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Great Lakes Fishery Research by the Michigan Department of Conservation, 1959*

Compiled by Paul H. Eschmeyer

Michigan's fishery research on the Great Lakes and their immediate tributary waters again in 1959 was directed principally toward the study of various aspects of the life history of the sea lamprey. This work was supported by an earmarked item of $45,600 in the 1959-60 budget of the Institute for Fisheries Research. Other Great Lakes fishery studies continued during the year included observations on the results of stocking hatchery-reared rainbow trout near the mouths of streams tributary to the Great Lakes; on the movement and recovery of tagged walleyes in northern Lake Michigan; and on the production of eggs by hatchery-reared brood stocks of lake trout.

Of very considerable significance to the Department's future role in Great Lakes fishery matters was the transfer to the Conservation Commission, by the State Legislature (Act 154 of P.A. 1959), of authority for regulation of the Great Lakes commercial fisheries. Work related to this new authority, which becomes effective 90 days after adjournment of the 1959 session of the Legislature, has been assigned to the Fish Management Section of the Department's Fish Division.

The accounts which follow are based on reports or information provided by the staff members who are principally responsible for the respective activities discussed. Results given here are based largely on preliminary tabulations of data collected during the year and are therefore subject to revision.

Sea lamprey research

Michigan's sea lamprey research is under the direct supervision of T. M. Stauffer and is carried out principally from the Marquette Office of the Institute for Fisheries Research. Staff members assigned to the work include two other fishery biologists (M. J. Hansen and W. C. Wagner), a technician, and a secretary, in addition to five seasonal employees. In 1959 the work was concerned principally with a continuing study of the distribution and abundance of sea lamprey ammocoetes in streams; the duration of the ammocoete stage; migration of ammocoetes in the Carp Lake River; and an estimate of the number of sea lamprey ammocoetes in the Ogontz River, Delta County.

Distribution and abundance of ammocoetes in streams.--Field collections with a direct-current electric shocker were continued during the 1959 field season, to determine the distribution and abundance of sea lamprey ammocoetes in State of Michigan tributaries of the Upper Great Lakes, and thus facilitate the later application of selective toxicants by the U. S. Bureau of Commercial Fisheries. The 1959 work was restricted to Lake Michigan tributaries in Delta

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and Menominee counties, in the western Upper Peninsula. A total of 129 collections were made in seven stream systems (Bark, Cedar, Days, Ford, Little, Tacoosh, and Walton rivers); in addition, 45 collections were made in three rivers which had been surveyed previously (Whitefish, Rapid, and Ogontz), to determine more closely the upstream limits of ammocoete distribution.

Duration of the ammocoete stage.--A study of the duration of the ammocoete stage of the sea lamprey in the Carp Lake River, Emmet County, was continued in 1959 by further collections in an inclined-plane trap near the mouth of the stream; inspection of the stream above the barrier for evidence of sea lamprey spawning; and by the collection of ammocoetes in the stream above the barrier with an electric shocker.

An inclined-plane trap has been operated near the mouth of the Carp Lake River since 1950, to capture downstream migrants and to prevent the upstream migration of adults. Newly transformed sea lampreys, as well as larvae, have been taken each year since the trap was installed. In the eight migration seasons (October to June) from 1950-51 to 1957-58, the catch of recently transformed sea lampreys averaged 6,250; the mean catch of ammocoetes was 7,965, an estimated 95 percent of which were sea lampreys (estimate based on identification of ammocoetes in representative samples from downstream runs in 1955-56 to 1958-59). (The catch records are incomplete because flood conditions, frequently coinciding with peaks of downstream movement, resulted in the loss of unknown numbers of both transformed adults and ammocoetes in all seasons except 1957-58.) In the 1958-59 season, the inclined trap continued to yield relatively large numbers of newly transformed sea lampreys (4,793) and sea lamprey ammocoetes (5,365).

Inspection of the spawning areas above the inclined-plane trap in July 1959 revealed no evidence of sea lamprey redds; a weir with an upstream and downstream trap operated during much of the year near the source of Carp Lake River revealed no movement of lampreys between the river and Carp Lake. (Identical observations were made each year from 1955 to 1958.)

