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MORPHOLOGY AND DEVELOPMENT OF PHILOMETRA ABDOMINALIS NYBELIN, 1928

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Species classified into the genus *Philometra* are fairly frequent fish parasites in Hungary. The morphological characteristics and life-history of three of them, *viz.*, *Ph. ovata* (Zeder, 1803), *Ph. rischta* (Skrjabin, 1917) and *Ph. sanguinea* (Rud., 1819) have recently been dealt with in this periodical (MOLNÁR, 1966a and b). In the present paper *Ph. abdominalis* Nybelin, 1928 is redescribed and its life history is dealt with.

The name *Ph. abdominalis* was proposed by NYBELIN (1928) to accommodate specimens which, though not tallying with RUDOLPHI's *Ph. sanguinea*, a parasite of Carassius, were assigned to that species by CREPLIN (1825), DIESING (1861), LINSTOW (1874) and other authors, who found them in various cyprinid fishes. NYBELIN (1928), while redescribing RUDOLPHI's *Ph. sanguinea*, failed to give a detailed description of *Ph. abdominalis*. However, in a later report (NYBELIN, 1931) he designated as its type those *Philometra* specimens which were collected by LINSTOW from *Gobio gobio* (syn. *Gobio fluviatilis)* and are preserved in the Natural History Museum of Berlin. In that paper NYBELIN presented also a table to differentiate *Ph. abdominalis* from *Ph. sanguinea* (Rud., 1819), *Ph. opercularis* (NYBELIN, 1931) and *Ph. ovata* (Zeder, 1803). The table clearly differentiates *Ph. sanguinea* females from the three other species on account of their cuticular papillae. Obvious differences exist also between *Ph. rischta* (syn. *Ph. opercularis)* on the one hand, and *Ph. ovata* and *Ph. abdominalis* on the other, because *Ph. rischta*, due to some morphological features as well as its localization, appears to represent a well-distinguishable species. However, as far as *Ph. ovata* and *Ph. abdominalis* are concerned, NYBELIN only discriminated them on account of their body colour and dimension. The tail-end is said to be rounded in both species.

These details given by NYBELIN appear to be somewhat inconclusive, for the *Philometra* species dealt with by CREPLIN, DIESING and LINSTOW, though in fact not identical with *Ph. sanguinea* (Rud., 1819), are most probably not conforming with *Ph. abdominalis* either. The mentioned authors had after all to do with *Ph. ovata*. This conception seems plausible; otherwise the name *Filaria cyprini rutili* created by CREPLIN (1825) would have priority over *Ph. abdominalis*, provided that the name is not invalidated by any provision of the international Code or has not been suppressed by the Commission.

Nevertheless, the specimens of *Ph. abdominalis* from *Gobio gobio*, designated by NYBELIN as types for that species, have proven according to my reexamination, with some minor corrections, to represent a valid species.

Later on DOGIEL and BYCHOWSKY (1939) observed two inconspicuous processes on the tail-end of *Ph. ovata* females, while IZYUMOVA (1962) had no difficulties in differentiating the two species on account of the shape of the tail-end, whether rounded or pointed, as well as with regard to the presence or absence of the processes mentioned. According to MOLNÁR (1966) the colour of live specimens of *Ph. ovata* is bright red, while NYBELIN's specimens are said to be of yellowish white hue.

Several authors, according to their having or not having realized the inconspicuous tail processes, were assuming to have met both species in various cyprinid hosts.

So far only one report has dealt in detail with *Ph. abdominalis* (LELEK, 1962/3). But this author while recording detailed statistical data on the frequency of that parasite in *Gobio gobio* from the river Rokitna, did not concern with details of its morphology and life cycle.

In the course of faunistic studies, I found in the abdominal cavity of some fish species (*Phoxinus phoxinus*, *Gobio gobio*, *Leuciscus cephalus*, *Leuciscus leuciscus*) *Philometra* specimens whose females bore a striking resemblance to *Ph. ovata* females, and also their actual developmental stage correlated with that of the latter; apparently the only inconspicuous difference was the presence of two processes on the tail-end. However, the male specimens found in the same host were readily distinguishable from *Ph. ovata* males by the shape and size of their accessory reproductive organs (spicules, gubernaculum).

In order to gain satisfactory information for a reliable identification of the species in question, I tried to collect data to show its distribution in various fish hosts. The examined fishes and their actual stages of infestation with *Ph. abdominalis* are summarized in Table I. Investigations conducted during all seasons of the year have revealed that by the end of May females of the *Philometra* species in question reached 10—12 cm in length, *i.e.*, nearly twofold the size given for this species by NYBELIN (1931), IZYUMOVA (1962), and others. Moreover, the parasites had processes on the tail-end, instead of being smooth as claimed by the cited authors. In spite of these differences, the species found by me was probably identical with *Ph. abdominalis*, the species described by NYBELIN: their specimens originated from *Gobio gobio*, the host found most frequently infested by me.

