalis* and localities other than spoil banks. There, that year's subadult animals were invaded by tapeworms less frequently than that year's and the previous year's adults, but this was not the case on the older spoil banks.

Quantitative characteristics of invasion by tapeworms were higher on the older spoil banks than at localities other than spoil banks. In all the host species the increase in invasion by tapeworms was accounted for by members of the family Anoplocephalidae. Since these tapeworms are biohelminths, one of the factors limiting their prevalence in hosts might be the occurrence of intermediate hosts. The prevalence of intermediate hosts may be influenced by number of local conditions or factors, both primary and anthropogenic or anthropic. In this connexion one could speculate in our case on the potential influence of intensive soil agriculture at the localities other than spoil banks (Jirouš, in press). The older spoil banks also displayed a decrease in the rates of rodents invaded by nematodes. One possible explanation might be the existence of interspecies competition between nematodes and tapeworms as described by Courtney and Forrester 1973.

This study suggests that the development of communities of some organisms on Most-Basin spoil bank may be proceeding in a somewhat different direction than in the surrounding areas. This assumption would have to be proved by further investigation. It might possibly also be taken into consideration in planning economic activities on these ever newly emerging elements of the landscape.

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Author's address: RNDr. Jan Jirouš, CSc., Institut hygieny a epidemiologie, Šrobárova 48, 100 42 Praha 10, Czechoslovakia.

De la Laboratoire de la Biologie d'Evolution de l'Académie Tchèqueoslovaque  
des Sciences

**LA CONTRIBUTION A L'AVIFAUNE DE HAMMAMET, TUNISIE**

Jiří MLIKOVSKÝ et Renata MLIKOVSKÁ

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**Abstract.** In June 1983, the bird fauna living in the Hammamet region in north-eastern Tunisia was studied. Three urban species, 19 species typical for macchia, and 2 species inhabiting open areas were observed. For the first time breeding of the Tree Sparrow (*Passer montanus*) in Africa is recorded.

Au mois de Juin 1983 (9.—22. VI.), à l'occasion de notre voyage en Tunisie, nous avons passé plusieurs jours en observant les oiseaux à Hammamet et dans ses environs. Vu le fait que l'avifaune de la Tunisie n'est pas très connue (cf. Etchécopar et Hùe 1964), nous présentons ici les résultats de nos observations.

La ville de Hammamet se trouve sur la côte Nord-Est de la Tunisie (le Sud du Cap Bon), coordonnées: 36°24'N, 10°37'E. Le climat de la région est sub-tropical, influencé par la Mer Méditerranée. Du point de vue géographique, le Cap Bon est situé dans la sous-région méditerranéenne de la Palearctis. Au cours de notre séjour à Hammamet, il faisait toujours du soleil ainsi que du vent de la mer, à savoir de l'Est, les températures du jour étant de 30 °C environ.

Nous avons distingué trois biotopes dans la région observée: à savoir le territoire urbain, la macchie, et les espaces ouverts à caractère sémi-désertique.

Le biotope urbain occupait la plus petite superficie du territoire observé, c'était seulement au centre historique de Hammamet, à la Médina, et dans ses environs les plus proches. L'habitat était formé principalement par les maisons à deux étages construites en style tunisien. Les oiseaux qui vivaient dans ce territoire pouvaient être considérés comme urbanisés.

La macchie méditerranéenne typique s'étendait sur une grande partie du territoire observé. Elle était inviolablement couverte par des bâtiments, à savoir par des hôtels, par des villas, et par des maisons basses occupées par les villageois résidants. A l'égard de ce fait, les oiseaux vivant dans cette région pouvaient être considérés comme tolérants envers l'homme. Comme nous n'avons pas eu l'occasion de comparer, nous ne pouvons pas dire si les oiseaux de cette région peuvent être considérés comme synanthrophes dans toute l'acceptation du mot.

Le reste du territoire observé était formé par des espaces ouverts à caractère sémi-désertique épars irrégulièrement dans la macchie.

Les oiseaux du biotope urbain

Martinet noir (*Apus apus*): Abondant.

Martinet pâle (*Apus pallidus*): Plus abondant que *Apus apus* ayant ses nids dans les murailles de la Forteresse de Hammamet. Nous n'avons pas eu l'occasion d'observer les relations écologiques entre les deux espèces, mais nous n'avons trouvé aucune différence entre les espaces où ils attrapent les insectes.

Moineau espagnol (*Passer hispaniolensis*): Très abondant, de nombreux nids dans les arbres, et beaucoup de jeunes qui ont déjà quitté les nids se retrouvaient dans la cour de la Forteresse.

#### Les oiseaux de la macchie :

Tourterelle des bois (*Streptopelia turtur*): Rare.

Tourterelle maillée (*Streptopelia senegalensis*): Abondante, quelques mâles chantaient encore.

Chouette chevêche (*Athene noctua*): Au moins 3 ex. observés.

Chouette holotte (*Strix aluco*): La voix d'un ex. a été entendue plusieurs fois au cours des nuits du 15 au 16 et du 16 au 17 Juin.

Martinet noir (*Apus apus*) et Martinet pâle (*Apus pallidus*): Les deux espèces ont été souvent observés dans l'espace aérien de la macchie. On ne peut pas les considérer comme les espèces qui y résident.

Huppe puput (*Upupa epops*): Seulement en survolant la macchie.

Hirondelle de cheminée (*Hirundo rustica*): Abondante, survolant bas au-dessus de la macchie.

Hirondelle de fenêtre (*Delichon urbica*): Rare, survolant bas au-dessus de la macchie

Fauvette mélanocéphale (*Sylvia melanocephala*): Abondante, particulièrement les mâles ont été observés, quelques uns chantaient.

Gobe-mouche gris (*Muscicapa striata*): Abondant, le 19. VI. nous avons vu trois jeunes qui venaient de quitter leur nid.

Agrobate roux (*Erythropygia galactotes*): Rare.

Merle noir (*Turdus merula*): Relativement abondant.

Mésange bleue (*Parus caeruleus*): Relativement abondante, de nombreux jeunes qui ont récemment quitté le nid.

Pinson des arbres (*Fringilla coelebs*): Abondant.

Chardonneret (*Carduelis carduelis*): Abondant, quelques jeunes qui venaient de quitter le nid.

Verdier (*Carduelis chloris*): Abondant, quelques jeunes qui venaient de quitter le nid.

Linotte mélodieuse (*Carduelis cannabina*): Rare.

Serin cini (*Serinus serinus*): Relativement abondant.

Moineau espagnol (*Passer hispaniolensis*): Très abondant.

Moineau friquet (*Passer montanus*): Le 19. VI., devant l'Hôtel Grand, nous avons trouvé une colonie des moineaux friquets. Considéré selon le comportement des adultes, les nids ont été placés dans les murs d'un vieux puits. Il n'était pas possible de contrôler l'état des nids. En utilisant le code international de l'Atlas des Oiseaux Nicheurs il s'agissait d'une nidification certaine N° 14. Le nombre de nids a été estimé entre 5 et 10. A ce que nous savons, cette découverte est la première constatation prouvée de la nidification de cet espèce en Afrique (cf. Etchécopar et Hùe 1964. Deckert 1968, K e v e 1978). Nous ne connaissons pas l'origine géographique de *Passer montanus* tunisien; la population la plus proche vit en Sicile (K e v e 1978) qui

se trouve à une distance de 130 km de l'Afrique (à savoir du Cap Bon). Egalement, nous n'avons pas pu déterminer la sous-espèce à laquelle les moineaux friquets tunisiens appartiennent, mais ceux-ci qui s'étendent à travers des îles méditerranéennes (Steinbacher 1960, Moltoni 1964, Sultana 1969, Gauci et Sultana 1971) appartiennent selon Keve (1978) à la sous-espèce *Passer montanus hispaniae* von Jordans 1933. Il est donc bien probable que c'est la même sous-espèce qui vit en Tunisie. Il n'était pas possible de déterminer depuis quand les moineaux friquets y nidifiaient parce qu'il y manquent des données antérieures sur l'avifaune de ce domaine-là. Comme nous n'avons observés les moineaux friquets dans aucune autre région, et comme leur extension à travers les îles méditerranéennes n'est prouvée qu'à partir des années 1950-1960 (Steinbacher 1960, Moltoni 1964, Sultana 1969, Gauci et Sultana 1971), nous supposons qu'il s'agit d'une colonisation récente.

Etourneau unicolor (*Sturnus unicolor*): Abondant.

En plus, cette région comprend les oiseaux domestiques suivants: Pintade sauvage (*Numida meleagris*), Paon (*Pavo cristatus*), Oie cendrée (*Anser anser* f. *domestica*), Poule (*Gallus gallus* f. *domestica*), Pigeon biset (*Columba livia* f. *domestica*), et Dindon (*Meleagris gallopavo* f. *domestica*).

#### Les oiseaux des espaces ouverts à caractère sémi-désertique:

Huppe puput (*Upupa epops*): 3 ex. observés.

Cochevis huppé ou Cochevis de Thékla (*Galerida cristata* vel *Galerida theklae*): Abondant.

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Adresses des auteurs: Jiří Mlíkovský, Laboratoire de la Biologie d'Evolution, Académie Tchécoslovaque des Sciences, Na Folimance 5, CS - 120 00 Praha 2, Tchécoslovaquie.

Renata Mlíkovská, Práčská 1884, CS - 106 00 Praha 10, Tchécoslovaquie.

Institute of Parasitology, Czechoslovak Academy of Sciences, Prague  
Hokkaido Fisheries Experimental Station, Kushiro

**ICHTHYOFILARIA JAPONICA SP. N. (PHILOMETRIDAE) AND SOME OTHER  
NEMATODES FROM MARINE FISHES FROM HOKKAIDO, JAPAN**

František MORAVEC and Kazuya NAGASAWA

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**Abstract.** In 1980 and 1981, samples of some marine fishes were collected from Hokkaido, Japan, which were examined for helminths. In addition to other parasites recovered, 9 species of nematodes were found of which one, *Ichthyofilaria japonica* sp. n. from the abdominal cavity of *Sebastes schlegeli*, proved to be new for science. The collection has included five species of adult nematodes (*Ichthyofilaria japonica* sp. n., *Ascarophis pacifica*, *A. japonica*, *Cucullanus incertus* and *Hysterothylacium aduncum*) and five species parasitizing fishes or larvae (*Hysterothylacium aduncum*, *H. fabri*, *Anisakis simplex*, Raphidascaridinea gen. sp. and *Cucullanus* (?) sp.); most of them have been briefly described and illustrated. Some problems concerning their taxonomy and geographical distribution have also been discussed.

Although there is an extensive Japanese and Soviet literature dealing with helminths from the marine fishes of Japan and adjacent area, the present knowledge about the composition of the nematode fauna of fishes from the seas of the Far East is still rather poor. The situation is complicated by many taxonomic problems resulting mainly from inadequate species descriptions which often make the identification of these parasites very difficult. In the autumn of 1980 and 1981, the second author (K. N.) had an opportunity to examine helminthologically several species of marine fishes collected from three localities (Shikabe, Otobe and Kushiro) along the coast of Hokkaido in Japan. Since the nematodes recovered have represented interesting findings, mainly from the viewpoint of taxonomy and zoogeography, results of their systematic evaluation are presented in this paper. The nematodes were fixed in 70% alcohol and, for examination, they were cleared with glycerine. All specimens (except for one paratype of *I. japonica* sp. n.) have been deposited in the collections of the Meguro Parasitological Museum in Tokyo. In the following review of the species encountered the measurements are given in mm.

REVIEW OF SPECIES

Fam. Philometridae Baylis et Daubney, 1926

1. *Ichthyofilaria japonica* sp. n. (Fig. 1)

Host: *Sebastes schlegeli* (fam. Scorpaenidae).

Localization: abdominal cavity.

Locality: Otobe, Hokkaido (20 November 1980).

Specimens: Meguro Parasit. Mus. coll. no. 19433 (holotype and 9 paratypes) and Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice, coll. n. N 154 (1 paratype).

Description: Male: unknown.

