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cc: Fish Division
Education-Game
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REPORT NO. 665

FISHERIES SURVEY OF SHAMROCK LAKE AND DAVID LAKE, OSCODA COUNTY

by

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At the request of James A. Reed, owner and Glen Karr, caretaker of Reed's Ranch in Oscoda County, the Institute for Fisheries Research conducted a biological inventory of two private lakes located on this property. The survey was made during the period August 29-September 5, 1940 by a regular party of investigators* engaged in the study of Michigan waters.

Reed's Ranch is a very extensive tract of land utilized by the owner as a summer retreat for his family and guests. Within its boundaries lie two lakes: Shamrock and David. These lakes are used as recreational waters by the occupants and many guests of the ranch. Some swimming and boating are done on the lakes, but the main use is fishing. Angling is confined mostly to northern pike. Other species of fish in the lakes are seldom sought after. Since the two lakes are somewhat different, they will be discussed separately and a plan of management suggested for each one.

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*The party personnel consisted of Mr. Fred E. Locke, Aquatic Biologist I, party leader; Messrs. Irving J. Cantrall and Burton P. Hunt, Fisheries Research Technicians A; and Mr. Pat Galvin, Fish Cultural Aide C, assistants.

Shamrock Lake

Shamrock Lake, lies in Comins Township (T. 27 N., R. 4 E., Sec. 10, 11, 15), Oscoda County. It is approximately 6 miles east of Fairview and is reached via a private side road off highway M-72. This lake is known as Flat or Fox Lake on most maps; Shamrock being a local designation. A rather narrow fill separates it from David Lake. This fill is approximately 30 feet wide and 110 feet long. Shamrock Lake was mapped by the Institute for Fisheries Research with the aid of Mr. Karr and others during the winter of 1939-40. Information concerning stocking records and fishing history was submitted by Messrs. Reed and Karr.

The fishing on this lake has been very light as far as all species of fish found there are concerned. Pike fishing has been heaviest. Due to somewhat of a decline in the average size of the northern pike, some anxiety was felt by the owners who report that about ten years ago the lake produced pike weighing up to 10 pounds. In recent years the catch of this species has apparently been limited to an average size of about 2 1/2 to 3 pounds. Reports seem to indicate that successful spawning for the pike is difficult. Catches of this species are said to consist of dominant year groups which coincide with plantings. Following stocking, the fish caught were larger each year, but distinctly fewer in numbers. This decline in numbers is to be expected if little natural reproduction occurs.

Physical Characters

The basin of Shamrock Lake is a shallow, uniform depression 220 acres in extent, lying amid low, sandy ridges. The greatest percentage of the basin is submerged beneath water from 3-9 feet deep. A single channel-like

depression from 10-12 feet in depth is located on the east side of the lake. The main axis of this lake runs north and south. The lake is rectangular in shape and considerable sweep is offered the prevailing northwest winds. This results in heavy wave action on the east shore. The drainage area of the basin is relatively small and consists mainly of sandy, porous soils. Jack pine and scrub oak are the dominant cover plants on this drainage.

Shamrock Lake lies within the Thunder Bay River drainage, but at present does not have an outlet. Construction of the narrow fill, mentioned above, probably cut off the outlet of the lake. However, there is a 3-inch capped, steel pipe which leads under this fill. Were it open, it would act as an outlet which would drain into David Lake, a contributing part of the Thunder Bay River system. A small, almost negligible stream, with its origin in Shear Lake and flowing through mats of dead leaves and brush, enters Shamrock Lake from the west. At the time of the survey, only a few small pockets of water with no perceptible flow marked its course. It is undoubtedly intermittent during normal years.

Although the territory surrounding Shamrock Lake is sandy and porous, the water level fluctuation of this lake is negligible. It varies about 6 inches annually. Certain lakes in this vicinity have become marshes or completely dried up during the past few years because of the lowered water table. Shamrock Lake has maintained its level consistently. There is some evidence of erosion on the east shore of this lake. Otherwise the shores are encroaching and consist of rather heavy mats of vegetation. Since the lake is so shallow (maximum depth 12 feet), all of it is considered as shoal area. Were it not for the wave action on the east shore, plants could grow throughout this lake. Effective light probably reaches the bottom at all points. A secchi disc (a white disc used to measure

relative transparency) disappears from view at 9 feet. This depth is only 3 feet shallower than the deepest part of Shamrock Lake. Practically all of the bottom material in the lake is pulpy peat, with the exception of rather limited gravel and sandy shoal areas on the east shore. Some fibrous peat occurs around the plant beds. The few sandy beaches found elsewhere in the lake are very narrow and limited in extent.