Later on I had the opportunity to examine the original specimens collected by LINSTOW deposited in the Berlin Museum of Natural History.* The specimens kept in alcohol were more or less intact juvenile females of 4—6 cm in length, showing already primordial eggs. On the tail-end of the unshrunk specimens two inconspicuous processes were clearly visible. The exact date

* I wish to extend my hearty thanks to Dr. G. HARTWICH, who kindly made it possible to have re-examined this valuable material.

Table I

Infestation of various fish species with *Philometra abdominalis*

Name of fish species	Number of examined fish specimens	Number of infested specimens	Per cent extensity of infestation	Quality of infestation											
				With adult or developing ♀♀			With retarded ♀♀ and ♂♂			With retarded ♀♀ alone			With ♂♂ alone		
				Infested fishes		Number of parasites per host	Infested fishes		Number of parasites per host	Infested fishes		Number of parasites per host	Infested fishes		Number of parasites per host
				No.	%		No.	%		No.	%		No.	%	
Gobio gobio	40	20	50.0	6	15	1—5	—	—	—	5	12.5	1—3	9	22.5	1—4
Phoxinus phoxinus	210	27	12.8	9	4.3	1—3	3	1.4	2—3	9	4.3	1—3	6	2.8	1—2
Leuciscus cephalus	36	27	75.0	5	13.9	1—3	20	55.5	2—15	1	2.8	1	1	2.8	1
Leuciscus leuciscus	6	4	66.6	1	—	1	—	—	—	1	—	1	2	—	1—2
Barbus meridionalis Petényi	13	2	15.4	—	—	—	—	—	—	2	—	1—2	—	—	—
Alburnoides bipunctatus	9	—													
Chondrostoma nasus	2	—													
Gobio albipinnatus	1	—													
Nemachilus barbatulus	10	—													
Esox lucius	3	—													
Lota lota	6	—													

(month and day) of collection was not noted on the vials. Considering the strictly one-year-lasting life cycle of *Philometra* species, there is every reason to suppose that the specimens in question were collected during autumn, showing an early stage of their life cycle, with lengths scarcely attaining one half of that of adults.

In view of the above considerations it seems well-founded to assume that the worm specimens collected by me from the above-mentioned fish species, belong to *Philometra abdominalis*.

Method

The specimens collected from fishes were immediately placed in physiological saline, where they preserved their colour and viability for 2 or 3 days, depending on the temperature. Examinations were performed partly on living worms, partly on specimens fixed in formalin or ethanol and kept in lactophenol.

Description of Philometra abdominalis

Adult females are red, less frequently yellowish-red in colour, 100—120 mm in length and 0.8—1 mm in width. Their body cavity is filled up with the uterus. The cuticle is smooth. The head is rounded, with 4 slightly protruding papillae and 3 lips. The cylindrical body appears uniform in diameter throughout. The tail-end is rounded, and if in a dorsoventral orientation, two hardly discernible, papillate cuticular processes are visible on it.

The structure of the inner organs is identical with that of *Ph. ovata*.

The papillate processes are more conspicuous on the tail-end of juvenile, 20—40 mm long females.

The males are 2.1—3.7 (average: 3.2) mm long, 0.037—0.057 (average: 0.049) mm wide, transparent worms. Their cuticle is smooth, the head rounded, carrying four retracted circumvallate cephalic papillae under the cuticle level. The body is uniformly wide over the whole length, except a very slight tapering towards the head-end. The tail-end is blunt, with two lateral papilla-like protrusions, connected dorsally by an inconspicuous, narrow lobule. There are two, nearly equal spicules, their movements being directed by the gubernaculum. The longer spicule is 0.127—0.172 (average: 0.154) mm, the shorter one 0.120—0.164 (average: 0.147) mm, in length. The width of the spicules is 0.007 mm at the slightly thickened shaft (calomus), 0.005 mm at the origin, and 0.003 mm in the middle of the blade (lamina). The gubernaculum is an 0.053—0.065 (0.060) mm long, bent chitinous plate, with a lancet-shaped end. In its distal third portion, there is dorsally a lace-like protrusion. (This protrusion is, however, less conspicuous than that of *Ph. ovata)*. Right after the protrusion the gubernaculum tends to bend in a dorso-cranial direction.

