AN ABSTRACT OF THE THESIS OF

Delpha Deane Dunlap for the Master of Science in Zoology

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Title: A Survey of the Helminth Parasites of Leptocottus armatus armatus Girard

Abstract approved [redacted]
(Major Professor)

Of the 100 specimens of Leptocottus armatus armatus Girard examined at the Oregon Institute of Marine Biology at Charleston, Oregon during June, July, and August, 1950, 99% were infected with helminth parasites. There was an 83% infection with Echinorhynchus gadi and a total of 1,258 individuals. There was a 16% infection with Podocotyle olssoni and a total of 2,004 individuals. There was a 19% infection with Podocotyle reflexa with a total of 50 individuals. There was a 27% infection with Tubulovesicula sp. with a total of 165 individuals. There was a 33% infection with nematodes with one specimen of a Spirurid, six specimens of Contracaecum sp. and 9 specimens of Anisakis, 17 specimens unidentified.

A SURVEY OF THE HELMINTH PARASITES OF *LEPTOCOTTUS ARMATUS ARMATUS* GIRARD

by

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A THESIS

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Professor of Zoology

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Typed by Louise Ferguson

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I wish to express my appreciation to my major professor, Dr. Ivan Pratt, for enabling me to use the facilities of his laboratory at the Oregon Institute of Marine Biology and at Oregon State College. I should also like to thank Dr. Harley J. Van Cleave and Dr. Paul V. Gustafson for specimen identification and the many people who have contributed time, aid, fish, and encouragement toward the completion of this project.

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A SURVEY OF THE HELMINTH PARASITES OF *LEPTOCOTTUS ARMATUS ARMATUS* GIRARD

Introduction

Leptocottus armatus Girard 1854 is found in tide pools on rocky areas and in bays along the Pacific Coast from Southern California to Northwestern Alaska. It might be classified as a scavenger fish, since it spends much of its time near the bottom and feeds on organic debris as well as many invertebrates. (1, pp.256-257)

Parasites which have been recorded from *Leptocottus armatus* include *Echinorhynchus gadi*, *Tubulovesicula sp.*, and several species of *Podocotyle*.

The acanthocephalan genus *Echinorhynchus* has been known for over 150 years. *Echinorhynchus gadi* was first described by Müller in 1776. (17, p.1) Originally the genus included all acanthocephalans; however, it was defined and limited by Lühe in 1911. (14, p.1) *Echinorhynchus gadi* has been recorded from numerous Atlantic fish by Linton in 1900, 1901, 1914, and 1933. (7,8,9,10) Van Cleave has recorded it from Canadian fish in 1920. (22, p.1) It was first recorded from the West Coast of North America by Ekbaum in 1938 (2, pp.267-274) from several of the species of salmon in British Columbian waters. Other records from the Pacific Area include Zschokke and Heitz (25, pp.204-210) and Heitz (4, pp.311-320), who recorded it in sockeye salmon, chum salmon, and chinook salmon from the Kamtschatkan Region of Siberia. The first record from Japan is that of Fujita, who found it in the intestine of sockeye salmon. (3, pp.278-281)

The genus Tubulovesicula was set up by Yamaguti in 1934 (24, pp. 462-465) as a genus in the family Hemiuridae. Species have been described from the stomach and intestine of fish from Japan, California (19, pp.477-482), British Columbia (16, p.335), the Atlantic Coast (11, p.137), and North Queensland, Australia (18, pp.32-34). Specimens identified as Tubulovesicula sp. were recorded from Leptocottus armatus from Friday Harbor, Washington by Lloyd in 1938. (12, p.103)

The genus Podocotyle Odhner (1905) includes P. reflexa and P. olssoni and belongs to the family Allocreadiidae.

Podocotyle reflexa (Creplin) 1825 is found in British waters and is recorded by McFarlane from Leptocottus armatus from Departure Bay, British Columbia in 1936. (15, pp.335-347)

Podocotyle olssoni Odhner (1905) is listed by Linton (11, p.67) as being found in the long spined sculpin, American sole, sand launce, and other fish from the Atlantic Coast.

The nematode Contracaecum magnum n. sp. is recorded from Leptocottus armatus from Canada by Smedley (21, pp.211-219).

The work in this thesis covers a survey of the helminth parasites of one hundred specimens of Leptocottus armatus armatus collected from Coos Bay, Oregon,during the summer of 1950.

Material and Methods

Fish were collected from the South Slough region of Coos Bay, Oregon, during the months of June, July and August of 1950, while the author was in residence at the Oregon Institute of Marine Biology, Charleston, Oregon. Most of the fish were caught from the Hallmark Dock or on the bridge over South Slough.

