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A FISHERIES SURVEY OF SPORLEY LAKE, MARQUETTE COUNTY

by

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Introduction

Sporley (Echo, Sproley) Lake covers portions of sections 5, 31, and 32, T. 45 and 46 N., R. 24 W., in West Branch and Forsyth Townships, Marquette County, in the north central part of the Upper Peninsula of Michigan. The lake is located about 5½ miles northeast of the Village of Gwinn. It is one of a group of lakes occurring in a relatively small area. Others in the group include Wilson (Big Trout), Engman's, and Martin's Lakes. The water is situated near the headwaters of the Chocolay River, to which it is tributary.

Highway M-35, as well as the Chicago and Northwestern Railroad, passes through the village of Little Lake, 3 miles to the south. The lake is reached by sand trails leading northeast from Gwinn or north from Little Lake across an extensive jack pine plain. Immanual Bible Camp is situated less than 1/4 mile from Sporley Lake, and the sand trail from Gwinn to the Camp is plainly marked by conspicuous signs.

The map of Sporley Lake, including shoreline, depth contours, bottom soils and shore features, was made by Dr. A. S. Hazzard and the writer, of the Institute staff, on August 15 and 16, 1941. A regular biological and chemical inventory was made during the succeeding 5 days.

Sporley Lake is said to have originally supported only brook trout, and good fishing for this species was had during an extended period preceding the turn of the century. The first planting of bass, thought to have been made about 1900, did well, and fishing for both trout and bass was good about 1906. The fishing has declined continually since that time until the lake is at the present time only very lightly fished. This is not due particularly to the fact that catches are light, but is chiefly due to the extremely heavy degree to which fish are parasitized in the lake. Although no parasites harmful to man are known to be present in the lake, the abundance of parasites in the skin, flesh and entrails of game fish caught exerts sufficient psychological effect to render them unpalatable to the average fisherman. This parasitism will be described in greater detail later in this report. It is not known when this serious condition first arose, but reports indicate it to have been present for at least the past 10 to 15 years.

Sporley Lake is quite far removed from population centers and has been little developed. Only 6 cottages are spread along its rather extensive shoreline, and there are no hotels, resorts, or boat liveries. There are several good swimming beaches, none of which is much used. No part of the shoreline is publicly owned, and cottage owners and their friends are the chief users of the lake. The road passing along the northeast shore touches the lake at several points, however, and probably no objections would be made to the landing of boats on the lake.

Unless public access is gained to Sporley Lake and the parasitism is controlled, future use of the water will probably be about as restricted as it has been in the past. If these two factors which most limit public use are eliminated, however, Sporley Lake would be expected to play an

increasingly vital role in the provision of outdoor recreation in the Marquette County area.

Physical Characters of Sporley Lake

The basin of Sporley Lake is irregular in shape, has an area of 76.4 acres and a maximum depth of 42 feet. The shoreline is about 1.9 miles (9,870 feet) in length and the shoreline development is 1.5. This means that the lake has 50 per cent (1.5 times) more shoreline than a perfectly circular lake of the same area. Ordinarily, the greater the length of shoreline on a lake, the greater is its productivity, since extensive shallow bays and coves found only in lakes with extended shorelines, provide more food, shelter, and spawning facilities (for most species of fish) than does the open water.

The country surrounding Sporley Lake is gently rolling, with low hills leading down to the relatively flat jack pine plains. The soil is chiefly sand, with some gravel and clay. The shores of the lake are densely wooded with pine, spruce, and mixed hardwoods. The water has some characteristics of the "pot hole" type of lake, and the basin is very probably of glacial origin.

The drainage of Sporley Lake is very limited in extent, being largely restricted to direct run-off from adjacent uplands. Two very short, intermittent inlets enter the lake, one from a short gulley in the southeast end of the lake, and one from a small wooded swamp adjacent to the east-central shore. The lake has a single, small, intermittent outlet which leaves the northwest end of the lake and enters Wilson Lake. It is apparently non-functional except during times of abnormal precipitation or during the spring run-off period. There is no dam in the outlet.

Water fluctuation in Sporley Lake is minimal and need not be considered in the management of the fishery there.

