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RESULTS OF THE 1945 OPERATIONS AT THE OCQUEOC RIVER SEA LAMPREY WEIR

by

David S. Shetter

Previous to 1944 for about five or six years, conservation officers have reported an increase in numbers of the sea lamprey (Petromyzon marinus) in the Ocqueoc River. As the numbers continued to increase, spearing parties were organized under direction of conservation officers in an attempt to control them, but such measures failed to halt their activities and multiplication.

In March, 1944, at a conference between R. S. Marks, Regional Fisheries Supervisor, H. L. Thompson, District Fisheries Supervisor, Conservation Officer Cyril Nelson of the Field Administration Division, officers of the East Presque Isle County Sportsmen's Club, and the writer, plans were drawn up for a cooperative study of the general problem. The contribution of the local sportsmen's club was to be labor and materials to erect a weir. The Conservation Department was to pay the salary of an attendant to keep the weir in order, to remove the fish and lampreys entering the traps, and to keep pertinent records. Reinhold A. Dode of Rogers City served in both 1944 and 1945 as weir attendant.

The primary purpose behind the installation of the weir was to learn whether or not the spawning run of the sea lampreys might be blocked,

and possibly eventually eliminated. Also it was hoped to secure additional information concerning the numbers of lampreys and the peak and duration of the run.

Operations at the weir during 1944 were under the direction of the Field Administration Division. During 1945, the writer was invited to take charge of the work.

Description of weir

The weir was located on the Occueoc River about 150 yards below the outlet of Occueoc Lake, just back of the Black Lake C. C. C. camp (now under the jurisdiction of the U. S. Coast Guard). The river here has steep banks approximately 35 feet high. Width of the river is approximately 50 feet at low water, and the greatest depth at low water does not exceed two feet. The bottom is hard clay and rubble with a surface covering of gravel and clam shells.

The design of the weir was more or less the conventional double "V" type with the traps in mid-current. The materials used were cast-off stone screening from the Michigan Limestone and Chemical Company (a subsidiary of the U. S. Steel Corporation). These screens were about 15 feet long and 3 feet wide, and were of 3/4-inch or 1-inch mesh. These sections, overlapping about a foot, were supported by and wired to steel stakes (of the type used to support snow fencing) driven firmly into the bottom with a sledge. They rested on the clay and rubble, and where there were irregularities in the bottom, any openings were filled in with gravel and rubble.

The traps proper were prefabricated in one unit from cast-off screen sections with a funnel-type lead-in which sloped up from the mouth on the bottom side. The traps were approximately 6 feet X 8 feet by 3 feet deep. Because it was noted in 1944 that numerous lampreys worked their way through the 3/4 inch mesh, or jumped over

the trap sides or blocking arms, an additional section of screen cloth of 1/4-inch mesh was used to line the trap and the downstream blocking arms and to make an "over-hang" downstream. Screen cloth of the same mesh was placed over the 3/4-inch mesh screen sections to prevent the smaller lampreys from "tailing" through the weir.

1944 Operations

In 1944, the weir was operated between May 22 and July 24. Very few records were kept. A total of 3,366 sea lampreys were destroyed as follows: May, 2,000; June, 1,225; July, 141. Because the weir was not installed early enough, and also because of the size of the mesh in the blocking arms, and due to numerous points of undercutting on the blocking arms, hundreds of spawning sea lampreys could be seen on the beds below Ocqueoc Falls at almost any time during the 1944 spawning season.

1945 Operations

In 1945, the structure was replaced at the same point and was blocking the stream on April 22. It was removed from the stream on July 16. Records for the 1945 run are more complete than for 1944. Water temperatures were taken four times daily, and the species and numbers of each entering the traps was recorded. Some measurements on the size of the sea lampreys are also available, and the proportion of the sexes among the sea lampreys is listed for certain days.

As in 1944, the weir did not function with 100 per cent efficiency because of faults inherent in the construction. The blocking arms were undercut because of the lack of sheet piling under the structure, and because there was no catwalk from which to operate a cleaning brush. High water caused by heavy rains overtopped the 3 foot weir sections during the periods April 25-28, and May 28-June 6. After the last period, sea lampreys were noted in increased numbers on the spawning beds below Ocqueoc Falls.

Species taken in the traps

In addition to four species of lampreys, 15 species of fresh-water fish, two turtles, and 5 water snakes were captured in the traps. A total of 9,911 individuals were recorded. All except 27 sea lampreys and one rainbow trout were upstream migrants.

