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THE LAMPREYS OF THE MANISTEE RIVER

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During 1937 and 1938 several letters were received by the Institute for Fisheries Research telling of the abundance of parasitic lampreys in the Manistee River in Kalkaska and Crawford Counties. These letters also reported that numbers of trout had been caught with lampreys attached. In 1939 a letter from Mr. Fred Bromwell, of Lake Leelanau, Michigan, gave sufficient information to indicate that the lampreys were present in sufficient numbers to perhaps be detrimental to the fish population.

Consequently, it was decided that I should spend some time on the stream in the hope of determining the magnitude of the population, its distribution, and possible means of control.

During the first half of May, 1939, I made an extensive search of the literature on parasitic lampreys. However, it was soon learned that information dealing with the general life history was extremely limited and that most of the publications were taxonomic in nature.

In company with Mr. William Beckman, I left Ann Arbor on May 16. A few days were spent in assisting Beckman with his work. We then passed through Grayling. Mr. Hans Peterson had been asked to inform the Institute

as soon as there was any sign of a spawning run of lampreys. I talked with Mr. Peterson on May 18, and from his observations it was evident that previous to that date no spawning had occurred. I left Grayling with Beckman, and returned on May 20.

Camp was established on the banks of the Manistee River, about 2 miles below the Highway M-76 bridge, because Mr. Peterson had told me that he judged the maximum lamprey population to be located between a short distance above the M-76 bridge and a short distance below the Livingstone property. Subsequent observations seemed to confirm this opinion.

Preliminary Investigations

The first few days were spent in becoming familiar with the stream, and in trying to determine if Mr. Peterson was correct in his surmise as to the location of the population. Since I had no assistant it was difficult to cover any appreciable extent of the stream at one time, for I had to walk back to the truck and get the boat the next day. However, the brief observations made from the boat enabled me to learn the nature of the stream sufficiently well to be able to conclude that the largest population of parasitic lampreys was located where Mr. Peterson said it was, that is, between the M-76 bridge and the Livingstone property. It was noticed at once that the length of stream between these two points is quite different in character from the portions above and below. Muck beds are numerous, gravel shoals can be observed readily, and vegetation (chiefly Chara) is abundant. It later became quite evident that there was a direct relationship between the ^{stream} conditions and the lamprey population. From the first the results of my fishing revealed that through this stretch of stream the parasitic lamprey was quite definitely a pest.

The stream was arbitrarily divided into five sections, and numbered 0, 1, 2, 3, 4. Section 0 was indefinite in extent beginning at the M-76 bridge and extending up stream from that point. Section 1 extended from the M-76 bridge down to camp; Section 2 was a short section, from camp down for about $3/4$ of a mile; Section 3 extended from the down stream end of Section 2 to the Livingstone property; Section 4 was again a section of indefinite length extending from Livingstone's property down stream.

Distribution

In order to make some fairly accurate estimate as to the distribution of the parasitic lampreys two kinds of records were made. First, fish which were caught or were seen, either with lampreys attached or with obviously fresh lamprey scars were recorded. Only trout were counted. Secondly, the presence or absence of lampreys was checked by the collection of larvae throughout the section of stream under examination. It was found that the presence of adults or sub-adults and the presence of larvae checked rather closely. The adults were, of course, more widely distributed because they would be carried by their hosts. The results of these observations are tabulated (Tables 1 and 2).

Habitat

Little need be said concerning the habitat of the adults or sub-adults for their habitat is that of the fish to which they are attached. However, the habitat requirements of the ammocoetes probably limits to a considerable extent the distribution of the adults. Consequently, the habitat requirements of the larval lampreys were examined rather closely. Several collections

Table 1

Table showing number of trout examined and the number of these trout carrying lampreys, or fresh scars. Spring, 1939.

