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A FISHERY SURVEY OF STRAWBERRY AND ZUKEY LAKES, LIVINGSTON COUNTY

by

L. Edward Perry

Introduction

Location and drainage

Strawberry and Zukey Lakes are located in south-central Livingston County, about a mile from the Washtenaw County border (Strawberry Lake: T. 1 N., R. 5 E., S. 27, 28; Zukey Lake: T. 1 N., R. 5 E., S. 21, 22, 27, 28). They are in the Huron River drainage and are part of a chain including Portage and Base Line Lakes. Strawberry and Zukey Lakes are joined by the very small lake known as "Devil's Basin." The town of Lakeland is on the north shore of Zukey Lake; Pinckney is about five miles west and Brighton, about seven miles northeast. The lakes are easily accessible by good roads from all nearby populated centers.

Acknowledgments

An outline map of Strawberry Lake was made by enlargements from AAA aerial photographs. The lake was sounded and bottom-typed on January 24-25, 1939, and given a biological inventory on July 13-15, 1939. Zukey Lake was mapped and bottom-typed on February 8-9, 1939, and given a biological inventory on July 11, 1939. Additional fish collections were made at both lakes on September 12-16, 1942. All parties were of the Institute for Fisheries Research.

Past and present use

Strawberry and Zukey Lakes are popular recreation centers in the summer. The shores have been well developed for summer homes. In 1939, the survey party estimated about 150 cottages on Strawberry Lake and

✓Personnel of survey parties:

Biological inventory party: J. W. Moffett, leader; L. D. Wesley, E. Goellner and F. Lydell, assistants.

Mapping party: F. Ames, leader; E. Moody and N. Murphy, assistants.

Fish party: P. Galvin and S. Lievens.

60 or 70 on Zukey Lake. Only one public boat livery was reported, which was on Zukey Lake. Swimming, boating and fishing are popular. The sandy shallow areas provide fine beaches. The fishing intensity is about medium in both lakes, summer as well as winter, but Strawberry Lake is generally considered to produce better fishing. Fishing in Zukey Lake is reportedly very poor. There has been little apparent change of fishing in recent years. Both lakes are best known for pan fish, although pike and bass are present.

The lakes in question are rather conveniently located and much frequented, hence the value of their sport fisheries is important, although they are not far from other more popular lakes.

Physical characteristics

Geological origin

Scott in "Inland Lakes of Michigan" describes the origin of Strawberry and Zukey Lakes to be the same as that of the Portage Lakes and Base Line Lake. This chain of lakes lies in a depression caused by the melting of a large buried block of ice left by the retreating glacier that covered this area. These four lakes and the other smaller ones of the chain occupy irregularities in this trough.

Shape of basin and extent of drainage

The basins of both lakes are irregular and defy simple description. Strawberry Lake really has two basins. It is divided near the middle by an elevation of the bottom and a small island. The east basin is 52 feet deep and the west one about 43 feet. The shore line is 1.8 times as great as that of a perfectly round lake of the same area. Although not extreme, this irregularity provides much protection from wave action, and permits a fair growth of plants in the bays and along windward shores. Strawberry Lake has rather broad shallow areas around most of the east and north shores and part of the south but very little elsewhere. The "drop-off" is sharp. Most of the shallow areas have sand bottom and the rest of the lake has a muck bottom.

The outline of Zukey Lake is more nearly circular, with a large indentation on the southeast, but the bottom is equally irregular. The greatest depth of 44 feet was found near the center of the lake. The shallow areas are very broad around all except the west shores. The bottom is sand and marl in the shallows and muck and marl in the depths. The shore line is 1.5 times that of a round lake of the same area. It does not have the irregularities of Strawberry Lake and has few protected bays which may be one reason for the broad expanses of barren sand bottom along the east side.

The two lakes are connected by a very small lake of nearly 25 foot depth, called Devil's Basin.

The drainage of Strawberry Lake includes that of Zukey Lake as well as all of the Huron River above this point. It comprises about 310 square miles of varying types of wooded areas, farm land and marshes, extending through the southeast corner of Livingston County, the northeast corner of Washtenaw County and much of the western part of Oakland County. The immediate shores of Strawberry Lake are grassy and wooded, and are generally suitable for cottages. Beyond, the countryside is hilly and wooded.

The drainage of Zukey Lake is comparatively small. It covers an area of about four square miles, including the surrounding terrain and drainage from Island and Winans Lakes on the north. The west side of the lake is mucky, but on the east conditions are more favorable for homes and cottages and here development is rather extensive. The surrounding land is hilly and mostly wooded with some farm land and marshes.

