



MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

No. 316

NOTES ON THE OCCURRENCE OF ACANTHOCEPHALA IN PACIFIC FISHES. I. ECHINORHYNCHUS GADI (ZOEGA) MULLER IN SALMON AND ECHINORHYNCHUS LAGENIFORMIS SP. NOV. AND CORYNOSOMA STRUMOSUM (RUDOLPHI) IN TWO SPECIES OF FLOUNDER. 1937

by

E. Kuitunen-Ekbaum

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O F C A N A D A

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NOTES ON THE OCCURRENCE OF ACANTHOCEPHALA IN
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NOTES ON THE OCCURRENCE OF ACANTHOCEPHALA IN PACIFIC FISHES. I. -
Echinorhynchus gadi (Zoega) Muller in salmon and Echinorhynchus
lageniformis sp. nov. and Corynosoma strumosum (Rudolphi)
in two species of flounder. 1937

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Echinorhynchus gadi (Zoega) Müller.

Syn. + E. acus Rud.
E. socialis Leidy
E. hepaticola v. Linstow
E. arcticus v. Linstow

This species has not previously been recorded from the West coast of North America and no species of Acanthocephala has hitherto been known to occur in any of the various species of Pacific salmon in British Columbia waters.

Zschokke and Heitz (1914) and Heitz (1920) state that E. gadi is a common and numerous parasite of Oncorhynchus nerka, O. keta and O. tshawytscha in Kamtschatkan waters. They found that individuals isolated from these hosts agreed in all particulars with the characters given by Lühe (1911), except that they were considerably smaller. Fujita (1920) records E. gadi from the intestine of O. nerka in Japan.

The present report is based on the examination of various species of the genus Oncorhynchus taken in British Columbian waters. The observations extended to only a limited area and were carried out for only a short period.

The results are summarised in Table I. The number of fish of each species examined, the date of examination, the proportion of individuals of each species examined which was found infected with E. gadi, and the number of these parasites found in each host are given. The majority of examinations were made at the Steveston cannery on the Fraser River and in these cases the exact point of capture of the fish is unknown but it was probably in the section of the Fraser

River between the mouth and the cannery. The others were caught at the entrance of Departure Bay and off Five Fingers Island.

All the parasites found were immature and about the same stage of development. Immature individuals taken from Oncorhynchus spp. were carefully compared with the specimens at the same stage of development taken from Melanogrammus aeglefinus, Pollachius virens and Gadus callarias from Atlantic waters and complete agreement was found in all respects. The length of the individuals from Oncorhynchus spp. varies from 10 to 25 mm., the width from 0.6 to 1.2 mm. The proboscis is from 0.4 to 0.6 mm. long and 0.2 mm. wide. The number of longitudinal rows of hooks on the proboscis varies from 18 to 20, and there are 12 to 13 hooks in each row. The receptaculum is 1.2 to 1.5 mm. long, the lemnisci 1.2 to 1.4 mm. The testes are 0.6 to 0.8 mm. long and 0.2 to 0.4 mm. wide. The cement glands are arranged linearly, which is characteristic of the species. They vary from 0.2 to 0.4 mm. in diameter. When killed and preserved fully extended the anterior portion of the body is noticeably enlarged, especially in females. This characteristic has also been found common among individual parasites obtained from the Atlantic hosts.

The observations were not continued over a sufficiently long period to determine whether the parasite attains the same size (up to 80 cm.) in Oncorhynchus spp. as it does in gadids. As already mentioned Zschokke and Heitz found it did not do so in the species of salmon examined by them.

TABLE I.

Host	Locality	Date of Capture	No. of fish examined	No. infected	No. of E. gadi found
O. kisutch	Entrance of Departure Bay	18/6/34	2	-	-
O. kisutch	" " " "	22/6/34	1	1	4
O. kisutch	" " " "	5/8/34	1	1	19
O. nerka	Steveston cannery	7/8/34	72	2	2-3
O. keta	" "	7/8/34	13	2	1-2
O. gorbuscha	" "	7/8/34	10	1	2
O. kisutch	" "	7/8/34	53	12	5-20
O. kisutch	Entrance of Departure Bay	22/8/34	1	-	0
O. tschawytscha	" " " "	30/8/34	1	-	-
O. kisutch	Off Five Fingers Island	30/8/34	3	3	26-108
O. kisutch	Entrance of Departure Bay	6/9/34	1	1	240
O. kisutch	" " " "	13/9/34	2	2	84-180
O. tschawytscha	" " " "	13/9/34	1	1	76
O. kisutch	Departure Bay	17/11/36	2	-	-
O. kisutch	" "	1/12/36	1	-	-
O. tschawytscha	" "	1/12/36	2	-	0

Oncorhynchus nerka was found to be only very slightly infected with E. gadi. Out of 72 fish examined only 2 were infected and each of these carried only 2 to 3 parasites. This is not in accordance with the findings of Zschokke and Heitz. It is extremely probable that the difference is due to the fact that the fish examined here were not feeding while those of the above authors were during the period of active feeding.

