PARASITE FAUNA OF THE SEA LAMPREY (PETROMYZON MARINUS VON LINNÉ) IN THE GREAT LAKES REGION

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Seven hundred and fifteen adult sea lampreys (*Petromyzon marinus* von Linné) from four streams tributary to Lake Huron and five offshore samples from the Manitoulin Island – Bruce Peninsula area, were examined for parasites.

Dissection and microscopic examination revealed the presence of eight parasite species. *Cucullanus stelmioides* Vessichelli, 1910 is recorded for the first time both as a parasite of *P. marinus* and from North American waters. *Ergasilus caeruleus* Wilson, 1911, *Anodontoides ferussacianus* Lea, 1834, *Diplostomum huronense* (La Rue 1927), *Plagioporus lepomis* Dobrovolny, 1939 are all recorded for the first time as parasites of *P. marinus*. *Echinorhynchus salmonis* Müller, 1784, *Triaenophorus crassus* Forel, 1868, and *Proteocephalus* sp. are redescribed as parasites of the sea lamprey.

Introduction

During the early spring, summer, and early fall months of 1961 and 1962, 284 adult sea lamprey (*Petromyzon marinus* von Linné 1758) were taken from four streams tributary to Lake Huron in the Manitoulin Island – Bruce Peninsula area. An additional 431 specimens were captured from five offshore sites in the same region. Subsequent dissection and microscopic examination revealed the presence of eight parasite species.

A review of the available literature indicated that, of the 54 parasite species known to parasitize the family Petromyzontidae, only 18 were reported as infecting *P. marinus*. The present study includes five species which are recorded for the first time as parasites of *P. marinus*.

Materials and Methods

Of the 284 stream specimens examined, those lampreys taken from Silver Creek, Mindemoya River, and Blue Jay Creek were captured either by hand or by spearing during the latter half of May and the first half of June (Fig. 1). Those taken from the Saugeen River were caught in weirs from late September until the first part of January.

Of the 431 lake specimens examined, all of those from Meaford, South Bay, and one-third of those from Burnt Island were captured during June, July, and August. The remaining Burnt Island specimens, and those from Tobermory and South Bay (mouth) were captured between October and January. These were feeding on splake, lake trout, perch, cisco, and whitefish. The fish were caught in the gill nets or pound nets of commercial fishermen. Each lamprey was preserved in 10% formalin.

Dissection was carried out under a binocular microscope at 10 to 20 magnification. Parasites were immediately placed in labelled vials containing 70% alcohol with 5% glycerine. A record was kept for each lamprey of the number and types of parasites present, the sex and the approximate stage of development of the adult lamprey, and other pertinent information.

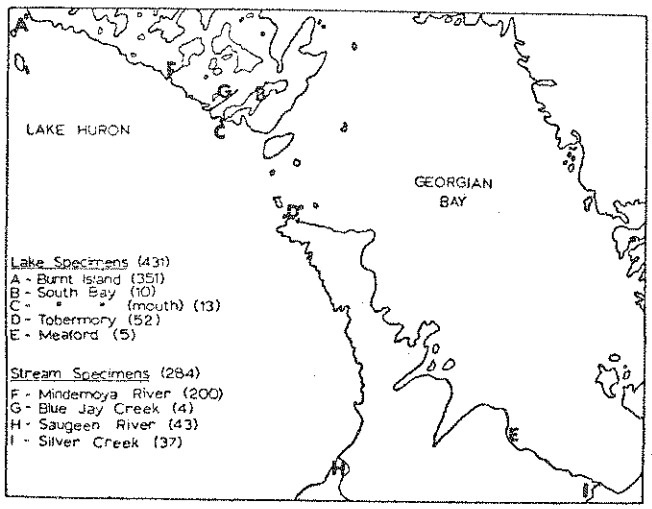

FIG. 1.

These procedures were carried out by two technicians associated with the project from the outset. The authors did not examine this material until January of 1966.

Although all of the sea lampreys examined were adults, they were not all at the same stage of development. Those specimens taken from the streams were, for the most part, spawning adults in which the gonads were fully developed, the intestine was thread-like and empty, and the liver was orange in color. The lake specimens were (with three exceptions) adults in the "active-feeding" stage, in which the gonads were not fully developed, the intestine was round and full of blood, and the liver was a red or green color.

