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A PRELIMINARY REPORT ON THE MIGRATION OF
SEA LAMPREY AMMOCOETES IN MICHIGAN

by

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Recent research by the U. S. Fish and Wildlife Service has led to the development of larvicides which destroy stream-dwelling ammocoetes of the sea lamprey, Petromyzon marinus. In view of this, it has become important to determine whether the ammocoetes remain in the parent stream throughout their larval life. Although ammocoetes¹ have often been considered sedentary, considerable evidence of migration has been accumulated in Michigan waters. This evidence is reviewed in the present paper.

Distribution of ammocoetes in relation to the spawning grounds

In a general survey of distribution of larvae in Upper Peninsula streams during the summers of 1955-1957, greatest numbers of ammocoetes were found downstream from known spawning sites. Only rarely were they found upstream from known spawning areas. Upstream migration for short distances is indicated by the occasional occurrence of ammocoetes in the mouths of streams which lack spawning facilities but which are tributary to streams with a large population of ammocoetes.

¹Unless stated otherwise the terms ammocoete or larva, as used in this paper, refer to the larva of the sea lamprey.

Repopulation of study areas after removal of ammocoetes

A study of ammocoete migration in the Chocolay River, Marquette County, was undertaken in 1956. Ammocoetes were removed from four stations (50 to 100 square feet in size), usually at weekly intervals (except during the winter months), with a D. C. shocker.^{2/} The initial shocking of Stations 1 and 2 (located approximately 6 miles upstream from the mouth of the Chocolay River), on July 27, 1956, removed 56 and 80 ammocoetes respectively from these areas. Fourteen subsequent removals, July 5-November 2, 1956, and May 1-August 5, 1957, resulted in the collection of a total of 207 ammocoetes from Station 1 and 418 from Station 2 (Table 1).

Stations 3 and 4 were located approximately 11 miles upstream from the mouth. On August 10, 1956, 141 ammocoetes were removed from Station 3, and 34 from Station 4. Fourteen subsequent removals from Station 3, August 16-November 2, 1956 and March 29-August 28, 1957, resulted in the collection of 469 ammocoetes. After the initial removal of larvae from Station 4, six later collections (August 17-November 2, 1956) produced a total of 24 ammocoetes.

Further investigation was begun in July, 1957, to determine the direction of the extensive movement of ammocoetes suggested by the experiments described above. Three study areas, enclosing typical silty-sand ammocoete habitat and isolated from each other by a rubble-gravel bottom, were set up in the Chocolay River, Marquette County. The middle area was located 60 feet from the downstream area and 100 feet from the upstream site. A total of 461 ammocoetes were collected, marked by an injection of cadmium sulfide (yellow) on the left

^{2/} Each station was shocked three consecutive times or until no (or very few) ammocoetes emerged. Although efficiency of the technique was not tested in the field, this procedure removed 54 and 61 percent of known populations from two hatchery troughs (8 inches by 14 inches by 13 feet).

Table 1.--Initial and later removals of sea lamprey ammocoetes
from study plots in the Chocolay River, 1956-1957

Station number	Location (miles above mouth of stream)	Number of ammocoetes removed at beginning of study	Later removals of ammocoetes	
			Number of collections	Total number removed
1	6	56	14	207
2	6	80	14	418
3	11	141	14	469
4	11	34	6	24

side beneath the outer layer of skin (Wigley, 1952) and released in the upstream area. This procedure was repeated at the downstream site where 443 ammocoetes were marked on the opposite side of the body and released. Weekly collections were made from the middle study area with a D. C. shocker.

The recovery from the middle study area of 34 marked ammocoetes, all of which had been released at the upstream marking site, indicated that movement during the period of study (July to November) was downstream. The recovery rates of the different size groups suggest that migratory behavior was independent of size (Table 2).

Operation of a weir and an inclined plane trap

A weir with an upstream and downstream trap was installed in the Carp Lake River, about 200 yards below Carp Lake (the source of the stream), Emmet County, to determine if there was any migration of adult and/or larval sea lampreys between the lake and stream. Although adult sea lampreys have been collected from Carp Lake, there is no known concentration of larvae in the lake or in the short section of stream above the weir. The nearest concentration of larvae is one-half mile downstream from the weir. The weir had screen with mesh of one-eighth inch. The weir was in operation from October 4, 1956 to April 20, 1957; from May 3 to May 13, 1957; and from May 20 to June 7, 1957. These dates include much of the period when large numbers of larvae were migrating downstream in the lower part of the river (see below). No ammocoetes were captured in either the upstream or downstream trap. The absence of downstream migrants was expected in view of the absence of ammocoetes above the weir. The absence of upstream migrants suggests that upstream migration of ammocoetes, if it occurred, was for distances of less than one-half mile.