Female (6 specimens) (measurements of holotype in brackets): Body of gravid female cylindrical, whitish, with smooth cuticle; head end narrowed, bottle-shaped, posterior end conical. Length of body 22.02–28.19 (22.20), maximum width 0.394–0.462 (0.408), width at mid-length of narrowed anterior portion 0.082–0.136 (0.082). Mouth aperture small, spherical. Head end provided with four lobe-like dorso- and ventrolateral projections, each of them containing

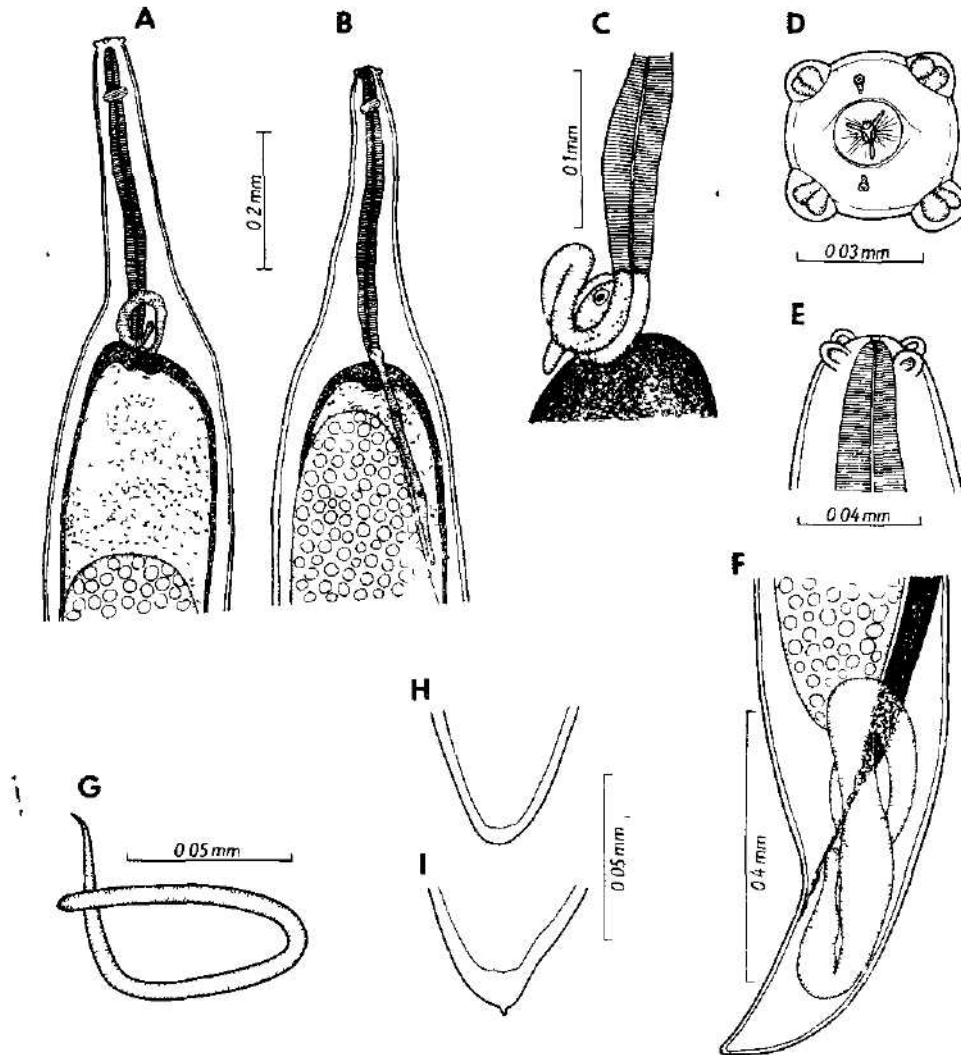


Fig. 1. *Ichthyofilaria japonica* sp. n. — gravid female. A, B — anterior end of body; C — junction of oesophagus and intestine; D, E — head end, apical and lateral views; F — posterior end of body; H, I — termination of posterior end of body; G — body shape of larva from female uterus. (A, F, H — holotype; B, C–E, G, I — paratypes).

double pappilla, and one pair of small lateral amphids. Height of head projections 0.006—0.012 (0.006). Oesophagus narrow, almost cylindrical, without head bulb; oesophagus of larger specimens moderately expanded at two sites. Almost whole oesophagus muscular, only its narrowed posterior end covered with oesophageal gland with long free appendix; latter mostly turned up or lengthened posteriorly along intestine. Length of entire oesophagus 0.476—0.598 (0.517), its maximum width 0.030—0.039 (0.030); length of posterior glandular portion of oesophagus 0.054—0.060 (0.060), length of glandular appendix 0.240—0.405 (0.240), its maximum width 0.018 (0.018). Oesophagus opening into intestine through distinct valves. Nerve ring encircling muscular oesophagus 0.102—0.126 (0.102) from anterior extremity. Intestine nontranslucent, markedly wide at its anterior end; posterior end of intestine slender, changing into ligament attached to ventral wall of body; intestine beginning near oesophagus end anteriorly and ending approximately at uterus end level. Uterus containing eggs, developing embryos and larvae; body length of larvae 0.195—0.207 (—), their maximum width 0.006 (0.006). Anterior ovary strongly reduced, practically absent, posterior ovary cylindrical, forming coils filling in considerable part of postuterine space; distance of posterior ovary end from body end 0.177—0.748 (0.177). Posterior end of body conical, with rounded tip, only in largest specimen with small distinct terminal cuticular point.

Comments: — The overall morphology of these nematodes, particularly the structure of oesophagus, shows the appurtenance of these parasites to the so far monotypic genus *Ichthyofilaria* Yamaguti, 1935 (see Rashied, 1963; Ivashkin et al., 1971; Chabaud, 1975). From the type species of the genus, *I. dasycotti*, described from the abdominal cavity of a cottid *Dasycottus setiger* also from Japan (Yamaguti, 1935), these nematodes markedly differ in possessing four conspicuous head projections, which are absent in *I. dasycotti*; additional differences between the two species concern mainly the shape and length of the oesophageal gland appendix, size of the rudimentary anterior ovary, length of the posterior ovary and distance of the intestine end from the end of body. Moreover, the hosts of these species are members of different fish families (Scorpaenidae versus Cottidae). From these reasons, we consider the nematodes from *S. schlegeli* to be members of an independent, hitherto undescribed species for which the name *I. japonica* sp. n. is now proposed.

Another philometrid species, *Philometra mariae* Layman, 1930, has been reported from the conspecific host fish (*S. schlegeli*) from the Japan Sea. This species differs expressively both in its morphology and measurements from *I. japonica* sp. n. Layman (1930) described it evidently from specimens found in the fins of pleuronectid fishes *Protopsetta herzensteini* (= *Cleisthenes pine-torum herzensteini*) and *Limanda schrenki*. He also reported it from the ovary of *Sebastes schlegelii* (= *Sebastes schlegeli*) but, in this case, the nematodes might be misidentified and they were probably conspecific with *I. japonica* sp. n. *Ph. mariae* appears to be the parasite of subcutaneous connective tissue of fishes of the family Pleuronectidae only (see e. g. Layman, 1930; Zhukov, 1960; Machida, 1970). According to Machida (1970), *Ph. mariae* belongs to the genus *Clavinema*.



Fam. Cystidicolidae (Skrjabin, 1946, subfam.)

2. *Ascarophis pacifica* Zhukov in Spassky et Rakova, 1958 (Fig. 2 A—D)

Syn.: *Ascarophis pacificus* Zhukov, 1960; *A. curilica* Zhukov, 1960.

Host: *Hexagrammos otaki* (fam. Hexagrammidae)

Localization: stomach.

Locality: Shikabe, Hokkaido (28 November 1980).

Specimen: Meguro Parasit. Mus. coll. no 19440 (1 ♀).

Description of female: Length of body 18.99, maximum width 0.176. Cuticle thick, with dense transverse striation, length of striae being 0.005—0.006; striation indistinct at both body ends. Mouth provided with two lateral pseudolabia, each bearing terminal tooth 0.005 long. Four small, simple cephalic papillae and pair of lateral amphids present. Vestibule 0.180 long, in lateral view forming distinct funnel-shaped prostom 0.018 long and 0.015 wide. Length of muscular oesophagus 1.06, width 0.021, length of glandular one 4.53, width 0.054. Distance of nerve ring and excretory pore from anterior extremity 0.258 and 0.336, respectively. Tail conical, 0.132 long, without distinct terminal projection. Vulva postequatorial, situated 7.59 from posterior end of body. Mature eggs oval, thick-walled, size 0.057—0.060 × 0.027—0.030; its wall 0.005 thick. Both egg poles bearing small polar cap; one pole provided with two long, fairly thick filaments, while opposite one bearing one thick, long and one thin, short filaments. Mature eggs embryonated.

Comments: — Only one female nematode was found whose morphology and measurements indicate its appurtenance to the species *A. pacifica*, as it has been described by Spassky and Rakova (1958), Zhukov (1960) and Pozdnyakov and Solovieva (1981); the present specimen differs from these descriptions of *A. pacifica* in having a somewhat longer tail, which can be considered as intraspecific variability. By the shape of tail it rather resembles *A. curvicauda* Zhukov, 1960, a species described from congeneric hosts (*Hexagrammos*) of the same region, but the eggs of the latter bear at one pole, besides the two long filaments, several fine, short additional filaments. However, it cannot be excluded that the differences in the structure of eggs are only within the framework of intraspecific variability and that, accordingly, both these forms are conspecific. Fishes of the family Hexagrammidae have been named among the hosts of both *A. pacifica* and *A. curvicauda*. This question can be elucidated only on the basis of study of more numerous materials. *H. otaki* is a new host record for *A. pacifica*.

*A. pacifica* was established by Zhukov (1960) on the basis of specimens from fishes of various orders (Rajiformes, Scorpaeniformes, Perciformes and Gadiformes) from the area of the Japan Sea and the South Kurile shallow waters; but a description of this species, designated as "*A. pacificus* Zhukov", had been given as early as in 1958 by Spassky and Rakova (1958), who based it on their own materials from fishes from the region of Komondor Islands. Later this species was reported from scorpaeniform and gadiform fishes from Far East by Tsimbalyuk' et al. (1970), Hasegawa (1978) and Pozdnyakov and Solovieva (1981); the latter authors synonymized with it the species *A. curilica* Zhukov, 1960. According to Tsimbalyuk et al. (1970), some crustaceans, mainly amphipods (*Anisogammarus*) but also isopods (*Idothea*) and decapods (*Pagurus*), serve as the intermediate hosts of *A. pacifica*.

3. *Ascarophis japonica* Zhukov, 1960 (Fig. 2 E—G)

Host: *Sebastes schlegeli* (fam. Scorpaenidae).

Localization: intestine.

Locality: Otobe, Hokkaido (20 November 1980).

Specimen: Meguro Parasit. Mus. coll. no. 19432 (1 ♀).

