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MORPHOLOGY AND DEVELOPMENT OF THWAITIA KOTLANI SP. N. (PHILOMETRIDAE, NEMATODA)

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The occurrence and development in home freshwater fishes of some roundworm species belonging to the family *Philometridae* have been described in previous papers (MOLNÁR, 1966a, b; 1967). In accordance with the earlier nomenclature, the above species have been uniformly classified as belonging to the genus *Philometra* Costa, 1845, which is still preferred by the majority of authors to the generic name *Thwaitia* proposed in RASHEED's revision (1963).

Since in the present work RASHEED's classification is followed, it should be mentioned that the previously described species *Philometra ovata* (Zeder, 1803), *Ph. rischta* Skrjabin, 1917, and *Ph. abdominalis* Nybelin, 1928, should be further on classified into the genus *Thwaitia* Rasheed, 1963, whereas *Ph. sanguinea* (Rud., 1819) into the genus *Philometroides* Yamaguti, 1935, and accordingly will be heretofore referred to as *Thwaitia ovata* (Zeder, 1803), *T. rischta* (Skrjabin, 1917), *T. abdominalis* (Nybelin, 1928) and *Philometroides sanguinea* (Rud., 1819), respectively.

In the course of faunistic studies, under the serosa of the air bladder of *Aspius aspius*, immature male and female roundworms, 2—2.5 mm long, have often been found. These parasites bore a striking resemblance to the developmental stages of *Thwaitia rischta*, but the males available for measurement differed from it in dimensions and neither developing, nor adult females were encountered.

Considering that as a predatory fish, *Aspius aspius* feeds mainly on *Alburnus alburnus* which is often harbouring *T. rischta*, it was supposed that the parasites in question were either *T. rischta* worms, whose development had come to a halt in the nonspecific host, or represented a new, hitherto undescribed species.

To clarify this problem, 41 *Aspius aspius* fishes were autopsied. Out of them 5 harboured either mature or immature females in their abdominal cavities. The morphological examination of the parasites as well as the studies of the course of their developmental cycle have evidenced that the *Thwaitia* species parasitic in *Aspius aspius* is not identical with *Th. rischta*, but actually represents a new species, the description of which is given below.

Habitat

The majority of the *Aspius aspius* fishes examined originated from the Lake Balaton and the river Tisza, whereas the minority from the river Duna

(Danube). The lengths of the fishes were between 280 mm and 570 mm, which corresponds to 2—6 summers. No correlation was found between the size of the body and the intensity of the infection.

Method

The parasites recovered either from the abdominal cavity or from the subserosa of the air bladder were placed in saline, where they remained viable and retained their colour for 2—3 days, depending on the temperature. Part of the examinations were carried out on living worms, part on lactophenol preparations fixed either in ethanol or in formalin.

Description

The only fully developed female found in our material was 61 mm in length, 1 mm in diameter, and of red colour. The body cavity was filled out by the uterus, full of larvae. The head seemed rounded off, with 4 in-

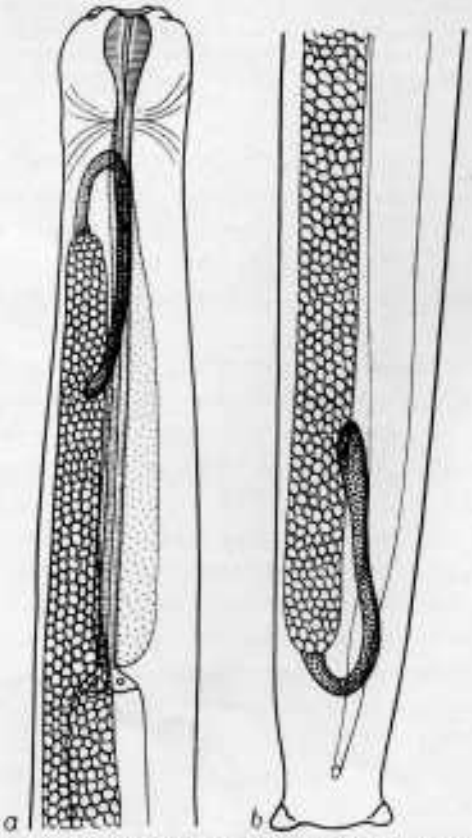

Fig. 1. a, Anterior end of a *T. kotlani* female, 20 mm long; b, posterior end of a *T. kotlani* female, 20 mm long

conspicuous papillae and three lips. The body was cylindrical in shape, very slightly tapering towards the anterior and posterior ends. The caudal end was rounded off, showing in dorsoventral position two small papillae-like processes on both sides. The length of the fixed larvae was 0.44—0.46 mm. Their anterior end appeared rounded off, whereas their posterior end tapering.