Areas sufficiently shallow to be potentially capable of supporting aquatic vegetation are rather restricted in Sporley Lake, being restricted to about 10 per cent of the area of the water. The declivity from the shallows to the depths is quite steep over most of the lake. Although many of the shallow areas are less than 35 or 40 feet in width, a few restricted shoals in the northwest end of the lake are almost 200 feet wide.

The bottom of all the shoal and most of the deeper water is composed of sand, with mixtures of gravel appearing at some places. Almost all of the water over 30 feet in depth has a pulpy peat substratum. A very small amount of pure clay occurs near the center of the western portion of the lake.

The water in Sporley Lake is colorless. A Secchi disk (white metal disk about 6 inches in diameter) when lowered into the water disappeared from view at a depth of 11 feet. This is probably slightly above average transparency for lakes of the vicinity. Degree of clearness of the water is an important factor in determining the depth to which aquatic plants will grow in a given water, since none of the higher aquatic plants can survive in the continued absence of light.

Temperature and Chemical Characters of Sporley Lake

As a part of the survey conducted at the lake, various physical and chemical data concerning the lake water itself were collected. Temperature of the water at various depths was observed, and information concerning the nature and amount of dissolved gases, minerals, etc. in the water was obtained. Such data are very important in determining the suitability of a lake to the various fish species.

Temperatures were taken and chemical analyses were made of the water on August 20. Temperatures were found to range from 69°F. near the surface

to 47.6°F. at the bottom. A thermocline (area of rapid change in temperature, e.g., at least 1°C. per meter of depth) was found to be present, extending from a depth of 20 feet to the bottom of the lake (31 feet). The temperature at the top of this layer was 67°F.

The presence of a thermocline in a lake ordinarily indicates the division of the water into 3 distinct strata with regard to temperature. The epilimnion is a warm, circulating layer of water above the thermocline (in this case extending from the surface to a depth of 20 feet). The hypolimnion is an area of cold, non-circulating water extending from the bottom of the thermocline to the bottom of the lake. (In the case of Sporley Lake, the presence of a hypolimnion was not demonstrated by the temperatures taken. Such a stratum was undoubtedly present in the deeper waters of the lake, however, probably extending, for example, from depths of 30 to 42 feet). When a thermocline is present in a lake, and sufficient oxygen exists in the thermocline or hypolimnion, the lake can ordinarily be managed for cold-water species such as trout. If a thermocline is not present, then the water in a given lake is ordinarily either too warm or without sufficient oxygen (4 parts per million) to support trout. A lake of this type can only be managed for warm-water species.

Sporley Lake was found to have adequate oxygen in the thermocline area to support trout. Although only 2.9 parts per million of the dissolved gas were found at a depth of 30 feet, 9.9 parts were found at a depth of 25 feet. Larger quantities of the dissolved gas would be expected at lesser depths.

Methyl Orange Alkalinity tests (made to determine the amounts of certain minerals and buffer salts in the water) showed the water in Sporley Lake to be quite soft. A dissolved salt and mineral content of from 19 to 20

parts per million was found. Ordinarily from 100 to 200 parts per million are considered best for high productivity. This is more true when the management of warm-water fish is being considered than it is in the case of trout. Many of Michigan's outstanding trout-producing lakes have a Methyl Orange Alkalinity entirely comparable to that of Sporley Lake.

No pollution was found in Sporley Lake. This would be expected in view of the lake's far removal from sources of industrial or significant amounts of domestic wastes.

Biological Characters of Sporley Lake

The biological characters of a given water are commonly of primary importance in revealing the management procedures which will be necessary to improve the quality of the fishing. Toward determining the biological nature of Sporley Lake, several types of data were collected. Representatives of the species of vegetation present in the lake were collected and identified, and samples of plankton (microscopic free swimming and floating plants and animals) were obtained. Bottom food studies were made, and fish collections, including all available species and sizes, were made to study growth, condition, parasitism, etc. Spawning facilities for the various species of fish present in the lake, as well as for those species which might be introduced, were evaluated.

The vegetation in Sporley Lake was found to be relatively sparse, although probably not below average for soft water lakes. Small quantities of emergent vegetation were present on the infrequent shallow shoals, and some submergent vegetation was found on the steep slopes. Floating vegetation was restricted to areas close to shore, chiefly in bays or coves protected from wind action. A list of the species of aquatic plants collected in Sporley Lake, with an estimate of abundance, is shown in Table I.