The various physical characters described above are usually conducive to productivity. Shallowness of the lake basin encourages warming of the water earlier in the spring and extends the growing season somewhat. It also brings the entire basin into the zone of highest productivity since there is no stratification and stagnation of bottom waters possible. In protected coves and on the lee side of such lakes tremendous growths of plants are usually maintained. It has been the experience of fisheries investigators that most of the primary food supply of fish comes from the plant zones. Several inhibiting factors tend to condition the productive potential in Shamrock Lake. The rather large size of this lake in relation to its maximum depth allows wave action set in motion by the prevailing northwest winds to stir the entire body of water and to keep in almost constant turbulence the flocculent pulpy peat constituents of the bottom. This destroys the sharp water-bottom interface which is necessary in most cases for successful production of bottom fauna. It also discourages the formation of plant beds by destroying or constantly changing the seed bed. The east shore of this lake is swept clean of organic material and no accumulation of nutrients is possible. Consequently, rather large areas of sand and gravel result. Sand is a poor substratum for food production, especially when it is influenced by heavy waves. Gravel, on the other hand, produces considerable numbers of food organisms. It is not known how available these organisms are to fish.

As a result of the wave action and general nature of Shamrock Lake, two rather distinct types of environment are created. One, the protected, plant inhabited west portion and the other, the rather exposed sand-gravel portion of the east shore. This diversity of habitats is reflected in the location of the fish inhabitants. Smallmouth bass were noted largely near the eastern shores while largemouth bass and northern pike were most abundant on the opposite side of the lake.

Chemical and Thermal Features

Thermal and chemical characters of a body of water determine to a considerable extent the species of fish and fish food organisms which inhabit it. Fish and their food organisms have maximum, optimum and minimum temperature and oxygen ranges. By learning the characteristics of a lake or stream, it is possible to state which fish will do best in that body of water. Some forms can tolerate higher temperatures and live on less oxygen than others. Other factors of importance in fisheries work are carbon-dioxide concentration, thermocline formation, acidity and hardness of the water. Often a thermocline or region of rapid temperature change (at least 1.9° F. per 3 feet of depth) occurs in a lake. This layer separates the surface waters from the bottom waters due to differences in density (cold water is denser than warm down to temperatures of about 39° Fahrenheit). The waters under the thermocline are isolated from wind and wave action which supplies oxygen to and removes carbon dioxide from the surface water. The bottom waters often become devoid of oxygen and charged with carbon dioxide (stagnate) because of the oxidation of organic matter in them and on the bottom of the lake. In such a state, these depths are uninhabitable by fish and most fish food organisms. The thermocline is usually disrupted in the fall of the year when the water is

cooled to near freezing (39.2° F.) at which point it is heaviest and settles through the thermocline finally bringing the lake to an even temperature throughout. In this condition it is mixed from top to bottom by winds and convection currents, recharged with oxygen and relieved of its load of carbon dioxide. There is no thermocline in winter, but in spring as the ice melts, the water is warmed up to near freezing and the turn-over process is repeated. In clean, clear lakes there is generally a lack of organic matter and even though a thermocline is formed, the oxygen supply in the lower waters is not removed. In such lakes, trout can survive by retreating into these cold bottom waters when surface temperatures rise above toleration limits. Acid and soft waters (water poor in calcium, magnesium and other essential salts) are poor food and fish producers since they restrict growth of many species of plants and fish food organisms. The most productive waters are generally alkaline in reaction and contain moderate amounts of dissolved salts.

The chemical and thermal characteristics of Shamrock Lake as found at the time of the survey are given in Table 1. It should be noted that there is no thermal stratification present in this shallow body of water. There is also sufficient oxygen from surface to bottom to maintain fish throughout. Shallowness and heavy wave and current action keep the water mixed thoroughly. It becomes charged with oxygen from the atmosphere and the activities of plants and loses its excess carbon dioxide to the atmosphere. Plants also utilize some of this carbon dioxide in their food manufacture. Waters of Shamrock Lake are highly alkaline, as is shown by a pH reading of 8.4. They are also moderately hard (M.O. alkalinity range 120-122 p.p.m.).

Table 1

Chemical and Thermal Features of Shamrock Lake

Sta. No.	Depth in feet	Date	Time of day	Sky	Wind	Air temp. °F.	Water temp. °F.	Oxygen in p.p.m.*	Carbon dioxide in p.p.m.	Methyl orange alk. in p.p.m.	pH
1	Surf.	8/29/40	3:15PM	Cloudy	Breeze	72.	64.8	9.0	0.0	120.0	8.4
	3						64.4				
	6						64.0				
	9						64.0	9.0	0.0	122.0	8.4
2	Surf.	8/30/40	2:30PM	Over-cast	Breeze	71.4	67.2	...	...	120.0	8.4
	3										
3	Surf.	8/30/40	4:20PM	Clear	Breeze	78	67.5	6.35	0.0	122	8.4

* p.p.m. = parts per million.