The majority of the fish was caught on a single hook on a hand line. The fish captured were always examined within a 48 hour period. Those which could not be examined at once were kept in cold storage. Most of the specimens were taken in close proximity to a crab cannery, and their stomachs were full of the cannery waste products which are thrown back into the slough. Copepods and amphipods were also found in their stomachs, as were various types of organic debris.

All of the acanthocephalans were found in the intestine, the flukes were found in the stomach, intestine, and gill region, and the nematodes were found in the intestine and body musculature.

The parasites were placed in chromic acid for relaxation, fixed in alcohol-formaldehyde-acetic acid fixitive and stored in 70% alcohol. The whole mounts of acanthocephalans and flukes were stained with Mayer's carmalum, dehydrated and mounted in balsam.

The acanthocephalans were identified by Dr. H. J. Van Cleave of the University of Illinois and the nematodes by Dr. Paul Gustafson of the University of Washington.

Incidence of Parasitism

Of the 100 fish examined, 99% were infected with at least one kind of helminth parasite, 83% were infected with *Echinorhynchus gadi* and 25% with only *E. gadi*. 68% were infected with *Podocotyle olssoni* and 65 with that form alone. 19% were infected with *P. reflexa* and 27% with *Tubulovesicula sp.* 33% were infected with nematodes and 1% with that form only.

The total number of parasites collected was as follows: *Echinorhynchus gadi* - 1,258, *Podocotyle olssoni* - 2,004, *P. reflexa* - 50, *Tubulovesicula sp.* - 165, and nematodes - 33. From this it can be seen that the average infection per individual fish was 12.58 for *E. gadi*, 20.04 for *P. olssoni*, 0.5 for *P. reflexa*, 1.65 for *Tubulovesicula*, and 0.33 for nematodes.

The median number of infection per fish for *E. gadi* was 6, for *P. olssoni* - 5.

Table 1. Incidence of Infection

FISH	Acantho-cephala	Podocotyle olssoni	Podocotyle reflexa	Tubulo-vesicula	Nema-tode
1	6				
2	4				
3	7				
4		3			
5	1		1		
6	4	1			1
7	14	5	2		1
8	2	40			
9	1				
10	15				
11	20				
12	43				
13	27				2
14	7	1			
15					
16	10	2			
17	4				
18	14				
19	8				
20	11				
21	52				
22	31	2	2		
23	60		2		
24	5				
25	32	8	3		1
26	1				
27	12	30			1
28					1
29	20				
30	10				
31	11				
32	17	46	2		
33	14				
34	8	8	5		
35	7	1		7	
36	6	157	7	5	
37	12	18	5	11	
38	6	6		1	
39	2	58			
40	15	13	1	15	
41	7			1	
42	36	5	3		
43	6	38	1	2	1
44	25	17	7		1
45	2				
46	1	34	2	4	
47		45	3		

Table 1. (continued)

FISH	Acantho-cephala	Podocotyle olssoni	Podocotyle reflexa	Tubulo-vesicula	Nema-tode
48	49				
49	19	1			
50	29				
51	46				
52	3	7			
53	6				
54	5	43	1		
55	6	2			
56	1	64			2
57	4	39	1	3	
58	4	18	1	2	
59	2	10			
60	23	1			
61	23	10			
62	9	8			
63	7	14	1	2	1
64	1	19		3	1
65	5	148		22	2
66	66				
67	21				3
68		105			4
69		73			
70		4			
71	10	19		9	1
72	8	54		9	3
73	3	103		3	
74	42	3			
75		13		3	
76	1	58		3	
77		13			
78	6	74		15	
79	1	43			
80		5			
81	15	3			
82	1	3			
83		2			
84		9			
85	3	25		5	
86	62				
87	81	16			
88	2	12		5	2
89	2	9			1
90	59	1		9	
91		35		5	
92	1	36			
93		62			1
94		26			

Table 1. (continued.)

FISH	Acantho-cephala	Podocotyle olssoni	Podocotyle reflexa	Tubulo-vesicula	Nema-tode
95		72			
96	1	5		5	
97	3	80		11	
98		60			
99	27	29		5	
100	5	30			3
TOTAL	1,258	2,004	50	165	33

Description of Species

In reply to an inquiry concerning the identity of the acanthocephalans, Dr. H. J. Van Cleave, University of Illinois, Urbana, Illinois, states *in littera*, "These specimens I have identified as *Echinorhynchus gadi*. This species has long been recognized as the most distinctive fish acanthocephalan from marine hosts of the Atlantic . . . I have had from two or three collectors on the West Coast additional materials, some of which were from the identical host as the one from which your specimens were taken. These individuals are all of them distinctly undersize when compared with the largest representatives from the Atlantic . . . This species is *extremely variable* in the features which are ordinarily regarded as available for specific diagnosis . . ."