The physical features of these lakes are summarized below.

	Strawberry Lake	Zukey Lake
Area in acres	257	155
Maximum depth	52	44
Shore line development	1.8	1.5
Dominant bottom types		
Shallows	sand	sand, marl
Depths	muck	marl, muck
Color of water	slightly brown	colorless
Transparency of water (Secchi disk in feet)	9	7
Area of drainage in square miles	310	4

Water fluctuation

The rather small fluctuation in the water level of these lakes is caused by fluctuation in rainfall and drainage. There is no means of regulating the water level.

The Huron River is both the principal inlet and outlet of Strawberry Lake. It enters on the northeast side and leaves from the southwest corner. The lake also receives water through Devil's Basin from Zukey Lake and from a small stream entering from the southeast.

Zukey Lake is supplied by a stream that comes from Island and Winans Lakes and a small drainage ditch. Both enter the north side of the lake. The outlet, as already mentioned, is through Devil's Basin to Strawberry Lake and Huron River.

Temperature and chemical characteristics

Temperature

The temperature and chemical observations of these lakes are shown in the following table.

Temperature and chemical observations in Strawberry and Zukey Lakes, June 11-13, 1939

Depth (feet)	Strawberry Lake East basin				Zukey Lake			
	Tempera- ture (°F.)	Oxygen parts per million	M.O. Alkalinity parts per million	pH	Tempera- ture (°F.)	Oxygen parts per million	M.O. Alkalinity parts per million	pH
0	78	7.8	191	8.2	77	7.4	198	8.2
13	78							
16	76	7.8	190	8.2	76	7.1	190	8.2
20	72				76			
23	64				64	6.1	184	8.0
26	59	1.4	190	7.6	59			
36	50	0.0	190	7.4	49	2.0	188	7.6
39	48							
43					48	1.3	190	7.6
52	48	0.0	196	7.4				
59	47							

Both lakes had a layer of warm water at the surface and a layer of cold water at the bottom with an intervening thermocline (zone of rapid change in temperature). In Strawberry Lake the thermocline occurred between 16 and 36 feet and in Zukey Lake it was between 20 and 36 feet. The thermocline serves to isolate the cold bottom water during the warm summer weather. Observations made at other points in Strawberry Lake were found to be similar to those of the east basin which are given in the table.

Chemical conditions

Oxygen was found from top to bottom in Zukey Lake, although the amount below the thermocline was not great (1.3 to 2.0 parts per million). In Strawberry Lake there was oxygen down to about 30 feet, which is in the lower end of the thermocline. At 26 feet there were 1.4 parts per million. Since these analyses were made in June, they do not represent the extreme conditions of the summer which would exist in late July or early August. At such time the volume of oxygenless water would probably become greater in Strawberry Lake and in Zukey Lake the lower water would very probably be entirely depleted of oxygen. The large area of muck bottom (largely decomposing organic matter) is the important factor in oxygen depletion.

Both lakes have hard, alkaline water as shown by the methyl orange alkalinity and pH analyses.

Pollution

There was no evidence of pollution.

Discussion of temperature and chemical factors in relation to fisheries

These lakes have suitable water for fishes only in the upper regions. Although there is cold water at the bottom there is not enough oxygen to satisfactorily support cold-water fishes. Evidence of this is the reported annual mortality of ciscoes which prefer cold water and remain in the lower regions of the lake until there is not enough oxygen to support them. Then they either move into the warmer water or suffocate. This summer mortality is reported from both lakes. Therefore, they are suitable only to warm-water fishes, such as basses and sunfishes. The hardness and alkalinity of the water of both lakes are more or less favorable.

Biological characteristics

Vegetation

Vegetation was more abundant in Strawberry Lake than in Zukey Lake, but it was not very abundant in either. In Strawberry it extended out to a depth of 10 feet in a few places, but it generally was limited to the much shallower water on the north and south sides and around the small island in the middle. In Zukey Lake most of the marginal shallows were barren, however, a few beds of plants extended from the south side and submerged forms were thinly scattered around part of the lake along the "drop-off." A complete list of the plants collected with notes on relative abundance is given below.