The thermal and chemical features of Shamrock Lake are quite favorable to productivity. An abundance of oxygen at all depths and a suitable temperature for warm water fish and food production are the main contributing factors.

Biological Characteristics

The biological production of any body of water is the net result of all physical and chemical factors operative therein and on the outside. This production is dependent upon the fertility of the drainage area, the rainfall, geographic position, climate and weather, besides all of the factors operative in the lake itself. Many complex food cycles each dependent on one or more conditions culminate in the crop of fish which is of chief interest to the angler. The problems of fish production are similar in many ways to those of agriculture.

Plants are quite abundant in Shamrock Lake. There is an almost continuous belt of emergent and submerged plants around the entire west shore. Several large beds of submerged vegetation occur in the middle of the lake. These are slightly toward the west shore and run the long axis of the lake. In the accompanying table (Table 2), names, abundance and

Table 2

Higher Aquatic Plants of Shamrock Lake, Oscoda County*

Name of plant		Sta.	Density	Approximate	Depth	Bottom
Common name	Scientific name	No.	of bed	area of bed	range	type
Water milfoil	Myriophyllum verticillatum	2	Dense	100x300'	9'	Peat
Bushy Pondweed	Najas flexilis	1/4	Dense	Vast	7-9'	Peat
White water lily	Nymphaea odorata	5	Dense	10x10'	5'	Peat
Yellow water lily	Nuphar variegatum	2	Dense	100x100'	3-6'	Peat
		5	Dense	50x50'	3-6'	Peat
Pondweed	Potamogeton angustifolius	2	Dense	100x300'	9'	Peat
Floating pondweed	Potamogeton natans	5	Dense	100x100'	3-6'	Peat
Pondweed	Potamogeton strictifolius var. rutiloides	1	Dense	Vast	7-9'	Peat
Hardstem bulrush	Scirpus acutus	3	Dense	10x40'	2-8'	Peat
		4	Dense	1000x1000'	8-9	
Bladderwort	Utricularia vulgaris var. americana	2	Dense	100x300'	9'	Peat
Muskgrass	Chara	2	Dense	100x100'	9'	Peat

*Plants identified by Miss Betty Robertson, Department of Botany, University of Michigan.

location of the plants collected by the survey party are given. The pondweed, (Potamogeton strictifolius), and the bushy pondweed (Najas flexilis) are the predominant forms present. Vegetation in Shamrock Lake is certainly adequate for all the food production and cover needed by the fish population.

Plankton production in this lake was adequate when the survey was made. At this time 11.0 cubic centimeters of these tiny, microscopic plants and animals were present in each cubic meter of water. The plant plankton was predominant. It is not possible to state definitely that plankton production in Shamrock Lake is always adequate since the population varies from one extreme to another seasonally. But it is highly probable that this lake produces enough plankton to fill all the needs of

those organisms which feed on it, including the young of many fish and the adults of certain species.

Bottom food is relatively scarce in Shamrock Lake. Pulpy peat so close to the surface of the lake is kept in almost constant agitation by wave action. Repeated sampling in this material showed only an occasional freshwater shrimp, mayfly nymph or aquatic earthworm. In limited areas, phantom midge larvae (Corethra) were fairly abundant. Mayfly nymphs were especially numerous in the sand of the shoals and under rocks along the beaches. Snails, clams, midge and caddisfly larvae were also quite common. The greatest production of food occurred on the plants. Snails, fingernail clams, freshwater shrimps, flatworms, dragonfly nymphs, mayfly nymphs, and midge larvae were especially abundant in the vegetation. The bottom and plant inhabitants are quite adequate as a food supply for those fishes requiring such organisms in their diets.

Fish taken by the survey party are listed in Table 3. Seven species of game fish were caught. Of these, perch seemed to be the most abundant. Small and largemouth bass were taken in about equal numbers. It is probable that the largemouth bass is most common of the two. Bluegills, rock bass and pumpkinseed sunfish were not very abundant. The population of northern pike, if the net catches are adequate to give a rough estimation of the numbers present, were more abundant than they usually are in most lakes of this region. Only two species of forage fish were found in the lake by the survey party. These were blunt-nosed minnows and black-nosed shiners. The blunt-nosed minnow was by far the most abundant.

