Original: Fish Division
cc: Educ.-Game
Inst. for Fish. Res.
Region III - Fish
District 11 - Fish
C. M. Taube

INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

GERALD R. COOPER PH.D.
DIRECTOR

ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

October 18, 1962

Report No. 1651

RESULTS OF A FISHERY INVENTORY OF SILVER LAKE, LIVINGSTON COUNTY, AND RECENT CHANGES IN THE FISH POPULATION[1]

By Clarence M. Taube

Personnel[2] of the Fish Division conducted an inventory of Silver Lake (T. 1N, R. 6E, Sec. 22) during August 20-23, 1962. Purpose of the study was to assess the current fish population and conditions for fish, and to determine therefrom whether special management practices were needed. In 1961, the Silver Lake Improvement Corporation had requested the Department of Conservation to carry out an investigation to learn how the fishing in Silver Lake might be improved. There were complaints that angling success had declined recently; a matter of some concern was whether several fish mortalities in 1960 had affected the fauna.

The first inventory of Silver Lake was made on August 28 and 30, 1940, the results of which appear in a report.[3] A partial inventory was

---

[1] Financed largely with Federal Aid to Fish Restoration funds under Dingell-Johnson Project F-27-R-1.

[2] Edward H. Bacon, District Fisheries Supervisor, and Percy W. Laarman, Clarence M. Taube, and Harry Westers, biologists with the Institute for Fisheries Research.

[3] Report No. 641, Institute for Fisheries Research, "Fisheries Survey of Silver Lake, Green Oak Township, Livingston County," by C. J. D. Brown, 1940.

made during August 18-20, 1954, consisting of water analysis, gill netting, and age and growth determinations on game fish. Data from these studies have been highly useful in showing what changes have occurred in the fish population since those years.

Physical, thermal, and chemical characteristics

The area of Silver Lake is 152 acres, and the maximum depth is 42 feet. Shoal (where depths are less than 15 feet) comprises approximately one-half the area of the basin. The one small inlet, a tile which drains a small marsh off the northeast shore, is only intermittently active. Flow in the small outlet is also intermittent, with drainage to the Huron River system. A dam, two feet high, is situated in the outlet at the edge of the lake shore. This dam was installed prior to 1940 to stabilize the level of the lake.

The predominant bottom soils of the lake are marl, a mixture of marl and organic materials, and sand. The sand lies adjacent to the shoreline and encircles the basin. It extends out to the 5-foot contour in some locations, but is generally associated with organic matter and marl a short distance from shore. At various places, some gravel is mixed with the sand.

About 175 homes and cottages (exclusive of the units in a trailer park) are situated on the shores of Silver Lake. In 1940, the count of permanent and temporary residences was 100. Presently one boat

livery is in operation. There is no publicly owned frontage other than several lots that have been reserved for common usage by local people.

The water of Silver Lake is colorless and relatively free of suspended materials. The Secchi disk was visible to a maximum depth of 9 feet in 1940 and to 9 1/2 feet in 1962. These readings fall within the average range of clarity for Michigan lakes.

A large (the deeper) part of Silver Lake is stratified in the summer. Typically, lakes such as Silver Lake show this pattern of summer-season stratification: an upper layer of water (the epilimnion) in which the temperatures are warm and quite uniform, and dissolved oxygen plentiful; a middle layer (the thermocline) characterized by a rapid decline in temperature from its top to bottom limit, often accompanied by abrupt decrease of dissolved oxygen; a bottom layer (the hypolimnion) in which the temperatures are even cooler than in the thermocline, but more uniform, and where oxygen is apt to be rather deficient, if not absent. On August 21, 1962, the locations of the three strata at the sampling station on Silver Lake were: epilimnion, surface to 21 feet; thermocline, 21 to 32 feet; hypolimnion, 32 feet to the bottom (see Table 1).

When the surface water of these lakes cools in late summer and early fall, an exchange of position occurs between the water at and near the surface and that at deeper levels. Wind action assists the exchange. This interchange is referred to as the fall overturn, and when it has been completed the temperatures are quite uniform from surface to bottom, as is the concentration of dissolved oxygen.

Table 1.--Temperature and chemistry data, Silver Lake, August 21, 1962

Location	Temperature (°F.)	Oxygen (ppm)	Methyl orange alkalinity (ppm)
Air	78	...	...
Surface	75	8.4	124
10 feet	74.5	...	...
16	73	...	...
18	72	...	...
21	70	...	...
22	69	4.2	...
24	66	...	...
27	59	2.0	...
30	56	0.7	...
34	53	...	...
36	53	...	...
39	53	...	187
40	52.5	...	...