Table I
Aquatic Vegetation Found in Sporley Lake*

Species	Abundance
Horsetail (Equisetum fluviatile)	Sparse
Pipewort (Eriocaulon septangulare)	Very common
White water lily (Nymphaea odorata)	Common
Smartweed (Polygonum natans f. genuinum)	Sparse
Large-leaf pondweed (Potamogeton amplifolius)	Sparse
Leafy pondweed (Potamogeton epihydrus)	Sparse
Pondweed (Potamogeton panormitanus var. minor)	Sparse
Sedge (Eleocharis olivacea ?)	Sparse
Stonewort (Chara)	Sparse

*Identifications by B. M. Robertson, Department of Botany, University of Michigan.

As has been stated above, Sporley Lake at present has about as much vegetation as a deep, shoal-sparse, sandy-bottomed lake of its limited basic fertility could be expected to support. The large numbers of deadheads, logs, snags, branches, etc., carry a good share of the burden of providing shelter for young fish and substrata for invertebrate life in the lake.

Plankton in Sporley Lake at the time of the survey was about average in abundance for lakes with similar physical and chemical characteristics. However, individual samples taken during a short survey period do not offer sufficient data to permit any definite conclusions regarding year-round plankton abundance. Plankton in Sporley Lake is probably ample to supply the needs of developing fry and fingerlings during the early summer, as well as the cisco population which feeds mainly on this fare.

Invertebrate bottom food in Sporley Lake was found to be relatively sparse. The pulpy peat substratum of the deeper waters yielded almost no bottom food, while the sandy soils did little better. The most productive sample taken (depth, 11 feet) yielded 15 midge larvae, one amphipod and a single mayfly nymph. Random observations near shore on submergent brush

and debris revealed the presence of a few amphipods, snails, clams, mayfly nymphs, caddis and midge larvae. The bottom food found in the lake is about as abundant as could be expected in a water with such limited fertility. About all the fish taken in the lake showed average growth and were in good condition (except for the previously mentioned extensive parasitism), so it may be assumed that adequate food is present in the lake to support the present population.

The species of fish collected in Sporley Lake by the survey party are shown in Table II. An estimate of the abundance of the various species is included, together with the range in size of fish in the collections, and a record of artificial stocking during the 5 years immediately preceding the survey.

Table II
Fish Collected in Sporley Lake; Their Size Range, Abundance, and Artificial Stocking

Species	Abundance (estimate)	Size Range (inches)	Stocking (1936-1940)
GAME FISH			
Rock bass	Abundant	4 1/8 - 8 3/4	...
Cisco	Abundant	9 - 11 3/4	...
Perch	Common	1 3/8 - 11 7/8	...
Smallmouth bass	Occasional	9 3/8 - 14 5/8	500
Bluegill			
adults	Occasional	7 5/8 - 9 1/2	...
fingerlings	Common	3/4 - 1 1/8	14,200
Pumpkinseed			
adults	Rare	6 1/2	...
fingerlings	Abundant	1/2 - 1	...
Largemouth bass	Rare or absent	...	700
FORAGE FISH			
Iowa darter	Common	7/8 - 1 3/4	...
COARSE FISH			
Common sucker	Abundant	3/4 - 18 1/4	...

The Centrarchids are seen to be very well represented in Sporley Lake, with cisco and perch representing the only game or food species foreign to that family. Rock bass are present in all sizes and ages

(although no young-of-the-year were found) and are apparently doing particularly well in the lake. No young-of-the-year smallmouth were captured, and few adults were taken. Heavy parasitism may be preventing the reproduction of this species in the lake. Adult bluegills were large and relatively free from parasites. Pumpkinseed adults, though scarce, apparently reproduced well, producing large numbers of fry which may overpopulate the lake in future years. The common sucker was the only coarse fish found, and Iowa darters were the only forage fish seen. Apparently forage minnows are unable to become established in the face of continued pressure by the pisciverous Centrarchids and perch in the lake. The latter species are probably able to maintain their own numbers by the production of particularly large numbers of young (especially bluegills and pumpkinseeds). In spite of the fact that over 14,000 bluegills and presumably no pumpkinseeds have been planted in the lake during the past 5 years, young pumpkinseeds outnumbered bluegills in the survey collections in the ratio of $2\frac{1}{2}$ to 1.