Table 3

Fish Taken or Reported from Shamrock Lake

Sta. No.	Station location	Gear used	Date 1940	N. pike	Yel. perch	S.M. bass	L.M. bass	Blue-gill	Rock bass	Pump-kinseed	Black nosed shiner	Blunt nosed minnow
1	NE end of lake - at boathouse	Seine	8/31	...	...	12	10	...	...	...	...	...
2	Dock - east side of lake	Seine	8/31	3	28	37	23	3	3	8	...	589
3	200 ft. S. of boathouse	Gill net	8/30	1	9	...	...	...	...	...	...	...
4	1200 ft. out from So. shore	Gill net	8/31	1	3	...	...	...	...	...	...	...
5	South end of lake	Seine	8/30	...	2	3	4	4	...	20	2	34
6	800 ft. off SW shore	Gill net	8/31	5	3	...	1	...	...	...	...	...
7	1400 ft. off SE shore	Gill net	8/30	2	9	...	...	...	...	...	...	...
8	Off point on W side of lake	Gill net	8/30	No fish								
9	900 ft. off NW shore	Gill net	8/30	...	2	...	...	...	...	...	...	...
10	Angling over most of lake	Angling	8/30-9/4	4	...	5	1	...	...	...	...	...

Growth-rate studies on the game fish taken from Shamrock Lake are given in Table 4. Although the series of scale samples is not as large as could be desired, some conjecture as to the growth of these species can be derived. The annulus, or year mark, on the scales of game fish is usually formed in the spring of each year. Consequently, fish belonging to the various age groups, as shown in the table, have had almost a complete summer's growing period since their last annulus was formed. They were collected August 30-31, 1940. Fish showing no annulus in their scales are the result of the previous spring's spawning. In other words, they have not yet spent a winter in the lake. From the results in the table, it should be noted that bluegills, pumpkinseed sunfish and rock bass are represented only by yearling or less than yearling specimens. These

Table 4

Growth-rate Studies of Fish from Shamrock Lake.
(All specimens taken Aug. 30-31, 1940)

Name of fish	No. of fish	Age Groups 0 Total length inches	0 Wt. in oz.	I Total length inches	I Wt. in oz.	II Total length inches	II Wt. in oz.	III Total length inches	III Wt. in oz.	IV Total length inches	IV Wt. in oz.	V Total length inches	V Wt. in oz.	VI Total length inches	VI Wt. in oz.	VII Total length inches	VII Wt. in oz.	VIII Total length inches	VIII Wt. in oz.
Bluegills	4	1.45	0.02	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pumpkinseed	8	...	...	3.4	0.4	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rock bass	1	1.6	0.35	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	3	...	...	3.8	0.65	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Largemouth bass	3	2.8	0.21	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1	...	...	...	...	...	...	13.0	19.0	...	...	...	...	...	...	...	...	...	...
	1	...	...	...	...	...	...	...	...	...	...	18.1	54.0	...	...	...	...	...	...
Smallmouth bass	11	3.0	0.24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1	...	...	6.8	0.35	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	2	...	...	...	...	...	...	13.5	23.5	...	...	...	...	...	...	...	...	...	...
	1	...	...	...	...	...	...	...	...	15.5	39.0	...	...	...	...	...	...	...	...
	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20.0	75.0
Yellow perch	12	2.9	0.17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	24	...	...	5.8	1.2	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	3	...	...	...	...	7.2	2.55	...	...	...	...	...	...	...	...	...	...	...	...
	5	...	...	...	...	...	...	8.3	3.5	...	...	...	...	...	...	...	...	...	...
Northern pike	3	7.9	1.6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	1	...	...	16.5	15.0	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	5	...	...	...	...	...	...	23.75	46.4	...	...	...	...	...	...	...	...	...	...
	4	(one was 32 1/4" long and weighed 7 lb., 2 oz.)								26.5	70.5	...	...	...	...	...	...	...	...
	2	...	...	...	...	...	...	...	...	...	...	25.7	57.0	...	...	...	...	...	...
	1	...	...	...	...	...	...	...	...	...	...	...	...	25.0	51.5	...	...	...	...