The four species of lampreys taken were the sea lamprey (Petromyzon marinus), the silver lamprey (Ichthyomyzon unicuspis), both of which are parasitic on fish in Lake Huron, and the Michigan brook lamprey (Ichthyomyzon fossor), and the American brook lamprey (Entosphenus lamotennii), the latter two species being non-parasitic. Mr. Dode was not able to distinguish between these forms, so the exact numbers of each species of lamprey present in the run cannot be stated. From observations in the spawning beds, however, it would appear that 90 per cent or more of the run is composed of sea lampreys. A total of 4,608 lampreys were trapped and destroyed.

The species of fish taken in the trap consisted of the following: Common sucker (C. commersonnii), 1,555; red-horse sucker (Moxcostoma aureolum), 649; rainbow trout (Salmo gairdnerii irideus), 10; brook trout (Salvelinus f. fontinalis), 3; yellow pike perch (Stizostedion v. vitreum), 6; northern pike (Esox lucius), 1; yellow perch fingerlings (Perca flavescens), 1,586; smallmouth bass (M. d. dolomieu), 250; common shiner (N. cornutus frontalis), 837; carp (Cyprinus carpio), 17; dogfish (Amia calva), 2; rock bass (Ambloplites rupestris), 44; Bullhead (sp.?), 107; smelt (Osmerus m. mordax), 3; creek chubs (S. a. atromaculatus), 226.

The species of the turtles (2) captured is not known, and the five water snakes were Natrix s. sipedon which is commonly found in the region.

The catch records for the traps have been divided into two-week periods (with the exception of the first period, which extended only

through the last nine days of April), and the totals are given for each period in Table 1.

Inspection of the table will show that previous to May 16, other species, such as the common sucker or fingerling perch entered the trap in greater numbers than did the sea lamprey. However, after May 16, the sea lamprey exceeded the other forms in every period. The largest runs occurred during May, with that in the latter part of the month being the heaviest.

The peak runs of the various species occurred as follows: April 22-30, common sucker, smelt; May 1-15, red-horse, fingerling perch, and rock bass; May 16-30, sea lamprey, yellow pikeperch, smallmouth bass fingerlings; June 16-30, common shiners, creek chubs; July 1-15, carp, bullheads, turtles, and water snakes.

The lamprey run probably had barely begun when the weir was blocking the stream completely on April 22, and the first sea lamprey taken. Between that time and April 30, eight more lampreys were captured. During May 1-15, a total of 893 lampreys entered the traps, and during May 16-31 some 2,688 were captured and destroyed. The run fell off in the following three two-week periods as follows: 491, 460, 67. When the weir was removed on July 16, the run was probably not entirely completed, as one to three lampreys were taken daily during the last week the traps were in place.

Relationship between water temperature and movement through the weir

In Figure 1, the average daily water temperature has been plotted along side the daily trap catches of lampreys. From this it will be noted that there was some movement even at the relatively low water temperature of 42°F. As the water temperature increased to 50°F., the trap catches also increased, going over 100 lampreys when it reached this point. During the period May 8-18, average daily temperatures

ranged between 44.5 and 48.5, and trap catches varied between 21 and 96 lampreys.

The average water temperature rose sharply on May 19 (from 49° to 51°) and continued to rise (to 58°) until May 23 and 24, when it fell back to 56° and 52.5°. This sudden warming of the water brought on the peak of the lamprey spawning run; starting with May 19, the daily trap catch was as follows: 212 (5/19), 228 (5/20), 441 (5/21), 257 (5/22), 288 (5/23). On the day water temperature averaged 52.5° (5/24) the run dropped to 125. Warming of the water again to the vicinity of 57°-60° during May 25-28 brought on the following runs on those days: 188, 285, 291, 237. It is also possible that the lampreys prefer normal or subnormal water levels, as the heaviest runs occurred during a period of normal and subnormal levels, although over-topping of the weir prevented counts during flood stages.

Unfortunately, high water overtopped the weir during the period May 28-June 6. The minor floods were the result of heavy rains in late May and early June. These also depressed the water temperature. How these lowered temperatures influenced the run can only be guessed at.

