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Mr. Stanley Shust. 5-22-42
Dr. Roelofs

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ALBERT S. HAZZARD, PH.D.
DIRECTOR

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A FISHERIES SURVEY OF SQUAW (LONG) AND WITCH LAKES,

MARQUETTE COUNTY

by

E. W. Roelofs

Introduction

These lakes are located in Republic Township in the southwestern part of Marquette County. (Squaw Lake--T. 45 N., R. 30 W., Sec. 9, 16, 21; Witch Lake--T. 45 N., R. 30 W., Sec. 23, 24, 25, 26). Witch Lake lies just east of M-95, 11 miles south from Republic. Squaw Lake lies 3 miles northwest of Witch Lake. Both lakes are in the Michigamme River drainage system.

An outline map of Witch Lake, showing contours, was provided by Camp Sagola (Emergency Conservation Work). During the summer of 1937, the Institute for Fisheries Research* completed this map of Witch Lake, mapped Squaw Lake, and made a biological survey of both lakes.

There are no records of past industrial uses of these lakes. The small community on the west shore of Witch Lake had less than 20 houses at the time of the survey. This undoubtedly was a larger community in the lumbering days. In addition to this small settlement, there are 5 cottages and one resort on Witch Lake; Squaw Lake also has 5 cottages.

* The party consisted of: F. Bond, leader; W. C. Beckman, J. Greenbank, and H. Erickson, assistants.

Squaw Lake is reported to have produced good lake trout fishing up to 1935, at which time a sharp decline in the catch was noted. It is almost certain that lake trout were introduced artificially and maintained by this same method. The survey party took no lake trout, and if natural propagation was responsible for the former population, some fish should have been taken by the survey party.

Witch Lake has had a good reputation in the past for its catches of trout, pike, and bass. During the time of the survey, and a few years previously, fishing was considered poor. In 1939 a heavy infestation of the bass tapeworm was noted.

These lakes are potentially important as public fishing waters, and will be used a great deal if good fishing is restored.

Physical Characters

Squaw Lake is long and narrow with the long axis in a northwest-southeast direction. This orientation accounts for the rather severe wave action during storms. The lake has a maximum depth of 33 feet. In spite of this great depth, there are several shallow bays and shoals for the spawning of most warm-water fish.

Witch Lake is even deeper than Squaw; the maximum depth is 102 feet. The basin is very irregular in outline, giving rise to many bays and coves so that ample shallow water is provided.

Both lakes have a limited watershed. Squaw Lake has no inlet, while Witch Lake has two short streams feeding it. Both lakes have outlets. The Fence River, flowing through several smaller lakes, connects Squaw Lake with the Michigamme River. The outlet of Witch Lake flows into the Michigamme River several miles south of the lake.

The physical characters of the two lakes are given below.

	Squaw Lake	Witch Lake
Area (acres)	221	210
Maximum depth (feet)	83	102
Per cent shoal	30	40
Bottom types		
Shoal	Sand	Sand, rubble, fibrous peat.
Depths	Pulpy peat, silt and marl.	Pulpy peat.
Color of water	None	None
Secchi disc (feet)	11	14

The physical qualities of these lakes do not favor high productivity. Large and deep lakes are usually less productive than small or shallow ones. The small percentage of shoal area means less suitable conditions for most warm water fish. The water is moderately clear as shown by the depth to which a Secchi disc was visible. (The Secchi disc is a black and white circular metal disc used to determine the clearness of the water).

Temperature and Chemical Character

Since the various kinds of plants, fish food organisms, and fish differ in their temperature and chemical requirements, a study of these characteristics is essential to a management program for any lake.

A summary of the temperature and chemistry of Squaw and Witch Lakes follows:

	Squaw Lake, 8/28/37				Witch Lake, 7/6/37			
	Surface	Thermocline		Bottom	Surface	Thermocline		Bottom
		Top	Bottom			Top	Bottom	
Depth (feet)	...	25	35	75	...	25*	40	95
Temperature (°F.)	74	67	50	44	78	52	44	41
Oxygen (p.p.m.)	7.6	...	2.9	0.2	7.8	7.5	4.1	1.1
CO ₂ (p.p.m.)	0.0	...	6.0	18.0	0.0	4.0	9.5	12.0
M. O. Alkalinity (p.p.m.)	108	...	14	157	115	116	119	132
pH	8.4	...	7.8	7.0	8.4	7.8	7.2	7.2

* The top of the thermocline (zone of rapid temperature change) was at 7 feet, but all readings given here were taken at 25 feet.