Age determinations by W. C. Beckman.

results do not give any indication of how these fish grow in later years, but it can be ventured that they are growing at a rate slightly below average. Both large and smallmouth bass are growing somewhat faster than such fish from other lakes of the region. One largemouth in its sixth summer was 18 inches long and weighed 3 pounds, 6 ounces. The largest smallmouth bass taken was in its 9th year, 20 inches long and weighed 4 pounds, 11 ounces. A rather good series of yellow perch scales shows that this species reaches legal length (6 inches) early in its 2nd year. The oldest perch taken were in their 4th summer. They averaged 8.3 inches in length and 3.5 ounces in weight. Northern pike were found to be growing quite satisfactorily. Some irregularity in the older age groups will be noted in the table. This is due to the small samples and also to the fact that when pike get to be about four years old they grow rather irregularly and the year marks are difficult to identify. To illustrate this irregularity, it will be noted that four specimens in the IV age group averaged 26.5 inches in length and 3 pounds, 9 ounces in weight. However, one of these specimens was 32.25 inches long and weighed 7 pounds, 2 ounces.

Shamrock Lake has been stocked by its owners since no state-reared fish are available for private lakes. From 1934 to 1938 the following fish were introduced into this lake:

1934 - 300 smallmouth bass - 6-8 inches
1935 -2000 northern pike - 12-15 inches
1935 -1000 bluegills - fingerlings
1935 -1000 largemouth bass - 2 inches
1936 -1000 smallmouth bass - 2 inches
1937 -2000 northern pike - 14-18 inches
1938 -1000 largemouth bass - 2 inches
1938 - 200 adult yellow perch.

Spawning facilities for the game fish present in Shamrock Lake are adequate to maintain the population despite much heavier fishing than this lake usually has. There may be some doubt that the northern pike grounds are adequate. However, young of the year were taken by the survey party as will be noted from the table on growth rates. The following tabulation illustrates the type of spawning ground preferred by the various species of game fish.

Species	Spawning ground	Availability
Perch	Plants and brush	Adequate
Largemouth bass	Roots of vegetation	Adequate
Smallmouth bass	Gravel and rubble shoals	Adequate
Rock bass	Gravel and rubble shoals	Adequate
Pumpkinseed, bluegills	Gravel and sandy shoals debris and mud mixed	Adequate
Northern pike	Marsh areas, usually on tributary streams	Probably adequate

Management Suggestions

1. The stocking of any game or forage fish in Shamrock Lake is not necessary. Natural reproduction and the general productivity of this lake are more than ample to furnish a population which will be on the increase despite the angling which is done. Additions of northern pike will not be necessary even though it is possible that these fish have limited opportunity to spawn. If the suggestions below are followed, ample spawning facilities will be furnished this species. The northern pike population can never be expected to enlarge greatly. Since these fish are carnivorous, only a limited number of them can grow satisfactorily in any population. The same is true to a lesser extent with the large- and smallmouth bass.

2. It is recommended that Shamrock and David lakes be joined. This process would require raising the level of David Lake by adding slash boards to the dam until the level of Shamrock Lake is reached. Then the two could be joined. If the cut is made without adjusting these levels, some damage might result from the rather sudden lowering of Shamrock. It will be necessary to construct a concrete culvert about six feet deep across the present barrier between the two lakes. At the head of the culvert, i.e., on the Shamrock Lake side, a provision for adequate slash boards or gates should be made so that water in Shamrock Lake may be controlled in the event that the dam on David Lake should give way or need repair. Furthermore, it might be advantageous to separate the two lakes in the future for some unforeseen reason. Enough space should be left between the top and sides of the culvert so that boats can pass from one lake to the other.

3. Parasites and predators. Mergansers and turtles were observed during the survey. No special control measures are recommended other than those already in use (turtle traps). The abundance of these predators is not great enough to warrant further control measures. Parasites were present in all of the game fish. However, their numbers were insufficient to need control. Neascus or black-spot was present on northern pike, large- and smallmouth bass and perch. Clinostomum (yellow grub) occurred in the perch but very lightly. Proteocephalus, the bass tapeworm, was present in all bass but was not hampering their reproduction. None of these parasites mentioned are harmful to man even if they were eaten raw. Cooking eliminates all possible danger of infection from any known fish parasites.

4. Cover and vegetation are abundant enough in Shamrock Lake.

5. Improvement of spawning facilities. Spawning areas are extensive enough for all game and forage fish present in the lake. By the joining of Shamrock and David lakes, opportunity for the northern pike to migrate into the vast tangle at the head of David Lake will be made. Successful spawning of this species should occur there. Forage fish found in David Lake will have access to Shamrock and should increase the stock of minnows.

It is believed that Shamrock Lake is producing a fish crop equal to its rather high productive capacity. The lake could stand much heavier fishing pressure than is now being applied. Diversification of the fishing effort is suggested. Fishing for one species almost exclusively only tends to allow the others to increase. These represent the greatest part of the possible fish crop. More bass and perch should be removed each year than northern pike.