Podocotyle olssoni Odhner (1905) was described by Linton (11, p.67) as being similar to *P. atomon*, the type species for the genus, but having a relatively shorter esophagus, a much longer cirrus pouch and seminal vesicle, greater breadth of testes, vitellaria usually interrupted at testes level, length of esophagus seldom equal to that of the pharynx, seminal vesicle may extend back of ventral sucker as much as halfway to the ovary. The testes are relatively much larger. On the basis of these distinctions, to which the examined specimens correspond to a great degree, it would seem more accurate to place them in the species *P. olssoni* than *P. atomon*. To the author's knowledge, *Podocotyle olssoni* has not been recorded from the Pacific Coast previous to this time.

The size range on seven specimens measured was: body length 2.40 to 4.50 mm; width 0.53 to 0.89 mm; oral sucker - length 0.17 to 0.29 mm, width 0.12 to 0.19 mm; ventral sucker - length 0.20 to 0.25 mm, width 0.23 to 0.31 mm; length of prepharynx 0.01 to 0.03 mm; pharynx 0.09 to 0.11 mm ; 0.09 to 0.11 mm; esophagus 0.12 to 0.15 mm; anterior testis - length 0.19 to 0.25 mm, width 0.20 to 0.26 mm; posterior testis - length p.25 to 0.60 mm, width 0.14 to 0.27 mm; ovary length 0.04 to 0.07 mm, width 0.10 to 0.20 mm; eggs - length 0.05 to 0.07 mm, width 0.02 to 0.04 mm.

Podocotyle reflexa (Creplin) 1825 was described by Miller (16, p.34) as being long, narrow, parallel-sided forms. The oral sucker is terminal and the ventral sucker is about twice as large as the oral sucker and oblong rather than round. Both are near the anterior end of the body. There is a short prepharynx, a well-developed pharynx and an esophagus which is usually longer than the pharynx. The esophagus divides shortly anterior to the ventral sucker and the intestinal caeca extend from here to near the posterior end of the body. The ovary is found about half way down the body and usually shows three lobes. The uterus is anterior to it and leads to the genital pore which is on the left side of the body on a level with the intestinal bifurcation.

The vitellaria extend along the sides of the body from the ventral sucker to posterior end. They fill in the intertesticular spaces but are discontinued laterally in the testes region. The testes are large, being from spindle to oval-shaped and are found in the posterior half

of the body. The elongate cirrus pouch extends about one third of the distance from the ventral sucker to the ovary.

The size range on measurements taken on five local specimens are as follows: body length 4.92 to 8.39 mm, width 0.48 to 0.89 mm; oral sucker - length 0.20 to 0.24 mm, width 0.18 to 0.28 mm; ventral sucker - length 0.17 to 0.27 mm, width 0.31 to 0.33 mm; prepharynx - length 0.01 to 0.02 mm; pharynx -length 0.12 to 0.15 mm, width 0.10 to 0.15 mm; esophagus 0.12 to 0.18 mm; anterior testis - length 0.31 to 0.47 mm, width 0.23 to 0.33 mm; post. testis - length 0.40 to 0.55 mm, width 0.21 to 0.36 mm; ovary - length 0.16 to 0.25 mm, width 0.22 to 0.27 mm; eggs - length 0.07 to 0.08 mm , 0.03 mm width.

The description of the genus Tubulovesicula as given by Yamaguti (24, p.469) in 1934 is as follows:

"Tubulovesicula n.g.

Generic diagnosis: Hemiuridae Lühe 1901. (13, pp.394-403) Body spindle-shaped with tail appendage. Pre-oral lip and cervical glands present. Cortical parenchymatous cells massed together into numerous groups separated from one another by interstices studded with refractive substance. Oral sucker subterminal. Pharynx contiguous to oral sucker. Esophagus short. Short proximal part of ceca lined by cuticule. Ceca terminating near posterior extremity of tail. Acetabulum definitely larger than oral sucker, in anterior third of body or a little further behind. Testes ventral, postacetabular, more or less obliquely juxtaposed, separated from each other by uterus.

Vesicula seminalis tubular, sinuous, anterodorsal to testes. Pars prostatica long, surrounded by numerous prostatic cells. Ductus hermaphroditicus enclosed in muscular pouch, expanded at base, opening into genital atrium. Genital atrium wide, opening at level of pharynx. Ovary closely behind posterior testis, submedian, ventral. Receptaculum seminis present. No Laurer's canal. Shell gland directly behind ovary. Vitelline gland consisting of seven tubular lobes. Receptaculum seminis uterinum present. Uterus descending into tail, ascending on opposite side of ovary and then between testes. Metraterm present. Eggs thick-shelled, embryonated. Excretory system bifurcating at level of anterior border of testes into arms uniting on dorsal side of pharynx. Parasitic in marine fishes."