Description of female: Length of body 7.86, maximum width 0.095. Cu-

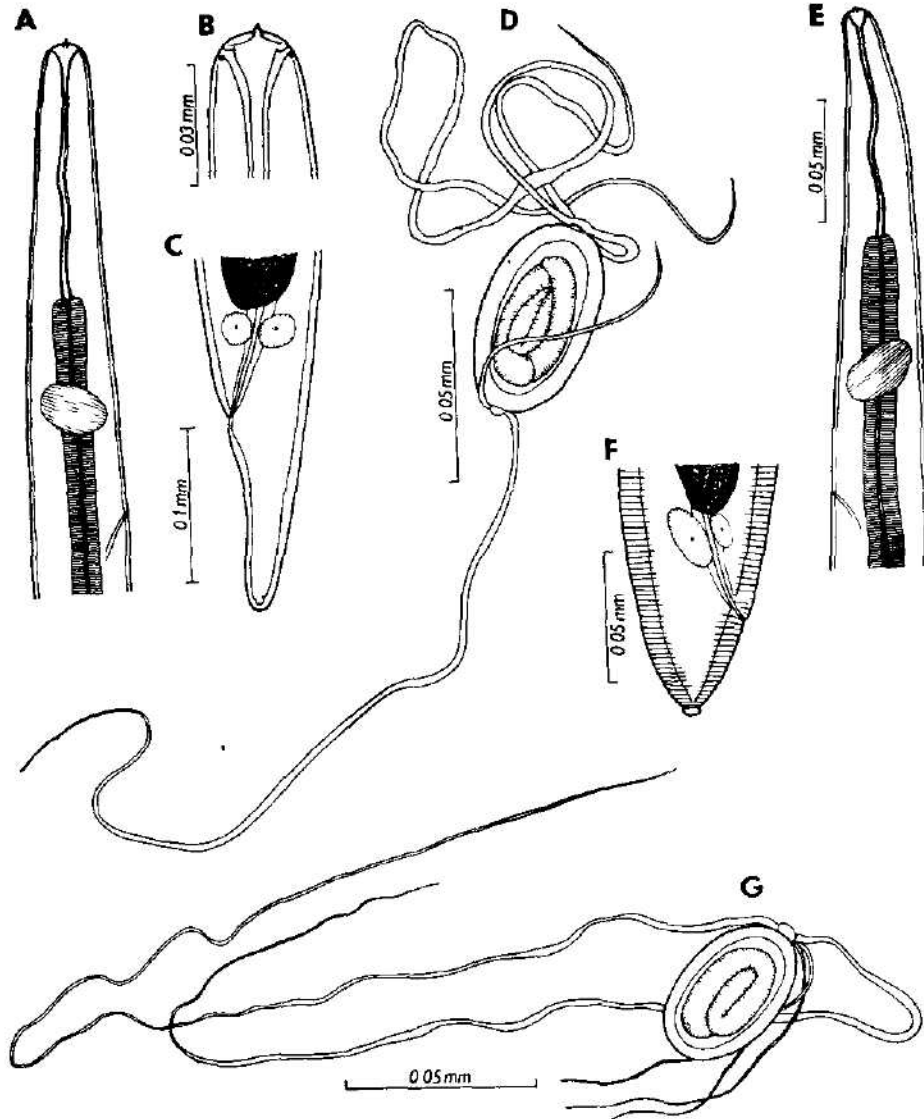


Fig. 2. A—D — *Ascarophis pacifica* (Zhukov in Spassky et Rakova, 1958) — female from *H. otaki* (A — anterior end of body; B — head end; C — tail; D — egg); E—G — *Ascarophis japonica* Zhukov, 1960 from *S. schlegeli* (E — anterior end of body, F — tail; G — egg).

ticle thick, with dense transverse striation, length of striae being 0.003; striation less distinct at anterior end. Mouth provided with two lateral pseudolabia, each of them bearing terminal tooth 0.003 long. Four small cephalic papillae and pair of lateral amphids present. Vestibule 0.099 long, in lateral view forming at its anterior end distinct funnel-shaped prostom 0.006 long and 0.006 wide. Length of muscular oesophagus 0.399, width 0.012, length of glandular one 2.37, width 0.033. Distance of nerve ring and excretory pore from anterior extremity 0.156 and 0.216, respectively. Tail conical, comparatively short, with knob-like projection at its tip: length of tail 0.039, that of caudal projection 0.003. Vulva postequatorial, situated 2.57 from posterior end of body. Mature eggs oval, thick-walled, size 0.045–0.048 × 0.027–0.030; egg wall 0.005 thick. One egg pole provided with polar cap and two long (0.36) filiform filaments and some four additional fine, short filaments; polar cap and filaments lacking on opposite pole. Mature eggs embryonated.

**Comments:** — A single female specimen was available whose morphology corresponded, on the whole, to the description of *A. japonica*; in contrast to the original description of this species, the specimen in study is noted for the generally smaller body measurements; the structure of eggs is typical of *A. japonica*.

*A. japonica* was described by Zhukov (1960) from scorpaenid fishes *Agonimalus jordani* and *Brachyopsis rostratus* (fam. Agonidae) from the Japan Sea (Putyatn Island). *S. schlegeli* is a new host record for this parasite species.

#### Fam. Cucullanidae Cobbold, 1864

#### 4. *Cucullanus incertus* Gendre, 1927 (Fig. 3)

**Host:** *Sebastes schlegeli* (fam. Scorpaenidae).

**Localization:** intestine.

**Locality:** Ootobe, Hokkaido (20 November 1980).

**Specimens:** Meguro Parasit. Mus. coll. no. 19430.

**Description:** Head end straight; mouth formed by two lateral valves, each of them bearing two mouth papillae and one amphid; margins of valves provided with narrow membraneous ala (collarete) and row of numerous minute teeth. Mouth opening slit-like. Cervical alae absent. Oesophagus muscular, expanded at anterior end to form pseudobuccal capsule; posterior end of oesophagus also somewhat expanded. Oesophagus opening into intestine through distinct valves. Excretory pore situated somewhat below nerve ring level. Slightly asymmetrical claw-shaped deirids present. Tail conical in both sexes. Male (2 specimens): Length of body 8.43–11.59, maximum width 0.204–0.272. Length of entire oesophagus 1.20–1.22, length of pseudobuccal capsule 0.219–0.288, its width 0.153–0.180. Distance of nerve ring from anterior extremity 0.435, of excretory pore 0.530–0.544, of deirids 0.993–1.006. Length of spicules 0.819 in smaller specimen, being indistinct in larger specimen. Moderately sclerotized gubernaculum 0.075–0.084 long seems to be present. Caudal papillae: 5 pairs of subventral preanal papillae present, of which two last pairs being close together; of 5 pairs of postanal papillae three pairs (first, third and fifth) subventral and two pairs (second and fourth) lateral; additional pair of small lateral papillae (outlets of phasmids) situated between second and third postanal pairs, 0.129–0.150 from posterior end of body. Ventral sucker

present in space between first and second pairs of preanal papillae. Length of conical tail 0.171—0.222.

**Female** (2 specimens): Length of body of females without eggs 8.36—15.42, maximum width 0.190—0.354. Length of entire oesophagus 1.16—1.54, length of pseudobuccal capsule 0.246—0.321, its width 0.159—0.213. Distance of nerve ring from anterior extremity 0.422—0.517, of excretory pore 0.530—0.680. of deirids 0.938—1.251. Tail narrow, conical, length 0.282—0.435; pair of small la-

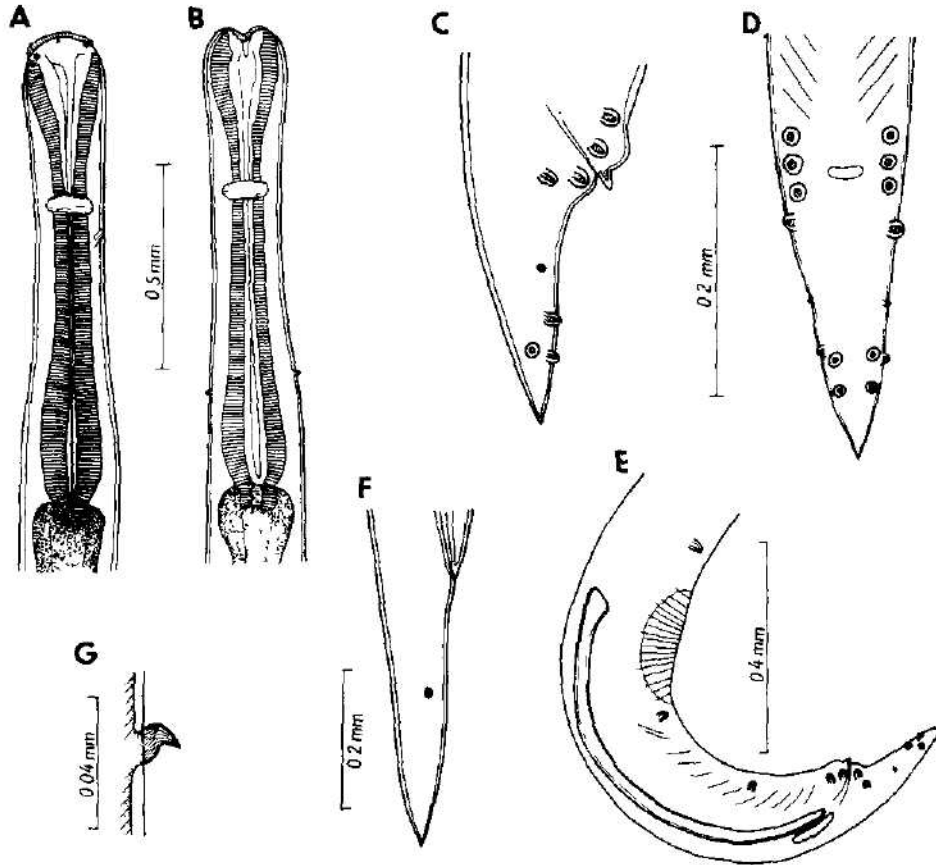


Fig. 3. *Cucullanus incertus* Gendre, 1927 from *S. schlegeli*, A, B — anterior end of male; C, D — tail of male, lateral and ventral views; E — posterior end of male; F — tail of female; G — deirid.

teral papillae (outlets of phasmids) present, being situated 0.162—0.246 from posterior end of body. Vulva postequatorial, 5.28—8.98 from anterior extremity; vulvar lips slightly elevating. Eggs absent from uterus.

**Comments:** — *C. incertus* was described from scorpaeniform fishes from the North Sea in Europe; from the region of Far East it was reported for the first time by Zhukov (1960) who recorded *C. incertus* from *Sebastes trivittatus* from the Japan Sea (Putyatin Island). In contrast to the descriptions of

*C. incertus* from Europe (Gendreau, 1927; Törnquist, 1931), our specimens from *S. schlegeli* are noted for somewhat different location of the excretory pore; however, this feature is often difficult to discern in members of *Cucullanus* and, therefore, a possibility of erroneous establishment of the excretory pore in the original description of this species cannot be excluded. Nevertheless, a detailed comparison of European and Asian specimens of *C. incertus*, based on more numerous materials, would be desirable.

5. *Cucullanus* (?) sp. — larva

Host: *Icelus spiniger* (fam. Cottidae).

Localization: abdominal cavity.

Locality: Shikabe, Hokkaido (28 November 1980).

Specimen: Meguro Parasit. Mus. coll. no. 19441.

Comments: — Only a fragment of larval nematode (posterior end of body) was obtained the morphology of which reminds juvenile specimens of the genus *Cucullanus*. It is possible that this larva is conspecific with the foregoing species.

Fam. Anisakidae (Railliet et Henry, 1912, subfam.)

6. *Hysterothylacium aduncum* (Rudolphi, 1802) (Fig. 4 A, B)

Syn.: *Ascaris adunca* Rudolphi, 1802; *Contracaecum benimasu* Fujita, 1932; *C. hippoglossi* Fujita, 1932; *C. hypomesi* Fujita, 1932; *C. ochotense* Fujita, 1932; *C. crassicaudatum* Fujita, 1939; *C. elongatum* Fujita, 1939; *C. longispiculum* Fujita, 1940; *C. mesopi* Fujita, 1940; *C. okadai* Fujita, 1940; *C. oshoroensis* Fujita, 1940; *C. saivelini* Fujita, 1940.

Hosts: adults including gravid females from intestine and stomach: *Cleisthenes pinetorum herzensteini* (fam. Pleuronectidae) and *Enophrys diceraus* (fam. Cottidae); larvae: *Cleisthenes pinetorum herzensteini* (Pleuronectidae) (intestine and abdominal cavity), *Neoditrema ransonneti* (Embiotocidae) (intestine) and *Sebastes steindachneri* (Scorpaenidae) (localization not determined).

Localities: Kushiro (*C. pinetorum herzensteini* — 21 October 1981) and Shikabe (*C. pinetorum herzensteini*, *E. diceraus*, *N. ransonneti* and *S. steindachneri* — 27 and 28 November 1980), Hokkaido.

Specimens: Meguro Parasit. Mus. coll. nos. 19429, 19435–38.

Comments: — Adult nematodes from *C. pinetorum herzensteini* and *E. diceraus* correspond both in their morphology and measurements (Table 1) to the description of *H. aduncum*, as it has been given by Moravec et al. (1985), who based it on materials from some freshwater and migratory fishes of Japan. A somewhat greater length of spicules in specimens from the first host (*C. pinetorum herzensteini*) is within the range of intraspecific variability of *H. aduncum* (see e. g. Hartwich, 1975). The larvae of *H. aduncum* from the abdominal cavity of *C. pinetorum herzensteini* and that from *S. steindachneri* measured 20–22 mm and morphologically they represented the fourth larval stage. The larva from the intestine of *N. ransonneti* was 7 mm long and it represented the advanced third larval stage (Fig. 4 A, B).