Some degree of stratification also occurs during the winter when these lakes are covered with ice. However, in this season the differences in temperatures from the surface to the bottom are small, and while a stratum near bottom may be devoid of oxygen, much less of the water mass is affected by oxygen deficiency than during the summer. As the ice breaks up in the spring, complete circulation is repeated, resulting in uniformity of temperatures and distribution of gaseous and mineral constituents. Summer-season stratification commences with the onset of warm weather.

The water temperatures and chemistry of Silver Lake in August 1962 were quite similar to what they were in August 1940 and 1954, except that in 1940 the thermocline was more restricted (27-30 feet) and the oxygen supply was adequate to a greater depth (about 28 feet) than in 1954 and 1962. In 1954, the location of the thermocline was 27-30 feet, and oxygen was sufficient to around 23 feet.

While the supply of dissolved oxygen meets the needs of warm-water fish, its restriction in the cool-water strata in summer is a critical factor for cold-water species such as trout. Because of its considerable depth, this lake is not subject to oxygen depletion in the winter, which frequently is responsible for death of fish from suffocation in shallow lakes.

The water of this lake is moderately hard. The methyl orange alkalinity values for surface and near-bottom water in parts per million of dissolved mineral salts (mainly lime) were 122 and 170 in 1940, and 124 and 187 in 1962.

Biological characteristics

Vegetation

General observations in 1962 on the vegetation of Silver Lake indicated that its density and distributional pattern has not changed much since 1940. Fifteen species of aquatic plants were recorded as present at that time. As in 1940, vegetation is generally sparse to a depth of 5 feet; bushypondweed (Najas flexilis) and musk grass (Chara) are two of the more prevalent plants in this area. Pondweeds (Potamogeton) are common between the 5- and 15-foot contours.

Fish

Fish collecting in August 1962 was done with gill nets and seines. In addition, a seine collection was taken on October 9. The catch from 12 overnight gill-net sets is summarized in Table 2, as is that taken with 11 sets in 1954. These data reflect several changes that have occurred in the fish population of Silver Lake in the interim between 1954 and 1962. Comparability of the collections is favored by various similarities of the gear and its use on the two occasions, namely, identical net dimensions (125' x 6'), and similarity of mesh sizes, location of the nets as to depth and area of placement, extent of collecting effort, and season and hours of fishing. In 1962, three of the nets were of the experimental type (one 25-foot section each of 3/4-, 1-, 1 1/4-, 1 1/2-, and 2-inch mesh, bar measure), two were entirely composed of 1-inch mesh, and one of 1 1/2-inch mesh. In 1954, the nets were four

Table 2.--Fish collected from Silver Lake with gill nets in 1962 and 1954

Species	1962			1954		
	Number	Size range (inches)	Average length (inches)	Number	Size range (inches)	Average length (inches)
Rainbow trout	None	...	...	3	12.6-13.8	13.4
Grass pickerel	3	10.7-11.3	11.0	1	9.9	...
Northern pike	3	16.7-21.3	19.1	5	23.1-26.1	25.1
Yellow perch	160	4.9-12.5	7.7*	15	5.6-10.6	7.0
Largemouth bass	None	...	...	1	8.5	...
Warmouth	2	3.8- 6.6	5.2	4	3.8- 5.6	4.9
Green sunfish	8	3.6- 4.2	4.0	None	...	...
Bluegill	27	3.8- 7.8	5.9	69	3.9- 7.3	5.3
Pumpkinseed	72	4.4- 7.4	5.5	8	4.0- 6.2	5.3
Black crappie	None	...	...	1	5.7	...
White sucker	37	10.7-13.8	12.1*	None	...	...
Lake chubsucker	2	6.2- 9.7	7.9	None	...	...
Yellow bullhead	32	5.7-10.2	7.6*	7	7.8-11.5	9.8
Carp	1	20.0	...	None	...	...
Golden shiner	1	...	...	None	...	...

* Averages with an asterisk were determined from less than the total catch. The numbers of fish involved in these averages were 53 perch, 18 suckers, and 14 bullheads.

"experimentals," one 1 1/4-inch, and one 1 1/2-inch. A variation that may have had some significance was that the webbing of the nets used in 1954 was of linen twine, whereas in 1962 it was nylon. Nylon gill nets have been found to be somewhat more effective than linen in catching fish. The ratio of difference among various experiments has ranged from about 1:1 to about 3:1. A small difference (995 fish caught by nylon nets, and 846 by linen) resulted from a test conducted in Michigan lakes.[4] But even if it were assumed that the nylon nets were three times more efficient than the linen in Silver Lake, the catch data would still indicate significant differences if the figures for 1962 were adjusted in accordance with this ratio.

The principal species of game fish that either are now present in Silver Lake or have occurred here in the past will now be considered one by one.

