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AN INVESTIGATION OF THE CONTINUED CAPTURE OF DOWNSTREAM-MIGRATING
RECENTLY TRANSFORMED SEA LAMPREYS IN THE DOWNSTREAM TRAP OF A WEIR
ON CARP LAKE RIVER, EMMET COUNTY, 1955

By Thomas M. Stauffer

An inclined downstream trap has been in effective operation on Carp Lake River since the summer of 1949^{1/2}, under the supervision of Dr. Vernon C. Applegate. This device blocks or traps upstream-migrating adult sea lampreys and captures all downstream-migrating recently transformed sea lampreys. It has been estimated by Applegate (1950) that the duration of larval life was four years, excluding the possibility of a "rest period" as postulated by Gage (1928). If the duration of larval life is four years and if there had been no escapement of adults at the trap, then there should not have been the downstream migration of recently transformed individuals which occurred in 1954 and 1955. Consequently, an investigation was launched in 1955 to determine the cause of the continued downstream migration. This continued downstream migration was deemed to be the result of either of two factors: (1) recruitment to the population either by escapement at the weir or by a resident population in Carp Lake dropping down into Carp Lake River to spawn, or (2) a duration of larval life longer than formerly thought.

^{1/2} Minutes of Great Lakes Trout and Sea Lamprey Committee, December 16, 1952.

Carp Lake River has its origin in Carp Lake, and is approximately 10 miles in length. Much of the stream is ideal habitat for sea lamprey spawning and for the ammocoetes. Carp Lake is a shallow, productive warm-water lake of several square miles in area. One tributary, Mud Creek which drains a large swampy area, flows into Carp Lake. About half way up Mud Creek is Mud Lake which is shallow and of about 40 acres in area.

Methods

Nine collections (Table 1) of ammocoetes were taken in Carp Lake River with a D. C. Shocker in July and October of 1955. Eight of these collections were above the weir and one was below. Inasmuch as 1,076 sea lamprey ammocoetes were collected above the weir, it was quite evident that a substantial population existed in Carp Lake River after six years of effective weir operation.

Sea lamprey ammocoetes were identified by the following characters:

- (1) sea lampreys and American brook lampreys were separated from Ichthyomyzon sp. by the divided dorsal fin and high myomere count of the former, and
- (2) sea lampreys were separated from American brook lampreys by head and tail pigmentation. Sea lamprey ammocoetes had larger amounts of dark pigmentation on the lobes of the caudal fin and in the head region, than did the American brook lamprey. Differences in pigmentation could be determined on specimens as small as 1.1 inches. Initial identifications were made by the author and verified by Dr. R. M. Bailey, Curator of Fishes, Museum of Zoology, University of Michigan, and Dr. G. P. Cooper, Director, Institute for Fisheries Research.

All Lamprey ammocoetes were measured, and length-frequency data for all collections above the weir were plotted (Fig. 1). In Figure 1,

Table 1

Number of lamprey ammocoetes and recently transformed individuals collected at various stations on Carp Lake River with a D. C. shocker, 1955

Station No. [✓] (CLR)	Date	Location			Sea lamprey		American brook lamprey		<u>Ichthyomyzon</u> sp.	
		T.	R.	Sec.	Larva	Adult	Larva	Adult	Larva	Adult
7	7-11-55	39N.	4W.	29	8	0	20	0	3	0
6	7-10-55	39N.	4W.	29	562	0	127	0	24	0
6A	10-2-55	39N.	4W.	29	218	52	94	13	23	0
6B ¹³	10-13-55	39N.	4W.	29	66	1	3	0	4	0
4	7-8-55	39N.	4W.	32	118	0	131	0	11	0
3	7-7-55	38N.	4W.	16	51	0	96	0	28	0
5	7-9-55	38N.	4W.	17, 20	3	0	12	0	32	0
2	7-7-55	38N.	4W.	22	5	0	41	0	93	0
1	7-6-55	38N.	4W.	15	0	0	1	0	0	0
Total	...	...	...	...	1,031	53	525	13	218	0

