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December 19, 1939

REPORT NO. 571

A SURVEY OF THE MUSKEGON RIVER AND ITS TRIBUTARIES FROM HOUGHTON LAKE DOWNSTREAM TWELVE MILES

by

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The Muskegon River arises in Higgins and Houghton lakes in Roscommon County, Michigan. It flows 227 miles from Houghton Lake to Lake Michigan in a southwesterly direction. The fall of the river over this distance is about 559 feet. Most of this fall occurs in the lower three-quarters of the river. The upper reaches, from Michaelson to Houghton Lake, slope much more gradually, averaging 1.1 feet per mile. The river drains an area of around 2,663 square miles.

The Muskegon was formerly used for extensive logging operations. Lumbering flourished from about 1850 to 1900. Since that time it has declined until, at present, only few occasional recoveries are made of stranded "deadheads" which make the river somewhat hazardous for navigation by small boats. Soils in the upper portion of the drainage are poor in quality and consequently, the land is not developed agriculturally. Since all of the timber has been removed, this land is practically worthless except for the production of wildlife and timber.

A very comprehensive study of the physical features of the river as concerns navigation, flood control, power development and irrigation was published in 1931 as Document No. 143, 72D. Congress, 1st. session, House of Representatives, U. S. A. The work was prepared by and is obtainable from the War Department. The reader is referred to this publication for additional, more detailed information on the entire river system.

Development of a duck marsh and lake on the upper end of the Muskegon River, flooding the 11 miles of river from a point where the old Pennsylvania Railroad grade, which ran to Michaelson during lumbering days, (T23N, R5W, S25) crosses the river to the county road crossing in Sec. 4, Lake Township, Roscommon County (T23N, R4W, Sec. 4) is a project of the Game Division, Michigan Department of Conservation. An 8 foot concrete and slash board dam is under construction and the old railroad grade is being used as a retaining dam in connection therewith. The Fish Division sent a survey party to inventory this portion of the stream and its tributaries as they are at present and to attempt a prediction from data obtained as to the suitability of the proposed lake for fish.

The personnel of the party consisted of four members: James W. Moffett, leader; L. D. Wesley and K. E. Goellner, biologists and Frank Lydell, assistant. The party spent 14 days, August 15-30, 1939, on the area but was impeded considerably by inclement weather.

Sections were established along the stream and divided into stations. Their precise location is shown on the accompanying map of the area. Numbering of stations and sections proceeded upstream. Due to lack of suitable roads, the river and its tributaries were negotiated by boat. Physical and biological observations were made at all stations but chemical analyses of the water were made only at points where the streams changed characteristics, received a tributary, or were worked on different days. These observations included, as physical: temperatures of air and water, average width and depth of the stream, current velocity and volume of flow, color and turbidity of the water, types of stream bottom, condition of pools and riffles, weather conditions and relative abundance of shade and cover. Under chemical observations were included tests for amounts of oxygen, carbon dioxide, carbonates and bicarbonates (methyl orange alkalinity) in the water and pH (acidity or alkalinity) of the water. Biological observations consisted of counts and volumetric measurements of organisms in quantitative bottom samples; quantitative plankton samples; qualitative plant and fish collections. The results of these observations are tabulated and will be discussed later.

The basin in which this proposed lake will be formed is flat and low-lying. At present, it is covered, for the most part, by marsh grasses, small patches of shrubbery and on the higher places, by second growth timber. The predominant soil which will constitute the lake bottom is of plant origin and can be designated as peat. Feeding this lake will be a drainage area of about 269 square miles, of which 46.2 square miles are lake surface now in existence. The Muskegon River and its tributaries meander through the low-lying meadows and are usually quite sluggish in flow. The water table in the river bottom ranges from the soil surface in early spring down to about one foot in early autumn. Periodic rains fluctuate this water table between these limits during average years. During the period of study the volume of water flowing past the dam site was 181.17 cubic feet per second. Water volumes at other stations on the main river and on tributaries are given in Table 1. Records of volume at the dam site taken by the Game Division show a fluctuation of over 1100 c.f.s., seasonally. They record 89.4 c.f.s. on June 30, 1937; 413.6 c.f.s. on November 18, 1937 and 1218.2 c.f.s. on March 26, 1938. These records are not sufficient to establish an average rate of discharge for this portion of the river but they do indicate the probable range of seasonal fluctuation.