However, after the weir was blocking the stream again on June 6, only on one day (June 7) did the trap catch exceed 100, and most of the time it was less than 50 specimens. About 52 per cent of the run (2,427 out of 4,581) passed the weir during May 19-28 when the water temperatures were between 50°F. and 59°F. The number of migrants apparently tapers off gradually after the water temperature reaches 66°F. This agrees with the data published by Gage (1928), who states that the spawning time of the sea lamprey occurs when the water temperature is between 59° and 70°F. The peak run at the weir might be expected when the temperatures were slightly below the optimum for spawning, as the lampreys still had between 8-12 miles to travel to the spawning grounds below Ocqueoc Falls.

Time of run during the day

For the period May 4-June 30, the daily trap catches were recorded so that the number dipped in four six-hour periods might be determined. This information will be found in Table 2. From the assembled data, it may be concluded that 95 per cent or more of the lampreys perform their migrations between the hours of midnight and noon. In both May and June, close to 55 per cent were recorded as trapped between midnight and 6 A.M., and between 41 and 45 per cent entered the traps between 6 A.M. and noon. The remainder were divided about equally between the noon and 6 P.M. periods as to the time of trap entrance.

Unquestionably the hours of greatest activity were the hours of complete darkness. Mr. Dode observed that the lampreys would run in the early morning hours until the sun's rays illuminated the mouth of the trap, then the run would cease. On one night when there was a full moon and a cloudless sky (May 24) the run was less than half the total for preceding days. However, this may have been the result of a drop in water temperature, too. The run most likely begins at "full dark" each evening, and the bulk of the lampreys move before daybreak the next morning. The exact hours would be difficult to state, because the trap was not inspected at the same time each day (it was emptied or inspected from 4 to 14 times daily).

Size of the lampreys, sex composition of the run

The first sea lamprey taken in the traps on April 22 was the largest specimen; its length was 30 inches. The next night a 24-inch sea lamprey was caught. On April 25, a 7-inch lamprey was captured. This specimen turned out to be a Michigan brook lamprey (Ichthyomyzon fossor).

Mr. Dode measured random samples of the trap catches from time to time and gave either the average sizes or the size range. This information will be found in the last column of Table 2.

From the data available, it may be seen that the size range of the lampreys trapped was from 7 to 30 inches. An unknown proportion of the lampreys trapped were of three species other than the sea lamprey which were identified in the run, and these were the smaller individuals which ranged in size from 7 to 14 inches.

The smallest sea lampreys observed were four specimens taken preying on a rainbow trout moving downstream on July 6. Four young sea lampreys were attacking this fish and apparently had caused its death, although it may also have been weakened by spawning. These sea lampreys measured 8.0, 9.1, 9.5, and 10.7 inches respectively. As the eyes were still covered by a translucent layer of epithelial tissue, it is to be assumed that they had not fully completed the transformation from their larval life; yet they were far enough advanced to initiate their cycle of active parasitism.

Thirty adult sea lampreys were preserved in a 5 per cent formaldehyde solution, and were later measured and sexed. These were collected at random from the run during the first ten days of July. Eighteen females ranged from 14.1 to 21.7 inches, and their average length was 17.9 inches. Twelve males measured from 15.5 to 19.6 inches, and their average length was 17.6 inches.

From the data available, it would appear that the mature, upstream-running sea lampreys of the Ocqueoc River probably range from 14 to 30 inches in length, and their average size probably is somewhere between 18 and 21 inches, somewhat larger than those described by Gage (1928), present in the inland lakes of New York

Information on the sex ratio is scanty. Samples examined on May 19 and 20 just before the peak of the run were 70 per cent males and 30 per cent females. On June 15, the run was 80 per cent female and 20 per cent male. It might be inferred from this that the males run earlier than the females.

Observations on the spawning grounds

According to reports of Conservation Officers Cyril Nelson and Clifford Mowry, the lampreys spawn in the Ocqueoc River only in that part of the stream immediately below Ocqueoc Falls. In the course of supervising activities at the weir, several visits to this spawning area were made. Lack of time prevented examination of other parts of the upper river. The spawning area is in T. 35N., R. 3E., section 22,23. The river here is composed of alternate riffles and pools, and the riffles are made up of rubble, gravel, and some sand, while the pools are usually silt and muck over a rubble substrate.

On June 4, about 3/4 mile of the stretch of stream below the Ocqueoc Falls was cruised, where, on May 30, 1944, several hundred spawning lampreys and their nests had been seen. On June 4, 1945, six nests, and a dozen lampreys were observed in nest-building operations. The air temperature was 63°F., the water temperature was 54°F., still several degrees below the optimal range as given by Gage (1928).