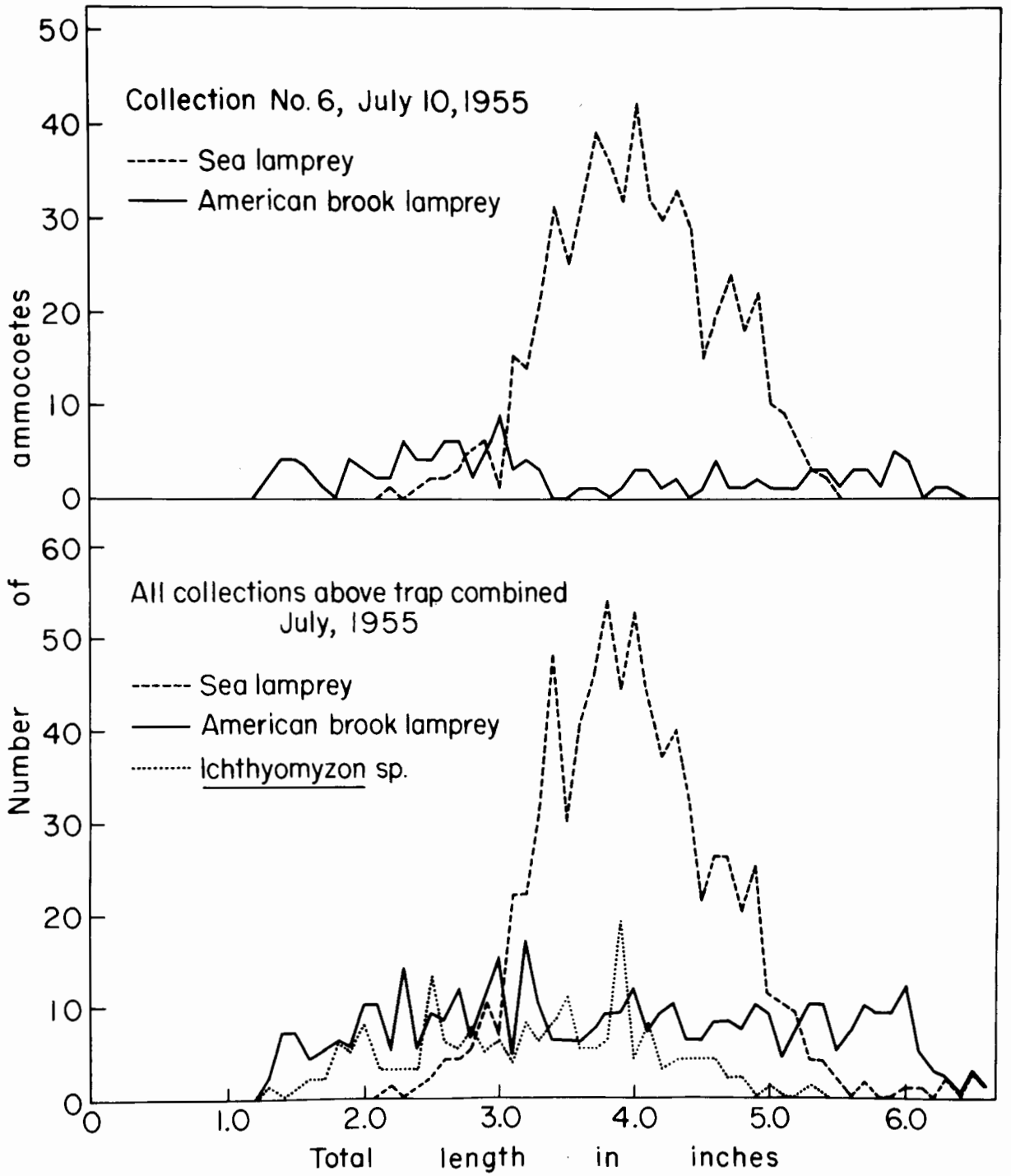
¹✓ Stations listed in order progressing upstream.

²✓ Below weir.

³✓ Collection made with a seine.

Fig. 1. Length frequency distributions of lamprey ammocoetes from
Carp Lake River, Emmet Co., July, 1955.

Fig. 1



collection No. 6, an unusually large collection, was plotted separately; but for this collection the number of Ichthyomyzon sp. was not sufficiently large to warrant inclusion. Also, for Figure 1, all collections of ammocoetes from Carp Lake River (above the weir) were combined. Length-frequencies of sea lamprey ammocoetes and adults were also plotted (Fig. 2) for Carp Lake River collection 6 A for purposes of comparison with a similar collection from the Black River, Mackinac County.

The entire length of Carp Lake River above the weir was visually inspected for sea lamprey redds on July 13, 1955 by Martin Hansen and Albert Gabrielson. Sea lamprey redds of the 1955 spawning season below the weir were still quite prominent at this time, so any redds above the weir presumably would be equally noticeable. Water level was low and visibility was excellent. Four possible redds were observed. On July 14, these were checked and photographed by the author. The photographs were later shown to U.S. Fish and Wildlife personnel at Marquette, who were of the opinion that the depressions depicted were not sea lamprey redds, an opinion with which the author concurs.