The length-frequency distributions of 167 sea lamprey ammocoetes collected with a direct-current shocker in July 1958 and 106 in July 1959 at a station about one-third mile above the Carp Lake River barrier were closely similar. Average lengths of ammocoetes during the two years were 5.1 and 4.9 inches, respectively; minimum lengths in the collections were 3.8 and 3.5 inches. With minor fluctuations (such as the small decreases in average and minimum lengths in 1959), both the average and minimum lengths of ammocoetes in annual summer collections above the barrier have increased gradually since 1955. Collections at two other stations, approximately 1 1/2 and 4 1/2 miles above the barrier, during the same period of years (1955-1959) have shown similar trends. (Judging by the catch per hour with an electric shocker, the population of ammocoetes was markedly lower in 1959 at the station 4 1/2 miles above the barrier, near the original upstream limit of ammocoete distribution, than during previous years of collection.) No sea lamprey ammocoetes less than 2.1 inches long were collected in the stream above the barrier in 1955-59, although smaller specimens of other species were frequently taken.

The observations in Carp Lake River strongly indicate that the minimum age of the ammocoetes remaining in the stream is not less than 6 years (1953 year class). Although less certain (no checks of the spawning area or collections of ammocoetes in the stream in 1950-54), the possibility that the minimum age

is 10 years or more (1949 or earlier year classes) cannot be excluded because the inclined trap may have been an effective barrier to spawning adult sea lampreys since 1950.

Migration of ammocoetes.--In June and July 1958, 2,187 sea lamprey ammocoetes were marked by subcutaneous injections of cadmium sulfide or mercuric sulfide and released at 5 stations above the Carp Lake River inclined trap. Judging by the recapture of marked sea lampreys (87 newly transformed adults and 52 ammocoetes) in the trap during the 1958-1959 migration season, 2.4 percent of the 1958 ammocoete population migrated downstream before transformation and 4.0 percent after transformation. Larger percentages of marked ammocoetes were recovered from the downstream marking stations (1/2 to 2/3 mile above the trap) than from upstream marking stations (2 to 3 miles above the trap). Larger ammocoetes showed a greater tendency to migrate downstream than smaller ones.

Estimates of ammocoete populations.--Of the 2,187 sea lamprey ammocoetes marked in the Carp Lake River in June and July 1958 (see preceding section), 139 recoveries were found among the 10,158 ammocoetes and newly transformed adults taken in the inclined-plane trap during the 1958-59 migration season. The resulting population estimate (by the Petersen method) was 159,800. (This preliminary estimate does not take into account the apparent variation in susceptibility to recapture among groups of specimens of different lengths and from different marking stations. The possibilities that marks may have been lost, that marked recoveries were overlooked, or that marking may have caused mortality, are also not considered, although there was no overt indication that any of these possibilities exerted an important effect on the population estimate.)

A more detailed population study was conducted at the Ogontz River, Delta County, in June to September, 1959.[1] Although the Ogontz River is small (5 c.f.s. discharge at the mouth), it contains ample spawning and larval habitat; sea lamprey ammocoetes were present throughout a large portion of the system. Although an electro-mechanical barrier has been operated near the mouth of the stream since 1958 by the U. S. Bureau of Commercial Fisheries, it is not believed that the original ammocoete population has been altered appreciably during the short interval since installation of the weir.

The study area included all portions of the Ogontz River system known to contain sea lamprey larvae (the entire mainstream and the lower portions of its four tributaries, a total of 9.6 miles), as determined in surveys of the distribution of ammocoetes in the stream in 1957 and 1959. The entire study area was measured, mapped, and subdivided into eight strata, mainly on the basis of the physical character of the various portions of the stream. Sampling sites were selected at random within strata. Two collecting methods were used, depending on the depth of water encountered. In the estuary (4,200 feet in length), where the water was relatively deep and turbid, an orange-peel dredge was used. In the rest of the stream, ammocoetes were collected by means of circular metal enclosures (2.5 feet in diameter) which were sunk in the stream bed at the collecting sites. A larvicide (3-trifluormethyl - 4-nitrophenol)

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[1] The advice of Don W. Hayne, Institute biometrician, was followed closely in the planning and analysis of the data.

was then introduced into the enclosure at concentrations of 40 to 60 parts per million. The chemical caused nearly all of the ammocoetes to emerge from their burrows. After an average waiting interval of about 1 1/2 hours, the substrate inside the enclosures was passed through a screen to insure the recovery of any additional ammocoetes killed within the substrate.