Both the parasitic copepods and the glochidial forms of Mollusca were first cleared and temporarily mounted in methyl salicylate on slides under a cover slip. The nematodes were cleared and mounted in lactophenol. The trematodes, cestodes, and Acanthocephala were first cleared and stained in Mayer's Paracarmine. They were then mounted permanently on slides.

The works of Dobrovolny (1939), Hoffman (1960), Manter (1954), Miller (1940), Pavlovskii (1962), Surber (1912), Wardle and McLeod (1952), Wilson (1911), and Yamaguti (1958) were used in identifying parasites.

Results

PHYLUM: Arthropoda
ORDER: Copepoda
FAMILY: Ergasilidae

Ergasilus caeruleus Wilson

These parasitic copepods were located within the gill pouches of the sea lamprey but were not found to be confined to any one gill pouch. All of the copepods observed were females and they usually bore a pair of long, pale-blue egg sacs. They were attached to the folded respiratory epithelium of the gill filaments by the two greatly enlarged and segmented second antennae.

Of the 284 sea lamprey (Fig. 2) captured in the streams, 64, or 22.5%, were infected by *E. caeruleus*. The infected lampreys contained an average of 3.6 copepods with a range of 1–33 copepods per lamprey. But only 43 or 10% of the 431 lake specimens had this parasite attached to the gills, an average of 3.3 with a range of 1–16 copepods.

PHYLUM: Mollusca
ORDER: Eulamellibranchia
FAMILY: Unionidae

Anodontoides ferussacianus Lea

Like the parasitic copepods, these glochidia were located in the paired gill pouches of the lamprey but were not found to be specific to any one gill pouch. The glochidia were found clamped tightly to the epithelial covering of the gill filaments. In some instances an adventitious cyst had been produced.

Thirty-four, or 12.0%, of the stream-caught lampreys were infected to give an average of 1.8 per fish and a range of 1–9. Only 1 (0.2%) of the lake-caught lampreys were infected by *A. ferussacianus* (Fig. 3).

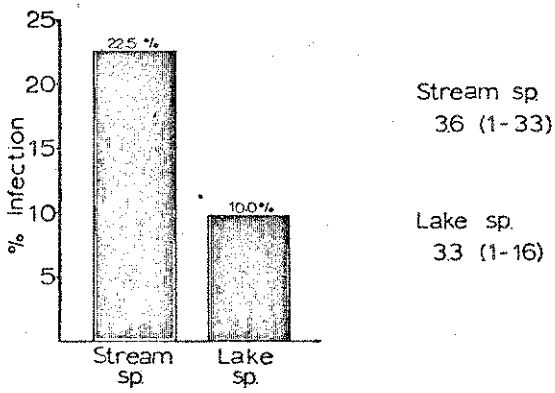

FIG. 2.

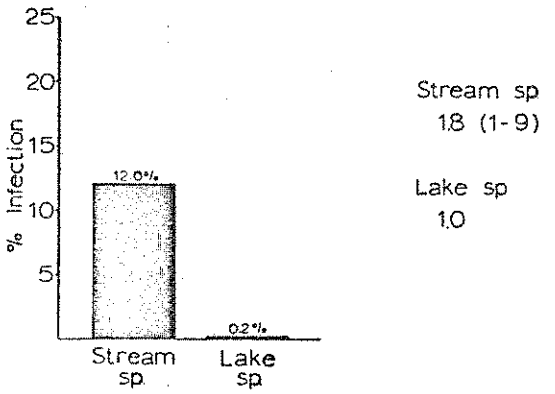

FIG. 3.

PHYLUM: Platyhelminthes
ORDER: Digenea
FAMILY: Diplostomidae

Diplostomum huronense (La Rue)

Larval trematodes of the species *D. huronense* were located in the eyes of the sea lampreys. Sixty-seven (23.6%) of the stream-caught lampreys were infected giving an average of 2.1 with a range of 1–11 parasites per fish. Nine (2.1%) of the lake-caught lampreys were infected by *D. huronense* to yield an average of 1.9 and a range of 1–6 trematodes per fish (Fig. 4).