7. *Hysterothylacium fabri* (Rudolphi, 1819) — larva (Fig. 4 C–G)

Syn.: *Ascaris fabri* Rudolphi, 1819; *A. biuncinata* Molin, 1858; *Contracaecum naitoi* Fujita, 1932; *C. taii* Fujita, 1932.

Table 1. Comparison of measurements (in mm) of *H. adunum* from marine fishes of the present material and from *Salvelinus leucomaenis* of Lake Toro

Host	<i>Cleisthenes pinetorum kerszelskii</i> (present material)		<i>Etophyx diceraus</i> (present material)		<i>Salvelinus leucomaenis</i> (after Moravec et al. 1985)	
	♂♂	gr. ♀♀	♂	gr. ♀	♂♂	gr. ♀♀
Length of body	30.00—68.16	60.87—72.80	23.87	58.48	17.25—50.73	27.85—65.00
Width of body	0.530—1.088	0.979—1.455	0.558	1.292	0.326—0.680	0.544—1.496
Length of lips	0.135—0.231	0.258—0.272	0.129	0.231	0.078—0.090	0.114—0.195
Length of interlabia	0.054—0.095	0.095—0.109	0.054	0.095	0.030—0.039	0.045—0.084
Width of cervical alae	0.024				0.021—0.027	0.033—0.045
Length of oesophagus	2.65—5.64	5.29—7.41	3.06	5.64	2.19—3.24	2.92—4.83
Size of ventriculus	0.122—0.272	0.299—0.394	0.136 × 0.136	0.204 × 0.177	0.082—0.150	0.109—0.272
	×	×			×	×
Length of ventr. appendix	0.109—0.218	0.272—0.381			0.068—0.150	0.109—0.272
Length of intest. caecum	0.912—1.605	1.292—1.360	1.156		0.707—1.061	0.639—1.330
Distance of exer. pore	1.006—1.727	2.120—2.380	0.898	2.108	0.748—0.925	0.979—1.564
Distance of nerve ring	0.666—1.088	1.034—1.251	0.653	1.020	0.571—0.775	0.748—1.074
Length of tail	0.639—1.061	0.966—1.183	0.585	0.962	0.503—0.734	0.680—0.979
Pairs of preanal papillae	0.195—0.432	0.328—0.367	0.190	0.354	0.147—0.180	0.367—0.503
Pairs of postanal papillae	17—30	—	29	—	27—29	—
Length of spicules	5—8	—	6	—	6	—
Diameter of eggs	1.700—2.924	0.048—0.063	1.496	0.048—0.060	0.911—1.632	0.084—0.080

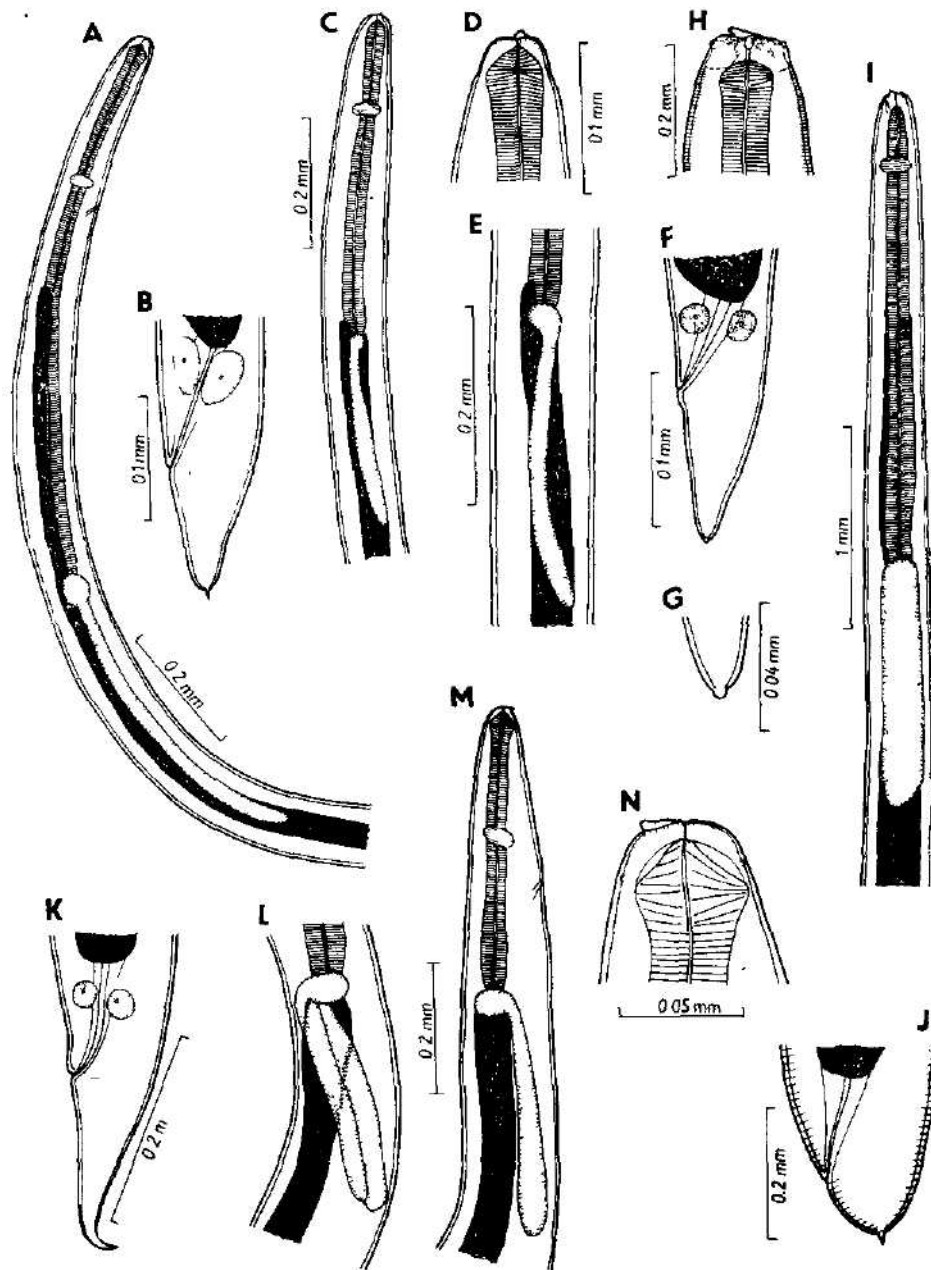


Fig. 4. A-B — *Hysterothylacium aduncum* (Rudolphi, 1802) — larva from *N. ransonneti* (A — head end; B — tail); C-G — *Hysterothylacium fabri* (Rudolphi, 1819) — larva from *Ph. maximowiczi* (C — anterior end of body; D — head end; E — region of ventriculus; F — tail; G — tip of tail); H-J — *Antisakis simplex* (Rudolphi, 1809) — larva from *T. chalcogramma* (H — head end; I — anterior end of body; J — tail); K-N — *Raphidascaridinea* gen. sp. larva from *S. schlegeli* (K — tail; L — region of ventriculus, ventral view; M — anterior end of body, lateral view; N — head end).

Host: *Physiculus maximowiczi* (fam. Moridae).  
Localization: intestine.  
Locality: Shikabe, Hokkaido (28 November 1980).  
Specimen: Meguro Parasit. Mus. coll. no. 19434.

Description (third-stage larva): Body whitish, with smooth cuticle. Length of body 3.13, maximum width 0.109. Anlagen of lips weakly developed; mouth papillae indistinct; boring tooth, 0.005 long, present. Excretory pore not established. Length of oesophagus 0.564; small, almost spherical ventriculus present. size  $0.027 \times 0.036$ . Length of ventricular appendix 0.300, length of anterior intestinal caecum 0.048. Intestine wide, light in colour. Nerve ring encircling oesophagus 0.172 from anterior extremity. Tail conical, 0.108 long, provided with knob-like projection 0.003 long.

Comments: — The only available larva corresponds by its morphology and measurements to the third-stage larva of *H. fabri*, as it has been described by Nikolaeva and Naidenova (1964). The species *H. fabri*, noted for the presence of a markedly short anterior intestinal caecum, was originally described from *Zeus faber* from the region of the Mediterranean Sea; conspecific larvae have been reported from this region from many species of marine fishes (see Janiszewska, 1949; Nikolaeva and Naidenova, 1964). The first record of this species from Far East is that of Zhukov (1960) who found adults and larvae of *H. fabri* in *Pneumatophorus japonicus*. According to Sheenko and Pozdnyakov (1981), also the larval forms described as *Contracaecum naitoi* Fujita, 1932, *C. taii* Fujita, 1932, *Contracaecum* sp. 1 in Yamaguti, 1935, 1941, *Contracaecum* sp. 1 A sensu Kagei et al., 1967 and *Thynnascaris* sp. 1 A sensu Koyama, 1974 belong to this species. Kagei et al. (1970) report these larvae (as *Contracaecum* sp. — Yamaguti — type I) from a number of species of Japanese marine fishes, including the type host, *Z. faber*. *Ph. maximowiczi* is a new host record.

#### 8. *Anisakis simplex* (Rudolphi, 1809) — larvae (Fig. 4 H—J)

Syn.: *Ascaris simplex* Rudolphi, 1809; *A. angulivalvis* Creplin, 1851; *A. bicolor* Baird in Murie, 1868; *A. kukenthalii* Cobb, 1889; *A. rosmari* Baylis, 1916; *A. similis* Baird, 1853; *Anisakis alata* Hsü, 1933; *A. catodontis* Baylis, 1929; *A. kogiae* Johnston et Mawson, 1939; *A. pegreffii* Campana-Rouget et Biocca, 1955; *A. tridentata* Kreis, 1938.

Host: *Theragra chalcogramma* (fam. Gadidae).  
Localization: liver.  
Locality: Shikabe, Hokkaido (28 November 1980).  
Specimen: Meguro Parasit. Mus. coll. no. 19439.

Description (third-stage larva): Two larvae obtained in the present study measure 28.53—31.55 in length, maximum width 0.544; cuticle with fine transverse striation. Excretory pore situated just below ventrally oriented boring tooth; latter 0.009 long. Anlagen of lips 0.045 long. Length of oesophagus 2.48—2.58, distance of nerve ring from anterior extremity 0.340—0.367. Ventriculus 1.32—1.36 long and 0.272 wide. Tail conical, 0.120—0.144 long, ending in sharp cuticular spike 0.021 long.

Comments: — The morphology of these larvae is identical with that of the larvae described by Moravec et al. (1985) from the Japanese migratory fish *Tribolodon hakonensis* from Lake Toro; according to Pippy and Banning (1975) this type of larvae belongs to the species *A. simplex* which is wide-



spread in the northern Pacific (see e. g. Oshima, 1972). Adult *A. simplex* are stomach parasites of marine mammals. Their larvae occur in various species of fishes, but also in crustaceans, cephalopods and other invertebrates and are known as the causative agents of human anisakiasis. According to Oshima (1972), these larvae (designated as *Anisakis* sp. Type I) currently occur in Pacific pollock (*Theragra chalcogramma*), the most important fish in the Japanese fishery, the prevalence often reaching 100 %.

9. *Raphidascaridinea* gen. sp. — larva (Fig. 4 K—N)

Host: *Sebastes schlegelii* (fam. Scorpaenidae).

Localization: intestine.

Locality: Otobe, Hokkaido (20 November 1980).

Specimen: Meguro Parasit. Mus. coll. no. 19431.

Description (female third-stage larva): Body whitish, cuticle with fine longitudinal striation, transverse striation absent. Length of body 5.30, maximum width 0.231. Anlagen of lips weakly developed; mouth papillae indistinct; ventral boring tooth present. Excretory pore situated below nerve ring level, 0.330 from anterior extremity. Oesophagus 0.489 long, its anterior end distinctly expanded. Size of ventriculus  $0.057 \times 0.066$ , length of posterior ventricular appendix 0.396, its width 0.054; in lateral view ventricular appendix appearing to be twofold inside (see Fig. 4L). Nerve ring encircling oesophagus 0.204 from anterior extremity. Intestine light in colour, with fairly rough granulation. Tail conical, 0.204 long, ending in sharp point. Cluster of tubular Anlagen of sexual glands present, being located approximately at mid-length of body; Anlage of vulva seems to be present slightly in front of it (1.17 from anterior extremity).