A record of the growth rate of game fish collected in Sporley Lake is shown in Table III. Since the scales were taken from the fish after mid-August, the fish are more than $\frac{1}{2}$ growing season older than is indicated by the number of annuli. (Annuli are probably formed in most species during late spring). Table III also shows the number of fish upon which each average is based. Averages based on only a very few specimens may not be accurate for the year group, as a whole, in the lake, due to individual variation.

Table III
Growth Rate of Fish Collected at Sporley Lake*

Species and number of annuli	Number of specimens	Average total length (inches)	Average weight (ounces)
Rock bass			
II	1	4 1/8	0.7
IV	15	5 5/8	1.9
V	10	6 7/8	3.3
VI	5	7 3/8	3.9
VII	2	8	5.5
VIII	1	8 1/4	4.5
IX	1	8 3/4	6.9
Smallmouth bass			
III	1	9 3/8	6.1
V	1	14 5/8	26.5
VI	2	14 3/8	22.4
Bluegill			
III	1	7 7/8	4.6
V	1	7 5/8	4.8
VI	1	9 1/2	9.2
Perch			
II	1	4 1/4	0.4
III	3	6 5/8	1.6
IV	5	6 5/8	1.5
V	1	7 3/8	2.1
VI	1	11 7/8	11.5
Cisco			
II	6	9 1/4	3.7
III	2	10 1/4	5.4
IV	11	10 1/2	5.2
V	11	10 3/4	5.7
VI	6	10 7/8	6.3
VII	1	11 1/8	6.4
Pumpkinseed			
IV	1	6 1/2	4.0

*Age determinations made by W. C. Beckman.

The table reveals that rock bass probably reach legal size (6 inches) toward the end of their 5th summer of life. This is about average growth for this species in Michigan. The very few specimens of smallmouth bass taken during the survey show this species to be growing somewhat slower than the average for the State, although their growth is probably average for the Upper Peninsula. Legal size is apparently reached late in the 4th or early in the 5th summer of life. Bluegills, judging from our scant

available data, are growing faster than the average of the species. Keeper size (6 inches) is attained during the third summer of life, or perhaps even earlier in some cases. At least a year longer is required by the average Michigan bluegill to reach this size. This faster than average growth rate may be due to its recent introduction. Perch appear to be growing at about an average rate for lakes of the Upper Peninsula. No serious stunting, such as is common for this species in many lakes of the area, appears to be present in Sporley Lake. Cisco seem to be reaching a good size early in life, and the only pumpkinseed available for study had grown at an average rate for the species.

When comparisons are made with data compiled for the State as a whole, as determined by Dr. W. C. Beckman of the Institute Staff, all of the species, with the possible exception of the rock bass, are in about average condition, i.e., have average length-weight proportions. It is thus apparent that with respect to growth in length and weight, Sporley Lake has close to an average, normal fish population.

A discussion of the growth and condition of Sporley Lake fish would probably not be complete without considering here a matter to which reference has been made above, but which has not been discussed, namely the parasitism of the fish. Several species of fish in Sporley Lake exhibit one of the highest degrees of parasitic infestation yet found in the State. At least 3 distinct types of parasites are present in abnormal abundance. These are the black spot (Neascus), the yellow grub (Clinostomum) and the bass tapeworm (Proteocephalus). The smallmouth bass, as well as the rock bass, had heavy concentrations of black spots and yellow grubs in the skin, fins, mouth cavity, and throughout the musculature. Most perch examined were heavily parasitized with black spots in the skin and

flesh, and about half of them had yellow grubs. The liver of some specimens contained cysts, believed to be those of Neascus. Bluegills were relatively clear of parasites and so was the one pumpkinseed examined.

The entire body cavities of all the smallmouth bass and rock bass examined were filled with an indistinguishable mass of organs, connective tissue, and incredible numbers of larval tapeworms and cysts. It seems impossible that any of the fish examined could have spawned successfully.

None of the ciscoes examined by the survey party (10 or 12 individuals) showed any parasitism, but one specimen given to a lakeshore resident was reported to have had tapeworms (peculiar to cisco, not Proteocephalus) in the musculature along the backbone.

None of the above named parasites is harmful to man, nor does it appreciably affect growth, but the organisms are present in sufficient abundance to render their hosts decidedly unpalatable. Few fishermen are able to enjoy eating fish which are so heavily parasitized that large numbers of the foreign organisms can be recognized at the time of catching the fish, during the course of dressing them, and probably even at the time of eating. As a result, the fish crop continues to go unharvested at Sporley Lake and extremely few fish taken from the lake are ever eaten.