ORDER: Digenea
FAMILY: Allocreadiidae

Plagioporus lepomis Dobrovolny

Only one specimen (0.4%) of this species of trematode was found in a stream-caught lamprey (Fig. 5). The adult trematode was found in the intestine and carried approximately 30 ova. This species was not found in lake-caught lamprey.

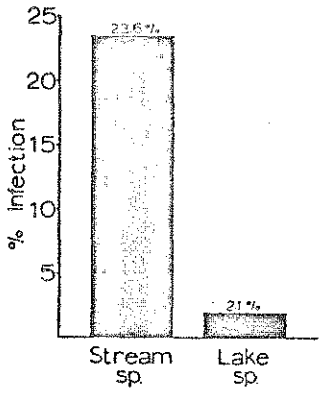

FIG. 4.

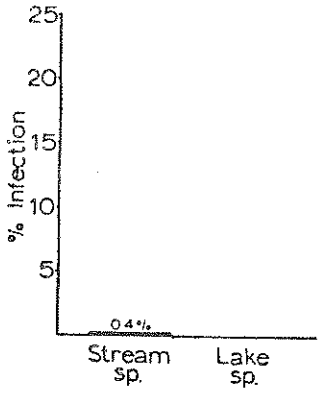

FIG. 5.

ORDER: Pseudophyllidea
FAMILY: Triaenophoridae

Triaenophorus crassus Forel

Partially disintegrated adult cestodes were found in the intestine of 3 (1.0%) of the stream-caught sea lampreys to yield an average of 1.3 with a range of 1–2 cestodes (Fig. 6).

ORDER: Proteocephala
FAMILY: Proteocephalidae

Proteocephalus sp.

These cestodes were found as mature worms and immature larvae in the intestine of the sea lamprey. In some, partial disintegration had occurred (Fig. 7). Two, or 0.7%, of the stream-caught specimens were infected to yield an average of 1.5 and a range of 1–2 cestodes. Three, or 0.7%, of the lake-caught lampreys were infected to give an average of 1.0 cestode per lamprey.

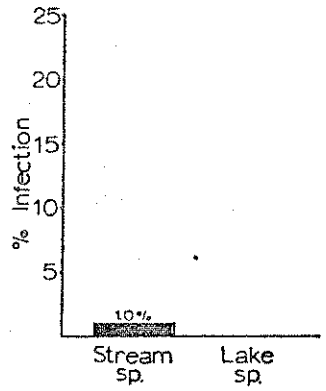

FIG. 6.

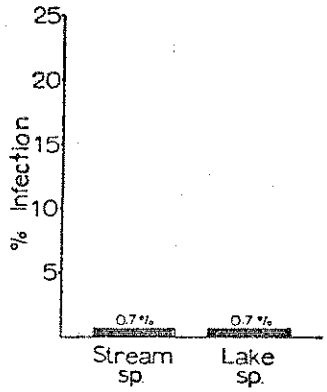

FIG. 7.

PHYLUM: Nemathelminthes
ORDER: Echinorhynchidea
FAMILY: Echinorhynchidae

Echinorhynchus salmonis Müller
(synonym: *Echinorhynchus coregoni* Linkins)

These acanthocephalans were found with the proboscis imbedded in the tissues of the intestinal wall. One specimen was found in the gill. Most of the Acanthocephala were adults with many of the females bearing a large number of ova.

Thirty-seven (13.0%) of the stream-caught lampreys were infected to give an average of 1.8 and a range of 1–15. Twenty-two (5.1%) of the lake-caught specimens were infected by *E. salmonis* to yield an average of 1.4 and a range of 1–4 Acanthocephala per host (Fig. 8).

ORDER: Spiruridea
FAMILY: Cucullanidae

Cucullanus stelmioides Vessichelli
(synonym: *Dacnitis stelmioides* Vessichelli)

Cysts of these nematodes were located in the gonads, liver, and intestinal walls of sea lampreys. Rarely, mature worms were found in the gills. When broken, these cysts were found to contain 1–8 nematodes in varying stages of development ranging from juvenile to mature specimens. The gonads of one lake-caught lamprey were found to contain 98 nematodes and its intestine and gills carried 10 more.