Table 2.--Length-frequency distribution of sea lamprey ammocoetes marked and of those recovered in the Chocolay River, 1957

Total length (inches)	Number marked	Number recovered	Percentage recovered
2.0 - 2.9	81	7	8.6
3.0 - 3.9	290	23	7.9
4.0 - 4.9	68	4	5.9
5.0 - 5.9	7	0	0.0
6.0 - 6.9	3	0	0.0
Total	461	34	...

A barrier to upstream-migrating sea lampreys, which included an inclined-plane (Wolf) trap designed to capture all downstream-migrating fish and lampreys, has been operated near the mouth of the Carp Lake River since the spring of 1950. A total of 63,157 ammocoetes (all species) were caught migrating downstream during the seven years of operation (Table 3). A few ammocoetes migrated downstream each month, but the majority were trapped in April and May (Applegate, 1952).

During the years 1950 to 1955, ammocoetes were not identified as to species. However, 59 percent of the 1956-57 catch of ammocoetes were preserved, identified, and measured. Of these, 95 percent were sea lampreys, 4 percent were American brook lampreys (Lampetra lamottei), and 1 percent were Ichthyomyzon spp. It is not unreasonable to assume that the species composition of the runs in previous years was similar.

Sea lamprey ammocoetes which were trapped in 1956-57 ranged in size from 2.3 to 6.1 inches in length and averaged 4.8 inches. In the fall of 1956, 137 ammocoetes collected with a D. C. shocker in the stream above the barrier ranged in size from 3.1 to 5.5 inches in length and averaged 4.2 inches. The size range of the downstream migrants shows that at least some of the smaller individuals moved downstream. However, the larger average size of the downstream migrants may indicate a greater migratory tendency among larger individuals.

It is apparent that large numbers of sea lamprey larvae of various sizes move downstream each year. Since the Carp Lake River trap is located only 1,500 feet from the stream's mouth, it is quite probable that this downstream migration continues into Lake Michigan.

Table 3.--Numbers of sea lampreys caught in the downstream trap
of Carp Lake River weir, 1950-1957

Migratory season	Number of recently transformed sea lampreys	Number of larvae ¹
1950-51	15,103	12,647
1951-52	4,069	1,414
1952-53	6,861	2,838
1953-54	10,238	14,827
1954-55	3,893	3,725
1955-56	2,401	22,822
1956-57	2,640	4,884
Total	45,205	63,157
Average annual catch	6,458	9,022

¹Includes all species trapped.

Collection of ammocoetes in Lake Michigan

The presence of ammocoetes along the north shore of Lake Michigan was demonstrated by the use of Peterson (sample size, 1 sq. ft.) and orange-peel (sample size, up to 132 square inches depending on depth of penetration) dredges in July and August, 1957. At 58 stations in 11 study areas (bays and/or deltas and surrounding areas) surveyed, 4,094 dredge samples produced 13 sea lamprey ammocoetes (3.2-5.5 inches), 8 American brook lamprey ammocoetes (2.9-6.6 inches), and 3 Ichthyomyzon spp. ammocoetes (3.7-4.2 inches). Ammocoetes were present in five of the general areas and at seven of the stations. Depths of 3 to 32 feet were dredged, and ammocoetes were found at depths of 3 to 15 feet.

At the seven stations where ammocoetes were encountered, aquatic vegetation (Potamogeton sp., Chara, and Vallisneria sp.) and bottom-dwelling organisms (burrowing mayflies, aquatic earthworms, crayfish, and clams) were usually present. However, at two stations where ammocoetes were found, other animals and aquatic vegetation were not collected. Bottom types inhabited by ammocoetes were generally of a silty-sand nature; none were collected in pure sand.

All of the seven stations where ammocoetes were taken were in areas protected from severe wave action either by contour of the shore or bottom, by depth, or by man-made devices. Five of the seven stations where larvae were collected were within one-quarter mile of the mouth of a stream containing ammocoetes. However, larvae were found at two stations which were 1 mile and 1 1/4 miles from any known source of ammocoetes. Excluding the possibility of reproduction of sea lampreys in the Great Lakes, it becomes evident that the downstream migration of ammocoetes in the stream continues (at least for some individuals) into the Great Lakes as far as 1 1/4 miles from the parent stream.

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