Spawning facilities in Sporley Lake are adequate for all species now present. Extensive areas along the shoreline with a bottom of sand mixed with some gravel, provide ample spawning habitat for the Centrarchids. Sufficient vegetation and brush is present for perch to lay their eggs upon, and since ciscoes spawn in the open water over shoal areas, their spawning needs are also met. In the absence of permanent inlet or outlet streams, trout would not be expected to reproduce in the lake.

Management Suggestions

Sporley Lake is at the present time classified in the "all others"

group, and the data gathered by the survey party in the field does not indicate a need for a change in this designation at the present time. If the suggestions offered below are carried out, it will be desirable to re-classify the water as a trout lake.

Since the present population of fish in Sporley Lake is of almost no public value, due to the high degree of parasitism, it is recommended that advantage be taken of the fact that the lake is suitable for trout. This seems logical, particularly because none of the parasites present in Sporley Lake is known to seriously infect trout.

It is recommended that permanent public access to the lake be guaranteed in some accepted legal manner (such as by purchase of a public fishing site) and that a partial poisoning operation be then undertaken in Sporley Lake. Poisoning of the entire lake to remove the present population of fish, although effective, would be quite costly in view of the water's large size and considerable depth. Also, the present population of ciscoes would be destroyed. This is undesirable since the ciscoes may furnish a good food supply for trout, if the latter are planted, since both inhabit the cooler, open water areas of the lake. Partial poisoning would involve the application of poison to all portions of the lake in sufficient amount for the material to be lethal to fish to a depth of 20 feet. This is the top of the thermocline. If the operation were as successful as other similar partial poisonings have been*, very nearly all the fish in the lake would be destroyed except the ciscoes, some of the suckers and possibly a few perch. A total of 1,645 pounds of derris root would be necessary to obtain the required $\frac{1}{2}$ part per million concentration in the upper 20-foot stratum of water.

*Greenbank, John, "Selective Poisoning of Fish", Transactions of the American Fisheries Society, Volume 70, 1940, pp. 80-86.

Following poisoning, a planting of 1,700 legal-size rainbow trout and 16,000 fingerling rainbows should be made. These figures are based on results from fingerling and legal-sized trout plantings in the Pigeon River lakes (Shetter, I.F.R. Report No. 620. From 30 to 50 legal-sized trout per acre and approximately 20 times these numbers of fingerlings seemed to give the best returns to the anglers). The minimum figures were used for Sporley Lake because of the relatively poor food supply and 2/3 of the stocking requirement was figured for legal-sized fish and 1/3 for fingerlings. The fish should be planted in the fall as soon as the water temperature drops below 60°F. at the surface. Artificial stocking with trout should be continued periodically, probably once each year. A careful check on the results will be made by the District Fisheries Biologist.

A few kingfishers, great blue herons and gulls, and one eagle were among the potential fish predators seen at Sporley Lake at the time of the survey. One mink was also observed. Neither these nor any other birds or mammals likely to occur at Sporley Lake would be apt to significantly affect the existing or proposed fishery there in their capacity as predators. However, water birds (particularly great blue herons) are the final hosts of the yellow grub parasite which occurs in such abundance at Sporley Lake. The birds are a necessary link in the completion of the life cycle of this parasite, and in this capacity they have greatly influenced the fishery at the lake. Although, for this reason, the elimination of the water birds might seem desirable, it would hardly be practicable, and is not here recommended.

The species of parasites present in Sporley Lake are extremely difficult and costly to control, no readily applied method for their eradication having been as yet discovered. Trout are relatively immune

from infection by the parasites most prevalent in the lake, and it is expected that this species will furnish the better portion of the fishing in the future.

The limited amounts of vegetation and the considerable numbers of deadheads, logs, branches, brush, etc., along the lake shore should furnish sufficient cover to meet the needs of the proposed fish population in the lake, and no increase seems required.

No advantage could be gained by a change in the present water levels and no further regulation is here recommended. Spawning facilities are adequate for all species except possibly trout, and such facilities for this species cannot be provided. No improvements are suggested.

INSTITUTE FOR FISHERIES RESEARCH

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