The flukes taken from Leptocottus armatus agree with the definition in all particulars. The tail appendage takes up about the last fourth of the body length. The testes and ovary are approximately equal in size. The uterus is greatly developed with loops extending from the middle of the ventral sucker down into the tail appendage.

The size range of measurements taken on 12 specimens is as follows: body length 1.90 to 4.40 mm, width 0.66 to 1.30 mm; oral sucker - length 0.14 to 0.24 mm, width 0.17 to 0.29 mm; ventral sucker - length 0.27 to 0.48 mm, 0.30 to 0.51 width; pharynx - length 0.08 to 0.12 mm, width 0.08 to 0.12 mm; right testis - length 0.11 to 0.25 mm, width 0.12 to 0.31 mm; left testis - length 0.16 to 0.27 mm, width 0.16 to 0.33 mm; ovary - length 0.07 to 0.25 mm, width 0.08 to 0.29 mm; eggs - length 0.02 to 0.04 mm, 0.01 to 0.03 mm width.

This specimen differs from T. anguillae Yamaguti (24, pp.465-467) in body to tail proportions, from T. californica Park (19, pp. 477-482) in the shape of the testes and their position in regard to the ovary, from T. pinguis (11, p.335) in the number of lobes of the vitellaria, from T. angusticauda (18, pp.32-34) and T. nanaimoensis (15, p.335) by the development of the uterus, and from the latter, also in the shape of the testes. It also lacks the star shape of the vitellaria mentioned for T. lindbergi. (6, pp.98-99)

The nematodes were examined by Dr. Paul V. Gustafson, Department of Microbiology, University of Washington, Seattle, Washington. While he was unable to identify all of them, he did tentatively identify 1 female Spirurid, 4 mature male Contracaecum sp., 2 immature Contracaecum sp. and 9 immature Anisakis sp.. The remaining 17 nematodes are unidentified at present.

Discussion

While Leptocottus armatus has been previously listed as a host for Echinorhynchus gadi, Podocotyle reflexa and Tubulovesicula sp., as far as this author has been able to determine, no survey of the parasites of this fish has been attempted. Also, there has been no work done on specimens taken from Oregon waters.

The life cycle of Echinorhynchus gadi was worked out about 25 years ago. It was discovered that an amphipod, Cyphocaris challengeri Stebbing was an intermediate host. Other amphipod hosts were Amphithöe rubricata, Calliopus rathkei, Gammarus locusta and Pontoporcia femorata. While these species may not be found in the Coos Bay region, closely related species of amphipods belonging to several of these genera are found there and could serve the same purpose.

Ekbaum found the parasites curled up in a spiral in the amphipod coelom. Usually, there was only one parasite in each amphipod. Often when the parasite was dissected out it was found to be longer than its host. At this stage, the parasite had all the recognizable characteristics of the adult, including sex differences. The amphipod seems to be the only intermediate host. (2, pp.267-269)

As far as the author was able to determine, little has been done on the life cycle of either Podocotyle olssoni or P. reflexa. It seems probable, however, that their life cycle would correspond in a considerable degree to that of P. atomon. In this form the sporocyst develops in the marine snail Littorina. The cercariae penetrate and encyst in the amphipods, Gammarus sp., Carinogammaris mucronatus and

Amphithöe longimana. The metacercariae develop in the haemocoel of the amphipods, become sexually mature here and produce eggs. (5,pp. 57-68) While the work on this form was done on the East Coast, it is extremely probable that the West Coast forms have a similar life cycle in animals which occupy the same niche.

Summary

An examination of 100 specimens of *Leptocottus armatus armatus* Girard at the Oregon Institute of Marine Biology at Charleston, Oregon during the months of June, July and August 1950 yielded 1,258 specimens of *Echinorhynchus gadi*, 2,004 specimens of *Podocotyle olssoni*, 50 specimens of *Podocotyle reflexa*, 165 specimens of *Tubulovesicula sp.*, and 33 nematodes; the identified specimens distributed as follows: 1 Spirurid, 4 mature *Contracaecum sp.*, 2 immature *Contracaecum sp.*, and 9 immature *Anisakis sp.*.

Bibliography

1. Clemens, W. A. and G. V. Wilby. Fishes of the Pacific Coast of Canada. Ottawa, Fisheries Research Board of Canada, 1949. 368p.

2. Ekbaum, Ella. Notes on the occurrence of acanthocephala in Pacific fishes. Parasitology 30(2):267-274. 1938.

3. Fujita, T. On the parasites of Japanese fishes. Dobuto Gaku Zasshi 32:275-281. 1920.

4. Heitz, F. A. Salmo salar L. seine Parasitenfauna und seine Ernahrung in Meer und in Süsswasser. Archiv für Hydrobiologie und Planktonkunde 12:311-372, 485-561. 1920.

