
PARASITIC FAUNA OF BENTHIC CRUSTACEANS OF THE BARENTS SEA

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ORDER ASCARIDIDA  
Genus EUSTOMA Van Benedon, 1870

Larva of Eustoma rotundatum (Rudolphi, 1819)(Fig. 27)

In one of 20 dissected Lithodes maja, we found an unknown larva of Nematoda. This larva was situated in the body cavity on the liver of a stone crab. The rather long body of the larva was constricted at both ends. The body length was 22.78 mm, the width of the anterior end 0.175 mm, the posterior end 0.200 mm, and the width in the middle part of the body was 0.375 - 0.4 mm. On the front end of the larva there is a thickening of the cuticle in the form of a tooth - a trait distinguishing the larval stages of many nematodes. Under it one can distinguish 3 almost equal labia which merge imperceptibly with the head end of the body. In shape, they resemble the labia of Eustoma rotundatum, the single representative of the nematodes of the genus Eustoma. As for the tooth apparatus which is characteristic of this species, it was not possible to find it in the larva. The digestive tract of our worm is also reminiscent in its structure of that of Eustoma rotundatum. It consists of a muscular esophagus (1.875 mm long and 0.133 mm wide), the glandular ventricle (0.9
mm long and 0.183 mm wide), lacking any kind of caecums, and an intestine (0.166 mm wide), also lacking caecums. The posterior end of the larva, which evidently had begun to incapsulate, could only be distinguished from the capsule with difficulty and was slightly damaged, but all the same it could be discerned that it was not recurved but was elongated and in shape resembled more the tail of the female than that of the male of the adult *Eustoma*. The anal glands, which are absent in *Eustoma* are also absent in our larva.
The sexually mature *Eustoma rotundatum* are parasites of rayfish, sharks and chimaeras. In the Barents Sea, according to Yu.I. Polyanskii (1955), they infest up to 73.3% of *Raja radiata*.

It should be noted that the synonymics of this species is marked by exceptional confusion, and this nematode figures in the literature under the names: *Ascaris rotundata* (Rudolphi, 1819), *Eustoma truncata* (Van Benedon, 1870), *Anacanthocheilus rotundatus* (Wülker, 1930), *Anisakis (Pseudanisakis) rotundata* (Laiman et Borovkova, 1926), *Eustoma rotundatum* (Punt, 1941). In a recently published monograph on the ascaridata (Mozgovoi, 1953), it is distinguished as the genus *Pseudanisakis*, but as Punt (1941) and Polyanskii (1955) have shown, the genus name *Eustoma*, proposed by Van Benedon, has priority. Therefore, we shall in fact use this last genus name. There is also insufficient clarity in the literature with respect to the larval stages of the nematode in which we are interested. In 1929 and 1930, Wülker (1930) described larvae of nematodes from various teleost fishes and assigned them to the given species, calling them larvae of *Anacanthocheilus rotundatus*. Judging by the description which he provided, these larvae more likely belong to the genus *Anisakis*. In 1938, Kahl (1938) repeated Wülker’s error and referred to him, while expanding the list of fish infested with these larvae. Punt (1941) in his monograph exposes Wülker’s mistake, pointing out that the larva which he described belongs to the genus *Anisakis*. He makes the following arguments against Wülker’s position: in the first place, the ventricle of the adult *Eustoma* is much less developed than in the larvae described by Wülker; in the second place, the larvae described by Wülker have a rounded tail, which does not correspond to the shape of the tail in *Eustoma*; in the third place, these larvae
have anal glands, which are absent in *Eustoma*. In the material available to Punt on similar larvae from teleost fishes, which was considerable, he was able to find only *Anisakis* larvae. Therefore, Punt, in expressing doubt that Wülkner could find anything else in the same fish, was inclined to consider that Wülkner had made a mistake. The rather extensive materials of Yu.I. Polyanskii on the parasites of Barents Sea fish also point to this conclusion. It is interesting that in the larva which we found in *Lithodes*, the very same characters are present which Punt noted as essential for the genus *Eustoma*: the ventricle is much less pronounced than in *Anisakis*, the anal glands are absent and the tail is rather sharply pointed and not curled. Therefore it seems to us to be possible to consider the worm which we have found to be a larva of *Eustoma rotundatum*, despite the fact that such a characteristic species trait as the annular row of teeth is absent in it. The latter can be explained by the fact that the tooth apparatus which is obligatory in the adult individuals of this species has not had time to develop yet in the larvae.