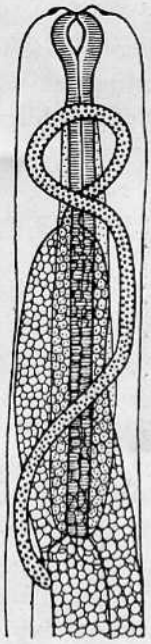

Fig. 1. Head-end of a 3-month-old growing ♀ *Ph. abdominalis*

Fig. 2. Tail-end of a 3-month-old ♀ *Ph. abdominalis*

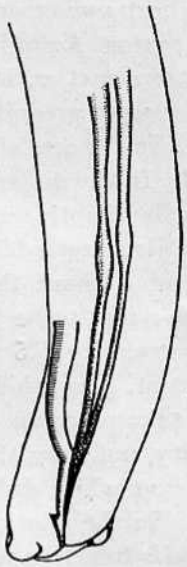

Fig. 3. Tail-end of a ♂ *Ph. abdominalis*

Incidence and host range

The examined fishes were collected from the brooks Magyarkút and Kemence in the mountain Börzsöny. Out of the fish hosts listed in the Table, *Ph. abdominalis* was found in *Phoxinus phoxinus*, *Gobio gobio*, *Leuciscus cephalus*, *Leuciscus leuciscus* and in *Barbus meridionalis* Petényi.

Three forms of *Ph. abdominalis* were encountered: (1) females of 1—12 cm length, in different phases of development depending on the season, located in the abdominal cavity; (2) males located throughout the year below the serosa of the air bladder; (3) females, not fertilized or retarded in growth, 2.6—3.9 (3.2) mm in length, also resting below the serosa of the air bladder.

In four out of the examined fish species *(Phoxinus phoxinus, Gobio gobio, Leuciscus cephalus, Leuciscus leuciscus)* also adult or developing females were found in the abdominal cavity. In *Barbus meridionalis* Petényi, only retarded females were found, exclusively in the air bladder. In the other examined fish species no *Philometra* specimens occurred.

It is known that in the temperate zone, the whole life cycle of *Philometra* specimens requires strictly one year, so that the size of females at different seasons of the year can be estimated with fair accuracy.

Accordingly, in an obligatory host harbouring worms of both sexes, the worms are likely to start development, and in the abdominal cavity of the host sooner or later females will be available, corresponding in stage to the season. According to our investigations, the requirements of an obligatory host are met with only by *Gobio gobio*, in which all females, provided also males were present, reached full maturity.

In the case of facultative hosts only some females are advancing a regular cycle. In the majority of such hosts, regardless of any numbers of young individuals of both sexes, the emigration of females from the air bladder did not take place; retarded in growth, they survive under the serosa of the air bladder, attaining about the length of males (2.6 to 3.9 mm) throughout the year. Such a facultative host has been found to be *Leuciscus cephalus* in which both the extensity (75 per cent) and intensity (2—15) of infestation have been greatest. Nevertheless, in only 13.9 per cent of the examined fish specimens did take place an emigration of 1—3 *Philometra* females into the abdominal cavity and only these individuals reached maturity, in contrast to the 55.5 per cent which did not.

In the relatively few *Leuciscus leuciscus* specimens examined, *Ph. abdominalis* infection was apparently of the same nature as in *Leuciscus cephalus*.

The fish *Phoxinus phoxinus*, irrespective of the relatively low intensity of infestation (12.8 per cent), has proved an obligatory host of *Ph. abdominalis*, like *Gobio gobio*. In the majority of the cases, adult or regularly developing females were found in hosts which occasionally harboured both sexes simultaneously.

The one or two retarded females detected under the serosa of the air bladder in *Barbus meridionalis* Petényi permitted no conclusion on the facultative or accidental nature of this host.

It seems probable that *Gobio albipinnatus* behaves very much like its close relative *Gobio gobio*.

The above observations appear to indicate that, out of the fish species known in this country, only *Gobio gobio* and *Phoxinus phoxinus* are obligatory hosts of *Ph. abdominalis*. That is, this parasite seems to be capable to go through its entire developmental cycle exclusively in these two species. In the fish species *Leuciscus cephalus*, *Leuciscus leuciscus* and probably also in *Barbus meridionalis* Petényi *Ph. abdominalis* females develop to maturity only exceptionally, indicating that they are merely facultative hosts of that parasite.