Gill nets and trap nets were fished in Carp Lake in July, 1955, to learn the number of scarred fish present and thus ascertain the presence of a resident population of sea lampreys. Some 569 fish (Table 2) over 10 inches in length were captured and examined for lamprey scars. Only one fish, a smallmouth bass of about 4 pounds, exhibited a scar which might have been caused by a lamprey. The scar, in the pectoral fin region, was old and healed.

Further investigations included an examination of Mud Creek, the only tributary to Carp Lake, to ascertain if this tributary was suitable

Fig. 2. Length frequency distributions of sea lamprey ammocoetes and adults from Carp Lake River, Emmet Co. (collection No. 6 A), and Black River, Mackinac Co., October, 1955.

Fig. 2

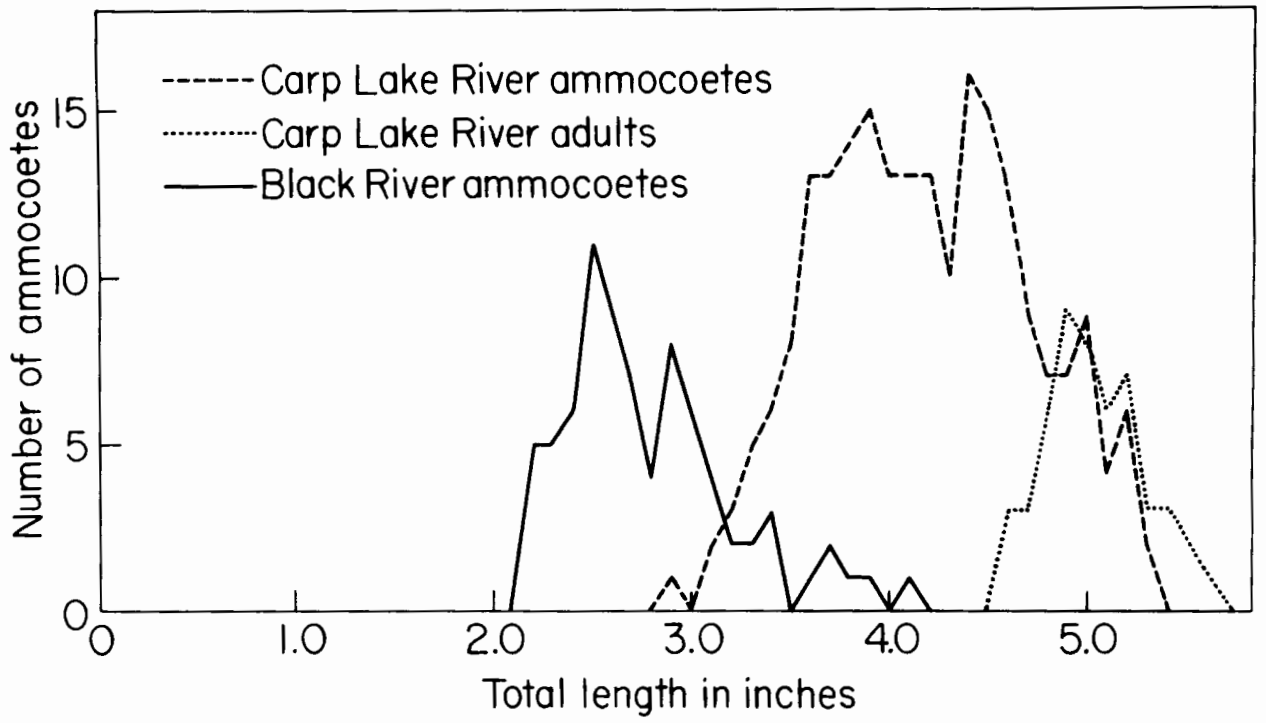


Table 2

Number and size of fish caught in gill nets and trap nets in
Carp Lake, Emmet County, July 7-17, 1955

Species	Size groups by inches					Total
	0-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20.0 and over	
Largemouth bass	0	2	5	2	0	9
Rock bass	2	93	12	0	0	107
Smallmouth bass	6	70	15	17	0	108
Bluegill	51	113	3	0	0	167
Yellow perch	4	131	8	0	0	143
Pike	0	0	0	7	2	9
Pumpkinseed	60	163	0	0	0	223
Redhorse	0	0	1	3	0	4
White sucker	0	24	209	90	0	323
Walleye	0	1	87	70	3	161
Brown bullhead	0	0	34	1	0	35
Total	123	597	374	190	5	1,289