We also find support for our view in the fact that apart from this nematode, we have also found *Anisakis* larvae in crustaceans. Comparison of these larvae with the nematode from *Lithodes* shows that they are not identical, and the difference lies precisely in the traits noted by Punt. We find this even more convincing of the correctness of the identification.

If our opinion is correct, it follows that *Lithodes* serves as an intermediate host for *Eustoma rotundatum*. How the worm develops from then on is still not clear. Whether they go directly to their final host, or another link is required in their cycle of development, as is the case in many Anisakida, and they must go to some kind of teleost fish, in whose body
Fig. 28. Larva of *Contracaecum aduncum*.

*1 - portion of body at level of intestinal and ventricular caecums; 2 - front end; 3 - posterior end.*

cavity or musculature they pass through the subsequent larval stages, has not been established.

Judging by the fact that sharks, which lead a mainly pelagic mode of existence and feed on fish, figure among the final hosts of *Eustoma*, the latter course of development seems to us to be the more likely.
Genus *CONTRACAECUM* Raliet et Henry, 1912

Larva of *Contracaecum aduncum* Raliet et Henry, 1912

(Fig. 28, 29)

A *Contracaecum aduncum* larva has been found in the musculature of *Pandulus borealis* (one of 600 dissected).

The total length of the larva is 19.425 mm, the width of the front end is 0.205 mm, the width of the middle part of the body is 0.380 mm, the width of the posterior end is 0.140 mm.
mm. The digestive system begins with the muscular esophagus (1.75 mm long and 0.105 - 0.110 mm wide), which merges with the small almost rectangular ventricle (0.14 mm wide, 0.10 mm long). A caecum runs posteriad from the ventricle, then the ventricle turns into the gut, which also puts out a caecum anteriad. The ventricular and intestinal caecums differ little in size: the length of the former is 0.805 mm, that of the latter 0.900 mm. The caudal end of the larva is pointed. The labia of the larva are still not developed; it is evidently preparing for moulting: the cuticle has come off in some places and a layer of new cuticle can be seen underneath. In structure, the specimen found is very similar to the larva of Contracaecum aduncum (Rud, 1812), a description and a drawing of which can be found in Punt (1941). Comparison of our parasite with Contracaecum larvae on Barents Sea fish indicates a great similarity between them, and since Yu.I. Polyanskii, who studied the fish of the Barents Sea considers that they are parasitized only by the species Contracaecum aduncum, then in all probability the nematode which we found is one of the developmental stages of this species. Margolis and Butler (1954) also found in Pandulus borealis a large number of nematodes, some of which had even reached sexual maturity. They consider these nematodes to be similar to C. aduncum. The life cycle of C. aduncum was studied experimentally by Markowsky (1937). This author demonstrated experimentally the participation of planktonic animals Acartia bifilosa and Euritemora affinis in the developmental cycle of C. aduncum.

The role of planktonic organisms in the life of the larvae of the genus Contracaecum has been demonstrated by other authors as well. Apstein (1911) and Pierantoni (1913) found larvae of the genus Contracaecum in Copepoda, and Lebour (1917) in Sagitta.
Fig. 30. Larva of *Terranora decipiens*.

1 - portion of body of worm at level of intestinal caecum; 2 - front end; 3 - posterior end.

Wülker (1930) postulates that medusas and Cephalopoda appear as possible first intermediate hosts of *Contracaecum*. In the Barents Sea, we once happened to see this larva in *Calanus finmarchicus*, and in the White Sea it has been found in *Harmothoe*. 
Fig. 31. Diagram of life cycle of *Terranova decipiens*.

1 - eggs in external milieu; 2 - first larval stage in first intermediate host; 3 - third larval stage in second intermediate host; 4 - sexually mature worm in final host.

*imbricata*. Thus, the circle of intermediate hosts for *Contracaecum aduncum* is quite large.

From the first intermediate host, the parasite goes to some fish that feeds on invertebrates (the second intermediate host). In the Barents Sea, *C. aduncum* is found in 37 species of fish (Polyanskii, 1955). Its final hosts are predatory fish, in which *C. aduncum* reaches sexual maturity.
From the facts adduced, it can be seen that *C. aduncum* exhibits nonspecificity with regard to the first and second as well as the final host (18 species according to Mozgovoi, 1953).