On June 12, the same piece of water was inspected, and 37 mature sea lampreys and 57 nests were seen. The air temperature was 79°, water, 68°. On June 20, a visit was again made, and in the same area a total of 263 adults counted on 169 nests. From one to eight individuals were counted on various nests. The air was 74°, the water was 67°.

Another cruise was made on the afternoon of June 26. On this date, the air was 73°, the water 76°. A total of 55 live adults were counted, of which four pairs were engaged in spawning. An indication that spawning was almost over was the presence of 52 dead sea lampreys which had already spawned and died. Many were in an advanced state of decomposition and were lying out of the current on the edges of the pools, while others were hanging on "sweepers," and some were just barely able to wriggle from my grasp.

This observation also agrees with the experimental work and observations of Gage (1928) that all lampreys spawn but once, and then die after spawning.

The stream was visited again on the afternoon of July 4, but no lampreys were seen in the spawning area.

On several occasions, the river below the weir was inspected for about 1/2 mile downstream. No lampreys or nests of lampreys were ever seen there. According to the testimony of Dode, and officer Nelson, the lampreys have never been observed to spawn downstream from the weir. Possibly the reason lies in the difference in the bottom types. The lower river has comparatively little gravel or rubble, which the lampreys appear to prefer for their nest sites.

The observations made below the Ocqueoc Falls indicate that the weir was very probably efficient in stopping most all of the run which occurred previous to May 28. However, the later increase in numbers of mature sea lampreys on the spawning beds would indicate that an unknown and fairly large number made their way past the weir on the high water during the period May 28-June 6.

Discussion and conclusions

One of the primary purposes of the work on the Ocqueoc River was to determine if it was possible to block off the spawning run. In the light of the experience gained in 1945, it would appear possible to accomplish this purpose, granted the necessary funds, materials, and labor. An absolutely lamprey-tight structure would be necessary, for should any succeed in reaching the spawning grounds, the species would be able to continue reproduction.

The proper type of structure would have to be built on sheet-piling to prevent under-cutting, and be of fine enough mesh (about 1/2-inch) to prevent any small sea lampreys from going through, and high and wide enough to be impassable under the highest flood conditions.

On the basis of costs for the Platte River Weir, see Institute for Fisheries Research Report No. 898, such a structure would cost about $750 to install in the Ocqueoc site.

Labor costs to clean the weir, pass on other fish that enter the traps, and destroy the lampreys also amount to considerable money. The weir should block the stream during the entire run, probably between April 15 and August 1. The salary for a C grade employee would amount to approximately $435 for such a period. Preferyably two men should handle such a project, so their salaries would amount to about $875. Allowances for mileage, subsistence, and expenses for equipment and repairs probably would take another $125.

These labor costs would have to be multiplied by at least 5 (personal communication with Dr. C. L. Hubbs), and possibly 8 (Gage, 1928), for the life cycle of the sea lamprey appears to be no less than 5 years. This means that the trap would have to block the stream each year until all the larvae (ammocoetes) produced by spawning in the 5 to 8 years preceeding had reached maturity. Using the figures given above, the labor costs for the Ocqueoc River alone would amount to between $5,000 and $8,000.

Assuming that it were decided to eliminate the sea lamprey run on the Ocqueoc River, it would have little or no effect on the population of the species in Lake Huron. To accomplish any reduction in the Lake Huron population, all streams flowing into Lake Huron and supporting sea lamprey runs would have to be effectively blocked for a 5 to 8 year period. To mention just a few that are personally known to the writer, sea lampreys have been seen in the Rifle, the Au Gres, and the Cheboygan Rivers in large numbers. There are undoubtedly other streams on both the Michigan and Ontario shores which would have to be blocked. The labor and construction costs for the four Michigan streams alone, were a program of complete elimination attempted, would probably exceed $45,000. Unless the province of Ontario

operated similar structures at the same time in all their lamprey infested streams, all suitable Michigan streams very likely would become repopulated again, despite our large investment.

Before the Conservation Department is committed to any such costly program to eliminate the sea lamprey from Michigan waters, (as some people have proposed), efforts should be made to assay the loss to the commercial fisheries resulting from the parasitic attacks on the food fishes in the Great Lakes. Admittedly this will be a difficult problem, but unless it can be proven that lampreys are the cause of at least $1,000 damage yearly per stream they spawn in, it would be difficult to justify the cost of their elimination.