Table 1. Physical and Chemical Data on the 12 Miles of
Muskegon River From the Dam Site Near Reedsburg
To Houghton Lake, and Its Tributaries

Name of Stream	Section No.	Station No.	Date - August 1939	Time of Day	Air Temperature °F.	Water Temperature °F.	Sky	Oxygen - parts per million	Carbon dioxide parts per million	Phenolphthalein alkalinity - ppm.	Methyl Orange alkalinity - ppm.	pH	Average Width in feet	Average Depth in feet	Velocity in feet per second	Volume in cubic feet per second
Muskegon River	I	1	23	2:30P	76	68	Clear	6.9	3.0	0.0	89	7.8	61	2.2	1.5	181.17
" "		2	23	12:45P	63	65	Clear		No Chemistry				...	3.1	...	...
" "		3	23	11:00A	63	65	Clear	6.4	4.0	0.0	87	7.6	...	2.7	1.0	...
" "	II	1	23	9:30A	63	65	Clear		No Chemistry				...	2.7	...	...
" "		2	22	5:25P	73	70	Clear		No Chemistry				...	2.4	0.7	...
" "		3	22	4:00P	76	70	Cloudy	7.8	2.0	0.0	98	7.9	80	3.0	0.8	172.80
" "	III	1	22	1:45P	71	70	Cloudy		No Chemistry				...	3.5	0.3	...
" "		2	22	11:00A	66	67	Clear	7.6	0.0	4.0	96	8.0	...	2.0	...	...
" "		3	18	3:45P	85	81	Cloudy	8.3	0.0	7.0	105	8.2	...	2.8	0.7	...
" "	IV	1	18	2:00P	83	79	Cloudy		No Chemistry				120	2.3	0.6	...
" "		2	18	11:00A	83	77	Clear	7.6	0.0	6.0	95	8.2	123	2.4	0.6	159.40
Haymarsh Creek	I	1	26	5:15P	68	63	Cloudy		No Chemistry				14	1.5	0.8	15.12
" "		2	26	2:00P	78	63	Cloudy	4.1	15.0	0.0	72	6.8	17	0.6	1.4	12.85
Dead Stream	I	1	25	4:00P	72	67	Cloudy		No Chemistry				...	...	...	...
" "		2	25	1:30P	69	63	Cloudy	5.8	8.0	0.0	77	6.8	52	2.4	0.4	44.92
" "	II	1	25	10:30A	69	54	Clear		No Chemistry				47	1.2	0.7	...
" "		2	24	4:15P	76	65	Cloudy	6.3	4.5	0.0	95	7.4	39	1.0	1.1	38.61
Coal Creek	I	1	25	11:25A	73	55	Clear	2.2	12.0	0.0	42	6.8	12	2.1	0.4	9.07

Log runs in former years have gouged the stream banks considerably and have aided current action in causing a rather uniform, sandy bottom. Removal of timber has probably accelerated erosion and filling of the river basin, but the general gradient is so gentle that erosion is not a potent factor. Remains of boom logs, piles and slash can be seen along the river course and one old dam remains at Michaelson. This dam is non-functional, impounding no water whatsoever. The logs and piles have been instrumental in forming some pools and in accumulating considerable debris in certain areas. Since currents and velocities in this river are rather slow, (see Table 1), riffles and pools are not too well defined. This is especially true in the Dead Stream. From the mouth of the Dead Stream down to the dam site along the main river, the fall is somewhat faster and riffles composed of sand are usual in stretches between pools at the bends of the meandering channel. Bottom materials on these riffles are generally bound by plant growths. Muck and peat occur in the pools but the current in some is sufficient to sweep them clean of this flocculent material, leaving a sand-muck combination in the bottom. In rare cases, the sand is swept away and clean clay hardpan is exposed. Lake conditions persist in the river from Houghton Lake to the county dam, a low, adjustable structure used to regulate the level of Houghton Lake. This dam is passable by fish. In Dead Stream, Coal Creek and the lower end of Haymarsh Creek accumulations of muck and sand are the predominant components of the bottom. The rate of flow in these waters is too slow to wash the sand clean or even cause it to shift in any appreciable amounts.