Life cycle of Ph. abdominalis

The life cycle of *Ph. abdominalis* was followed up by seasonal autopsies of *Phoxinus phoxinus* and *Gobio gobio*. It appeared to be closely resemblant

to that of *Ph. ovata*. Under natural conditions the fishes become infected through the ingestion of cyclopses carrying *Ph. abdominalis*-larvae, during the months June and July. This has been concluded with respect to the observation that juvenile parasites, with pointed tails reminding of larvae, were first encountered in the abdominal cavities of the hosts in those months. During summer, the developing worms were found under the serosa of the air bladder. Here, too, copulation is taking place. Developing females were as a rule staying in the abdominal cavity already during August and September. Males and unfertilized females may be detected throughout the year under the serosa of the air bladder; they do not grow. Specimens that emigrated into the abdominal cavity reach 22 to 66 mm in length by the autumn, and 60 to 72 mm by the next spring. At the beginning of May appear the first stages of the developing larvae, and by the middle of May the uterus is filled with fully-developed larvae, measuring 77—110 mm. By the end of June the females leave their hosts actively, escaping through the anus. The parasites reaching the water, burst in the hypotonic medium, liberate the larvae that survive for a few (3—5) days, attracting the attention of cyclopses by their vivid movements. Cyclops specimens are the intermediate hosts in which the ingested larvae develop into infectious stages ready to invade fishes. Cyclopses collected at the sites where the fish collection was carried out were successfully infected with *Ph. abdominalis*-larvae under laboratory conditions. Rarely mature females are unable to leave the abdominal cavity of the fish host, and perish therein. Nevertheless, some of the larvae may supposedly leave the abdominal cavity, being extruded with the products (eggs or semen) of the reproductive organs. In such cases the shrunken cuticle of the mother worm is detectable in the abdominal cavity of the fish up to the next year.

Key to Philometra species parasitic in European Cyprinidae

1 (4) Cuticle of females densely covered with papillae.

2 (3) Fully-developed females are 40—42 cm in length, and parasitize the tail fin of the crucian carp *(Carassius carassius)*. Spicules of males are 0.066—0.072 mm in length. Gubernaculum is hardly shorter than the spicules ..... *Ph. sanguinea* (Rud., 1819).

3 (2) Fully-developed females are up to 11.5 cm in length. They take shelter under the squamae of carps. Spicules of males are 0.19—0.23 mm long, gubernaculum is four times shorter than the spicules .... *Ph. lusiana* Visman, 1962.

4 (1) Cuticle of females is smooth.

5 (6) Fully-developed females are 30—32 cm in length.
On their tail-end there are two large, conspicuous papilla-like processes.

They locate under the head skin of cyprinids. Spicules of the males nearly equal in size (0.045—0.057 mm) ..... *Ph. rischta* Skrjabin, 1917.

6 (5) Fully-developed females, 10—12 cm in length. On their tail-end there are two inconspicuous papilla-like processes. They parasitize the abdominal cavity of cyprinids.

7 (8) On the tail-end of females there are laterally two small, but well-visible papilla-like processes. The males have two unequal spicules, the longer measuring 0.246—0.325 mm, the shorter 0.136—0.204 mm in length ..... *Ph. ovata* (Zeder, 1803).

8 (7) On the tail-end of females there are laterally two hardly discernible papilla-like processes. The spicules of the males are nearly equal in size, being 0.127—0.172, respectively, 0.120—0.164 in length .... *Ph. abdominalis* Nybelin, 1928.

SUMMARY

Detailed redescription of the females of *Ph. abdominalis* Nybelin, 1928 and a description of the hithertho unknown males is presented.

The life cycle of *Ph. abdominalis* and its relationship with various fish hosts has been clarified by systematic post mortem examinations of 336 fish specimens collected from mountain brooks.

The infestation of the various fish hosts, its percentage and the recovered stages of the parasites are shown in a Table.

A key to the *Philometra* species parasitic in European cyprinid freshwater fishes is attached.

REFERENCES

Creplin, F. Ch.: Observations de Entozois. Pars I. Gryphiswaldiae, 1825. Diesing, C. M.: S. B. Akad. Wiss. (Wien) **42** (1961). Догель, В. А. and Быховский, Б. Е.: Паразиты рыб Каспийского моря. Москва—Ленинград, 1939. Изюмова, Н. А.: Nematoda. In: Определитель паразитов пресноводных рыб СССР. Москва—Ленинград, 1962. Lelek, A.: Zschr. Fischerei **11** (1962—63), 779—789. Linstow, V.: Arch. Naturgesch. **40** (1874), 122—134. Molnár, K.: Acta Vet. Hung. **16** (1966), 143—157. Idem: Ibidem **16** (1966), 227—242. Nybelin, O.: Arkiv för Zool. **19** (1928), 1—4. Idem: Zbl. Bakt. **121** (1931), 58—64. Rasheed, S.: J. Helminthol. **37** (1963), 89—130. Скрябин К. И.: Русск. гидробиол. журн. **2** (1923), 236—240. Висманис, К. О.: Изв. АН Латвийской ССР. Биология **4** (1962), 93—96. Idem: Сымпозиюм по паразитам и болезням рыб и водных беспозвоночных. Тезисы докладов. 1966, 9—10. Wierzbicki, K.: Acta Parasitol. Polon. **8** (1960), 181—194. Yamaguti, S.: Japan. J. Zool. **6** (1935), 337—386.