These lakes are quite similar in temperature and chemical conditions. Each has a warm surface layer, a deeper zone of rapid temperature change (the thermocline), and a cold zone below the thermocline.

The surface waters are warm and well aerated, and suitable for warm-water fish. Trout require well aerated water at a colder temperature (below 75°F.). Such conditions are found in the thermocline region of both lakes. The region below the thermocline is cold but there is not sufficient oxygen to maintain fish life.

The water in both lakes is moderately hard; this condition is generally associated with good productivity. Hardness is an expression of the amount of dissolved mineral salts. Since plants and animals require mineral salts for their life processes, the amount of salts influences the abundance of plants and animals.

The pH of the water indicates an alkaline condition. (pH of 7.0 is neutral; below 7.0 is acid). Neutral or slightly alkaline waters are generally the most productive.

Biological Character

Biological characters include a study of the vegetation, fish food, fish, and other animals present.

Vegetation

A list of the aquatic plants and their relative abundance in Squaw and Witch Lakes is given below.

Plant		Relative abundance	
		Squaw Lake	Witch Lake
Common name	Scientific name		
Musk grass (<i>Chara</i> sp.)		...	Few
Horsetail (<i>Equisetum limosum</i>)		Rare	Rare
Duckweed (<i>Lemna</i> sp.)		...	Rare
Water milfoil (<i>Myriophyllum spicatum</i>)		...	Common
Bushy pondweed (<i>Najas flexilis</i>)		...	Few
White water lily (<i>Nymphaea odorata</i>)		...	Few
Yellow water lily (<i>Nuphar advena</i>)		...	Rare
Large-leaf pondweed (<i>Potamogeton amplifolius</i>)		Present	Present
Pondweed (<i>Potamogeton foliosus</i>)		...	Present
Pondweed (<i>Potamogeton gramineus</i>)		...	Present
Floating-leaf pondweed (<i>Potamogeton natans</i>)		Present	Present
Sago pondweed (<i>Potamogeton pectinatus</i>)		...	Present
Clasping-leaf pondweed (<i>Potamogeton Richardsonii</i>)		...	Present
Flat-stemmed pondweed (<i>Potamogeton zosteriformis</i>)		...	Present
Duck potato (<i>Sagittaria latifolia</i>)		...	Few
Tall bulrush (<i>Scirpus acutus</i>)		...	Common
Bur reed (<i>Sparganium</i> sp.)		...	Rare
Cattail (<i>Typha latifolia</i>)		...	Few

Vegetation is not prolific in either lake, but of the two Witch Lake has the larger variety and greater amount, having 18 species as compared with 3 in Squaw Lake. No single plant species seems to be abundant in either lake.

Fish Foods

Bottom food studies on Squaw Lake were entirely too inadequate to warrant comment. The sampling in Witch Lake, while more extensive than in Squaw Lake, gives little indication of fish food abundance. The only organisms found were in water deeper than 25 feet. Samples at depths of 1.5, 2, and 24 feet produced no organisms. It is unlikely that this condition is representative of the lake; it might indicate a general scarcity of bottom fauna, however.

Plankton studies on Squaw Lake, based on one sample, indicate low plankton production. (Plankton is the group name of very small, free floating plants and animals common to practically all natural waters).

Witch Lake contained a fair amount of plankton, largely animal forms. However, since plankton populations vary tremendously from time to time, this information has only general significance.

In general, the food supply in these two lakes seems scarce. Vegetation, a usual source of many food organisms, is rare. Bottom-food studies indicated a scarcity of organisms. It is, therefore, questionable whether these lakes will support a large population of insect-eating fish.

Fish

Through netting, seining, and angling, the following fish have been collected or reported for Squaw and Witch Lakes. The stocking records (total numbers) for the five-year period 1936-1940, inclusive, are given.

Fish	Squaw Lake		Witch Lake	
	Abundance	No. planted 1936-1940	Abundance	No. planted 1936-1940
GAME FISH				
Brook trout	...	...	Few	8,500✓
Lake trout	Reported	31,000	...	...
Northern pike	...	...	Few	...
Perch	Few	...	Common	...
Walleyed pike	...	...	...	1,210,000
Smallmouth bass	...	...	Common	300
Largemouth bass	...	...	Few	300
Crappie	...	...	Reported	...
Green sunfish	Rare	...	...	...
Bluegill	...	...	Rare	10,000
Pumpkinseed	Rare	...	Few	...
COARSE FISH				
Sucker	Common	...	Common	...
FORAGE FISH				
Blunt-nosed minnow	Common	...	Common	...
Golden shiner	Rare	...	Few	...
Common shiner	Rare	...	Common	...
Creek chub	Rare	...	Common	...
Iowa darter	Reported	...	Common	...
Muddler	...	...	Few	...
Northern dace	...	...	Rare	...