The resulting preliminary population estimate (and percentage standard error) for sea lamprey ammocoetes more than 1 inch in length was 136,100 ± 20.4 percent. Tributaries, making up 44 percent of the length of stream studied, contained 16 percent of the ammocoetes.

In 1958, the number of sea lamprey ammocoetes in 146 acres of Ogontz Bay adjacent to the river was estimated at 5,900, on the basis of 6,150 samples taken with an orange-peel dredge. Results this year in Ogontz River suggest that the estimate for the bay should be multiplied by a factor of about 5. This is because field calibration of the dredge showed that the area sampled was less than previously assumed, and also because comparative sampling using the dredge and enclosures in the same part of the river showed that the dredge apparently brought up only about one third of the lamprey ammocoetes. Recalculated, the population of the bay in 1958 was about 30,000 ammocoetes, or a little over 15 percent of the combined bay and river populations.

Rainbow trout

Stocking of rainbow trout near the mouths of Great Lakes tributaries.--The experiment begun in the spring of 1955 to determine whether stocking of various strains of rainbow trout near the mouths of tributaries of the Upper Great Lakes would materially increase runs of "steelheads" was continued. A total of 23,949 jaw-tagged rainbow trout of three strains were stocked during the period April 16-June 16, 1959, at 11 localities. The fish included 10,190 "domestic" trout (reared from eggs taken from hatchery brood stock); 8,100 "Michigan wild" (eggs collected from Great Lakes rainbow trout during their spawning migration); and 5,659 "West Coast steelheads" (reared from eggs collected in the State of Washington from sea-run rainbow trout). Of the fish planted, 9,496 were stocked in Lake Superior waters (i.e., in tributaries near their mouths, or in the lake off the mouth of a stream), 7,579 in Lake Michigan, and 6,874 in Lake Huron. The 1959 plantings brought the total number of marked rainbow trout stocked in the Upper Great Lakes during the 5-year study to more than 100,000.

Recoveries by anglers of tagged rainbow trout from the 1959 and earlier plantings followed closely the pattern set by recoveries in 1955-58, which were summarized briefly in Michigan's 1958 report on Great Lakes fishery research. In general, the voluntary return of tags by anglers has been small (about 3 percent) and less than half of the fish recovered showed the rapid growth increment of lake-run fish (many were caught within a few weeks after planting). Some lake-run fish were recovered at considerable distances (predominantly "down-lake") from the place of release. Migrations of more than 100 miles were relatively common, and one rainbow trout stocked near the mouth of the Ocqueoc River, Lake Huron, was recovered in the Bay of Quinte, Lake Ontario, more than 600 miles away.

It is expected that the 1959 planting will be the last large release of tagged fish in the current phase of the experiment, although further analysis of the recovery data currently being collected may reveal a need for limited additional plantings to complete certain aspects of the study. It is believed that predation by sea lampreys was a significant factor in limiting the number of returns of lake-run fish, and that further experimental stocking of marked hatchery-reared rainbow trout may be desirable after the sea lamprey has been brought under control.

Other studies.--A study of the life history of "native" rainbow trout in the Black River, Mackinac County, which was begun in 1950 was terminated in the fall of 1959. Progress has been made in the preparation of reports summarizing the observations during this 10-year period. Two years of observations on loss of marks, mortality, and growth of tagged and fin-clipped legal-size rainbow trout held in a hatchery were completed in the spring of 1959 (data not yet compiled).