Much larger numbers of E. gadi were found in O. kisutch and O. tshawytscha than in other species of Oncorhynchus. In cases of these fish caught late in August and early September infection was very heavy. The parasites were free in the stomach; in the intestine they were both free and attached to the wall of the lower part.

It was possible to examine the stomach contents of fish caught in the neighbourhood of Departure Bay more carefully than of those handled at the Steveston cannery. The food was found to consist mainly of Amphipoda and megalopae of Cancer sp. ? (probably C. magister), and in lesser degree of the euphausiid Euphausia pacifica Hansen. In some cases only young herring were found in the alimentary tract.

In examining the food material of the fish the life history of the parasite was made apparent. The amphipod, Cyphocaris challengeri Stebbing, which is said to be abundant at depths of 50 fathoms or more, was found to be the intermediary host of E. gadi. Other species of Amphipoda may possibly also serve as intermediary hosts since several occur in the food, but individuals of E. gadi were found infecting C. challengeri only. Much of the amphipod food was too much digested to be identified. Specimens of C. challengeri found in the stomach and intestine of O. kisutch and O. tshawytscha were infected with E. gadi and many of the parasites had left the amphipod host and were found free in the food material.

The parasite is usually curled up in a close spiral within the coelom of the amphipod, or it may be only doubled over and extended along the longitudinal axis of the coelom. When dissected out and preserved in extended condition, the parasite, particularly the female, is longer than the amphipod host. There was usually only one parasite in each amphipod, rarely two.

The parasites freed from the amphipods were carefully studied and compared with those loose in the stomach and attached to the intestinal wall of the various species of *Oncorhynchus*. They were found to agree in all essential characters and to correspond with the juvenile individuals of *E. gadi* taken from various Atlantic fishes. Those taken from the lower part of the intestine of *Oncorhynchus* showed a more advanced stage of development than those found free in the stomach of the fish or in the coelom of the amphipod host. The parasites assume all the recognisable adult characters of *E. gadi* within the amphipod host, the sexual differences being clearly established. In the case of some male parasites dissected out of the amphipod the development of the cement glands was incomplete. The fate of such a parasite set free prematurely is unknown. It is possible that the development is continued in the definitive host, or the parasite may die. Amphipoda are apparently the only intermediary hosts for *E. gadi* and there appear to be no subsequent carriers.

It is of interest to note that this parasite has been known for more than a hundred and fifty years and is common in numerous holarctic fishes, but nothing was known about its development until Nybelin (1923, 1924) discovered and studied its life history; it was the first instance in which the development of any marine acanthocephalan was followed. This author found the following Amphipoda serving as intermediate hosts for *E. gadi*: *Amphithoe rubricata* (Mont.), *Calliopius rathkei* (Zaddach), *Gammarus locusta* (L.) and *Pentoporeia femorata*

Kroyer.

Egadi has been recorded from numerous Atlantic fishes by Linton (1892, 1914, 1933) and from Canadian Arctic fishes by Van Cleave (1920). It has been found infecting other Pacific fishes than those dealt with in this paper, but particulars of these cases will be reserved for a later communication.

Echinorhynchus lageniformis sp. nov.

This species is one of the commonest intestinal parasites of the Starry flounder, Platichthys stellatus (Pallas), caught in the shore waters of Departure Bay, Vancouver Island. It has also been found in a few cases infecting the Two-lined flounder, Lepidosetta bilineata (Ayres). It appears to be a distinct species which has, hitherto, not been described.

Layman (1930) studying the parasitic worms from the fishes of Peter the Great Bay found 33.3 per cent of Platichthys stellatus infected with Acanthocephala, but he did not identify the parasite.

Sexual dimorphism is very marked in this parasite. The female has the shape of a Florence flask (fig. 1) and the male is fusiform (fig. 2). This morphological differentiation is already apparent in the individuals not more than 1.5 mm. long. The colour of the parasite may vary from white through gray to orange, but, as in the case of all Acanthocephala, this characteristic is of no significance, since it varies with the food of the host.