Some idea as to their economic effects might be obtained through periodic inspections of the catches landed at various fishing ports by Conservation Officers or fisheries workers, noting the number, size, and species of fish bearing lamprey marks, numbers of fish with lampreys attached, and numbers of dead fish found with lamprey marks. The writer has heard estimates for various ports and fishermen given, but few if any actual figures seem to be available. It might also be noted in passing that one commercial fisherman stated that he would get just as good a market price for a lamprey-marked lake trout as for an uninjured specimen.

Also, further investigation should be pursued to determine the possible use of the sea lampreys for food. They were regarded rather highly in the New England States in earlier days, according to Gage (1928), and the Encyclopedia Britannica[1] states that, "Lampreys, especially the sea-lamprey, are esteemed as food, but their flesh is not easy of digestion. Henry I of England is said to have fallen a victim to this, his favourite dish." (Sea lamprey = Petromyzon marinus)

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[1] Encyclopaedia Britannica. 13 p. 634. 1942 Eleventh ed. 16: 134-135. 1910

A possible use for the larvae and ammocoetes as bait for the commercial fishermen is suggested by Gage (1928). The immature stages are readily collected in the silt and mud banks slightly downstream from the spawning sites by scooping a portion of the muddy bottom out on the bank and capturing the larvae as they wriggle toward the water. As they are tough and active, they should make an excellent form of live bait. There is some danger, however, in permitting the use of larval lampreys as bait as some would escape and might establish the species in some of the larger inland lakes of Michigan.

The capture of young and adults for biological study in high school and college zoology courses is not unremunerative. Properly preserved sea lampreys sell at retail for about $9 a dozen, and one collector was paid $20 per hundred for his collection work by a biological supply house. This is a limited market however.

It is to be regretted that the sea lamprey was able to enter the Great Lakes and become established in these inland waters. Rather than trying to attempt the almost impossible task of eradication, we should explore all possibilities to turn its presence into an economic gain.

Summary and Recommendations

1. A fish-trap (or weir) has been operated during the spring and early summer of 1944 and 1945 on the Ocqueoc River just below the outlet of Ocqueoc Lake as a cooperative project between the East Presque Isle Sportsmen's Club and the Department of Conservation.

2. In 1944, a total of 3,366 lampreys were trapped; and in 1945, a total of 4,608 lampreys were taken in the trap. The yearly run probably numbers between 4,000 and 6,000 mature individuals.

3. The four species of lampreys present are the sea lamprey, the Michigan brook lamprey, the silver lamprey, and the American brook lamprey. In addition to the lampreys, the 1945 data indicated that

15 other species of fresh-water fish moved upstream during the spawning run of the lampreys. The time and peak of these runs are given.

4. Lampreys were moving almost every day the trap was in operation in 1945. The peak of the run occurred during the period May 16-31, when 2,688 were captured. This run appeared to have been brought on by water temperatures above 50°F. accompanied by a drop in water level.

5. Over 95 per cent of the movement occurs between midnight and the following noon, with about 55 per cent of the movement between midnight and 6 A.M.

6. The size of the mature sea lampreys in the Ocqueoc River appears to be from about 15 inches to 30 inches, and their average size is estimated at between 19 and 22 inches. Four transforming specimens were captured which ranged in size from 8.0 to 10.7 inches long.

7. From three examinations, concerning the sex composition in the upstream run, it appears that approximately 70 per cent of the migrants before the peak of the run are males. After the peak run had passed, 80 per cent of the migrants were females.

8. Observations on the spawning grounds just below Ocqueoc Falls led to the conclusion that the run was effectively blocked until high water overtopped the weir in late May and early June. In mid-June, many lampreys and nests were observed. The peak of the spawning occurred probably between June 12 and June 22 at water temperatures between 58° and 70°.

9. The cost of installing and maintaining a fish-tight weir are outlined. For the Ocqueoc River, an installation and maintenance cost of $750 and $1,000 yearly for labor was estimated.

10. The possible use of mature sea lampreys as food, of the larvae as fishing bait, and of both forms as specimens for zoological study are suggested.

11. Because there are no data available on the actual damage done to the commercial fisheries by the adult sea lampreys, it is suggested that such damage be definitely established and evaluated before any attempts at complete elimination of the sea lamprey in the Michigan waters of the Great Lakes are initiated.