List of plants and their relative abundance in Strawberry and Zukey Lakes

Common Name	Scientific Name	Relative Abundance	
		Strawberry Lake	Zukey Lake
Coontail	<u>Ceratophyllum demersum</u>		few
Swamp loosestrife	<u>Decodon verticillatus</u>	common	
Water willow	<u>Dianthera americana</u>		few
Water milfoil	<u>Myriophyllum sp.</u>	few	
Bushy pondweed	<u>Najas flexilis</u>	common	
Yellow water lily	<u>Nuphar variegatum</u>	common	
Arrow Arum	<u>Peltandra virginica</u>	common	
Pickeral weed	<u>Pontederia cordata</u>	common	
Large-leaf pondweed	<u>Potamogeton amplifolius</u>	common	
Pondweed	<u>P. angustifolius</u>	few	
Pondweed	<u>P. crispus</u>		few
Sago pondweed	<u>P. pectinatus</u>	few	few
Flat-stemmed pondweed	<u>P. zosteriformis</u>	few	
Arrowhead	<u>Sagittaria Engelmanniana</u>		few
Softstem bulrush	<u>Scirpus validus</u>	common	common
Muskgrass	<u>Chara sp.</u>	common	
Common cattail	<u>Typha latifolia</u>		few

Identifications by Betty R. Clarke.

The survey party found that plants were growing wherever the habitat was suitable in Strawberry Lake. Molar action of the sand caused by wave action was an important limiting factor in both lakes, but it is believed that the vegetation was sufficient for most needs in Strawberry Lake. The deposition of marl on plants was excessive in Zukey Lake and appeared to be the most important hindrance to their proper growth. This is a common occurrence in marl lakes of this type and the reasons and remedies are not yet known. It is granted, however, that an increase in the vegetation in Zukey Lake if this could be accomplished would certainly be beneficial and would probably increase the food supply for fish to a considerable extent.

Fish foods

Plankton (the free-floating organisms) was moderately abundant in these lakes, but it is well known that it varies considerably from time to time and place to place. Consequently a few samples are not a reliable indication of the general productivity.

Bottom food organisms were fairly abundant in both lakes, probably being more numerous in Zukey Lake than in Strawberry Lake. The predominant organisms were blood worms (chironomids), phantom midges (Corethra) and aquatic earthworms (oligochaetes). Organisms are always more abundant in plant beds where many aquatic insects live, however, in Zukey Lake plant beds were not extensive enough to greatly increase this part of the fish food supply. Undoubtedly added vegetation would be beneficial to both lakes, but the need is greater in Zukey Lake.

A fair number of forage minnows was collected from the lakes although not very abundant.

Fishes present

Fish collections were made on two occasions in these lakes. In 1939, the party was unable to obtain the desired number of fish so further collections were made in 1942. This may be evidence of the paucity of fish in the lakes. The species collected are listed in the following table with stocking records since 1934. Bluegills, smallmouth bass, largemouth bass, northern pike and pumpkinseed sunfish were the most common species taken in the nets. Fishing records tend to show that bluegills are the most popular among fishermen and provide some fair catches in Strawberry Lake. Walleye have been stocked in large numbers as fry in both lakes, but their importance to the fisheries of these lakes has not become great. Only one was caught by the most recent fish collecting party from Strawberry Lake and very few are reported caught by fishermen.

List of fish and stocking in Strawberry and Zukey Lakes

Name	Strawberry Lake		Zukey Lake	
	Presence	Stocking (1934-1941)	Presence	Stocking (1934-1941)
Game fishes:				
Northern pike	x		Reported	
Perch	x	9,000 fingerlings	Reported	15,000 fingerlings
Walleyes	x	410,000 fry	...	440,000 fry
Smallmouth bass	x	600 fingerlings	x	
Largemouth bass	x	5,500 fingerlings	x	7,100 fingerlings
Bluegills	x	104,750 fingerlings	x	77,500 fingerlings
Pumpkinseed sunfish	x		x	
Rock bass	x		x	
Black crappie	x			
Coarse fishes:				
Golden redhorse	x			
Black bullheads			x	
Yellow bullheads			x	
Green sunfish	x			
Longear sunfish			x	
Obnoxious fishes:				
Longnose gar	x		x	
Dogfish	x			
Forage fishes:				
Black-nosed shiner			x	
Mimic shiner	x		x	
Straw-colored shiner	x		x	
Spot-tail shiner			x	
Common shiner	x		x	
Lake emerald shiner			x	
Blunt-nosed minnow	x		x	
Brassy minnow			x	
Black-banded topminnow			x	
Menona killifish			x	
Log perch	x		x	
Johnny darter	x		x	
Black-sided darter	x			
Rainbow darter			x	
Northern sand darter	x			
Silversides	x		x	

Gars were found in both lakes and dogfish were caught in Strawberry. In 1942, gars were fairly common, but were not believed harmful to the game fishery.

More forage fishes were taken from Zukey Lake than from Strawberry Lake, but there is a fair number in both lakes.