Fig. 2. Posterior end of a *T. kotlani* male

Table 1

Comparative data of *T. kotlani* and *T. rischta*

Measurements	*T. kotlani*	*T. rischta*
♀♀ length	61 mm	30—32 mm
diameter	1 mm	0.8— 1 mm
♂♂ length	2.1—2.6 (2.3) mm	1.7—2.0 (1.8) mm
diameter	0.041—0.062 (0.045) mm	0.022—0.039 (0.036) mm
spiculum I, length	0.090—0.108 (0.100) mm	0.045—0.057 (0.051) mm
spiculum II, length	0.082—0.098 (0.092) mm	0.045—0.053 (0.050) mm
diameter of spicula at base	0.005 mm	0.003 mm
diameter of spicula, median	0.004 mm	—
length of gubernaculum	0.053—0.066 (0.060) mm	0.031—0.041 mm

The immature 20—30 mm long females showed papillae-like processes on the caudal end. The anterior papillae were more distinct and conspicuous than those seen in older females (Figs 1a and b).

The structure of the internal organs (MOLNÁR, 1964a) was in every respect similar to that of *T. ovata* (Zeder, 1803).

The transparent males were 2.1—2.6 mm (av. 2.3 mm) in length and 0.041—0.062 mm (av. 0.045 mm) in diameter. The head was rounded off, without papillae. The body was slightly tapering toward both ends. The caudal end was blunt, with two lateral papillae-like protrusions, connected dorsally by a narrow inconspicuous membrane. The two narrow, relatively short

spicula were nearly equal and governed by a gubernaculum. The gubernaculum was represented by a bent chitinous plate, with a spear-like end. At about its middle, the gubernaculum bent dorsally, then dorso-cranially (Fig. 2). The body dimensions of males and females, as well as the measurements of the male chitinous organs are compared with the corresponding dimensions of *Thwaitia rischta* in Table 1.

Host—parasite relationship

As shown in Table 2, despite the relatively high intensity of infestation, migration of the females from the air bladder to the abdominal cavity took place in only few *Aspius aspius* fishes and less than half of the parasites had

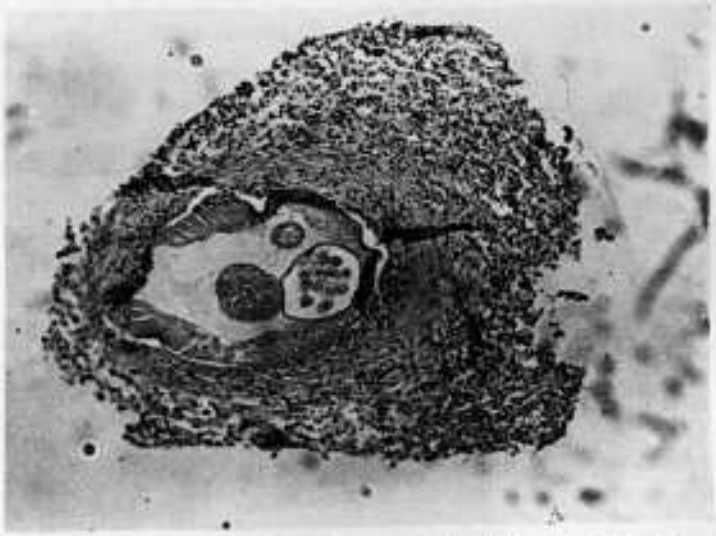

Fig. 3. Cross section of a *T. kotlani* female, encapsulated by connective tissue, but freely moving in the abdominal cavity. Note the uterus, oesophagus and ovary in the body cavity (H. E. stain)

reached full maturation. The mature females moved freely in the host's abdominal cavity; their body surface was smooth and their colour was vivid red. The development of the other females seemed to be suppressed, presumably by the resistance of the host. The body of the retarded specimens was encased partly or entirely, by connective tissue (Figs 3 and 4). Their colour was either white or pale pink, their movements were limited; some were even unable to change place as their connective tissue capsule was adherent to the surface of intestines or abdominal organs. Part of the encapsulated 10—30 mm long females deteriorated and the only indication of their