David Lake

David Lake is separated from Shamrock Lake by an earth fill about thirty feet wide and one hundred and ten feet long. It lies to the northeast of the latter. This lake was surveyed immediately following the survey of Shamrock Lake. The map used in the survey was made while the survey was in progress.

The present Lake David has evolved through several stages of small ponds and lakes. Previous to 1936 several beaver dams, lying within the area now covered by water, impounded small bodies of water. During 1936 a one acre pond was formed by a small earth fill at the present dam site. In 1937 the fill was increased to make approximately 8 acres of impounded

water. In 1939 the present dam was installed. At first an 8-foot head of water, or two-thirds the present level, was maintained. Later in 1939 a 12-foot head was maintained until fall, when the level was lowered one foot to facilitate removal of brush during the winter. By the spring of 1940 the present water level was reached where it has been maintained.

There has been no fishing in this lake since its development.

Physical Characters

Lake David was formed by damming the lower end of a narrow valley through which a small creek flowed. Its basin is therefore long and narrow with a rather irregular shore line. Broad bays, with a finger of land between them, project to the southeast and southwest. Near the north end, a narrow channel runs from the west side of the lake to a fill separating Lakes David and Shamrock. The basin slopes rather gently and beginning with a depth range from 8 to 12 feet, adjacent to the dam, becomes progressively shallower towards the south end where depths of only 2 and 3 feet are found. The only sudden drop-offs result from what were at one time the banks of the small stream flowing through the valley.

Practically the entire basin was formerly clothed with a typical cedar swamp which had been cut away, except for the south end, prior to flooding. Thus, stumps, deadheads, snags and brush occur in profusion throughout the basin. Detritus left by beaver and old beaver dams, which formerly occupied this valley, is strewn about the floor of the lake. The southern third of the lake is occupied by a dense, dead cedar swamp of which the western half still stands and the eastern half has been cut over to about the present level of the water. It is virtually impossible to navigate this area.

The immediate area about the lake is composed of sandy, gravelly, porous, low-lying hills partially covered with typical scrub oak - jack pine succession.

Flat Creek, two feet wide and 6 inches deep, originates about one-half mile to the south of David Lake. It has a rather rapid flow. Lake David occupies a portion of its channel. During the spring floods, it arises in swamp-like Island Lake, although at the present time the stream is entirely spring fed. Flat Creek, in its lower reaches, flows into the upper South Branch of the Thunder Bay River.

An earth-fill dam, 450 feet long, 16 feet high and wide enough to support a roadway, forms the north shore of the lake and maintains a constant water level in the lake. A 4-foot wide concrete spillway, constructed near the middle of the dam, is equipped with slash boards to facilitate regulation of the water level.

David Lake has an area of 75 acres and a maximum depth of 12 feet. Since vegetation grows in the deeper portions of this lake and since the lake is relatively shallow, the entire area is considered as shoal. With the exception of a narrow belt of sand (0-10 feet wide) adjacent to the shoreline, the entire basin is covered with detritus and poorly decomposed fibrous peat. This soil is generally rather deep but at some points it is so thin that the underlying sand is apparent. Water in this lake is brown in color. It is also somewhat turbid (Secchi disc reading 5 feet) due mostly to suspended organic matter and plankton.

Practically all of the attributes referred to above tend to enhance the productivity of this body of water. The newness of the bottom soils has caused a rise in production. This phenomenon has been observed in other artificial lakes in this state and elsewhere. Shallowness encourages plant growth in the protected areas of the lake although it may induce limited production in places where wave action is fairly constant and heavy. The narrowness of the basin of David Lake minimizes wave action somewhat. Irregularity of the shoreline results in many protected coves which foster plant and food production.

Chemical and thermal attributes of Lake David as found during the survey are shown in the following table (Table 5).

Table 5

Chemical and Thermal Conditions in David Lake as Found During the Survey

Sta. No.	Depth in feet	Date	Time of day	Air temp. °F.	Water temp. °F.	Oxygen in p.p.m.*	Carbon dioxide in p.p.m.	Methyl orange alk. in p.p.m.	pH
1	Surf.	8/31/40	9:50AM	71.6	68.7	7.25	1.0	148	8.0
	3				66.9				
	6				65.7				
	9				65.5				
	11				64.8	5.95	4.0	156	8.0
2	Surf.	9/3/40	8:00AM	62.0	50.0	5.45	2.0	155	7.8

* = parts per million.