for sea lamprey reproduction. Three collections of fish were made with a D. C. shocker in the lower portion of the stream below Mud Lake. The section of the stream above Mud Lake was surveyed only visually. In the stream below Mud Lake, water temperatures were high (74° to 78° F.) in the early part of July, 1955; bottom types were generally silty sand, silt and mud; the current was very sluggish, and aquatic vegetation was abundant at the three stations shocked. No ammocoetes were collected. The dominant fish species were yellow perch and mudminnows. The visual survey of Mud Creek above Mud Lake was undertaken by Gerald Van Deusen, Conservation Worker. Regarding the watershed above Mud Lake he stated in field notes, "The regions of the stream observed in this area (T. 38 N., R. 3 W., Secs. 27 and 36) were characterized by silty bottom, sparse vegetation and swampy bank areas. The current is sluggish. No areas of gravel were observed along the creek upstream from Mud Lake. Mud Creek drains a large, swampy tract characterized by thick cedar and tamarack growth and very soft muck bog areas....." He observed brook trout to be present. He reported that in some places in the stream "fine mucky silt" was present to a depth of 30 inches. The water temperature of Mud Creek above Mud Lake was 59° F. at 10:30 a.m. on July 13, 1955 with an air temperature of 74°.

In 1947, Walter R. Crowe (verbal communication) reported the presence of a spawning run of sea lampreys in Mud Creek below Mud Lake (T. 48 N., R. 3 W., Sec. 20). In view of the fact that 3 collections were made below this section in 1955 and no sea lamprey ammocoetes were found, it can be tentatively concluded that: either (1) the adult sea lampreys could not spawn successfully at this station or, (2) the progeny of the 1947 run had disappeared from the stream because they had reached adulthood and had migrated out of the stream.

Recruitment Through the Weir

Dr. Applegate (in charge of the weir since its construction) feels sure that there has been no escapement of the upstream-migrating adult sea lampreys through the weir since 1949, excluding the possibility that malicious or uninformed persons may have thrown some of the adults upstream over the weir. Each spring, a large concentration of the adults gather below the weir in shallow water where they are quite easy to catch by hand. Therefore, the possibility of recruitment over the weir, however remote, must be kept in mind.

Recruitment from Carp Lake

The possibility exists that there is a resident population of adult sea lampreys in Carp Lake which spawn in Carp Lake River. The basis for this belief is the report by Fish Area Biologist Jack Hammond that 2 or 3 small sea lampreys attached to common suckers were taken from a trap net set in Carp Lake in the spring of 1955. From this same trap netting, several scarred fish were reported. Unfortunately, these lampreys were not preserved for verification of the identification.

Opposing the theory, that there is a resident population, are the following points: (1) Carp Lake is a shallow, productive, warm-water lake which would appear to be unsuitable habitat for adult lampreys, (2) there is some doubt as to whether recently transformed sea lampreys could make their way back upstream over a low-head dam (1'-1.5') to the lake from which their parents came, and (3) the inlet stream was not thought to be satisfactory for successful sea lamprey spawning.

The trap netting during July, 1955, in Carp Lake produced only one scarred fish (from a total of 569 suckers, walleyes, etc. over 10 inches

in length), indicating that the sea lamprey is rare in the lake, if present at all.

Assuming for the moment that there is a resident population of sea lampreys in Carp Lake, to maintain their numbers they would have to spawn in Mud Creek or Carp Lake River. Since Mud Creek is believed to be unsuitable for spawning, the resident population would have to spawn in Carp Lake River. To maintain the population, the recently transformed adults in the river would have to make their way back upstream to the lake over a low head (1'-1.5') concrete dam. This seems unlikely in view of the observed passive movements (Applegate, op. cit.) of recently transformed adults. Then, too, if there were a resident population of sea lampreys in Carp Lake, they presumably would spawn every year, and all sizes would be represented in the length-frequency distribution of the ammocoetes; the latter was not true for Carp Lake River ammocoetes during 1955 (Fig. 1).

Extended Longevity

Figure 1 indicates that, within the entire system, all sizes of American brook lampreys and Ichthyomyzon sp. are represented in more or less equal numbers from 1.5 inches up. Size distribution of the sea lampreys contrasted sharply: 89 percent of the individuals fell within a range of 3.1 to 4.9 inches, suggesting the presence of fewer year classes than for the other lampreys. The implication is either that sporadic recruitment accounted for the presence of only the larger sea lampreys or that the sea lampreys present are of the 1949 year class or older. The data plotted in Figures 1 and 2 indicate that there were at least two year classes of sea lampreys present during the summer and fall of 1955--those recently transformed and those which would hold over as