Growth rate of game species

The ages of all fish collected were determined from their scales and the average sizes for each age-group are compared with the average for the state of Michigan in the table below.

Growth of game fishes in Strawberry and Zukey Lakes

Name	Age	Tentative State average length* (inches)	Strawberry Lake			Zukey Lake		
			Number of individuals	Average total length (inches)	Average weight (pounds-ounces)	Number of individuals	Average total length (inches)	Average weight (pounds-ounces)
Northern pike	I		4	18.2	1 - 6.5			
	II					1	17	14.0
Walleye	IV		1	20.2	2 - 13.0			
Perch	II	6.2	1	7.4	2.7			
	III	7.1	2	6.9	2.1			
Smallmouth bass	I	6.0	1	6.1	1.6			
	II	8.8	3	8.6	4.8			
Largemouth bass	II	8.4	2	8.9	5.9			
Bluegill	II	4.3	15	4.9	1.3	13	4.5	1.0
	III	5.6				2	4.9	1.3
	IV	6.7	1	9.5	10.3	1	6.7	2.9
	V	7.4	2	9.1	10.4			
	VI	7.8	3	9.8	12.2			
	VII	7.9				1	9.9	13.2
Pumpkinseed	II	4.4	1	5.8	2.7	1	4.0	0.7
	III	5.8				1	5.0	1.8
Rock bass	II	4.3	4	5.4	1.9	3	4.8	1.0
	III	4.9	5	7.1	4.2	4	5.5	2.1
	IV	5.6				1	6.9	3.7
Black crappie	I	5.3	5	5.8	1.8			
	II	5.9	4	9.0	7.4			
	III	8.7	4	10.3	10.4			
	IV	9.2	1	12.0	1 - 1.4			

* State averages determined by W. C. Beckman.

It was difficult to obtain a good sample of fish from these lakes, consequently, there are several age-groups that contain only one or two fish. There are enough in most cases, however, to give a fair estimate of the growth. In Strawberry Lake none of the game fish appeared to have slower than average growth and the growth of the bluegills, rock bass and black crappies were decidedly above average. In Zukey Lake

the growth of bluegills was about average, that of rock bass was somewhat above average and the pumpkinseeds were probably a little below. A state average has not been determined for northern pike and walleyes, but their growth appears to be good.

Natural propagation

The necessary spawning facilities for bass, perch and sunfish in Strawberry Lake are provided by combinations of sand, gravel and vegetation on the broad shallow areas of the north and east sides. In Zukey Lake bluegills and other sunfish use the marl shallows to some extent, but suitable areas of gravel bottom are not available and for this reason it is reported that facilities for smallmouth bass are not adequate. Pike undoubtedly spawn in the inlets of both lakes.

Management proposals

Designation of lakes

Both Strawberry and Zukey Lakes are in the "all other lakes" category which at present appears to be the most suitable.

Stocking

Stocking of all species of fish should be discontinued in these lakes. It is believed that they will produce enough fish by natural means to fully utilize the available food in the lake, and if there is any increase in the food supply there will be a corresponding increase in the number of fish by natural means.

Predators and parasites

No control of predators is believed necessary in these lakes. It has been found that predation from gars and dogfish may be more beneficial than harmful in preventing an overabundance of small fish and in destroying fish in sick or diseased condition.

The fish in both lakes were considered relatively free from parasites and no control measures are practical or necessary. The only heavy losses were of ciscoes which frequently die from lack of oxygen in late summer as mentioned above. Nothing can be done to control this mortality.

Shelter

The survey party reported the need of brush shelters in Zukey. There is not enough vegetation in the lake to give good protection to young game fish and minnows, thus the installation of artificial sheltering devices along the west and north sides would be worth while. Shelters would

probably have less value on the east side because of the stronger wave action there. Although natural shelter in Strawberry Lake is fair, additional protection is advisable. Brush shelters should be installed along the west and north sides.

Regulation of water level

No regulation is possible or necessary at present.

Improvement of spawning facilities

Spawning boxes might be added along the north side of Zukey Lake to better the spawning conditions for smallmouth bass. For other species facilities are adequate. In Strawberry Lake conditions are believed reasonably satisfactory.

Increase in vegetation

Possibly the greatest need in these lakes is an increase in the aquatic vegetation. While no method is known at present whereby this can be accomplished an opportunity is afforded here, particularly in Zukey Lake, to conduct experiments to this end. An increase in plant beds would be the surest way of increasing fish food and shelter and consequently fish.

INSTITUTE FOR FISHERIES RESEARCH

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