Walleyes in Lake Michigan

A joint study (with the U. S. Bureau of Commercial Fisheries) of the walleye in the Bay de Noc area of northern Lake Michigan, begun in 1957, was advanced during the year by the tagging of 1,981 walleyes on April 22 to May 7 near the mouth of the Whitefish River (Table 1).[2] Of 1,376 walleyes tagged in the fall of 1957 or the spring of 1958, which had been free for approximately two fishing seasons, 159 (11.6 percent) had been reported caught by anglers or commercial fishermen by November 1, 1959. Of the 3,668 walleyes tagged, 2,158 were marked with No. 3 strap tags on the upper jaw, 1,447 with "spaghetti dart" tags, and 63 with other types of tags. The recovery percentages for fish marked with strap tags and with dart tags (available to fishermen for closely comparable periods of time) were nearly equal--7.8 and 7.5 percent, respectively. Most tagged walleyes reported by fishermen were caught within a few miles of the locality of release, and none had moved out of Green Bay before recapture; the greatest distance between the points of release and recapture was 110 miles.

The annual transfer of sizable numbers of Lake Michigan walleyes from the Muskegon River to upstream impoundments, during the spring spawning run, provides an opportunity for Department employees to determine the incidence of lamprey scarring and lymphocystis. Of 3,719 walleyes examined on March 31-April 14, 1959, 1.6 percent were scarred (slightly less than the 1954-1958 average of 2.0 percent) and lymphocystis was observed in 7.4 percent (up 0.4 percent from 1958, and continuing a gradual upward trend in the observed incidence of the disease since 1952).[3]

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[2] Walter R. Crowe is representing the Institute for Fisheries Research in this study.

[3] Data provided by District Fisheries Supervisor Edward H. Andersen.

Lake trout

Collection of lake trout eggs.--The Fish Division continued experimental fishing operations in five large inland lakes during the 1959 lake trout spawning season for the purpose of collecting lake trout eggs to aid in the rehabilitation of the species in the Upper Great Lakes. Fishing with 6-inch-mesh

Table 1.--Number of tagged walleyes recovered by anglers and commercial fishermen in the Bay de Noc area of northern Lake Michigan, 1957-59

Date of tagging	Number of fish	Total length (inches)		Number of recoveries reported[1]		
		Average	Range	By anglers	By commercial fishermen	Total
Sept. 12-21, 1957	770	13.6	9.4-25.0	60 (7.8)	22 (2.9)	82 (10.6)
April 30-May 9, 1958	604	18.4	12.3-30.0	46 (7.6)	31 (5.1)	77 (12.7)
June 6-Oct. 29, 1958	313	11.2	7.9-14.8	2 (0.6)	1 (0.3)	3 (1.0)
April 22-May 7, 1959	1,981	19.4	12.7-30.2	101 (5.1)	19 (1.0)	120 (6.1)
Total	3,668	17.3	7.9-30.2	209 (5.7)	73 (2.0)	282 (7.7)

[1]Percentage recovery in parentheses.

(extension measure) linen gill nets yielded sufficient ripe fish to produce 429,339 green eggs (Table 2). The unseasonably cold and inclement weather of the October 15-November 15 period of operation is believed to have affected the lake trout's spawning activities in the lakes, and very few concentrations of spawning fish were found. Despite intensive efforts by two field crews, 266,000 fewer eggs were collected than the number taken in the same lakes in 1958.

No lake trout eggs were collected by southern Lake Superior commercial fishermen in 1959, but 4,284 eyed eggs resulted from collections by personnel of the U. S. Bureau of Commercial Fisheries (aboard a commercial operator's vessel) in the vicinity of Isle Royald. The eggs, which are from a subpopulation of lake trout common in the Isle Royale region, known by commercial fishermen as "humpers," are being incubated at the Marquette, Michigan Hatchery. Flesh samples were collected from a series of the parent fish, for comparison of the chemical composition of their flesh with the flesh of common lake trout and siscowets.

Table 2.--Numbers of lake trout eggs collected in five Michigan lakes, 1959[1]

Lake	County	Number of eggs collected
Torch	Antrim	53,866
Glen	Leelanau	51,549
Crystal	Benzie	112,382
Elk	Grand Traverse	150,268
Higgins	Roscommon	61,274
Total		429,339

[1]Data provided by C. Troy Yoder, Supervisor of Hatchery Operations.