5. Hunninen, A. V. and R. M. Cable. The life history of Podocotyle atomon (Rudolphi) (Trematoda:Opecoelidae). Transactions of the American Microscopical Society 62(1):57-68. 1943.

6. Layman, E. M. Parasitic worms from the fishes of Peter the Great Bay. Bulletins of the Pacific Scientific Fishery Research Station 3(6):98-99. 1930.

7. Linton, Edwin. Fish parasites collected at Woods Hole in 1898. Bulletin of the United States Fisheries Commission 19:276-304. 1900.

8. _____ Parasites of fishes of the Woods Hole region. Bulletin of the United States Fisheries Commission 19:405-492. 1901.

9. _____ On the seasonal distribution of fish parasites. Transactions of the American Fisheries Society 44:48-56. 1914.

10. _____ On the occurrence of Echinorhynchus gadi in the fishes of the Woods Hole region. Transactions of the American Microscopical Society 52(1):32-34. 1933.

11. _____ Trematodes from fishes mainly from the Woods Hole region. Proceedings of the United States National Museum 88:1-172. 1940.

12. Lloyd, Lowell Clyde. Some digenetic trematodes from Puget Sound fish. Journal of Parasitology 24(2):103-133. 1938.

13. Lühe, M. Über Hemiuriden. Zoologischer Anzeiger 24:394-403, 473-488. 1901.

14. _____ Acanthocephalan. Brauer, Die Süsswasserfauna Deutschlands. Jena (16) 1911. 116p.

15. McFarlane, S. Hanford. A study of the endoparasitic trematodes from the marine fishes of Departure Bay, B. C. Journal of the Biological Board of Canada 2(4):335-347. 1936.

16. Miller, Max J. A critical study of Stafford's report on "Trematodes of Canadian Fishes" based on his trematode collection. Canadian Journal of Research, Section D, Zoological Science 19(1):28-52. 1941

17. Müller, M. Zoologiae Danicae Prodromus seu Animalium Daniae at Norvegiae Indigenarum Characteres, Nomina, et Sejnonyma imprimis popularium. Havniae. 1776.

18. Nicoll, William. The trematode parasites of North Queensland. Parasitology 8:32-34. 1915.

19. Park, James T. Two new trematodes, Sterrhurus magnatestis and Tubulovesicula californica Hemiuridae from littoral fish of Dillon's Beach, California. Transactions of the American Microscopical Society 55(4):477-482. 1936.

20. _____ A revision of the genus Podocotyle (Allocreadiidae) with a description of eight new species from the tide pools of Dillon's Beach, California. Journal of Parasitology 23:405-422. 1937.

21. Smedley, Enid M. Some parasitic nematodes from Canadian fish. Journal of Helminthology 12(4):205-220. 1934.

22. Van Cleave, Harley Jones. Acanthocephala. Report of the Canadian Arctic Expedition 9:1-11. 1920.

23. _____ A critical study of the Acanthocephala described and identified by Joseph Leidy. Proceedings of the Academy of Natural Sciences of Philadelphia 76:287-289. 1924.

24. Yamaguti, Satyû. Studies on the helminth fauna of Japan, Part 2 Trematodes of fishes I. Japanese Journal of Zoology 5(3): 462-470. 1934

25. Zschokke, Fr. and Heitz, F. A. Entoparasiten aus Salmoniden von Kamtschatka. Revue Suisse De Zoologie. 22:195-256. 1914.

PLATE 1

Male and Female *Echinorhynchus gadi*

C.G., cement gland; L., lemniscus; O., ovary; P., proboscis; P.R., proboscis receptacle; T., testes.