Number of Trout	With Lampreys or Fresh Scars	Section	Per Cent of Infection	Average	Date
9	5	0	35	11.6	5/30/39
6	4	0	40		6/1/39
29	2	0	6		6/5/39
8	0	0	0		6/7/39
6	0	0	0		6/8/39
12	0	0	0		6/10/39
4	0	0	0		6/13/39
1	1	1	100	46.3	6/7/39
8	0	1	0		6/11/39
19	12	1	39		6/17/39
8	7	2	47	45.0	5/29/39
5	3	2	37		5/30/39
2	1	2	33		6/2/39
4	3	2	43		6/3/39
2	2	2	100		6/5/39
1	1	2	100		6/7/39
1	1	2	100		6/8/39
2	1	2	33		6/9/39
5	2	2	29		6/10/39
4	3	2	43		6/11/39
5	2	2	29		6/13/39
* 13	0	2	0		6/11/39
* 9	2	2	18		6/15/39
* 5	2	2	29	6/16/39	
20	10	2	33	6/17/39	
6	4	3	40	45.7	5/31/39
1	0	3	0		6/1/39
4	3	3	43		6/2/39
1	1	3	100		6/11/39
6	2	4	25	25.3	6/1/39
9	2	4	18		6/11/39
4	2	4	33		6/16/39
Grand average				34.8	

*Probably a fresh planting.

Table 2

Section	Muck beds	Bottom	Vegetation	Collection
0	Very limited except at lower end.	Mostly sand except at lower end.	Not abundant except at lower end. Found on what muck beds present.	Larvae collected in small numbers where muck beds and gravel shoals were present.
1	Numerous especially at upper end.	Mostly gravel and muck.	Abundant over muck. Found along entire section at edges.	Easily collected in muck beds.
2	Numerous throughout. Along both edges. Much marshy area. Many gravel shoals.	Gravel and muck. Little sand.	Abundant along marshy edges.	Easily collected. Most numerous in this section.
3	As above.	As above, except more sand present along high banks.	Abundant on muck beds.	Easily collected.
4	Less numerous except at the upper end.	Gravel and sand. Fewer muck beds.	Less abundant, even where muck beds are present.	Very few collected, all taken from upper end.

were made. At first I could find no larvae, but after I had found a few it became increasingly apparent that their distribution was rather rigidly defined by habitat.

Through stream Sections 1, 2, 3, and the upper end of Section 4 much of the stream edge is composed of soft muck beds. These muck beds comprise approximately from 5 to 10 per cent of the area. The muck beds are usually found on the low bank side of the stream although occasionally they are located near a high sand bank. Larvae are found in these muck beds, but not distributed throughout. My observations indicate that the larvae may be collected at the point where the flow of the stream merges with the semi-stagnant water over the muck beds. The ideal situation seems to be one where fairly soft muck is overlaid by 1 or 2 inches of sand, over which there is sufficient flow of water to prevent stagnation, yet with the current amply sluggish to allow a growth of plants on the surface of the sand. I was never able to collect ammocoetes where plants were not present. Throughout Sections 1, 2, and 3 of the stream one can notice along the edges, and sometimes in the open water, "muck humps" covered with a shallow layer of sand and a slight growth of plants. These places are ideal for ammocoetes and where the humps are present ammocoetes can be dipped at will. The accompanying photograph (Fig. 1) shows more or less clearly the type of stream conditions where ammocoetes can be found.

Methods of Control

During the spring of 1939 while I was on the river I observed no spawning of the parasitic form, Ichthyomyzon castaneus. In order to suggest any control methods I feel that it will be necessary to observe a spawning run, for obviously the ideal procedure would be to prevent the parasitic



Figure 1. Photograph showing ideal larval habitat of parasitic lamprey (Ichthyomyzon castaneus). Dark areas along edge of stream represent muck beds. Note small embayment; the muck is too soft to satisfy requirements.



Figure 2. Device used to screen ammocoetes from muck beds.

form from spawning. However, since I was unable to observe spawning I can offer no suggestions for the control of the run. Other suggestions will be made subsequently, but they would perhaps be of little value except to supplement the measures taken to prevent spawning.

1. Removal of Ammocoetes

To collect the ammocoetes I used a long handled dip net made of fly screen in a rigid frame (Fig. 2). The frame was strong enough to allow me to dig into the muck with it, and by running water through the screen I was able to wash most of the muck through, leaving only the ammocoetes and vegetation. A group of men equipped with screens of this sort, and instructed where to search might be able to remove larvae in sufficient numbers to cut down the population. However, some of the dangers should be pointed out. In removing the larvae there is danger of destroying much of the natural fish food, and, in disturbing the silt beds, there is, I suppose, some danger of moving the population to another part of the stream. This method could be recommended only after some methods of control had been tried on the spawning adults.