Diagnosis.- Small Acanthocephala with marked sexual dimorphism. The proboscis, 0.25 to 0.4 mm. long, is cylindrical or, more frequently, dilated in the median region. Proboscis hooks arranged in 14 to 16 longitudinal rows of 8 to 10 hooks each. Apical hooks 0.045 to 0.050 mm. long, median hooks 0.050 to 0.055 mm., basal hooks 0.035 to 0.040 mm. ~~lea-~~ The neck is short and conical. The receptaculum is 0.8 to 1.2 mm. long, the lemnisci slightly longer if not

TABLE II

Date of capture	<u>Platichthys stellatus</u>		<u>Echinorhynchus lageniformis</u>	
	Length in mm.	Sex	No. of ♀ found.	No. of ♂ found
4/6/34	260	♂	9	-
9/6/34	195	♂	17	4
25/6/34	196	♂	15	-
25/6/34	205	♂	19	5
27/6/34	335	♂	2	-
27/6/34	234	♂	6	1
27/6/34	112	♂	13	-
27/6/34	142	♂	9	6
27/6/34	108	♂	56	39
13/7/34	140	♀	18	10
13/7/34	305	♀	7	-
24/7/34	217	♂	28	2
24/7/34	245	♀	14	-
24/7/34	238	♂	20	4
24/7/34	224	♂	8	1
25/7/34	242	♀	7	2
25/7/34	154	♂	6	2
6/8/34	234	♂	9	-
22/8/34	230	♂	16	1
22/8/34	220	♀	4	-
22/8/34	252	♀	5	-
22/8/34	247	♂	2	-
22/8/34	312	♀	3	-
22/10/34	230	♂	8	-
10/3/36	180	♀	10	2
10/3/36	220	♀	5	-
10/3/36	190	♂	12	1
17/11/36	270	♂	4	-
30/11/36	240	♂	28	-
30/11/36	245	♂	3	-
1/12/36	268	♀	10	1

contracted. The central nervous system near center of receptaculum.

Male.- The length varies from 1.5 to 5 mm. The greatest diameter, 0.5 to 0.8 mm., is posterior to the mid-region of the body. The testes are placed oblique and vary from 0.3 to 0.5 mm. in length and 0.2 to 0.35 mm. in width. Six pear-shaped cement glands, 0.2 to 0.25 mm. long and 0.1 to 0.15 mm. wide, are closely together.

Female.- The length varies from 2.5 to 6.5 mm. The greatest diameter of the bulbous posterior portion of the body varies from 1.2 to 2.2 mm., that of the cylindrical anterior portion from 0.4 to 0.7 mm. The eggs are 0.065 to 0.080 mm. long and 0.015 to 0.020 mm. wide.

Host: Platichthys stellatus (Pallas) and, occasionally, Lepidopsetta bilineata (Ayres).

Locality: Departure Bay, B. C.

Type specimens and cotypes in the author's collection.

The alternative host of this parasite is unknown, but since the food of the hosts consists in large part of shore Amphipoda and Isopoda it is probable that one or more of these serves in this capacity.

Corynosoma strumosum (Rudolphi)

Syn.: Echinorhynchus strumosus Rud.

E. ventricosus Rud.

E. gibbosus Rud.

E. hystrix Bremser

E. gibber Olsson

E. striatus Villot.

The larval form of this species has been found encysted in the liver, mesenteries and intestinal wall of Platichthys stellatus and of Lepidopsetta bilineata. It has not previously been recorded from the West Coast of North America. It is easily identified by the dilated anterior region and the long

cylindrical posterior region and by the anterior cuticular spines, which extend farther posteriorly on the ventral than on the dorsal surface. Good descriptions and figures are given by Luhe (1911) and by Meyer (1932). The parasite recorded here was compared with these descriptions and with actual specimens from Europe.

Of the specimens of Platichthys stellatus examined, 13.8% were found infected with this parasite. In some cases the infection was very heavy; as many as 120 larvae were encountered in one host. In others only a few parasites were present. The parasite is closely coiled in the oval cysts.

Infection in Lepidopsatta bilineata seems to be less frequent. Out of 30 specimens of this fish examined only two contained the parasite.

Nybelin (1923) first suggested that *Corynosoma* larvae in fishes underwent their earlier development in some species of arthropod. In 1924 he showed that the postembryonic development took place in certain amphipoda. When these are eaten by fishes the parasites are set free in the alimentary canal, make their way into the body cavity and encapsulate in the peritoneum, where they remain, without undergoing any further development, until the fish is eaten by a mammal or bird. When this occurs the parasite is set free in the mammal or bird where it becomes sexually mature. In the life history of *Corynosoma* the fish plays only the part of a carrier.

It is not yet known what animals serve as intermediate and definitive hosts respectively for this parasite on the Pacific Coast of Canada.

The author wishes to express her appreciation to the Biological Board of Canada and to the University of Toronto for the facilities afforded her at the Pacific Biological Station and the Department of Biology respectively which have enabled her to carry out this work.

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