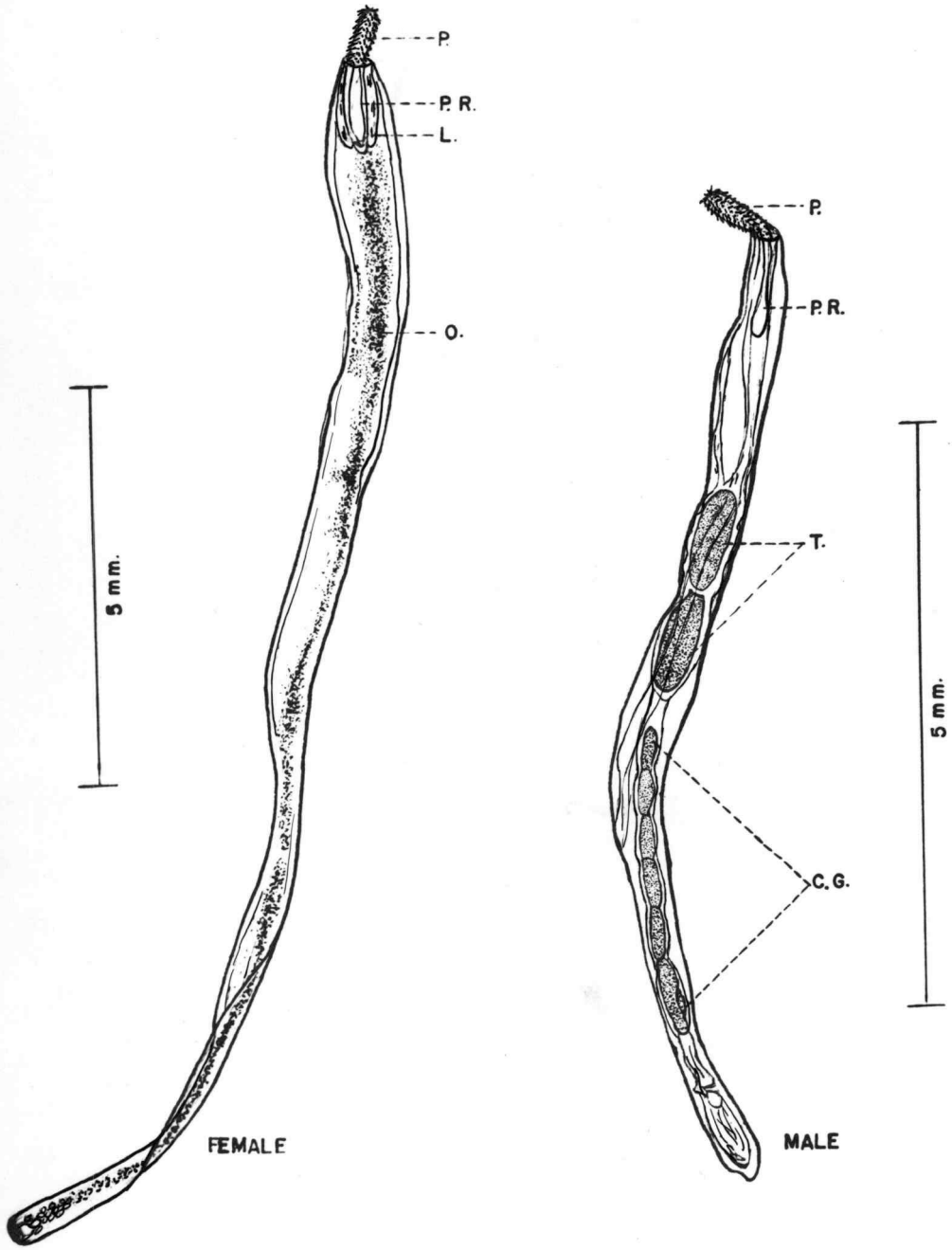

P.
P. R.
L.
O.
5 mm.
FEMALE
P.
P. R.
T.
C. G.
5 mm.
MALE

PLATE 2

Proboscis of *Echinorhynchus gadi*

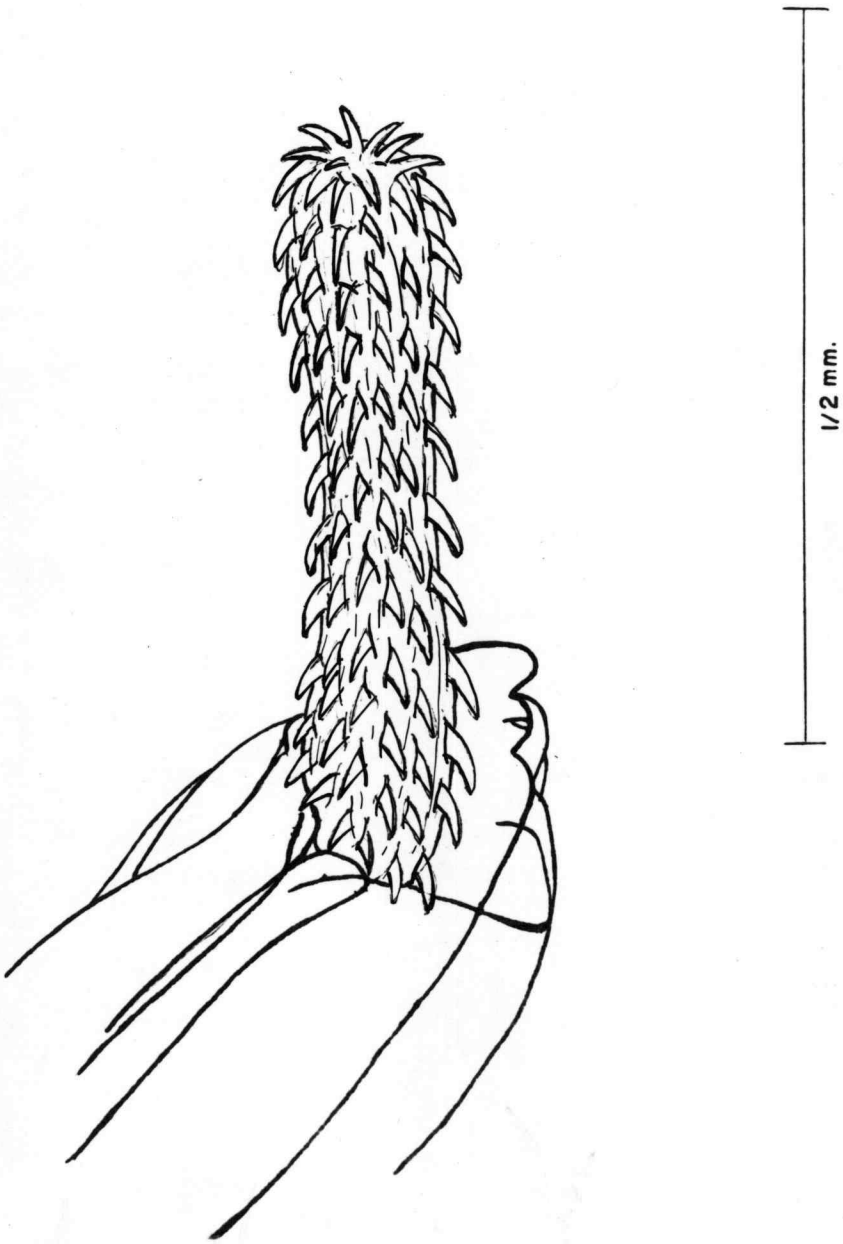

1/2 mm.

PLATE 3

Podocotyle olssoni

ESO., esophagus; EX.P., excretory pore; I.C., intestinal ceca; O., ovary; O.S., oral sucker; P., pharynx; P.P., prepharynx; SH.G., shell gland; S.R., seminal receptacle; T., testes; UT., uterus; VIT., vitellaria; V.S., ventral sucker.