Eggs again were collected in 1959 by Superintendent Russell Robertson from brood lake trout which are being reared at the Marquette Hatchery. Fifty-one female lake trout reared from eggs collected in Lake Superior in the fall of 1948 (age-group X) produced a total of 126,222 eggs. The average egg production was down from a high of 2,964 in 1958 to 2,475 in 1959 (Table 3). Future egg collections will determine whether this is the result of an undetermined seasonal factor operative in 1959, or whether the captive fish have passed their peak egg-production levels.

Table 3.--Number of eggs produced by brood stock lake trout reared at the Marquette Hatchery

		Mature females			Mature males			Number of green eggs produced[1]	
Year	Age of fish	Number	Average total length (inches)	Average weight (pounds)	Number	Average total length (inches)	Average weight (pounds)	Total	Average per mature female[2]
1954	V	18	20.2	2.3	31	20.8	2.6	18,120	1,007
1955	VI	52	21.4	3.0	146	21.3	3.0	90,720	1,890
1956	VII	49	22.0	3.4	113	22.8	3.8	94,176	2,093
1957	VIII	54	22.8	3.6	78	24.2	4.5	138,888	2,621
1958	IX	50	23.6	4.2	78	24.5	4.7	148,176	2,964
1959	X	51	24.3	4.5	72	26.0	5.7	126,222	2,475

[1]Numbers based on counts of 240 eggs per ounce in 1954 and 216 in 1955-1959.

[2]Mature females which were found to be spent at the time of stripping (4 in 1955, 4 in 1956, and 1 in 1957) were not included in the computation of the averages.

Eggs also were collected at the Marquette Hatchery from the mature females among 479 common lake trout and 355 "hybrids" (common lake trout x siscowet) which have been reared from eggs collected in the fall of 1952 (age-group VI). The 208 mature common lake trout females (average length, 21.6 inches; weight, 3.0 pounds) yielded 354,858 eggs (average, 1,706); the 154 mature hybrid females (average length, 22.3 inches; weight, 3.5 pounds) produced 279,312 eggs (average, 1,813).

Still another group of 167 age-group V female lake trout at the Marquette Hatchery produced 193,248 eggs (mean, 1,157).

The three age-groups of brood lake trout (580 females) at the Marquette Hatchery yielded a total of 953,640 green eggs during the 1959 season. The egg production of the 5- and 6-year-old fish was rather closely comparable to the earlier production of the 10-year-old fish at these respective ages.

Commercial production of lake trout in Lake Superior.--Commercial lake trout production in State of Michigan waters of Lake Superior during the first nine months of 1959 declined by 13.5 percent from production for the same period in 1958; it was lower during 7 of the 9 months and was off as much as 87 and 83 percent in February and March, respectively (Table 4). Despite the fact that inclement weather limited commercial operations during the first three months of 1959, and although there was probably a continuation of the trend toward decreasing fishing intensity which has been observed in recent years, the lower production is probably at least partly due to continued reduction of lake trout stocks by the sea lamprey.

Table 4.--Monthly commercial catch (pounds) of lake trout in State of Michigan waters of Lake Superior, 1958-59[1]

Month	Year		Percentage change
	1958	1959[2]	
January	38,014	17,462	-54
February	10,289	1,378	-87
March	33,310	5,725	-83
April	127,149	89,972	-29
May	150,460	168,821	+12
June	104,219	102,810	- 1
July	78,715	83,047	+ 6
August	77,414	65,902	-15
September	77,491	67,715	-13
Nine-month total	697,061	602,832	-13.5

[1]Data provided by S. M. Bower.

[2]Tentative totals, based on reports received by November 23, 1959.

Other studies

A manuscript entitled, "The life history of the smallmouth bass at Waugoshance Point, Lake Michigan," by W. C. Latta is nearing completion. Frank F. Hooper and his staff continued work on analysis of data collected in a hydrographic survey of Saginaw Bay (joint project with the U. S. Bureau of Commercial Fisheries). Additional collections of yellow perch from the Saginaw Bay area were examined for incidence of the "red worm," Philonema (Nematoda), by L. N. Allison. Samples of 6-year-old common lake trout and "hybrids" (common lake trout x siscowet) reared under identical conditions at the Marquette Hatchery were collected for comparisons of the chemical composition of the flesh. The analysis of data on fat content of the flesh of common lake trout and siscowets from Lake Superior was continued.