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PARASITES OF THE TIDE POOL FISH *Liparis atlanticus* (OSTEICHTHYES:LIPARIDAE)*

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Abstract: Of 128 seasnails (*Liparis atlanticus*) collected from tide pools along the New Hampshire coast, over 90% were infected with the cestode *Spathebothrium simplex* and with one or both of the trematodes *Podocotyle reflexa* and *Podocotyle atomon*. Additional helminths found included *Echinorhynchus gadi, Prosorhynchus crucibulum,* and larval *Thynnascaris* sp. in 21, 12, and 9 percent of the hosts, respectively. All fish were infected with a species of *Eimeria,* and almost 30% had *Trichodina* sp. on their gills. The microscopic lesions associated with these infections are described, and the possible effects of these parasites on populations of *L. atlanticus* are discussed.

INTRODUCTION

Knowledge of the parasites of tide pool fish of the New England coast is very incomplete. *Liparis atlanticus,* commonly known as the seasnail, is found along rocky shores from Newfoundland to southern New England.[2] Fish are found adhering to the undersides of rocks and clinging to vegetation in littoral tide pools and in the sublittoral.

MATERIALS AND METHODS

Over a 2 year period 128 seasnails were collected by dip net from tide pools at Odiorne's Point and Rye Ledges, Rye, New Hampshire. Most fish were killed and examined immediately upon return to the laboratory. The remainder were held in aquaria for several days to allow removal of undigested food from the intestine.

Excised intestines were either fixed unopened with the parasites *in situ,* or were placed in saline, opened, and the individual worms were removed and fixed. Trematodes, cestodes, and acanthocephalans were relaxed, fixed in alcohol-formalin-acetic acid, and stained with either borax carmine or chrome alum-gallocyanin. Nematodes were fixed in glacial acetic acid and cleared in 5% glycerine in 70% alcohol which was subsequently evaporated to pure glycerine. Unopened intestines were fixed in either neutral buffered formalin or Bouin's fixative and embedded in paraffin. Sections were cut at seven microns and stained with either Ehrlich's hematoxylin and eosin or Gomori's trichrome stain.

Fecal smears and gill scrapings were examined from each fish.

RESULTS AND DISCUSSION

Table 1 lists the parasites found in *Liparis atlanticus* during this investigation.

Protozoa

Eimeria sp.—Every fish was infected with this coccidian. Parasites were distributed throughout the length of the intestine, but the heaviest infections were in the posterior intestine where much of the mucosa was often invaded and destroyed (Fig. 1). This parasite caused the

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TABLE 1. Parasites of 128 **Liparis atlanticus** from New Hampshire tide pools.

Parasite	Number of Fish Infected	Percent Infected
Protozoa:		
Eimeria sp.	128	100.0
Trichodina sp.	38	29.7
Trematoda:		
Prosorhynchus crucibulum	15	11.7
Podocotyle reflexa, P. atomon	117	91.4
Cestoda:		
Spathebothrium simplex	119	93.0
Acanthocephala:		
Echinorhynchus gadi	27	21.1
Nematoda:		
Thynnascaris sp.	12	9.4

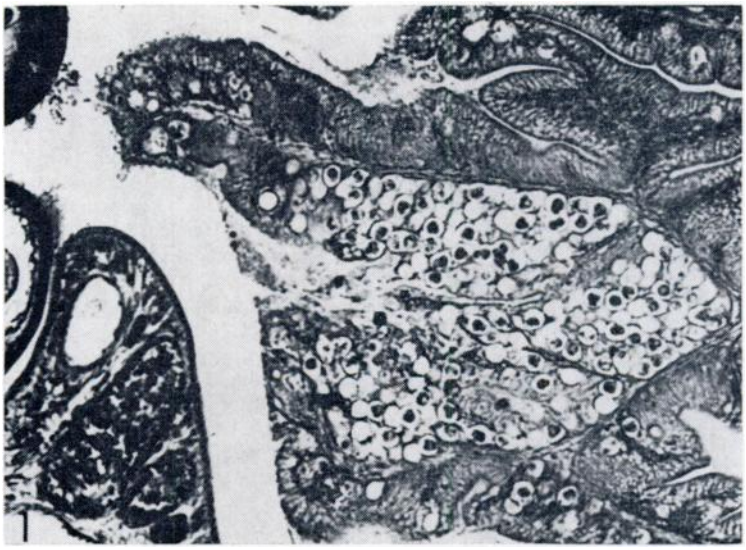

FIGURE 1. Section through the posterior intestine of **L. atlanticus** showing heavy infection of **Eimeria** sp. in the mucosa. Note section through **Podocotyle** sp. in the lumen of the intestine. Bouin's, H and E. X100