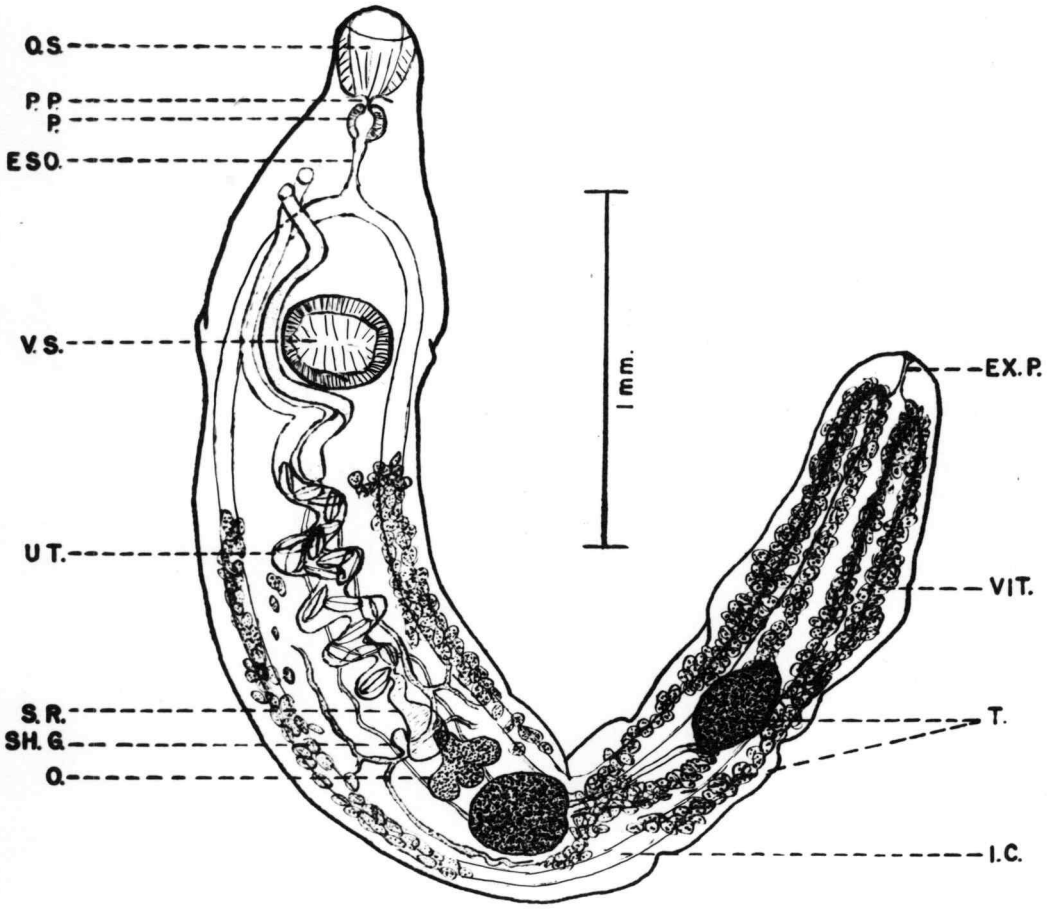
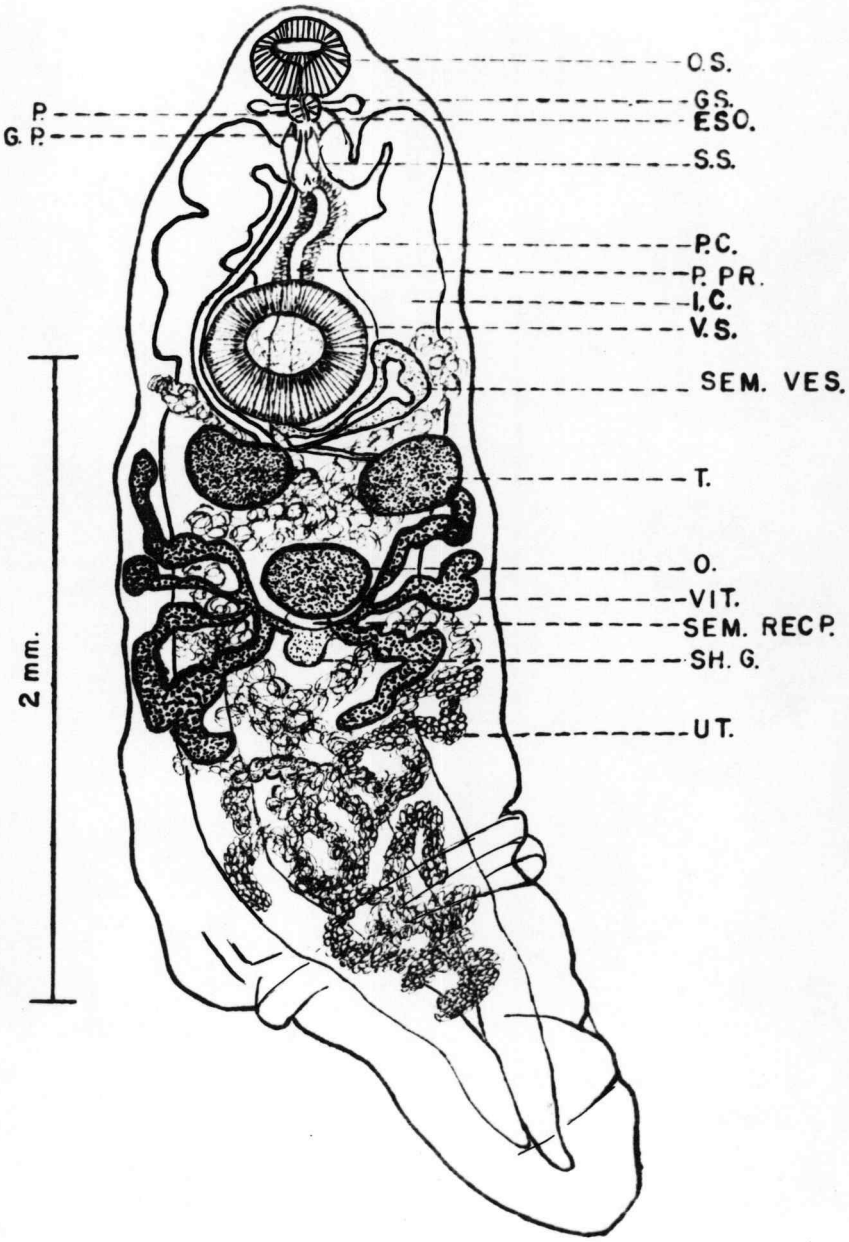

O.S.
P.P.
P.
ESO.
V.S.
UT.
S.R.
SH.G.
O.
1 mm.
EX.P.
VIT.
T.
I.C.

PLATE 4

Tubulovesicula sp.

ESO., esophagus; G.S., gland stomach; G.P., genital pore; I.C., intestinal ceca; O., ovary; O.S., oral sucker; P., pharynx; P.C., prostatic cells; P.PR., pars prostatica; SEM. RECP., seminal receptacle; SEM. VES., seminal vesicle; SH.G., shell gland; S.S., sinus sac; T., testis; UT., uterus; VIT., vitellaria; V.S., ventral sucker.


O.S.
G.S.
ESO.
S.S.
P.C.
P. PR.
I.C.
V.S.
SEM. VES.
T.
O.
VIT.
SEM. RECP.
SH. G.
UT.
P.
G. P.
2 mm.