✓ 7,000 of these were planted in Witch Lake outlet, and 1,500 in the lake.

In lakes as large as these, it is difficult to obtain a population estimate in a few days, particularly in the fall. The estimates in the above table are based on the limited seining and netting, and reports of local people, and may not be representative of relative species abundance.

It is obvious that Witch Lake has a more varied fish population, having 8 game species as compared with 4 in Squaw Lake. Forage fish are also more varied and abundant in Witch Lake. This difference is not surprising because Witch Lake has a wider variety of habitats to accommodate more species of fish.

Growth studies on the game fish are given below.

Fish	Age group	Squaw Lake		Witch Lake	
		Number of fish	Average length (inches)	Number of fish	Average length (inches)
Brook trout	II	...	...	2	8.9
	III	...	...	2	12.6
Northern pike	I	...	...	1	14.9
	II	...	...	2	21.3
	IV	...	...	1	28.8
Perch	II	3	5.0	...	...
	III	2	6.8	2	6.0
	IV	1	7.0	3	6.7
	V	1	9.7	1	9.6
	VI	...	...	1	7.1
	IX	...	...	1	10.7
Pumpkinseed	III	1	4.5	...	...
	IV	1	6.1	...	...

These studies indicate a good growth of brook trout and northern pike in Witch Lake when compared with other lakes in this section of the state. Little can be said concerning perch and pumpkinseed growth because the data are too few.

General Discussion

Spawning facilities are adequate in both lakes for the warm-water fish. Rainbow trout might spawn successfully in the outlet. Brook trout

have spawning requirements met by few Michigan lakes. Lake trout are believed to utilize rubble bottoms in 10-15 feet of water; such conditions seem to be lacking in Squaw Lake. The past population of lake trout, therefore, was probably maintained by artificial plantings.

From the physical and chemical conditions in these two lakes, Witch Lake seems better suited to lake trout than does Squaw Lake. It has suitable spawning areas and a larger volume of cold, aerated water. Rainbow trout might spawn successfully in the outlet stream, or even to a limited extent in the inlet.

Management Suggestions

Squaw Lake

This lake is designated as an "all other" lake. Lake trout have been planted in 1938, 1939, and 1940. Some check should be made to determine whether or not this species is being restored. An experimental planting of 15,000 rainbow trout from 4 to 7 inches in length should be made just before the ice forms in the fall of 1942. A check on the success of this should be made in the spring of 1943.

Cover conditions are apparently inadequate, but no improvements are suggested at present because of the uncertainty of the lake's trout possibilities. If rainbow trout do well, additional cover may not be needed or might even be a disadvantage by encouraging warm-water fish.

Predators and parasites in Squaw Lake are few and require no control.

Witch Lake

Witch Lake is an "all other" lake but, in view of its pike and perch population, should be changed to a "pike" lake. Such a change would allow the sportsman to fish for pike and perch at a season when they are

taken more readily. Also, trout are taken more readily prior to June 25. Bass fishing need not suffer on this account; in fact, if more pike are removed, the bass may increase in number.

Since Witch Lake is presumed to have good spawning conditions for lake trout and possibly for rainbow trout, an experimental planting of 5,000 yearling lake trout from 7 to 12 inches in length, and of 10,000 legal-sized rainbow trout are recommended. Planting of trout should be done late in the fall just before ice forms. A check of the results should be made in future years. To provide food for trout, especially the lake trout, it is recommended that an attempt be made to introduce cisco. Best results would probably be secured by a transfer of adult fish. The cisco should be examined carefully for parasites before transfer.

The stocking of walleyes also seems futile in the presence of northern pike and bass. In addition, the introduction of a fifth predacious species may cause such competition for food and space that poorer growth of all would result. Also, since Witch Lake is of the trout lake type, plantings should be confined to cold-water species. The bass, pike and perch will be able to maintain their maximum populations without any planting.

The present status of the parasite problem is unknown. Predators are few and require no control. Witch Lake requires no improvement in the form of cover or spawning facilities.

INSTITUTE FOR FISHERIES RESEARCH

By E. W. Roelofs

Report approved by: A. S. Hazzard

Report typed by: R. Bauch