Significance of chemical and thermal factors in fisheries work has been discussed in the report on Shamrock Lake and need not be repeated here. Interesting features of the above table are the apparent lack of thermal and chemical stratification, the moderate hardness of the water and the high alkalinity which prevails at all depths. Water temperatures recorded in the table are quite low. They are within the toleration range of trout. However, it is suspected that this condition is due to rather cold, rainy weather during the survey. Excepting the limited deep water area directly in front of the dam, it is quite certain that water temperatures rise above the trout range during mid-summer.

All of the chemical and thermal characteristics of this lake are favorable to production of fish and fish foods. There is plenty of oxygen at all depths to maintain fish life during the open water period. Alkalinity and hardness of the water encourage plant growth, aid food production and buffer most excesses of acidity which might arise from

rapid decomposition of the debris in the bottom. There is some danger of winter kill during years of extended cold and deep snow cover. Blanketing of the lake with snow and cutting out light from plants (chiefly plankton) might result in the removal of oxygen from the water by decomposition of organic materials and respiration of animals and plants to a point where survival of fish would be impossible. If it is found that this has not occurred during the winter 1940-41, there is little likelihood that it will happen when less snow is present. However, further bottom filling and aging of the lake might sometime introduce conditions which are favorable for winter kill.

Biological Features

Vegetation is abundant in Lake David. All three types, i.e., emergent, submerged and floating are well represented as can be seen from Table 6. Smartweed, pondweeds and duckweed were the most abundant floating types. Submerged vegetation consisted mainly of bladderwort and pondweeds. Emergent plants were confined mostly to a very narrow belt adjacent to the shoreline. Plants in David Lake are certainly adequate.

Plankton (small microscopic plants and animals living free in the water) samples taken at the time of the survey indicate a rather high production of this potential food supply in Lake David. An average of 52.0 cubic centimeters of plankton for every cubic meter of water was present at the time of the survey. Plant forms dominated this population. One series of plankton samples is insufficient to give a true picture of the crop throughout the year. However, it is believed the plankton in this lake is high and quite adequate as a food supply for young fish and other plankton feeders.

Table 6

Higher Aquatic Plants[1] of Lake David, Oscoda County

Name of plant		Sta. No.	Density of bed	Approximate area of bed	Depth range	Bottom type
Common name	Scientific name					
Waterweed	Anacharis canadensis	1	Dense	50x100	1½'-3'	Fibrous peat, sand
Watershield	Brasenia Schreberi	1	Sparse	10x10	2'-3'	Fibrous peat
Star duckweed	Lemna trisulca	1	Dense	Vast	0	
Lesser duckweed	Lemna minor	1	Dense	Vast	Surface	
Yellow water lily	Nuphar advenum	1	Dense	15x20'	1-3'	Sand
Smartweed	Polygonum natans forma genuinum	1	Dense	Vast in center of lake	5-7'	Fibrous peat
Pondweed	Potamogeton foliosus var. marcellus	1	Dense	Vast	2-10'	Fibrous peat
Floating brownleaf	Potamogeton natans	1	Dense	Vast	3-10	Fibrous peat
Flat-stemmed pondweed	Potamogeton zosteriformis	1	Dense	Vast	3-6'	Fibrous peat
Wapato	Sagittaria latifolia	1	Sparse	2x2'	1'	Sand
Big duckweed	Spirodela polyrhiza	1	Dense	Vast in unprotected areas	Surface vegetation	
Cattail	Typha latifolia	1	Dense	2x20'	1'	Sand
Bladderwort	Utricularia vulgaris var. americana	1	Dense	Vast	2-10'	Fibrous peat
Northern wild rice	Zizania aquatica var. angustifolia	1	Dense	20x50'	1-2'	Sand

[1] = Identifications by Miss Betty Robertson, Department of Botany, University of Michigan.

Bottom organisms were quite abundant in David Lake. Samples of sand taken in shallow water from 1 to 2 feet in depth were rich in mayfly nymphs and midge larvae. Snails were numerous on plants taken with the sand samples. Scuds, water mits and various fly larvae were present in more limited numbers. Many crawfish were seined along the shores. Fibrous peat

harbored a fair population of phantom midge and regular midge larvae. Masses of plants were found to be rich in dragonfly nymphs, midge and other fly larvae. Scuds (fresh-water shrimps), snails and fingernail clams were abundant. Adult beetles and leeches occurred in lesser numbers. The bottom fauna of Lake David is adequate to support a rather large population of fish.

A list of the fish found in Lake David by the survey party is given in Table 7.

Yellow perch, pumpkinseed sunfish and rainbow trout were the game fish present. Perch were the most abundant. Pumpkinseeds were taken as small fish during seining operations. No adults were caught. Common suckers were quite prevalent in this lake. Of the forage fish captured, sticklebacks were encountered most frequently. Fat-head minnows were next in numbers represented in seine hauls. There is a greater variety of the forage fish species in Lake David than in Shamrock.