most serious histopathological damage seen during this study, sometimes occupying large areas of the intestinal mucosa in a given microscopic section. There was no evidence of preference for specific epithelial regions. Cells from the tips of the villi to the depths of the crypts of Lieberkühn were parasitized with equal frequency. Heavily infected villi appeared slightly flattened, but there was no accompanying infiltration of the lamina propria with lymphocytes or other inflamatory cells. The submucosa was not invaded. Several species of this genus have been reported from marine fish,[7] among them *E. gadi* from cod, *E. sardinae* from sardines, *E. brevoortiana* from menhaden, and *E. clupearum* from herring and mackeral.

Trichodina sp.—This ciliate was observed on the gills of 38 fish. No apparent injury was associated with this organism, all infections being relatively light. More than 90 species of trichodinids have been described from marine and freshwater fish.[12]

Trematoda

Prosorhynchus crucibulum—Fifteen fish were parasitized by this gasterostome. All worms were located deep in the intestinal ceca where their spinous teguments caused light abrasion of the mucosa. Dawes[3] states that the three most commonly reported species of *Prosorhynchus* in marine fish are *P. aculeatus, P. squamatus,* and *P. crucibulum,* and believes the first two species may be synonomous with the last. *Liparis* spp. have been reported as definitive hosts or *P. crucibulum* in Asian waters[10] and for *P. squamatus* in the Baltic Sea.[17] Cercariae of *P. squamatus* are found in *Mytilus edulis.*[4] If the three species of *Prosorhynchus* are synonomous, then *Mytilus edulis,* also found in tide pools with *L. atlanticus,* may serve as an intermediate host for *P. crucibulum* along the New England coast.

Podocotyle reflexa and *Podocotyle atomon*—Only 11 seasnails were not parasitized by a species of *Podocotyle. P. reflexa* was more prevalent than was *P. atomon.* These trematodes were distributed throughout the length of the intestine when the cestode *Spathebothrium simplex* was absent, but were located in the mid- and posterior intestine when the tapeworm occupied the anterior end. Histopathological damage caused by these parasites was limited to the grasping of small areas of the mucosa with their suckers.

Seventeen species of *Podocotyle* are parasitic in marine fish of the colder waters of the Atlantic and Pacific Oceans.[13] *P. reflexa* has been reported from *Cyclopterus lumpus* (a fish related to *L. atlanticus*) in the Baltic Sea,[17] and from *Onos mustelus,* a British tide pool fish.[14] In Asian waters *Liparis* spp. are hosts for both *P. reflexa* and *P. atomon.*[10] Cercariae of *P. atomon* are found in *Littorina rudis* (= *L. saxatilis*) and metacercariae occur in *Gammarus* sp.[17] These invertebrates are present in the tide pools with *L. atlanticus.*

Cestoda

Spathebothrium simplex—This tapeworm was present in all but nine hosts. Worms were always located in the anterior intestine and their scolices often protruded deep into the ceca. Little tissue damage was caused by the undifferentiated scolex of *S. simplex,* but in heavy infections the worm mass flattened the mucosa and eroded the brush border (Fig. 2). The number of goblet cells appeared constant in both light and heavy infections, contrasting with the disappearance of goblet cells seen in the intestine of the marine fish *Synodus intermedius* when heavily infected by the cestode *Acompsocephalum tortum.*[15]

S. simplex has been reported from several hosts including *Liparis liparis* at Woods Hole,[10] *Liparis fuscensis* from the west coast of North America,[8] *Crystallias matshushima* from the Sea of Japan,[16] and *Liparis* spp. in Asian waters.[10]

Acanthocephala

Echinorhynchus gadi—This parasite was found in 27 fish. All specimens were immature, indicating that *L. atlanticus* may not be a normal definitive host for the parasite. Grossly, the infected intestine

appeared normal, showing no fibrous capsule or nodule formation on its external surface. Microscopically total destruction of the epithelium occurred at the point of proboscis penetration (Fig. 3). Penetration never extended deeper than the lamina propria. A slight thickening of the lamina propria occurred near the site of penetration. This thickening was due to an increase in the number of fibroblasts and lymphocytes located around the proboscis (Fig. 4). These fibrous and cellular elements were loosely arranged, but did give the appearance of beginning capsule formation. Acanthocephalans were found in the anterior intestine when *S. simplex* was absent, but were restricted to the mid- and posterior regions when the cestode was present.