Shade conditions are rather poor, that is, at present. In areas where shade had been plentiful, removal of trees in preparation for flooding has laid the stream open to the sun. Naturally, shade always was lacking from most of the stream because the surrounding peaty grass lands were probably not suited to tree growth. In the headwater areas of the Dead Stream, Coal Creek and Haymarsh Creek, shade is abundant. These streams are lined on their banks with willows and alder. In a few places second growth forests reach the banks. These headwaters also have some gravel and shifting sand as bottom types.

Cover is generally adequate throughout the stream and its tributaries. With the exception of the stretch between county dam and Houghton Lake (Section IV on map), submerged logs, tree roots, undercut banks, overhanging grasses and aquatic plant beds afforded plenty of shelter. Water depth in the pools and in most places on the riffles is sufficient to act as cover (see Table 1 for average depths). In section IV, cover consists mainly of plant beds which line the banks.

The color of the waters in this area range from deep brown to "white" or colorless. As the river flows out of Houghton Lake, it is white and continues as such until the junction with the Dead Stream is reached. Following the mixing of these two streams the water is colored brown and remains so to and beyond the dam site. Dead Stream water is deep brown, being surpassed in color intensity only by Coal Creek. Haymarsh Creek is light brown and about the same shade as the river at the junction of the two.

Turbidity measurements made cannot be used as an index of this characteristic because of color in the water and its filtering effect upon light. Some slight turbidity due to suspended organic matter was observed following three days of heavy rain; otherwise the water in the stream system would be considered clear.

Water and air temperatures taken during the survey of the Muskegon River and its tributaries are given in Table 1. Houghton Lake exerts considerable influence on the river temperature. It will be noted that in Section IV, stations 1, 2, and in Section III, station 3, which are just below the lake, water temperatures average about 5°F. colder than the atmosphere. Beyond the junction with the Dead Stream the river runs somewhat cooler. The Dead Stream is fairly cool and supports trout in its upper reaches. Coal Creek is cold and probably is trout water throughout its length as far as temperature is concerned. Haymarsh Creek maintains a fairly even temperature throughout that portion of it which was surveyed. Maximum water temperatures are probably not represented in Table 1, unless it be in the case of Stations 1 and 2 of Section IV. Adverse weather conditions kept the atmosphere and waters cooled considerably during the period of this survey. All of the tributaries are reported to be good trout water as regards temperature in their upper ends and temperatures recorded in Table 1 for these streams seem to support this assertion.

Results of chemical analyses of water in this part of the river and its tributaries are given in Table 1. The waters under consideration are interesting chemically in that they tend to be diverse in characteristics. Examination of the table referred to will illustrate this diversity. Waters in Section IV were very similar to Houghton Lake water. They contained no measurable carbon dioxide, plenty of dissolved oxygen for fish and were moderately soft. The alkalinity was high as shown by a pH of 8.2. After mixing with water from Dead Stream, the chemical nature of the river was changed. Carbon dioxide became evident and in general the oxygen content was lowered a little and the water became slightly softer. The pH was 7.9, considerably lower than it was above the junction. Haymarsh Creek also influences the river chemically but is not large enough to have a profound effect. It might be called to attention that the pH of the river water drops to 7.6 below the mouth of Haymarsh Creek. Other factors remain about the same.

In the case of Dead Stream, it is noted that the water was charged with as much as 8.0 parts per million of carbon dioxide (a concentration not lethal to fish). Oxygen dissolved in the water was never as high as that in the main river but was higher above the mouth of Coal Creek than below. Methyl orange alkalinity ranged between 77 and 95 parts per million, which indicates that this water is moderately soft. The reading of 95 parts per million is from the upper part of the stream above the mouth of Coal Creek. A pH reading of 6.8 below the mouth of Coal Creek as compared with 7.4 above, shows the influence of this tributary on Dead Stream. It should be indicated that in the pH scale of acidity and alkalinity, 7.0 is the neutral point where water is neither acid nor alkaline. Anything above 7 is regarded as alkaline and anything below as acid. Hence, the waters of Dead Stream were changed from the alkaline side to the acid side after they were mixed with additions from Coal Creek.