12. Unless further details concerning the life history of the sea lamprey are desired, it is recommended that operations on the Ocqueoc weir be discontinued, since it will not block off the run efficiently in its present size and condition, and since the Ocqueoc is only one of many possible spawning streams entering Lake Huron.

INSTITUTE FOR FISHERIES RESEARCH

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Table 1

FISH CAUGHT IN THE OCQUEOC WEIR, SEASON OF 1945

Figures in carets indicate numbers of individuals taken in downstream traps. M-measured; E-estimated; N.G.-not given.

The peak run for each species is underlined.

Species	April 22-April 30	May 1-May 15	May 16-May 31	June 1-June 15	June 16-June 30	July 1-July 15	Totals	Size range (in. or lbs.)	
Sea Lamprey	9	893	2,688	491	460 (18)	67 (11)	4,608 (29)	14"-30"	M.
Common Sucker	1,196	174	74	79	21	11	1,555	14"-20"	E.
Red Horse	309	340	...	...	...	...	649	14"-20"	E.
Rainbow	...	...	9	...	...	1 (1)	10 (1)	18"-30"	M.
Brook	...	1	...	...	...	2	3	...	N.G.
Walleye	1	2	3	...	...	...	6	2-5 lbs.	E.
Northern Pike	...	1	...	...	...	...	1	...	N.G.
Fingerling Perch	...	1,450	114	22	...	...	1,586	3"-6"	E.
Smallmouth Bass	2	20	99	25	96	8	250	4"-7"	E.
Common Shiner	...	243	50	132	372	40	837	4"-8"	E.
Carp	...	2	3	3	3	6	17	3-8 lbs.	E.
Dogfish	...	...	1	1	...	...	2	3-5 lbs.	E.
Rock Bass	...	22	...	6	13	3	44	4"-8"	E.
Bullhead	...	...	1	29	27	50	107	5"-10"	E.
Smelt	3	...	...	...	...	...	3	...	E.
Chubs	...	...	...	82	144	...	226	4"-7"	E.
Turtle (sp?)	...	...	...	...	...	2	2	...	N.G.
Water Snake	...	...	...	...	...	5	5	...	N.G.
Totals	1,520	3,148	3,042	870	1,136 (18)	195 (12)	9,911 (30)		

Table 2

DAILY CATCH OF SEA LAMPREYS, AND DATA ON WATER TEMPERATURE AND WATER LEVEL AT OCQUEOC WEIR, 1945

Figures in carets indicate numbers of downstream migrants trapped.

Date	Number of sea lampreys trapped between 12 A.M.- 6 A.M.	6 A.M.- Noon	Noon- 6 P.M.	6 P.M.- 12 P.M.	Daily Total	Av. daily water temp. (°F.)	Water level (inches above or below normal)	Av. size or size range (inches)
April 22	...	...	...	...	1	42°	...	30
23	...	...	...	...	1	42°	...	24
24	...	...	...	...	1	42°	...	...
25	...	...	...	...	...	44°	+14	7
26	...	...	...	...	...	42°	+12	...
27	...	...	...	...	...	43°	+10	...
28	...	...	...	...	...	43°	+ 8	...
29	...	...	...	...	2	43°	+ 6	...
30	...	...	...	...	4	43°	+ 7	...
April totals	...	...	...	...	9			
May 1	...	...	...	...	11	43°	+ 3	...
2	...	...	...	...	33	44°	+ 2	...
3	...	...	...	...	43	45°	+ 1	20
4	...	11	...	51	62	46°	N.	21
5	31	23	...	...	54	47°	N.	...
6	73	55	3	...	131	50°	N.	...
7	43	30	4	4	81	50°	- 1	...
8	56	40	...	...	96	48.5°	+ 6	...
9	37	41	...	...	78	44.5°	+ 8	...
10	27	33	...	...	60	46°	+ 7	...
11	27	17	...	...	44	46°	+ 5	...
12	29	17	...	...	46	45°	+ 5	...
13	...	21	...	34	55	46°	+ 5	...
14	31	6	...	1	38	46°	+ 5	...
15	...	38	23	...	61	47°	+ 4	...
16	43	37	...	...	80	48°	+ 5	16-26
17	47	28	...	...	75	48°	+ 4	24
18	52	29	...	...	81	48°	+ 4	...
19	172	40	...	...	212	51°	+ 3	14-26
20	42	186	...	...	228	52°	- 1	14-26
21	200	141	...	...	341	52°	- 1	14-21
22	186	71	...	...	257	58°	- 2	12-26
23	212	76	...	...	288	56°	+ 2 1/2	12-26
24	20	105	...	...	125	52.5°	+ 2	...
25	46	142	...	...	188	57°	+ 2	14-20
26	177	108	...	...	285	58°	+ 2	...
27	105	186	...	...	291	59°	+ 3	12-26
28	163	74	...	...	237	60.5°	+ 7	14-24
29	...	...	...	...	...	62°	+ 9	...
30	...	...	...	...	...	60°	+16	...
31	...	...	...	...	...	60°	+14	...
May totals	1,918	1,555	30	56	3,581			