The rainbow trout present in 1954 resulted from stocking. Fish of legal length were planted in the autumns of 1952 (2,000) and 1953 (4,000), and 2,000 were added in 1954. The introductions provided some good spring-season fishing, but many trout died in July 1953 and August 1955, presumably because of oxygen depletion in the cool-water strata. Plantings were discontinued after 1954.

The lake has supported a small population of northern pike. One pike was obtained with two gill-net sets in 1940; five were caught in 1954,

---

[4] Report No. 1299, Institute for Fisheries Research, "The Relative Efficiencies of Nylon and Linen Gill Nets Fished in Seven Inland Lakes in Michigan," by K. L. Peterson, 1951.

and three in 1962. As this fish is quite vulnerable to capture in gill nets, the small catches strongly point to low abundance, which probably is mainly due to the scarcity of suitable spawning areas for pike.

Perch now are abundant in Silver Lake. Only 15 perch were collected in 1954, and none were taken with either gill nets or seines in 1940. This species is also readily caught in gill nets, so they can provide a good index of its abundance. Yearlings predominated strongly in the 1962 collection.

Gill nets catch few largemouth bass, and therefore are virtually useless for obtaining estimates of the abundance of this species. Other sources of evidence, however, indicate that this species now is extremely scarce in Silver Lake. Besides reports that angling for bass has been very poor the last two seasons, none were captured in 1962 by extensive seining. Young-of-year bass are readily caught with seines. No seining was done in 1954, but bass were well represented in seine collections taken in 1940. This lake has provided good bass fishing in the past.

Bluegills appear to be less plentiful now than in 1940 and 1954. Besides the reduced gill-net catch, only 4 bluegills (among over 500 pumpkinseeds) were collected with seines in 1962. The reduction has every appearance of being advantageous. This fish grew slowly when it was abundant.

While abundance of bluegills has decreased, that of pumpkinseed sunfish has apparently increased. Despite fast growth at the present time, the species does not attain large size in Silver Lake.

Green sunfish, a nuisance species, continues to be plentiful. There are some warmouths. No crappies were collected in 1962; one was captured in 1940 and one in 1954.

White suckers now are numerous in Silver Lake. As no suckers were collected here before (they are highly susceptible to capture with gill nets), their appearance represents another change in the fish fauna. Chubsuckers were collected for the first time in 1962. One carp was also taken this year; local people say they have seen schools of carp at night, but it is doubtful that their population is large. Bullheads continue to be fairly common.

Forage fish are abundant. The kinds collected in 1962 were blacknose, blackchin, sand, spottail, and golden shiners, bluntnose minnows, fathead minnows, mudminnows, and Iowa and least darters. Blackchin and sand shiners predominated in these collections. The species obtained in 1962 which were not observed in 1940 were the blackchin shiner, spottail shiner, golden shiner, fathead minnow, mudminnow, and least darter; the brook silverside (or "skipjack") was collected in 1940, but not in 1962.

Ages and growth rates

The average lengths by age groups of the principal game fish of Silver Lake, as determined from various collections, appear in Table 3. The Roman numerals denote age in years; unenclosed figures under age groups are average total lengths in inches; parenthesized figures show the number of fish in the samples. State-average lengths, based on

Table 3.--Age and growth of Silver Lake fish

	I	II	III	IV	V	VI	VII
Largemouth bass							
1940	...	5.8(2)	...	...	...	...	...
1954	...	...	8.5(1)	...	...	...	...
State average	6.1	8.7	10.0	12.1	13.7	15.1	16.1
Bluegill							
1940	...	3.2(5)	5.8(2)	5.8(2)	6.3(8)	6.8(10)	6.8(8)
*1953	...	...	4.5(2)	5.5(25)	...	...	...
1954	...	4.0(4)	4.5(30)	5.6(7)	6.6(25)	6.7(1)	...
1962	3.6(6)	6.0(13)	6.3(7)	...	...	7.8(1)	8.5(1)
State average	2.9	4.3	5.5	6.5	7.3	7.8	8.0
Pumpkinseed							
1940	...	3.3(3)	4.7(8)	4.8(1)	...	...	...
1954	...	4.0(1)	4.8(3)	6.2(1)	6.2(2)	...	...
1962	3.1(3)	5.2(58)	5.9(17)	...	7.4(1)	...	...
State average	2.9	4.1	4.9	5.7	6.2	6.8	7.3
Yellow perch							
1954	...	...	...	6.7(13)	...	...	...
1962	7.0(44)	9.4(1)	10.9(2)	11.6(4)	11.0(2)	...	...
State average	4.2	5.8	6.8	7.9	8.8	9.8	10.4
Northern pike							
1940	18.2(1)	...	...	...	...	...	...
1954	...	25.1(5)	...	...	...	...	...
1962	17.9(2)	21.5(1)	...	...	...	...	...
State average	15.5	19.4	22.2	23.9	25.4	27.7	32.5

* Hook-and-line collection.

large samples of fish in which numerous Michigan lakes are represented,[5] are included to afford comparison with averages for Silver Lake. The standard of average growth for northern pike and largemouth bass includes measurements which fall within one inch to either side (plus or minus) of the state-average figure; for smaller species (bluegills, perch, etc.), the range is 0.5 inch to either side of the state-average value.