2. Destruction of Habitat of Ammocoetes

By destroying the silt beds and muck deposits it might be possible to prevent the larvae from reaching maturity. However, this method, unless very carefully carried out, does not seem very advisable because of the danger of merely transplanting the population. Complete removal of the muck beds is impossible for they are located at all marshy points along the course of the stream.

3. Control Measures to be Exercised by the Fishermen

Because of the fact that the lampreys which are attached to the fish drop off almost immediately when the fish is lifted out of water they are somewhat difficult to capture. Most landing nets are made with mesh large enough to permit the lamprey to escape even when in the net. If the fishermen would net their fish before lifting them out of the water, and kill the lampreys attached, I think that a considerable reduction of population might be made in a few years' time. The use of a landing net with a longer handle than usual would be necessary, and it would have to be made with a rather fine mesh, not more than $1/4$ inch. However, of the three methods suggested, this might well be the most efficient, and show the most immediate results.

Supplementary Observations

While working on the Manistee River during the spring of 1939 two tributaries, Portage Creek and Goose Creek, were examined. One, Portage Creek, emptied into that section of the stream which I have designated as Section 4, at that point spoken of as "the bayou" by the residents. I spent two evenings on this stream. I had heard that in years past there had been a run of lampreys up this stream. I saw the non-parasitic form, Entosphenous lamottennii spawning. The air temperature was 78° F. and that of the water 69° F. The first evening I was unable to find larvae or adults of the parasitic form, though the habitat appeared suitable. On the second visit to the stream I found larvae and saw three fish carrying lampreys; one a common shiner, the other two rainbow trout.

The other tributary, Goose Creek, empties into Section O. I examined this stream in two places; first at its junction with the main stream, and second, about $\frac{1}{2}$ mile up stream from here. In neither place was I able to find lampreys of any sort, although the upper part of the stream seems to have the necessary habitat requirements.

One other point of interest which should be mentioned in connection with this report is the rapidity with which recently planted fish are caught by the lampreys. On June 14 I noted that the 13 fish caught were rather dull in color, just over legal size, and thin. They were taken in a section of the stream where lampreys seemed most abundant. None of them carried lampreys. The second day nine were taken, two of the nine carrying lampreys, and on the third day two of five were infected. All of these were apparently recently planted fish, and I learned that a planting had been made in that section of the stream at the time.

Temperatures on the Manistee River, Spring, 1939

Date	Air °F.	Water °F.	Time
5/29/1939	64	66	9:00 P.M.
5/30/1939	76	60	9:00 A.M.
	78	69	12:00 M.
	71	71	9:00 P.M.
5/31/1939	73	66	9:00 A.M.
	84	70	12:00 M.
	55	69	9:00 P.M.
6/1/1939	79	64	9:00 A.M.
	74	69	12:00 M.
	67	70	9:00 P.M.
6/2/1939	79	64	9:00 A.M.
	74	68	12:00 M.
	69	69	9:00 P.M.
6/3/1939	69	56	9:00 A.M.
	62	65	12:00 M.
	54	70	9:00 P.M.
6/4/1939	57	57	9:00 A.M.
	63	62	12:00 M.
6/5/1939	73	62	9:00 A.M.
	74	65	12:00 M.
	60	64	9:00 P.M.
6/6/1939	72	64	9:00 A.M.
	83	70	12:00 M.
	66	70	9:00 P.M.
6/7/1939	77	66	9:00 A.M.
	77	68	12:00 M.
6/8/1939	68	62	9:00 A.M.
	73	63	12:00 M.
	66	63	9:00 P.M.
6/9/1939	70	64	9:00 A.M.
	78	68	12:00 M.
6/10/1939	67	64	9:00 A.M.
	72	66	12:00 M.
6/11/1939	43	57	9:00 P.M.
6/12/1939			
6/13/1939	60	53	12:00 M.
	57	57	9:00 P.M.
6/14/1939	65	57	9:00 A.M.
	68	63	12:00 M.
	55	60	9:00 P.M.
6/15/1939	60	57	9:00 A.M.
	63	57	12:00 M.
	57	58	9:00 P.M.
6/16/1939	54	52	9:00 A.M.
	57	54	12:00 M.
	58	53	9:00 P.M.
6/17/1939	50	53	9:00 A.M.
	58	54	12:00 M.
	53	55	9:00 P.M.

Hunt Creek