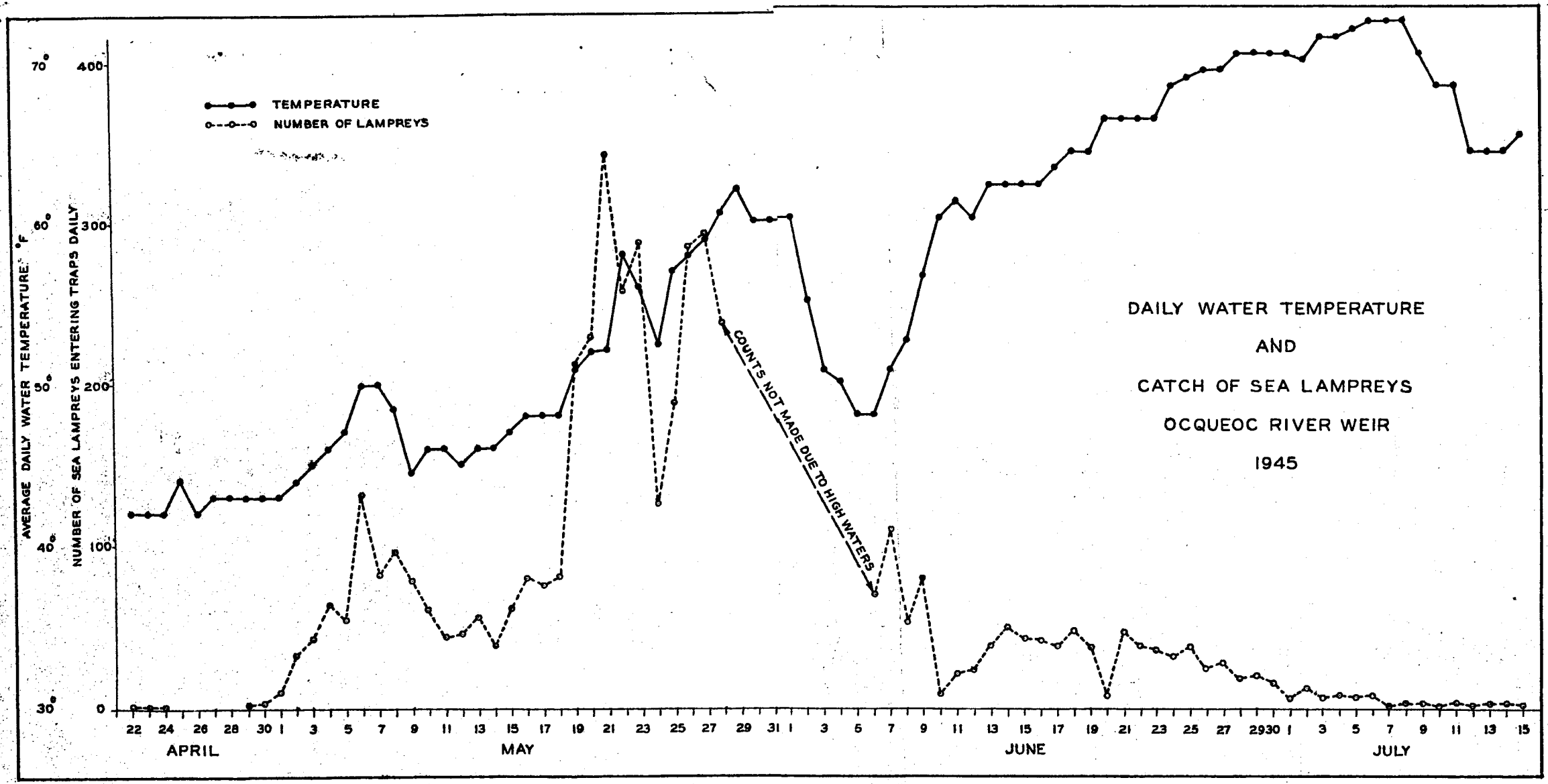
(Continued on next page)