The data in Table 3 illustrate the improved growth of bluegills, pumpkinseeds, and perch. The growth rates are now well above state average. In 1954, they were below average for bluegills and perch, and average for pumpkinseeds; in 1940, they were below average for bluegills and pumpkinseeds. The scales of the older fish collected in August 1962 clearly demonstrate marked growth acceleration beginning in 1961, pointing to some drastic change in the environment at about that time.

Interpretation of the population changes

Differences between the biological results of the 1962 inventory and those of the preceding inventories are of various importance. Some of the differences surely do not represent either an actual or significant change in the fish population (collection of least darters only in 1962, for example); others seem to reflect an actual change, but one of limited significance (e.g., establishment of a sizeable population of suckers); still other differences not only give every indication of being actual, but are important as well. To the third category belong the decline of largemouth bass, increase of perch, and the large increase in the growth rates of several species.

---

[5] Fish Division Pamphlet No. 26, "Age and Growth of Fish in Michigan," by W. C. Latta, 1958.

Although the underlying cause of the more significant changes in the fish population of Silver Lake is unknown, mortality is strongly suspected. Three fish kills were observed here in 1960, two in the summer (the first of which quite certainly resulted from aerial spraying done near the lake for insect control), and one in December when ice was forming. Species reported to have been involved in the die-off of early June were largemouth bass ("many, 2-10 inches"), bluegills, black crappies, rock bass, warmouths, northern pike, and minnows. Two dead largemouth bass and one northern pike were picked up on December 15, 1960, and were brought to the Institute for Fisheries Research for examination; at least 18 other dead bass and another pike were seen when these fish were collected. Dr. Leonard N. Allison, Fish Division pathologist, examined the three specimens but found no clues to account for their death.

Whatever the cause of the alteration in the population, the results have benefited as well as harmed the fishing. While loss of large game fish and the decline of bass were unfortunate, improvement in growth rates has been a desirable gain, possibly outweighing the loss. A question likely to be asked is how long good growth will continue. Judging from the history of Silver Lake and rebounds from decimations that have occurred elsewhere in similar situations, and provided the lake is not sharply disturbed again in the near future, growth rates are apt to level off within a year or two as the affected species increase in number, and may well decline to their former levels soon thereafter. However,

as in long-range forecasts of the weather, predictions on future trends of biological phenomena are not highly reliable. Consequently, good growth could continue here longer than anticipated.

Management practices

Blue gills, largemouth and smallmouth bass, and perch were planted in Silver Lake from 1934 through 1942. Routine stocking of warm-water fish was discontinued in Michigan after 1945. As previously mentioned, the lake received plantings of rainbow trout in 1952, 1953, and 1954.

Following the 1940 inventory, brush shelters were recommended as additional cover for fish. Fifty-eight shelters were installed here in 1958. Presently, vegetation apparently affords adequate cover.

A planting of largemouth bass is advised at this time for Silver Lake. Although it seems unlikely that bass have completely disappeared, their number must be small. Restocking will speed recovery of the bass population if some bass are still present, and would of course be a necessity if they are gone. A minimum of 500 four- to five-inch fingerlings is recommended, which would have to be obtained from a private source as the State does not distribute bass of this size. Local people have indicated willingness to purchase stock. Planting of large rather than small fingerlings is advised to afford a better rate of survival and a quicker recovery of the population.

Some interest has been expressed in increasing the number of northern pike in Silver Lake. Provision of good spawning facilities seems the best procedure for effecting an increase. Perhaps the small marsh off the northeast shore could be converted into a pike nursery; the owner of the property has suggested its use for this purpose. The site should be examined by Fish Division personnel who are concerned with pike marsh development to evaluate its possibilities and, if found adequate, to recommend procedures for development.

Another sampling of the fish population of Silver Lake either in 1964 or 1965 would be desirable, particularly to assess the status of bass at that time and to reevaluate the growth rates of game species.

INSTITUTE FOR FISHERIES RESEARCH

Clarence M. Taube

Report approved by W. R. Crowe

Typed by M. S. McClure