Only 1 (0.4%) of the stream-caught sea lampreys was infected to give a slightly biased average of 8.0. But 12 (2.8%) of the lake-caught specimens were found to be infected by *C. stelmioides* to yield an average of 10.2 and a range of 1–108 nematodes (Fig. 9). This average is rather unrealistic as it includes the one lamprey bearing 108 nematodes.

Of the 284 stream-caught sea lamprey, 149 (52.5%) were infected by at least one of the aforementioned 8 parasites. Still other specimens were infected

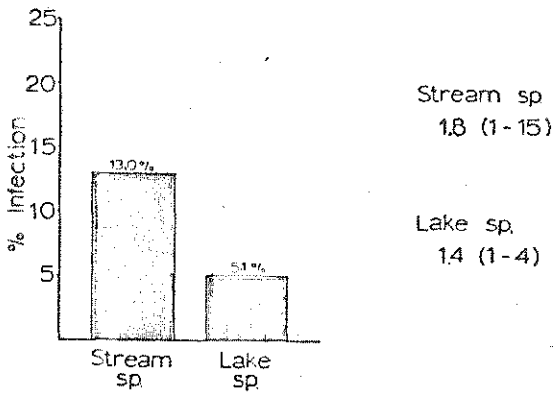

FIG. 8.

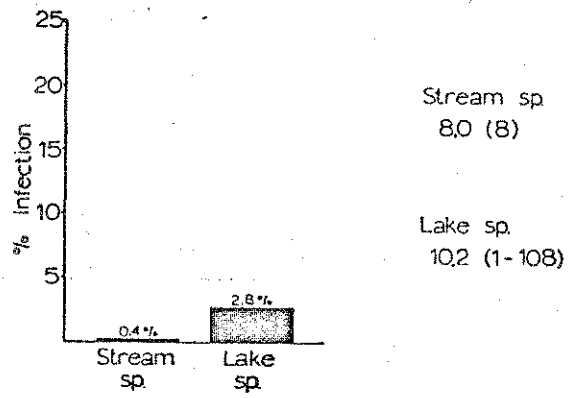

FIG. 9.

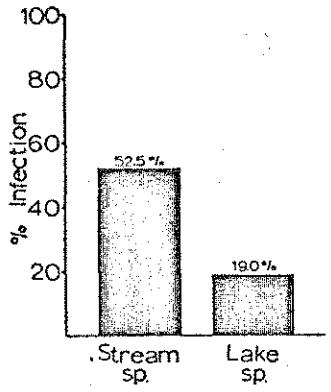

FIG. 10.

by unidentified fungi, spore-like bodies, and bacteria. If those lampreys infected by parasites of this protistan group are included, the figure increases to 216, or 76.0% (Fig. 10).

Of the 431 lake-caught sea lamprey, 82, or 19.0%, were infected by at least 1 of the 8 parasites mentioned in this report. This figure increases to 130, or 30.2%, if those lampreys infected by parasites of the protistan group are included.

Discussion

Adult sea lampreys captured in the lake (active feeders) had a much lower incidence of infection (19.0%) by these eight parasites than did those specimens which returned to the streams to spawn (52.5%). The only instance in which infected lake-caught sea lampreys (2.8%) outnumbered the infected stream-caught specimens (0.4%) involved nematode infection by *Cucullanus stelmioides*.

With the exceptions of *Proteocephalus* sp. and *Cucullanus stelmioides*, the numbers of individual parasites found in lake-caught sea lampreys were less

than those found in stream-caught specimens. *Proteocephalus* sp. numbers were the same (3) in both instances. However, *Cucullanus stelmioides* was more prevalent (122) in lake-caught sea lampreys than in stream-caught specimens (8).

TABLE I

Parasites infecting the sea lamprey (*Petromyzon marinus*) in the Lake Huron area

Stream-caught specimens		Lake-caught specimens	
Parasite	% infection	Parasite	% infection
Diplostomum huronense	23.6	*Ergasilus caeruleus*	10.0
Ergasilus caeruleus	22.5	*Echinorhynchus salmonis*	5.1
Echinorhynchus salmonis	13.0	*Cucullanus stelmioides*	2.8
Anodontoides ferussacianus	12.0	*Diplostomum huronense*	2.1
Triaenophorus crassus	1.0	*Proteocephalus* sp.	0.7
Proteocephalus sp.	0.7	*Anodontoides ferussacianus*	0.2
Cucullanus stelmioides	0.4		
Plagioporus lepomis	0.4		

The sea lamprey may become infected by *E. caeruleus* females and glochidia of *A. ferussacianus* by taking in water which contains them in temporary suspension. Such entry into the gill pouches may be gained either through the mouth and respiratory tube or through the external gill apertures.