larvae for at least another year. Applegate and Brynildson (1951) found that the size range of recently transformed sea lampreys taken migrating downstream during the 1948-49 and 1949-50 seasons in the downstream trap of the Carp Lake River weir were 3.7 to 7.4 inches and 4.1 to 7.5 inches, respectively. Then, even if all the sea lamprey ammocoetes 3.7 inches and over transformed during the 1955-56 season, some still would hold over until the 1956-57 season. Applegate (op. cit) has shown, by a length-frequency distribution plotted for lamprey ammocoetes taken in October, 1947, from the Ocqueoc River, that sea lamprey ammocoetes from 0.8" to 1.3" were young-of-year and that lampreys from 1.5" to 2.7" were of age-group I. The lamprey ammocoetes then grow at a rate of approximately 1" per year for the first two growing seasons. If this rate of growth continues and is applicable to Carp Lake River ammocoetes, then a lamprey 4" long should have had a maximum of only 4 growing seasons. Consequently, it is difficult to believe that the 4" sea lamprey ammocoetes which were present in Carp Lake River during 1955 were nearly 7 years old.

On the other hand, an investigation of the size composition of sea lamprey ammocoetes above another barrier (on the Black River) revealed a size-frequency distribution similar to that from Carp Lake River. An experimental sea lamprey barrier has been operated on the Black River in Mackinac County in conjunction with a checking weir, since the winter of 1950-51. No adult sea lampreys have been known to penetrate both the barrier and checking weir, except for two spent individuals taken in the downstream trap of the checking weir in 1952. Since 1952, there has been no known escapement over both barrier and checking weir, although 12 adults escaped over the barrier in 1953 and 18 in 1954 and were captured in the upstream trap of the checking weir. Figure 2 compares the length-

frequency distributions of sea lamprey ammocoetes in Carp Lake River collection 6 A and a collection from the Black River above the barrier and checking weir; both collections were made during October, 1955. The Carp Lake River ammocoetes ranged from 2.8" to 5.4"; those from the Black River ranged from 2.2" to 4.2". The absence of smaller sea lamprey ammocoetes was the outstanding characteristic of the length-frequency distributions in these two stream systems, in contrast to other streams which have been studied (Sucker and Rock rivers, Alger County; Chocolay River, Marquette County).

Among ammocoetes from the Black River and Carp Lake River, both demonstrated a bimodal distribution. Difference in the two distributions was, in the main, one of average size. The Black River ammocoetes were somewhat smaller than those from Carp Lake River. Presumably, this was to be expected since Black River ammocoetes should not all be as old as those from the Carp Lake River, inasmuch as the barrier and checking weir on the Black River were not a complete block until 1953. The similarity between the two size-frequency distributions from the Carp Lake River and the Black River cannot be dismissed as mere coincidence, especially in view of the observed smaller size of lampreys in streams where barriers have not been effectively operated. Therefore, in spite of the incredibly slow rate of growth, which must be present if recruitment has not taken place, it is possible that the duration of the larval stage of the sea lamprey is 7 to 8 years and possibly longer.

Future Investigations

Further research is contemplated to determine if a longer larval life is the cause of the continued presence of sea lamprey ammocoetes

in Carp Lake River. It is planned to continue operating both the Carp Lake River and Black River barriers. If sea lamprey ammocoetes disappear from the Black River three years after they disappear from Carp Lake River, this will support the idea that no recruitment has taken place since 1949 to the Carp Lake River population and that the maximum duration of the larval stage of the sea lamprey is seven years or over. Additional investigations call for a weir with a downstream trap to be added at the outlet of Carp Lake to determine if there is a resident population of adult sea lampreys in Carp Lake which are spawning in the outlet. The ammocoete population in Carp Lake River will be sampled in July and October of 1956 to determine the size and age (?) composition, and checks will be made of the stream in June and July to determine if spawning is taking place. A similar check is contemplated for the Black River. As suckers in Carp Lake are to be trapnetted for spawn-taking purposes, by Fish Division field personnel, it has been requested that they preserve any lampreys which are taken from Carp Lake.

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Literature Cited

- Applegate, Vernon C. 1950. Natural history of the sea lamprey Petromyzon marinus in Michigan. U. S. Dept. Int., Fish and Wildlife Serv., Spec. Sci. Rept.: Fisheries No. 55, 237 pp.
- Applegate, Vernon C. and Clifford L. Brynildson. 1951. Downstream movement of recently transformed sea lampreys Petromyzon marinus in the Carp Lake River, Michigan. Trans. Am. Fish. Soc., Vol. 81 (1951) pp. 275-290.
- Gage, Simon H. 1928. The lampreys of New York State...life history and economics. (In) Biol. Surv. of the Oswego River System. State of New York Cons. Dept., Suppl. to 17th Ann. Rept., 1927: pp. 158-191.