From the analysis of waters of Coal Creek, it is important that in the lower end of this stream, oxygen content was very low (2.2 parts per million). Under <u>certain</u> conditions this might be insufficient to maintain fish life. Carbon dioxide was present in rather high concentration, especially for a stream, but was probably not lethal for fish. The water was quite soft, showing a methyl orange alkalinity of 42 parts per million, which was just half the amount present in the main Muskegon at its source in Houghton Lake. This stream hada pH of 6.8, slightly on the acid side in its reaction.

Haymarsh Creek contained just enough oxygen to be ~~xxxxx~~ above the danger point for some fish. It had the highest carbon dioxide content of any waters from this drainage which were tested. However, it was not found to be as soft as Coal Creek. A pH reading of 6.8 classified it as an acid water stream, at least, at the time of the survey.

The significance of pH and methyl orange alkalinity in biological productivity is only important over wide ranges. However, it is generally accepted that productivity tends to be greater if the pH is above 7.0 and the content of methyl orange alkalinity (lime and other mineral salts) is not below 50 parts per million. Many exceptions to this statement could be cited, but it is intended only as a general guide in the evaluation of chemical characteristics of these waters.

Biologically, the waters of Muskegon River included in this survey are quite productive. This is especially true when speaking of the sections above the Dead Stream junction. Table 2 presents the findings in bottom samples and examination of the results will add support to the assertion. Most of the volume recorded was made up of fingernail clams. These small Mollusca were quite abundant and, excepting midges, the most numerous form taken. Mayflies, caddisflies, other Diptera, fresh water shrimps and beetles follow in sequence of numerical dominance. Interesting and important in these results is the correlation between bottom type and quantity of food produced per unit area. One sample, in the upper waters of Dead Stream (Section II, station 2), where gravel and sand constitute the bottom, had the phenomenal volume of 10.6 cc. per square foot. Those areas of muck and sand mixtures which were sampled had volumes ranging from 0.1 to 6.9 cc., which average about 2.2 cc. per square foot. Samples from shifting or clean sand had volumes ranging from 0.0 to 0.2 cc. Most samples from this bottom type had volumes too small to measure. Considering the quantitative bottom samples and the water chemistry and disregarding variations in bottom type, a rough correlation might be pointed out. The largest samples taken from the Muskegon were above its junction with Dead Stream. The largest sample from Dead Stream was taken above its junction with Coal Creek, at a point where its waters were not acid and contained a higher methyl orange alkalinity.

Table 2. Kinds, Numbers and Volume of Bottom Organisms Per Square Foot Sample Taken From the 12 Miles of Muskegon River From Dam Site Near Reedsburg to Houghton Lake and Its Tributaries

Name of Stream	Section No.	Station No.	Date - August 1939	Mayflies	Beetles	Caddisflies	Midges	Other Diptera	Dragon and Damsel flies	Fresh-water Shrimps	Alderfly Larvae	Leeches	Aquatic Earthworms	Finger-nail Clams	Clams	Snails	Flatworms	Water Mites	Total Number	Volume of Sample in cc.	Bottom Type
Muskegon River	I	1	23	...	1	6	2	2	...	...	...	...	...	80	...	2	12	...	105	4.1	muck-sand
" "		2	23	...	...	...	...	24	...	...	...	...	...	...	...	...	...	...	24	Tr.	sand
" "		3	23	...	...	...	...	7	...	...	...	...	...	...	...	...	...	...	7	Tr.	sand
" "	II	1	23	6	14	10	6	3	1	2	1	1	1	14	1	...	1	...	61	2.9	sand-muck
" "		2	22	7	1	15	21	2	2	...	...	...	...	10	...	...	...	...	58	1.2	sand-muck
" "		3	22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0	0.0	sand
" "	III	1	22	4	2	1	...	6	7	...	...	...	9	3	...	7	...	...	39	2.3	sand-muck
" "		2	22	8	12	48	33	...	2	3	...	...	4	...	...	...	7	...	117	0.8	sand-muck
" "		3	18	9	...	...	11	...	...	...	...	...	...	8	...	3	...	...	31	0.2	sand
" "	IV	1	18	76	1	22	2	10	...	19	1	...	2	43	...	8	...	...	184	4.1	sand-muck
" "		2	18	65	2	11	12	8	7	17	2	...	9	86	...	8	18	1	246	6.9	sand-muck
Haymarsh Creek	I	1	26	...	1	...	25	2	...	...	...	...	...	10	...	...	...	...	38	0.1	muck-sand
" "		2	26	1	...	4	90	7	1	3	...	2	5	4	...	...	...	...	117	0.7	muck-sand
Dead Stream	I	1	25	...	5	19	142	4	5	16	4	20	1	...	...	...	2	10	227	1.0	muck-sand
" "		2	25	...	2	2	108	4	...	10	12	8	...	6	...	...	...	...	152	1.4	muck-sand
" "	II	1	25	60	15	13	58	8	2	7	...	1	...	2	...	7	...	2	175	1.3	sand-muck
" "		2	24	45	...	11	24	13	...	6	...	1	...	113	1	...	1	...	215	10.6	sand-gravel
Coal Creek	I	1	25	...	...	...	20	8	2	20	10	2	10	134	...	...	...	...	206	1.4	muck
Totals		18	...	281	56	162	554	108	29	103	30	35	41	513	2	35	41	13	2002	39.0	
Average				15.6	3.1	9.0	30.7	6.0	1.6	5.7	1.6	1.9	2.3	28.5	0.1	1.9	2.3	0.7	111.2	2.16	