Table 2

Infection of *Aspius aspius* fishes with various developmental stages of *Thwaitia kotlani*

Habitat	Infection			♂♂			Mature or developing ♀♀			Retarded ♀♀ bladder			In air	Retarded ♀♀ in abdominal cavity			Deteriorated ♀♀ encapsulated in abdominal cavity		
	Number of fishes examined	Number of infected fishes	Per cent infected	Infected hosts		Intensity of infection	Infected hosts		Intensity of infection	Infected hosts		Intensity of infection		Infected hosts		Intensity of infection	Infected hosts		Intensity of infection
				No.	%		No.	%		No.	%			No.	%		No.	%	
Balaton	23	18	78.3	16	69.5	1—20	4	17.4	1—3	10	43.4	1—7	3	13	1—3	1—8	4	17.4	
Tisza	12	8	66.6	7	58.3	1—8	1	8.3	1	5	41.6	1—5	—	—	—		1	8.3	1
Duna (Danube)	6	3	50	2	33.3	2—6	—	—	—	2	33.3	1—2	—	—	—	—	—	—	—
Total	41	29	70.7	25	61	1—20	5	12.2	1—3	17	41.5	1—7	3	7.3	1.3	1—8	5	12.2	1—8

Fig. 4. Longitudinal section through part of the body of a freely moving, encapsulated *T. kotlani* female. The body cavity is full of immature eggs. (H. E. stain)

Fig. 5. Cross section of an encapsulated, nonviable *T. kotlani* female (Farkas—Mallory's stain)

Thwaitia nature was the dried, shrunken cuticle (Fig. 5). Another part of the encapsulated worms reached maturity but were unable to release their larvae. Deteriorated, encapsulated females full of larvae were still found in the host's abdominal cavity in June.

In the majority of the cases not even the above outlined incomplete development took place; like the males, the retarded females were retained in the air bladder all the year round; they remained viable but did not grow larger than the males, having been incapable of further development.

Developmental cycle

Since only a few of the examined parasites were normally developed, the life cycle could be followed up only in rough outlines. Anyway, it seems fairly certain that like the other *Thwaitia* parasites known in Hungary, also *T. kotlani* has a regular one-year developmental cycle. Mature females full of larvae have been found exclusively in May. The length of such females is approx. 60 mm. The larvae swarmed into the water — presumably after release of the females — continue their development in cyclopses. The *Aspius aspius* fishes become infected during the summer, supposedly by eating the infected cyclopses discharged from the digestive tract of smaller plankton-eating fishes. The time of the female's migration from air bladder to abdominal cavity is as yet unknown, but presumably takes place during the early autumn or even earlier, as young 15—20 mm females are found in the host's abdominal cavity already in the early spring. The uteri of such females are filled out by many juvenile eggs. By early April the females reach 25—30 mm in length and the eggs become mature; by the end of April juvenile larvae are apparent in the eggs. The mature larvae hatch in May. This cycle of *T. kotlani* differs notably from that of *T. rischta*. After copulation by about the end of summer, the males and females of *T. rischta* uniformly leave the air bladder; the females settle subcutaneously in the anterior part of the host's body, primarily under the skin covering the gills. The *T. kotlani* males, however, remain in the air bladder throughout the year and the fertilized females capable of further development settle in the abdominal cavity.

SUMMARY

A new roundworm parasite of the fish *Aspius aspius* is described under the name *Thwaitia kotlani* sp. n. The males settle under the serosa of the air bladder, whereas the females are capable of further development in the abdominal cavity.

T. kotlani has a season-governed one-year developmental cycle. Mature females full of larvae are found exclusively in May.

In part of the hosts the development of the parasite is suppressed, thus retarded or deteriorated specimens are often encountered.

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