Sea lampreys were captured in the Saugeen River between late September and the first part of January. During this period of time the parasitic copepods and glochidia are not present in the stream to infect the lampreys. The infective stages of these parasites are not present in the water until early spring. This may account for the absence of these two parasites in sea lampreys caught in the Saugeen River.

By positioning itself in the gills of the lamprey, the female *E. caeruleus* is afforded an abundance of food, protection, aeration for the eggs, and a good site from which to release the mature nauplii.

After spending 20–30 days in an obligatory phase of parasitism upon the gills of the sea lamprey, the young mussel bursts out of the cyst and falls to the bottom of the stream to enter a juvenile stage. During the parasitic period, the glochidium develops rudiments of most of the adult organs. (All of the sea lampreys infected with glochidia were obtained either from streams located on Manitoulin Island or waters just off its shoreline.) No glochidia were obtained from specimens taken in the Bruce Peninsula area.

The cercaria of *Diplostomum huronense* are present in the water. After penetrating the lamprey's skin, the cercariae migrate through the circulatory system until they arrive at the lens of the eye. Here they become metacercariae often called *Diplostomulum huronense*. The sea lamprey is a second intermediate host, and the gulls (Laridae) are the definitive hosts (Hoffman 1960).

Plagioporus lepomis is a common parasite of *Lepomis megalotis peltastes* (longear sunfish), *L. gibbosus* (pumpkinseed), *L. macrochirus* (bluegill), and other Centrarchids (Dobrovolny 1939). It had not been found previously in the sea lamprey. As only one specimen was located, the sea lamprey must be regarded as only an occasional host of *P. lepomis*. The adult trematode located was in excellent condition and did not appear to be affected by the host.

Adult *Triaenophorus crassus* were present in the intestines of three stream-caught lamprey but were partially disintegrated. The mature worms and immature larvae of *Proteocephalus* sp. were present in 0.7% of both the stream-caught and lake-caught sea lampreys. It is suggested that these cestodes may be ingested by lamprey while feeding upon whitefish already infected by the larval stage of the parasite.

Echinorhynchus salmonis may encyst in the mesenteries of coregonid and other freshwater fish. The sea lamprey could then take in the encysted stage while feeding, or it might ingest infected amphipods or copepods. The specimens observed were in excellent condition and did not appear to be adversely affected by the host.

Cucullanus stelmioides was the only helminth parasite which gave evidence of serious damage to the sea lamprey. Large cysts were found on the intestine, liver, and gonads. Generally, this resulted in a pathological condition. The lake-caught lamprey, which contained 98 of these nematodes within cysts on the gonads, most certainly must have been sterile as the entire organ was affected. If the relatively high (2.8%) incidence of nematode infection among lake-caught sea lamprey is compared with the low (0.4%) incidence among stream-caught specimens, there is an indication that *C. stelmioides* may cause some mortality among *Petromyzon marinus* and could be useful as a biological tag.

The results may be summarized as follows.

(1) Adult sea lampreys captured in the lake had a much lower incidence of infection than did those specimens which entered the streams to spawn. (2) *Cucullanus stelmioides* was the only parasite which was more prevalent in lake-caught sea lampreys than in stream-caught specimens. (3) *Cucullanus stelmioides* was the only helminth parasite which gave evidence of serious damage to the host, possibly to the extent of causing sterility or death of the lamprey. (4) *Cucullanus stelmioides*, *Ergasilus caeruleus*, *Anodontoides ferussacianus*, *Diplostomum huronense*, and *Plagioporus lepomis* were all recorded for the first time as parasites of *Petromyzon marinus*. *Cucullanus stelmioides* was also recorded for the first time as being present in North American waters.

Acknowledgments

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