Comments: — The general morphology of the only larva obtained corresponds to the genera *Raphidascaris* or *Raphidascaroides*. In view of the fact that members of both these genera occur in marine fishes of this region (see e.g. Yamaguti, 1941), which can be distinguished from each other only by the presence or absence of the interlabia that are not developed in third-stage larvae, it is impossible to assign the larva in question to any of these two genera. Larvae designated *Raphidascaris* or *Raphidascaroides* spp. have been reported from marine fishes in Japan e. g. by Yamaguti (1935, 1941) and Ichihara (1968).

Acknowledgments

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Authors' addresses: F. Moravec, Institute of Parasitology, Czechoslovak Academy of Sciences, Branišovská 31, 370 05 České Budějovice, Czechoslovakia;  
K. Nagasawa, Hokkaido Fish. Exper. Station, 2—6, Hama-cho, Kushiro, Hokkaido 085, Japan.

Institute of Parasitology, Czechoslovak Academy of Sciences, Prague  
Hokkaido Fisheries Experimental Station, Kushiro

**SOME GASTROINTESTINAL NEMATODES OF THREE SPECIES OF PACIFIC SALMONS (*ONCORHYNCHUS* SPP.) FROM FRESH WATERS IN JAPAN**

František MORAVEC and Kazuya NAGASAWA

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**Abstract.** Helminthological examinations of three species of Pacific salmon (*Oncorhynchus masou*, *O. rhodurus* and *O. iwame*) collected from a number of rivers from all the main islands of Japan yielded some gastrointestinal nematodes the systematic evaluation of which is presented in this paper. A total of 4 species were recorded: *Rhabdochona oncorhynchi*, *Cystidicoloides ephemeridarum*, *Pseudocapillaria salvelini* and *Cystidicolidae* gen. sp. larvae. The last three species named were briefly described and illustrated. In addition to data expanding considerably the knowledge base on the distribution of these parasites on the territory of Japan, for some of them new hosts were also recorded: *O. rhodurus* for *C. ephemeridarum* and *P. salvelini*, and *O. iwame* for *R. oncorhynchi*. *P. salvelini* is a new record for Japan. Some problems concerning the taxonomy, hosts and geographical distribution of these nematodes are also discussed.

As it has already been mentioned by Margolis (1982), Pacific salmon (genus *Oncorhynchus*) constitute one of the most valuable fisheries resources in the North Pacific region. Besides the five species inhabiting both sides of the Pacific, there are three additional species on the Asian side. The species found only in Asia are *O. masou*, *O. rhodurus* and *O. iwame*, of which the first one is primarily anadromous, while the last two spend their entire life in fresh water; *O. masou* also forms a landlocked variety called "yamame" in Japanese.

In view of the great importance of Pacific salmon as a highly valuable food and sport fishes, it is not surprising that there is an extensive literature referring to their parasites. The parasitological studies have also been stimulated by attempts to apply the parasite-tag method for determining the freshwater areas of origin of salmon caught on the high seas of the North Pacific Ocean and adjacent seas. A detailed review of parasitological information concerning Pacific salmon has recently been provided by Margolis (1982).

Also in Japan many papers on the parasites of Pacific salmon and other salmonids were published, relating to both wild fish stocks and cultured fishes; data on the gastrointestinal nematodes of salmonids from the fresh waters of Japan are comprised in the contributions by Fujita (1921, 1922, 1927a, b, 1928, 1932, 1940), Yamaguti (1935, 1941), Fukui (1961), Seki (1975a, b), Moravec et al. (1981, 1985) and others. However, mainly due to a confused situation in the taxonomy of some groups of fish nematodes, the present knowledge about the species composition of the nematode fauna of Pacific salmon and other fishes in Japanese fresh waters as also on the distribution of these parasites on the territory of Japan is still inadequate. The present paper gives

an account of the gastrointestinal nematodes recorded by us from three species of Pacific salmon from various rivers in Japan in the years 1968—1980.

#### MATERIAL AND METHODS

Nematodes were collected by the second author (K. N.) in 1968—80 from a number of specimens of Pacific salmon belonging to three species: *Oncorhynchus masou* (Brevoort) (a landlocked variety called "yamame" in Japanese), *O. rhodurus* Jordan et McGregor ("amago" in Japanese) and *O. iwame* Kimura et Nakamura ("iwame"

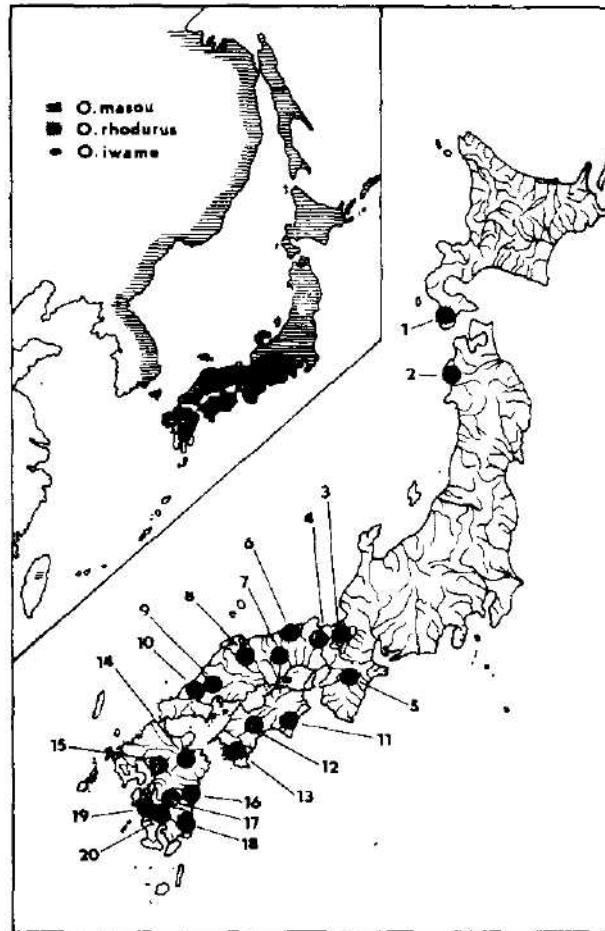


Fig. 1. Distribution of *Oncorhynchus masou*, *O. rhodurus* and *O. iwame* and a map of Japan showing the localities where the samples of Pacific salmon were taken. Hokkaido: 1 — Amano River; Honshu: 2 — Omine River, 3 — Ado River, 4 — Yura River, 5 — Yoshino River, 6 — Kishida River, 7 — Yoshii River, 8 — Takahashi River, 9 — Ota River, 10 — Takatsu River; Shikoku: 11 — Kaifu River, 12 — Niyodo River, 13 — Shimanto River; Kyushu: 14 — Ono River, 15 — Kikuchi River, 16 — Nanuki River, 17 — Oyodo River, 18 — Hiroto River, 19 — Komenotsu River, 20 — Sendai River.

in Japanese). These fishes were caught in 20 rivers from all the main islands of Japan (Hokkaido, Honshu, Shikoku, Kyushu) (Fig 1). The nematodes were fixed in 70% alcohol and for examination they were cleared in glycerine. All specimens have been deposited at the Meguro Parasitological Museum, Tokyo. In the following account of the species encountered, measurements are given in millimeters and the names of hosts are in accordance with those used by Nakamura (1975).

#### REVIEW OF SPECIES

Fam. Rhabdochonidae (Travassos, Artigas et Pereira, 1928, subfam.)

##### 1 *Rhabdochona oncorhynchi* (Fujita, 1921)

Syn. *Cystidicola oncorhynchi* Fujita, 1921, *C. fujii* Fujita 1921, *Rhabdochona salvelini* Fujita, 1927, *R. amago* Yamaguti, 1935, *R. oncorhynchi* Fujita, 1940

Hosts *Oncorhynchus masou*, *O. rhodurus*, *O. iwame*

Localization intestine, occasionally also stomach

Localities Honshu — Yura River Kyoto Pref (*O. masou* — date ?), Kishida River Hyogo Pref (*O. masou* — ?), Yoshino River, Nara Pref (*O. rhodurus* — ?), Takahashi River, Okayama Pref (*O. rhodurus* — 31 III 1980), Ota River, Hiroshima Pref (*O. rhodurus* — ?) Shikoku — Niyodo River, Ehime Pref (*O. rhodurus* — 19 IX 1980), Kyushu — Ono River, Oita Pref (*O. rhodurus*, *O. iwame* — 14 VIII 1969), Kikuchi River, Kumamoto Pref (*O. masou* — 10 V 1980), Nanuki River, Miyazaki Pref (*O. masou* — 19 IX 1968), Oyodo River Miyazaki Pref (*O. masou* — ?), Hiroto River, Miyazaki Pref (*O. masou* — 21 V 1968)

Specimens Meguro Parasit. Mus. coll. nos 19460–465, 19467, 19469–471, 19473–474

Comments — The morphology of nematodes from the present material fully corresponds to the description of this species as given by Moravec et al. (1981), since the redescription of *R. oncorhynchi* by the latter authors was based on specimens from Japan, we refrained from describing this species again in this paper. The present material of *R. oncorhynchi* comprised many adult and juvenile specimens, gravid females containing mature eggs were found in March, May, August and September.

This species was originally described by Fujita (1921) from fry of *Oncorhynchus keta* from Hokkaido. It was reported from Japanese salmonids also under the synonyms *R. fujii*, *R. salvelini* and *R. amago* (for details see Moravec, 1975, and Moravec et al., 1981). The principle hosts of *R. oncorhynchi* are various salmonid fishes of the genera *Oncorhynchus* (*O. keta*, *O. masou*, *O. nerka*, *O. rhodurus*), *Salmo* (*S. trutta*, *S. gairdneri*) and *Salvelinus* (*S. leucomaenis*, *S. fontinalis*, *S. malma*, *S. pluvius*), data on the findings of this parasite in fishes of other families (see e.g. Yamaguti, 1941, Belouss 1965) need to be verified. *O. iwame* is a new host record.

According to Moravec (1975) this species is widespread in fishes in Far East (Japan — Hokkaido, Honshu, USSR — Sakhalin, Kurile Is., Primorye, R. Kolyma basin) and probably it occurs also in Europe (Scotland); moreover, Butorina et al. (1980) have reported *Rhabdochona* sp. from *Salvelinus malma* from Kamchatka that may be conspecific with *R. oncorhynchi*. From Japan this species has so far been reported only from Hokkaido and Honshu (Fujita, 1921, 1927a, b, Yamaguti, 1935, 1941, Fukui, 1961, Moravec et al., 1981, 1985), also the nematodes designated *Rhabdochona* sp., found in salmonids from Hokkaido (Seki, 1975a, b), belonged probably to this species. Our material indicates that *R. oncorhynchi* is distributed practically over the whole territory of Japan, including the South-Japanese islands Shikoku and Kyushu.

The life cycle of *R. oncorhynchi* is not known so far, however, it can be presumed that some mayfly nymphs serve as its intermediate hosts

Fam Cystidicolidae (Skrjabin, 1946, subfam)

2 *Cystidicoloides ephemeridarum* (Linstow, 1872) (Fig. 2)

Syn. *Filaria ephemeridarum* Linstow, 1872, *F. ochracea* Linstow, 1894, *Ascaris tenuissima* Rudolphi, 1809 sensu Nufer, 1905 nec Zeder, 1800 *Spiroptera tenuissima* (Rudolphi, 1809) sensu Linstow, 1909, nec Zeder, 1800, *S. salvelini* Fujita, 1922, *Cystidicola harwoodi* Chandler, 1931, *Metabronema canadense* Skinner, 1931, *M. truttae* Baylis, 1935, *Spiroptera denticulata* (Rudolphi, 1809) sensu Dinulescu, 1942, nec Rudolphi, 1809, *Sterliadochona ssavini* Skrjabin, 1946, *S. pedispicula* Maggenti et Paxman, 1971

Hosts *Oncorhynchus masou*, *O. rhodurus*

Localization stomach and intestine

Localities Hokkaido — Amano River (*O. masou* — 20 IV 1980), Honshu — Omne River, Aomori Pref (*O. masou* — 25 VII 1978), Ado River, Shiga Pref (*O. rhodurus* — 1 VIII 1973), Yura River, Kyoto Pref (*O. masou* — ?), Yoshino River, Nara Pref (*O. rhodurus* — ?), Kishida River, Hyogo Pref (*O. masou* — ?), Takahashi River, Okayama Pref (*O. rhodurus* — 31 III 1980), Ota River, Hiroshima Pref (*O. rhodurus* — ?), Takatsu River, Shimane Pref (*O. masou* — 25 VIII 1980), Shikoku — Kaifu River, Tokushima Pref (*O. rhodurus* — 30 I 1979), Nivodo River Ehime Pref (*O. rhodurus* — 19 IX 1980), Shimanto River, Kochi Pref (*O. rhodurus* — 8 VIII 1976), Kvushu — Ono River Oita Pref (*O. rhodurus* — 14 VIII 1969), Kikuchi River, Kumamoto Pref (*O. masou* — 10 V 1980), Nanuki River Miyazaki Pref (*O. masou* — 19 IX 1968) Oyodo River, Miyazaki Pref (*O. masou* — ?), Komenotsu River, Kagoshima Pref (*O. masou* — 9 X 1972), Sendai River, Miyazaki Pref (*O. masou* — 31 III 1971), Hiroto River, Miyazaki Pref (*O. masou* — 21 V 1968)

Specimens Meguro Parasit Mus coll nos 19458–463, 19465–471, 19473–478.