Stocking of this lake during 1938-40 consisted of the following lots of fish:

1938 -	5000	fingerling perch
1939 -	500	fingerling smallmouth bass
1939 -	500	fingerling largemouth bass
1940 -	500	fingerling rainbow trout
1940 -	12	mature smallmouth bass
1940 -	24	small rock bass.

Of these, perch, and rainbow trout were the only species evident in the catches of the party. It is almost certain that the trout taken were not from the lot stocked in 1940. That pumpkinseed sunfish were taken in the nets but were never stocked, as such, in the lake is interesting. They probably entered the lake as contamination in some lot of fish previously stocked or they may have been inhabitants of the ponds inundated when the present lake was formed.

Table 7

Fish Taken from David Lake by the Survey Party, September 2-4, 1940

Sta. No.	Station location	Rainbow trout	Yellow perch	Pumpkinseed sunfish	Common sucker	Brown bullhead	Fine scaled dace	Red bellied dace	Black nosed shiner	Fathead minnow	Mud minnow	Iowa darter	Brook stickleback
1	600 ft. S. of boathouse and off west shore	1	5	...	4	...	...	...	...	...	...	...	...
2	500 ft. S. of dam--off east shore	1	22	...	1	...	...	...	...	...	...	...	...
3	Across east arm of lake	...	2	...	...	1	...	...	...	...	...	...	...
4	Off E. shore, midway along N-S axis of lake	...	17	...	1	...	...	...	...	...	...	...	...
5	Off shore, S. of E. arm of lake	...	...	...	...	...	17	5	...	6	...	5	148
6	Fill between David and Shamrock	...	1	1	...	...	9	35	...	18	7	...	116
7	Boathouse - E. end of dam	...	4	9	...	...	12	20	6	168	3	3	66
Totals		2	51	10	6	1	38	60	6	192	10	8	330

Growth rate studies made on scales of fish collected from this lake reveal some rather startling results. Two rainbow trout found to be in their third summer of life averaged 9.6 inches in length and 7.8 ounces in weight. Thirty-nine perch in their first summer, therefore not yet a year old, averaged 5.3 inches in total length and 1.2 ounces in weight. Twelve specimens in their third summer had an average total length of 10.5 inches and averaged 9.4 ounces in weight. Such growth is rapid. Usually it takes rainbow trout about 4 summers to reach 10 inches in natural waters. Perch are generally in their third or fourth summer when they reach legal size in most of the lakes of this state. A growth rate such as was found in Lake David is truly exceptional. Age determinations on these fish were made by W. C. Beckman of the Institute staff.

Natural spawning facilities for all warm-water fish in David Lake are entirely adequate. Northern pike, if allowed to migrate from Shamrock, should find ample grounds in the vast tangle at the south end of the lake. Whether rainbow trout can utilize the stream which feeds this lake is not known. If the stream is rapid and has a gravel bottom in places, it should be suitable.

Practically every biological attribute of David Lake is indicative of an unusually high productivity. These evidences bear out the statements concerning the physical and chemical features of the lake. The rich growths of vegetation, numerous brush piles and deadheads make this lake well suited for perch, largemouth bass and perhaps bluegills. Smallmouth bass will probably not do well in David Lake because of the lack of extensive rubble and sand shoals.

Management Suggestions

1. Considering the carrying capacity of Lake David and the evident growth and increase of game fish now present, no further stocking with any

species is suggested. If this lake is connected with Shamrock, additional species will be added which should complete the association of desirable species. Further stocking of trout is believed inadvisable since the water probably gets too warm in summer for them. Competition with a large and rapidly growing perch population would also tend to hasten their failure.

2. No additional cover is necessary.

3. Parasites and predators, although present, are not numerous enough to require any control.

4. Connection of this lake with Shamrock as described in the report on the latter is recommended. This will raise the level of David Lake one foot and should decrease the likelihood of winter-kill there. Furthermore, deeper water will tend to reduce excessive growths of submerged plants; increase the navigable water in the lake and create more shoal areas for food production. Grounds thus flooded should be cleared of most terrestrial growths before the water is allowed to rise.

5. This lake should be fished heavily. Perch, especially should be removed to avoid overcrowding and consequent stunting when the population becomes too large for the available food supply. Introduction of predatory species of fish, such as northern pike and largemouth bass, will tend to hold in check the perch population. Largemouth bass would prosper well on the forage fish population and might also help to reduce the young perch crop produced each year.

INSTITUTE FOR FISHERIES RESEARCH

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