Table 2 (Continued)

DAILY CATCH OF SEA LAMPREYS, AND DATA ON WATER TEMPERATURE AND WATER LEVEL AT OCQUEOC WEIR, 1945

Figures in carets indicate numbers of downstream migrants trapped.

Date	Number of sea lampreys trapped between: 12 A.M.– 6 A.M.	6 A.M.– Noon	Noon– 6 P.M.	6 P.M.– 12 P.M.	Daily Total	Av. daily water temp. (°F.)	Water level (inches above or below normal)	Av. size or size range (inches)
June 1	...	...	...	...	...	60°	+10	...
2	...	...	...	...	...	55°	+10	...
3	...	...	...	...	...	50.8°	+ 9	...
4	...	...	...	...	...	50°	+ 7	...
5	...	...	...	...	...	48°	+ 8	...
6	6	63	...	...	69	48°	+ 8	12-20
7	74	35	...	...	109	50.8°	+ 6	...
8	46	6	...	...	52	52.5°	+ 4	...
9	39	40	...	...	79	56.5°	+ 3	12-18
10	8	1	...	...	9	60°	+ 2	...
11	21	...	...	...	21	61°	+ 5	18
12	12	11	...	...	23	60°	+ 4	...
13	21	17	...	...	38	62°	+ 3	20
14	28	21	...	...	49	62°	+ 3	24
15	14	28	...	...	42	62°	+ 6	22
16	21	20	...	...	41	62°	+ 7	22
17	17	21	...	...	38	63°	+ 8	22
18	26	21	...	...	47	64°	+ 8	12-24
19	26	11	...	...	37	64°	+ 6	22
20	7	1	...	...	8	66°	+ 4	...
21	17	29	...	...	46	66°	+ 3	...
22	6	32 (8)	...	...	38 (8)	66°	+ 3	...
23	18	17 (2)	...	...	35 (2)	66°	+ 3	...
24	17	11	...	3 (3)	31 (3)	68°	N.	...
25	23	14 (2)	...	...	37 (2)	68.5°	N.	22
26	13	...	11	...	24	69°	N.	...
27	16	...	11	...	27	69°	N.	...
28	16	...	1 (1)	...	17 (1)	70°	N.	...
29	17	...	2 (2)	...	19 (2)	70°	N.	...
30	11	...	4	...	15	70°	N.	...
June totals	520	399 (12)	29 (3)	3 (3)	951 (18)			
July 1	3	...	3 (1)	...	6 (1)	70°	+ 2	...
2	12		...	...	12	69.5°	+ 2	...
3	6		...	...	6	71°	+ 2	...
4	8		...	...	8	71°	+ 2	...
5	7 (1)		...	...	7 (1)	71.5°	+ 1	...
6	8 (5)		...	...	8 (5)	72°	N.	10-18
7	1		...	...	1	72°	N.	20
8	3		...	...	3	72°	N.	16
9	3		...	...	3	70°	N.	18
10	1		...	...	1	68°	+ 2	...
11	3		...	...	3	68°	N.	...
12	1		...	...	1	64°	N.	...
13	3 (2)		...	...	3 (2)	64°	N.	...
14	3 (1)		...	...	3 (1)	64°	N.	...
15	2 (1)		...	...	2 (1)	65°	N.	...
July totals	...		...	...	67 (11)	...		
Grand totals	...		...	...	4,608 (29)	...	...	...


TEMPERATURE
NUMBER OF LAMPREYS
AVERAGE DAILY WATER TEMPERATURE °F
NUMBER OF SEA LAMPREYS ENTERING TRAPS DAILY
70°
60°
50°
40°
30°
400
300
200
100
0
COUNTS NOT MADE DUE TO HIGH WATERS
DAILY WATER TEMPERATURE
AND
CATCH OF SEA LAMPREYS
OCQUEOC RIVER WEIR
1945
22 24 26 28 30 1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 30 1 3 5 7 9 11 13 15
APRIL
MAY
JUNE
JULY