Description (based on specimens from *O. masou*) Medium-sized, whitish nematodes with dense transverse striation of cuticle. Mouth provided with two small lateral pseudolabia typical of genus. Four small, dorso- and ventrolateral cephalic papillae present. Mouth aperture oval, dorsoventrally flattened. Very small deirids located at level of posterior half of vestibule length. Vestibule relatively long, well sclerotized, in lateral view forming small funnel-shaped prostom at its anterior end. Oesophagus distinctly divided into anterior muscular and posterior glandular portions. Nerve ring encircling muscular oesophagus near its anterior end, excretory pore situated somewhat below nerve ring level. Male (10 specimens) Length of body 6.15–8.11, maximum width 0.122–0.163. Length of vestibule 0.105–0.135, of muscular oesophagus 0.530–0.834, of glandular one 1.48–1.90. Nerve ring 0.132–0.195 from anterior extremity, excretory pore 0.186–0.279, deirids 0.087–0.117. Posterior end of body spirally coiled, provided with rather wide caudal alae. Caudal papillae 4 pairs of subventral pedunculated preanal papillae and 5 pairs of subventral pedunculated postanal papillae present, first and second pairs of postanals close together, additional pair of small ventral sessile papillae present at level of last subventral postanal pair. Cuticular ridges (area rugosa) present in front of cloaca. Spicules unequal, dissimilar. Larger (left) spicule 0.369–0.390 long, its distal end provided with cone-shaped cuticular membrane, length of its shaft 0.135–0.165. Smaller (right) spicule boat-shaped, 0.132–0.144 long, provided with ventral cuticular ala. Tail conical, 0.114–0.126 long, with rounded tip.

Female (10 specimens) Body length of gravid females 9.75–16.96, maximum width 0.150–0.299. Length of vestibule 0.129–0.147, of muscular

oesophagus 0.789—1.088, of glandular one 1.63—2.92. Nerve ring situated 0.176—0.218 from anterior extremity, excretory pore 0.190—0.272, deirids 0.093—0.114. Tail very short, rounded, length 0.060—0.069. Vulva postequatorial, 3.85—7.41 from posterior end of body. Uterus opposed. Eggs oval, thick-walled, with smooth surface; size of eggs 0.045—0.051 × 0.030. Mature egg containing already formed larva.

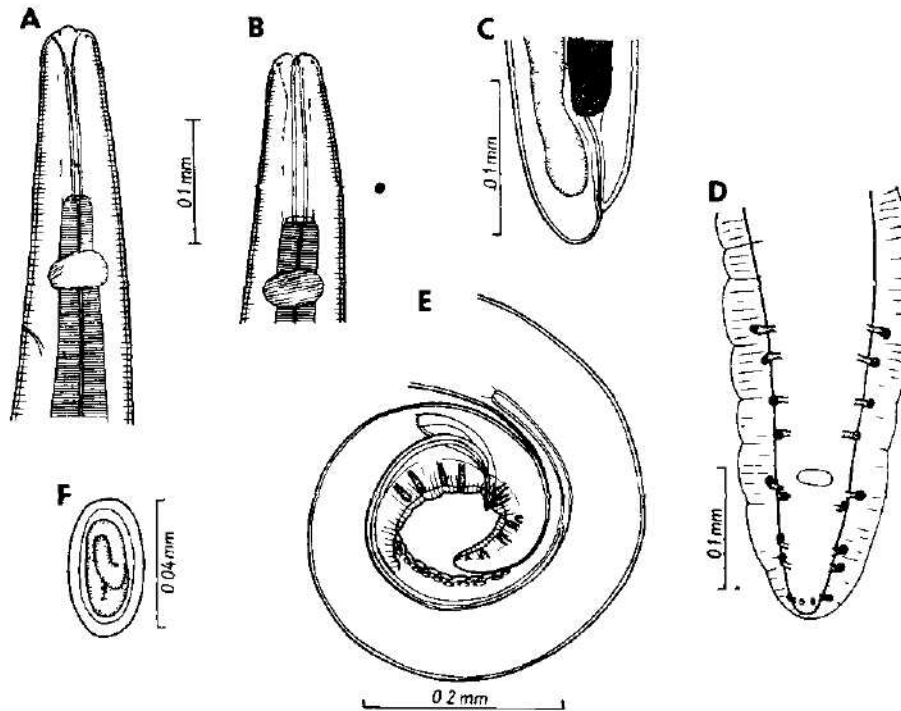


Fig. 2. *Cystidicoloides ephemeridarum* (Linstow, 1872). A, B — head end of gravid female, lateral and dorsoventral views; C — tail of female; D — tail of male, ventral view; E — posterior end of male, lateral view; F — egg. (According to specimens from *O. masou*)

Comments: — As it has been confirmed by this material, both the morphology and measurements of these nematodes from Japanese salmonids are in a full accordance with the descriptions of *C. ephemeridarum* based on European specimens (see e. g. Moravec, 1967; De and Moravec, 1979) and there are no doubts as to their belonging to this species.

This holarctic freshwater parasite of salmonids is widely distributed in both Eurasia and North America from where it has often been reported under various synonyms; it has mostly been named *C. tenuissima* (Zeder, 1800) in the recent years. But Moravec (1981) in his recent study has shown that *C. ephemeridarum* (Linstow, 1872) is its valid name, whereas *Fusaria tenuissima* Zeder, 1800 should be considered *species inquirenda*.

As reported by Margolis (1968), Fujita (1922) was the first to find

this nematode species in Japan; his nematodes were obtained from the intestine of *Salvelinus leucomaenis* and *Oncorhynchus nerka* from Shikotsu Lake in Hokkaido and Fujita described them as a new species *Spiroptera salvelini*. Later it was reported by the same author (Fujita, 1928) from Lake Biwa (central Honshu) where it was recorded also by Yamaguti (1935); both these authors reported *Salvelinus malma* to be the host but, apparently, *S. pluvius* was mistaken for the latter (see Margolis, 1968). Under the synonym *Metabronema salvelini* (Fujita, 1922) this species was also reported by Seki (1975a, b) from salmonids in Hokkaido. It has been confirmed by the present materials that *C. ephemeridarum* is widely distributed in Japan, occurring commonly not only in Hokkaido and Honshu but also on the southern islands Shikoku and Kyushu; it was found to be the most frequent nematode parasite of *Oncorhynchus masou* and *O. rhodurus* in the rivers of Japan. Gravid females of *C. ephemeridarum* containing mature eggs in their uteri were found in March, May and July-October.

*C. ephemeridarum* is a parasite of various salmonid fishes, occasional findings were recorded as well from some fishes of other families. *O. rhodurus* is a new host record.

The life cycle of this nematode involves an obligate intermediate host, this being various mayfly nymphs (e. g. Choquette, 1955; Moravec, 1971a).

### 3. Cystidicolidae gen. sp. — larvae (Fig 3 A—D)

Host: *Oncorhynchus masou*.

Localization: stomach.

Locality: Kyushu — Kikuchi River, Kumamoto Pref. (10. V. 1980).

Specimens: Meguro Parasit. Mus. coll. no. 19465.

Description (5 specimens): Body whitish, 9.44–12.63 long and 0.204–0.245 wide, with smooth cuticle. Mouth provided with two small lateral elevated pseudolabia, appearing in lateral view as small, rounded anterior projections 0.004–0.006 long. Four small simple dorso- and ventrolateral cephalic papillae present. Prostom wide, funnel-shaped, divided into dorsal and ventral chambers by medially constricted region; length of prostom in lateral view 0.030–0.036, maximum width 0.033. Length of whole vestibule including prostom 0.126–0.138, width of its posterior cylindrical region 0.009; length ratio of prostom and cylindrical region 1 : 3.8–4.2. Muscular oesophagus 0.321–0.375 long, 0.027–0.036 wide; glandular oesophagus 1.088 long, 0.060–0.069 wide; length ratio of muscular and glandular portions of oesophagus 1 : 2.9–3.4. Nerve ring and excretory pore 0.245 and 0.354, respectively, from anterior end. Intestine narrow. Unicellular rectal glands well developed. Genital primordium indistinct. Tail conical, 0.132–0.135 long, provided with small caudal process 0.015 long at its tip.

Comments: — The morphology of these larvae (structure of prostom, length ratio of muscular and glandular portions of oesophagus, width of glandular oesophagus, location of excretory pore, structure of tail, smooth cuticle) indicates that they belong either to the genus *Salvelinema* or *Cystidicola*; members of these two genera are parasitic as adults in the swimbladder of salmonids. Although the structure of mouth of these larvae, representing apparently the fourth larval stage, reminds *Salvelinema*, the length ratio of their prostom and cylindrical part of vestibule is higher than in *Salvelinema*, indicating rather



a member of *Cystidicola* (see e. g. Margolis, 1967; Black and Lankester, 1980). Since both the genera are very close by their morphology and the morphogenesis of *Salvelinema* larvae in the definitive host has not been studied in detail so far, the generic determination of the larvae found is problematic and we are designating them, for the time being, as *Cystidicolidae* gen. sp.

The body length of the larvae in question suggest that they are apparently fourth-stage larvae; the current site of location of the larvae of this stage in

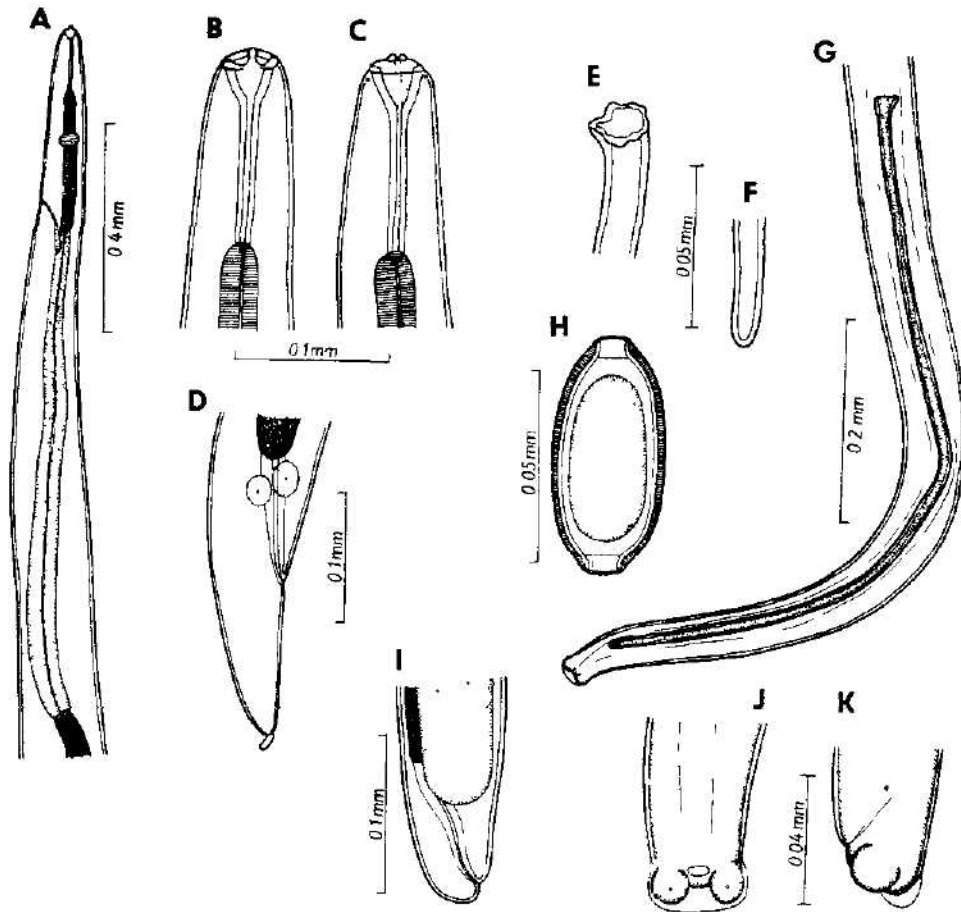


Fig. 3. A--D -- *Cystidicolidae* gen. sp. larva from the stomach of *O. masou* (A -- anterior end of body; B, C -- head end, lateral and dorsoventral views; D -- tail); E--K -- *Pseudocapillaria salvelini* (Polyansky, 1952 from the intestine of *O. masou* (E, F -- proximal and distal ends of spicule; G -- caudal end of male; H -- egg; I -- caudal end of female; J, K -- tail of male, ventral and lateral views).