Genus **TERRANOVA** (Leiper et Atkinson, 1914) Karokhin, 1946

Larva of *Terranova decipiens* (Krabbe, 1878, Baylis, 1916) Karokhin, 1946 (Fig. 30, 31).

A *Terranova* larva was extracted from the musculature of one of 420 dissected *Sclerorangon boreas*. From its structure, it is not difficult to suppose that it belongs to the species *Terranova decipiens* (Krabbe, 1878). Comparison of the parasite from *Sclerocrangon* with the larvae of *Terranova decipiens* from the Barents Sea fish indicates a great similarity in their structure. The total length of our larva is 1.75 mm, width of the front end 0.12 mm, mid-body width 0.425 mm, width of the posterior end 0.15 mm. The intestinal caecum is quite large (0.7 mm long and 0.15 - 0.17 mm wide) and is 1.5 times longer than the ventricle. The muscular esophagus has a length of 1.68 mm, width 0.135 mm. The posterior end of the larva is pointed, and the distance from the anus to the end of the tail is 0.270 mm. At the end of the tail there is a small cuticular hook, evidently a larval formation. The labia, although rather inadequately developed, can still be discerned under the upper layer of cuticle.

There is no doubt that the nematode which we found belongs to the species *Terranova decipiens*, and hence *Sclerocrangon boreas* serves as the first intermediate host for this species. The next larval stage parasitizes in fish. Various marine mammals (Mozgovoi,
1953), become infested with the parasite by consuming fish. The parasite gets into their digestive tract and reaches sexual maturity there. In the Barents Sea, the late larval stages of *Terranova decipiens* are found in 7 species of fish, for which *Sclerocrangon boreas* is a readily accessible food. It is interesting that *Terranova* is found only in adult cod, and has
not been noted in cod fingerlings. Indeed this is natural, since benthic crustaceans are absent in the food ration of cod fingerlings and planktonic organisms are their main food.

Genus ANISAKIS Dujardin, 1845.

Larva of *Anisakis* sp. Dujardin, 1845 (Fig. 32).

From benthic crustaceans, *Anisakis* larvae came to us in *Caprella septentrianalis* (in one of 855 dissected) and in *Hyas araneus* (in one of 990 dissected). In addition, we once found it in *Thysanoëssa raschii* - a planktonic crustacean from Euphausidae. The *Anisakis* larva from crustaceans, on the basis of our materials, has a length of 8.14 to 16.17 mm. The width of the front end is 0.085 - 0.125 mm. The width of the posterior end is 0.105 - 0.150 mm, the mid-body width 0.145 - 0.410 mm. The front end, as is indeed typical of the larvae from fish described by other authors (Wülker, 1930 - under the name *A. rotundatus*; Punt, 1941), has a larval tooth - a cuticular outgrowth in the form of a beak, whose height can be 0.0147 mm. Underneath can be seen three labia, still not finally formed. The digestive apparatus consists of the muscular esophagus from 0.88 to 1.425 mm long and 0.09 - 0.1 mm wide, the ventricle, which is clearly demarcated and strongly differentiated from the esophagus by its glandular structure (length 0.62 - 0.85, width 0.135 - 0.295 mm) and the intestine (0.135 - 0.285 mm wide). The caudal end of the larva is pointed. The length of the tail is 0.105 - 0.125 mm. There are anal glands. We were able to discern two of them in our specimens. Just like the stages from fish, the nematodes from crustaceans are characterized by a spiral curled condition, and their caudal end remains curled even after fixation.

Comparison of our larvae with *Anisakis* larvae from Barents Sea fish shows beyond
a doubt that the next stage of development of these parasites from crustaceans must occur in fish. However, determination of the precise species affiliation of both the larvae from fish, and especially our larvae, has so far not been possible owing to the small number of definitive traits in them which are characteristic of particular species of the genus *Anisakis*.

In sexually mature condition, these nematodes parasitize in marine mammals or else in birds.

In the Barents Sea, the late larval stages of *Anisakis* infest 28 species of fish, and this number includes fish with different types of feeding: benthos-feeding (gobies, rays and others), and planktonophages (herring). This is quite in agreement with our findings, which indicate that both benthic and planktonic crustaceans serve as the first intermediate hosts for *Anisakis*.