E. gadi has been found in 54 species of marine teleosts at Woods Hole.[11] *Gammarus locusta* (=*G. oceanicus*) is an intermediate host for this parasite.[14] This amphipod constitutes a major part of the diet of *L. atlanticus*[9] and is probably the source of infection.

Nematoda

Thynnascaris sp.—Larval stages of this nematode were entwined in the mesenteries of 12 fish. No apparent lesion was associated with the parasite. A closely related genus, *Contracaecum*, has been reported from *Liparis* sp. at Woods Hole.[11]

All fish examined appeared normal. None were emaciated or showed signs of sickness or malnutrition. However, the relative confinement of a tide pool does increase the possibility for reinfection which could result in severely pathogenic massive infections. This would be especially true of parasites with direct life cycles such as *Eimeria* and *Trichodina*. The pathogenecity of *Trichodina* in aquaria and hatcheries is well known, and fishes with small opercular openings such as *L. atlanticus* would be especially susceptible to respiratory impairment due to a heavy infection with this ciliate. The destruction of intestinal epithelium by *Eimeria* sp. would certainly have a deleterious effect on intestinal absorption and glandular secretion, and this parasite is

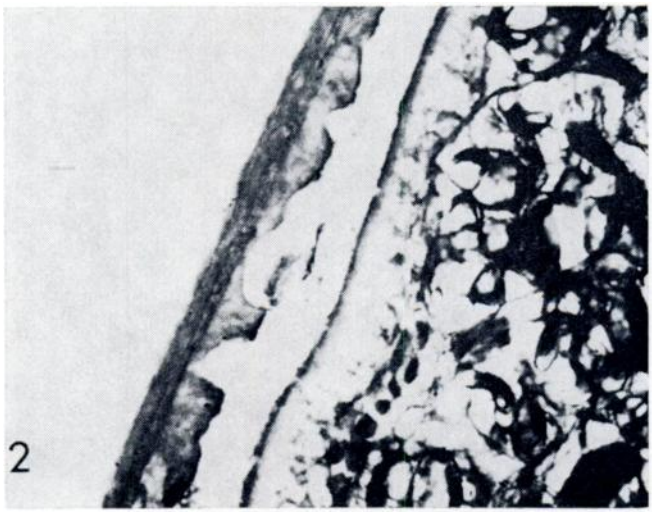

FIGURE 2. Section through the anterior intestine of **L. atlanticus** showing flattening of the mucosa due to a heavy infection of **Spathebothrium simplex**. Bouin's, Trichrome. X 250

FIGURE 3. Longitudinal section through the proboscis of **Echinorhynchus gadi** showing total destruction of seasnail intestinal epithelium at the point of proboscis penetration. Bouin's, H and E. X 250

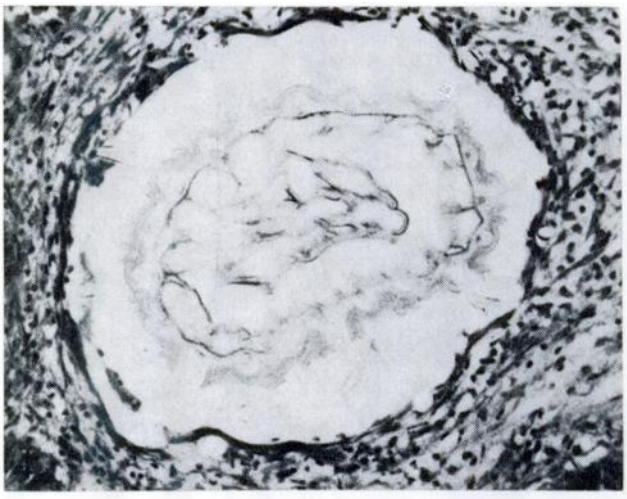

FIGURE 4. Cross section of the proboscis of **E. gadi** in the lamina propria of seasnail intestine. Note the loosely arranged fibroblasts and lymphocytic infiltration located around the proboscis. H and E. X250.

capable of a rapid build up in population. Both of these protozoans could have serious effects on a population of seasnails in a given tide pool. The distortion and flattening of the mucosa by *S. simplex* would also affect intestinal absorption. The life cycle of this tapeworm is unknown, but related cestodes utilize amphipods as intermediate hosts.[1,3] *Gammarus oceanicus* is commonly found in tide pools and may serve as intermediate host for this parasite. If this were true, it would certainly increase the possibility of the occurrence of heavy cestode infections. Because *L. atlanticus* is apparently an abnormal definitive host for *E. gadi*, the chances of heavy parasitism by this acanthocephalan appear minimal, even though the probable amphipod intermediate host is readily available. The other helminths found apparently have little, if any, effect on populations of *L. atlanticus*.

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