*Salvelinema* and *Cystidicola* is the swimbladder of the definitive host. However, since the larvae from the present material were found in the stomach, it can be supposed that these were acquired by the fish host secondarily while feeding on other salmonids.

As intermediate hosts of *Salvelinema* and *Cystidicola* members serve small crustaceans (Amphipoda, Mysidacea). In Japan, only the intermediate hosts of *Salvelinema salmonicola* have so far been recorded, these being amphipods *Gammarus* sp. and *Paramoera japonica* (Koshida, 1905; Moravec and Nagasawa, 1985).

Fam. Capillariidae Neveu-Lemaire, 1936

4. *Pseudocapillaria salvelini* (Polyansky, 1952) (Fig. 3 E–K)

Syn.: *Capillaria salvelini* Polyansky, 1952; *C. baicalensis* Ryzhikov et Sudarikov, 1953; *C. coregoni* Shulman-Albova, 1953; *C. curilica* Zhukov, 1960; *C. hispida* Finogenova in Bykhovskaya-Pavlovskaya et al., 1962; *C. lagodowskii* Belouss, 1952 sensu Roytman, 1963.

Hosts: *Oncorhynchus masou*, *O. rhodurus*.

Localization: intestine.

Localities: Honshu — Yura River, Kyoto Pref. (*O. masou* — date ?), Yoshii River, Okayama Pref. (*O. rhodurus* — ?); Kyushu — Oyodo River, Miyazaki Pref. (*O. masou* — ?).

Specimens: Meguro Parasit. Mus. coll. nos. 19462, 19472, 19474.

Description (based on specimens from *O. masou*): Medium-sized nematodes. Two lateral bacillary bands extending along almost whole body length. Head end attenuated, provided with minute mouth papillae. Stichosom consisting of single row of stichocytes subdivided into several transverse annuli.

Male (2 fragments of posterior body ends): Width of body 0.109. Spicule well sclerotized, smooth, 0.810–0.885 long and 0.009–0.012 wide; proximal end of spicule expanded, with lobular rim, distal end rounded. Spicular sheath non-spiny. Tail very short (0.009), provided with two large ventrolateral round lobes; both lobes connected between each other by well developed dorsal cuticular membrane, forming thus caudal bursa 0.007 long.

Female (4 specimens): Body length of gravid females 13.12–15.22, maximum width 0.109–0.136. Width of bacillary bands 0.027–0.036. Length of entire oesophagus 4.19–5.24 (28–34%, of body length), of muscular oesophagus 0.270–0.330; distance of nerve ring from anterior extremity 0.090–0.099. Vulva situated 0.036–0.081 below end of oesophagus; anterior vulvar lip usually weakly elevated. Mature eggs barrel-shaped, with not protruding polar plugs. Egg wall two-layered; inner layer hyaline, outer layer with distinct superficial network sculpture. Egg content uncleaved. Size of eggs 0.066–0.069 × 0.027–0.030, their wall 0.03 thick. Posterior end of body rounded, anus subterminal; length of tail 0.012–0.018.

Comments: — The morphological features of the specimens obtained from Japanese fishes fully correspond to the species *P. salvelini*, as it was redescribed (as *Capillaria*) e. g. by Moravec (1980) and Lomakin and Trofimenko (1982); however, the body size is somewhat larger in these specimens, this being also reflected in a somewhat longer spicule and a lower ratio of the length of oesophagus to the length of body. However, these differences are negligible and may be considered as individual or geographical intraspecific variability. The structure of the male tail is typical of the species *P. salvelini*.

*P. salvelini* is a holarctic species widespread in Eurasia and North America (Moravec, 1980); from Far-eastern salmonids it has been reported by Soviet authors from the river systems of the Amur, the Anadyr, from the rivers and lakes in Kamchatka, from Sakhalin and South Kurile Islands (e. g. Mamaev

et al., 1959; Zhukov, 1960; Beiouss, 1965; Butorina et al., 1980; Lomakin and Trofimenko, 1982). This species has not hitherto been recorded from Japan, only Seki (1957a, b) reports the *Capillaria* sp. from salmonids in Hokkaido, which might be identical with *P. salvelini*. The finding of this parasite in the fishes of Kyushu represents so far the most southern recorded distribution of *P. salvelini*.

The definitive hosts of *P. salvelini* are mainly freshwater and migratory fishes of the orders Salmoniformes and Scorpaeniformes. *O. rhodurus* is a new host record. It can be supposed that this parasite will be also found in other species of salmonid fishes in Japan.

The life cycle of *P. salvelini* has not been studied in detail, only Lomakin and Trofimenko (1982) mention that oligochaetes play a role in it

#### Acknowledgments

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*Authors' addresses:* F. Moravec, Institute of Parasitology, Czechoslovak Academy of Sciences, Branišovská 31, 370 05 České Budějovice, Czechoslovakia;  
K. Nagasawa, Hokkaido Fisheries Experimental Station, 2—6, Hama-cho, Kushiro, Hokkaido 085, Japan.

Czechoslovak Academy of Sciences, Institute of Landscape Ecology,  
České Budějovice

**LEPHYPHANTES RETEZATICUS SP. N., A NEW SPIDER FROM  
THE RUMANIAN MOUNTAINS (ARANEAE, LINYPHIIDAE)**

Vlastimil RŮŽIČKA

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**Abstract.** Both sexes of *Lepthyphantes retezaticus* sp. n., occurring in the coarse rock debris of the Rumanian mountain range Muntii Retezat, are described and illustrated. Owing to the morphology of this species, the diagnosis of the *L. tenuis* species group has been emended.

Coarse rock debris represents a typical biotope where the new species occurs. This debris is an exceptional biotope in the landscape, especially as regards its temperature and moisture regime. The biotopes of this kind occur mostly in high mountains, so that they are not easily accessible and passable. Also catching of animals here is laborious. That's why our knowledge of fauna of coarse rock debris is still rather fragmentary. In most cases, only partial data on the occurrence of individual species are at disposal. For example, Thaler (1981) makes collections in the coarse rock debris of the Alpine countries. The spider communities or individual finds from the rock debris in the territory of Bohemia have been described by Antuš (1982), Buchar (1967), Buchar et al. (1979), Kůrka (1981) and Růžička (in press). Růžička (1982) has recommended a modification of pitfall traps for collecting in coarse rock debris. In the rock debris the finds of further new species may be supposed. Through the find of *L. retezaticus* the prediction by Helsdingen, Thaler et Deltshhev (1977), who supposed the finds of new species of the *L. tenuis* group in the Carpathian mountains, has been fulfilled.

*Lepthyphantes retezaticus* sp. n. (Fig. 1 A–E)

**Material**

Holotype: ♂ Rumania, Muntii Retezat, Virful Papusa (2 200 m a. s. l.), 14-7-1983, individual picking in the rock debris fields, lgt. V. Růžička.

Paratypes: 1 ♂ 6 ♀ at the same place, 1 subad. ♂ 1 ♀ Virful Sesele (2 100 m a. s. l.), 11-7-1983, individual picking in the rock debris fields, lgt. V. Růžička.

The holotype and four female paratypes are preserved in the collections of the National Museum in Prague (no. P6E-2573 and P6E-2574). The other paratypes are preserved in the author's collection.

**Derivatio nominis**

The species is denominated after the site of its first find, i. e. the Rumanian mountain range Retezat.

## Description

Male (holotype): Total length 2.3 mm. Length cephalothorax 1.1 mm, width 0.9 mm. Cephalothorax brownish-yellow. Sternum black-yellow, wider than long (in the ♂ paratype length: width 0.85), between coxae IV reaching with a wide, at the end emarginate projection. Chelicerae with three teeth on outer edge, with three denticles on inner edge. On the chelicera sides areas with stridulating files.

Legs brownish-yellow like cephalothorax. Femora I with one prolateral spine. Tibiae I — IV with two dorsal spines. Tibia I with one prolateral and one retrolateral spine, tibia II with one retrolateral spine. Tibiae I — III with one single ventral spine (Fig. 1 C). Metatarsi I — IV with one dorsal spine respectively. Metatarsus IV with trichobothrium. Trichobothrium I 0.18.

### Lengths of leg joints (mm)

	fe	pt	ti	mt	ta	total
I	1.31	0.29	1.33	1.35	0.84	5.12
II	1.27	0.29	1.25	1.28	0.78	4.87
III	1.10	0.27	1.02	1.10	0.63	4.12
IV	1.31	0.27	1.35	1.39	0.75	5.07

Palp (Fig. 1 A, B). Palp tibia with one stout spine. Anterior margin of paracymbium with an obtuse denticle. Lamella at its end flat, membranous, with smoothly rounded anterior margin. Basis of the terminal apophysis terminates in a smaller, oval triangular plate. Basal part of embolus furnished with four denticles.

Abdomen light grey, without pattern.

Female (paratype): Total length 2.6 mm. Length cephalothorax 1.1 mm, width 0.9 mm.

Cephalothorax uniformly brownish-yellow. Sternum black-yellow, as wide as long, between coxae IV it reaches with a wide, at the end emarginate projection. Dentition of chelicerae and stridulating files the same as in the male.

Legs. Coloration and chaetotaxy the same as in male. Only the ventral spine in tibia III is absent. Metatarsus IV with trichobothrium. Trichobothrium I 0.19.

### Lengths of leg joints (mm)

	fe	pt	ti	mt	ta	total
I	1.35	0.29	1.27	1.27	0.76	4.94
II	1.31	0.29	1.20	1.22	0.73	4.75
III	1.12	0.27	0.96	1.04	0.59	3.98
IV	1.37	0.27	1.29	1.27	0.71	4.91

Epigyne (Fig. 1 D). Scape rather widening from the relatively narrow stem. Beneath the scape stem protrude the rounded lobes of the inner part of scape. Width of scape stem 0.03 mm, width of the widened part of scape 0.19 mm, width of the inner scape 0.15 mm, width of the posterior median plate 0.21 mm.

Vulva see Fig. 1 E. (The bending of margins of the inner part of scape is not visible in the epigyne ; it arose probably by deforming pressure on the preparation.)

Abdomen light grey, without pattern.

#### Variability

Ventral spines on tibiae I and II are always present (even in the subadult male). On tibia III they are only sometimes present (in the male paratype they

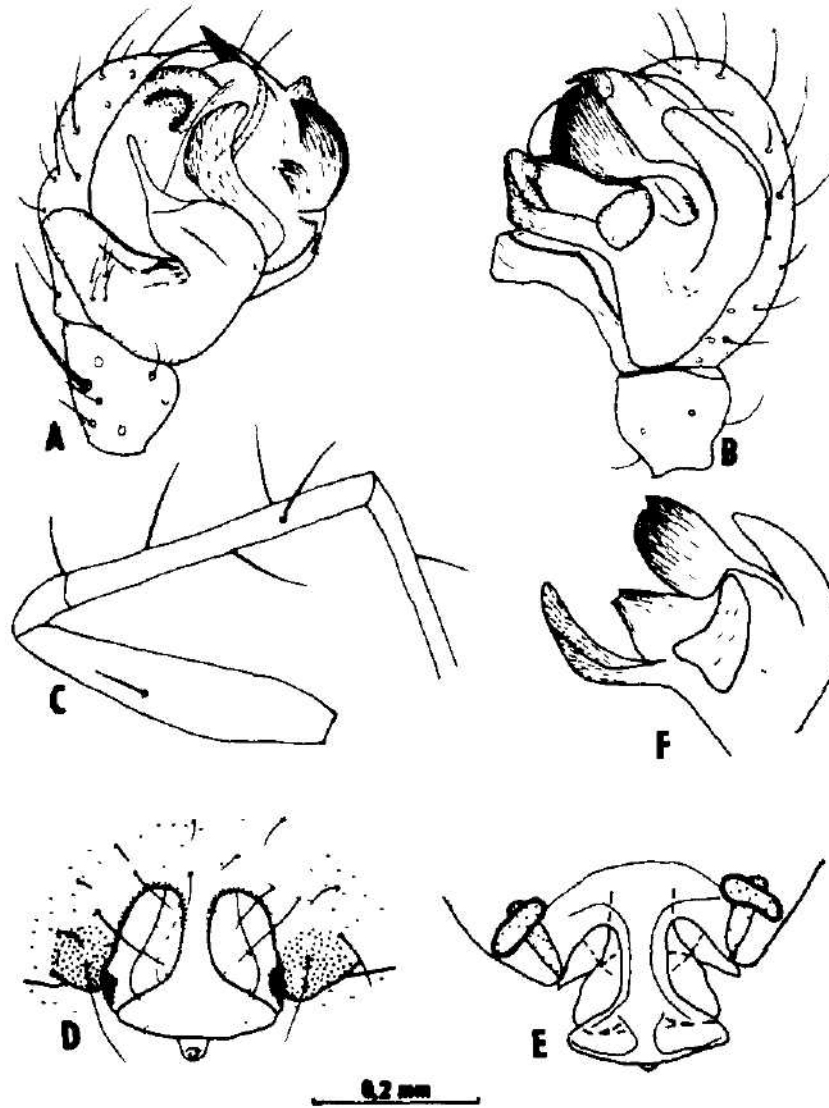


Fig. 1. A – E *Lephyphantes retzaticus* sp. n. A, B – palp (holotype), C – left leg I (holotype), D – epigyne (paratype 1), E – vulva (paratype 2), F – *Lephyphantes cristatus* – radical section, in the middle with the basal projection of the terminal apophysis (Chlum u Třeboně, Czechoslovakia, 15. 10. 1977, lgt. J. Buchar).

are developed slightly, in six females they are slightly developed only in two cases). Further surplus spines occur irregularly (the holotype has two spines on the right tibia retrolaterally, the male paratype and one female have two spines on the right tibia II, two females have two spines on femora prolaterally).

The male paratype has also 4 denticles on the basis of embolus.

#### Diagnosis and relations

Judging by the structure of copulation organs and by the majority of the other characters (dentition of chelicerae, presence of stridulating files on the chelicerae, position of trichobothrium on metatarsus I, chaetotaxy of legs — with one exception, see below, *L. retezaticus* belongs univocally to the species group of *L. tenuis*. A comprehensive paper on the species group of *L. tenuis* was written by Helsdingen, Thaler, Deltshv (1977). *L. retezaticus* differs from all species of this group by the presence of a single ventral spine on tibiae I and II (sometimes also on tibia III). By the structure of paracymbium and lamella, *L. retezaticus* resembles the species *L. cristatus*. A certain conformity to this species is also represented by the surplus spines of legs (in *L. cristatus* the surplus spine lies retrolaterally on tibiae III and IV). *L. retezaticus* differs from *L. cristatus* by the presence of only one spine on the palp tibia, by the absence of the basal tubercle on the cymbium, by the dentition of the basal part of embolus and by the smaller size of the basal projection of terminal apophysis (cf. Figs. 1 B and 1 F). The basal projection of terminal apophysis is triangular to quadrangular with convex margins. In the comparative specimen of *L. cristatus* this projection is distinctly triangular with the concave anterior margin. Helsdingen, Thaler, Deltshv (1977) pictured this projection as distinctly quadrangular, but rather big and with the concave anterior margin as well.

In the characteristic of the species group *L. tenuis*, with respect to the newly described species, the possibility of the absence of pattern on the abdomen and especially of the presence of a single ventral spine on tibiae I and II (sometimes also III) is to be taken into account. In the keys of the species groups of the genus *Lepthyphantes* both in the paper by Locket, Millidge (1953) and in that by Wiehle (1956) a point is to be found where the species group of *L. mughi* is separated from the other species groups.

A — Tibia I with stout ventral spines . . . species group of *L. mughi*  
a — Tibia I without ventral spines . . . the other species groups

The new species described here would not fit in this key, because the alternative with one ventral spine has not been considered here. Thus, the antithesis in the key for the future is to be formulated in the following way:

a — Tibia I without ventral spines, or at most with one ventral spine.

#### Acknowledgment

I am much obliged to Senior Lecturer Dr. K. Thaler, Dr. C. Deltshv, Dr. I. Weiss, Senior Lecturer Dr. J. Buchar and especially to Dr. P. J. van Helsdingen for his kind inspection of my material and for valuable comments to its description.

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*Author's address:* RNDr. Vlastimil Růžička, CSc., Czechoslovak Academy of Sciences, Institute of Landscape Ecology, Na sádkách 7, 370 05 České Budějovice, Czechoslovakia.

Fischer, A., Pfannenstiel, H.-D. (eds): *Polychaete Reproduction*. Fortschritte der Zoologie, Bd. 29, 341 pp., 184 figs, 26 tabs. Gustav Fischer Verlag, Stuttgart, New York 1984. Price DM 138,—

Since the nineteenth century, Polychaeta of the phylum Annelida have been an important model group for studies of the reproduction of marine invertebrates. Methodological approaches have steadily been improving, leading to a broad diversification of the examined questions. This has created an urgent need for compiling and revising the existing findings, which would enable their assessment as well as the planning of new lines of research.

An international symposium was held on Helgoland in April 1982 on the initiative of the two editors. Twenty two papers by 25 authors were read, dealing with the present trends of research on the reproduction of Polychaeta. Most of the contributions (17) are review papers based on 40—110 references, except for those whose subjects either are very narrow (Reproduction of *Arenicola marina*, Speciation in *Ophryotrocha*) or require the latest methodological approaches (Gene transcription during oogenesis).

The papers are divided into four sections. An introduction by C. Hauenschild is followed by 7 papers on the control of sexuality and reproduction (pp. 9—98). The first deals with the physiology of epitokous metamorphosis (M. Durchon), another three present the results of experimental studies of the effects of external factors on reproduction. P. J. W. Olive has summarized findings on the effects of temperature and relative length of day on synchronization of gametogenesis in relation to circa-annual, circa-lunar and circadian periodicity. H. Goerke reports that his experiments indicate a correlation between the geographic distribution of the species of Nereidae and the minimum temperature allowing the swarming of sexually mature individuals. In contrast, V. Anger experimentally found that the manner of reproduction in *Pygospio elegans* does not depend so much on temperature (she cultivated individuals from three different regions at 36 different combinations of temperature and salinity) as on the origin of samples: individuals from the western part of the Baltic were incapable of sexual reproduction.

The last three papers in this section are about endocrine control and determination of sex. Two of them are summaries of general findings. H.-D. Franke and H.-D. Pfannenstiel have arrived at the conclusion that the system of endocrine control of reproduction in Polychaeta is far from uniform. Besides, the latter author presents a survey of information on sex determination, inclining, among others, to the concept of polygenic sex determination in the cases when the total representation of males and females in a population does not approximate the 1:1 ratio (besides the genera *Ophryotrocha* and *Dinophilus*, this hypothesis is also applied to *Bonellia viridis*, a classical object of study which does not belong to Polychaeta, not even to Annelida).

Gametogenesis and fertilization are discussed in nine papers (pp. 99—267). Recent information obtained by means of electron microscopy since 1980 is summarized in the first of them by N. Sawada. The great structural diversity during spermatogenesis is pointed out. The only phenomenon evidently related to phylogeny is the so-called cytophore (known to occur at spermatogenesis in the earthworm). In Polychaeta, it is found in some families traditionally classed with Sedentaria, but it has not yet been found in the Errantia. This paper is followed by a report on spermatogenesis in *Nereis diversicolor*, used as a model for the study of endocrine control of meiosis (M. Bertout).

There is an extensive treatment of oogenesis. According to K. J. Eckelbarger, it takes two forms in the polychaetes, being either extraovarian, which is a more primitive process, or intraovarian in the most derived cases the developing oocytes are in immediate contact with the walls of branching genital blood vessels.

As concerns research on fertilization in the polychaetes, the echinoid worm *Urechis caupo* is a suitable model, as its coelom contains mature gametes throughout the year. The results of investigations of fertilization in this species have been compared with previous data of this kind in Polychaeta by N. L. Cross (California).

Most of the other papers deal with more specific questions, usually investigated in a single model species (or a group of related ones): gene transcription during

oogenesis in *Schizobranchia insignis*; metabolism, ultrastructure and biochemical differentiation of oocytes in nereids; and the entire reproductive biology in *Arenicola marina*.

The last section on "Reproductive mechanism and speciation" includes five papers. The first is on reproductive strategy in species living in interstitial environment. Twenty species of 10 families of different orders of the Polychaeta are involved. All of them are distinguished by numerous convergences, e. g. in minute body sizes and different ways of reproduction: small numbers of relatively large oocytes are produced, copulatory organs develop etc.

Individual narrowly delimited problems, such as the mode of sperm transfer in the sedentary polychaete *Fabricia sabella*, speciation in *Capitella*, *Ophryotrocha* and in the *Malacoceros fuliginosus* species group are the subjects of the other papers. The so-called poecilogony, a parallel occurrence of planktonic and benthic larvae of the same species, is discussed in connection with the questions of speciation. The relationship of this phenomenon to one of the principles mentioned by Udvardy in his Dynamic Zoogeography should be pointed out, namely the polymorphism of populations (e. g. brachy- and macroptery in beetles), which is manifested by different representations of the individual forms at the margin and in the centre of distribution areas.

Besides facilitating options of further research on reproduction in the polychaetes the book contains much information useful for general biological comparative studies, in particular of the neurohormonal control and ultrastructure of gametogenesis, genetic and climatic effects on life cycles in animals, including sex determination, speciation, etc.

J. Buchar

Opler, P. A., Krizek, G. O., 1984. *Butterflies East of the Great Plains. An Illustrated Natural History*. 294 pages, 33 figs., 54 plates. The Johns Hopkins University Press, Baltimore and London, US \$ 50.

Moderní výzkum fauny denních motýlů se dostává stále více do popředí zájmu širší biologické veřejnosti, zejména ekologů a genetiků. Jen málo knih od vydání klasické publikace E. B. Forda: *Butterflies*, spojuje tak úspěšně lepidopterologická, obecně biologická a estetická hlediska vědecké činnosti. Recenzovaná kniha se zabývá 250 druhy denních motýlů (Papilionoidea a Hesperioidea) východní části USA a zahrnuje také druhy holarktické s výskytem ve střední Evropě. Jednotlivé druhy jsou zobrazeny na dokonalých barevných fotografiích G. O. Krizeka pořízených v terénu na živých objektech v charakteristickém prostředí. Text doprovázejí i četné perovky a mapky rozšíření. Obecná textová část se zabývá metodickým úvodem do výzkumu Lepidoptera, morfologií, biogeografií a synekologií. Ve speciální části je podrobně probírána bionomie jednotlivých druhů se zvláštním zřetelem k ekologii, biindikacním hodnotám a ochraně ohrožené fauny. Je patrné, že jeden z autorů — P. A. Opler je povoláním entomolog státní ochrany přírody v USA (Office of Endangered species). Publikaci uzavírá kromě rejstříku rozsáhlá bibliografie severoamerických prací a slovníček odborných termínů. Vkusně upravenou knihu Oplera a Krizeka doporučujeme nejen lepidopterologům a ekologům se zájmem o motýlí faunu Severní Ameriky, ale všem kdož sledují současnou problematiku ochrany entomofauny i cesty moderní zoologické fotografie.

K. Spitzer

## POKYNY PRO AUTORY

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