Aquatic vegetation collected during this survey has not yet been identified. Tentative identifications include: Valisneria (Wild celery), Potamogeton (pond weed) both narrow and broad leaved types, and Najas growing on the bottom of the main Muskegon. These plants were quite abundant, especially the Potamogetons. Valisneria was found commonly on the riffles. In section ~~4~~ IV especially and in old oxbows along the river course, Sagittaria (arrowhead), Peltandra (arum), Typha (cattail), Spartina (cord grass), Nymphaea and Castalia (yellow and white water lilies), Scirpus (bullrush), Sparganum (burreed), and several species of Potamogeton were found quite abundant in quiet water. Dead Stream flora was limited to Sparganum (burreed) and Valisneria, although some Potamogeton occurred sparingly. In the upper end of Dead Stream fine leaved Potamogeton and Valisneria occupied the riffles. Haymarsh and Coal Creeks were very similar to Dead Stream.

Plankton measured from two stations on the main river showed a volume of 1.12 cc. per cubic meter at station 3, Section IV, about 200 yards downstream from Houghton Lake, and a volume of 0.96 cc. per cubic meter immediately below county dam (station 3, section III). These samples were composed of typical lake plankton and the plankters undoubtedly had their origin in Houghton Lake. A sample obtained at Station 1, Section I, right near the dam site, had a volume of 3.52 cc. per cubic meter, which appears to be great when compared with the above samples. However, most of the sample contents were silt and peat, not representing any aquatic life whatever. From preliminary examination of this sample, it appears not to have as much true, living plankton in it as the samples taken near the lake. Plankton is important to young fish and usually is the source from which fry derive their first food. It also is important in the food chains of many fish food organisms.

Fish are abundant in the Muskegon River. Table 3 shows the species taken during the survey in seines and by angling. This table is not quantitative but shows the distribution of the forms found. Quantitative evaluation of the fishes was not attempted, but each seine haul contained many small perch, sunfish, bluegills, and small-mouthed bass among the game fish, and many common shiners, mimic shiners, spot-tailed shiners, blunt-nosed minnows, spot-finned shiners and Johnny darters among the forage fishes. The coarse fish were mostly common suckers, red horse and bullheads. Angling yielded perch and northern pike almost exclusively. Members of the party caught pike ranging from 2-3 pounds in weight. This stretch of river is fished for pike by sportsmen. The intensity of fishing is not heavy but quite consistent throughout the season. From five to ten fishermen were seen each time the river was traversed. It is reported that the headwaters of the tributaries included in this study are fished for trout during the early part of the trout season. Some good catches of brook trout have been taken from the Dead Stream and Coal Creek.

A few northern pike from Houghton Lake descend the river to spawn early in the spring according to studies made by W. F. Carbine. Since pike seek flooded, grassy areas in which to lay their eggs, it is surmized that this part of the river offers ample spawning opportunity, especially when the water is high. During years when low water conditions closely follow the spring run-off, danger of stranding young pike in the marshes is imminent.

Studies of scales taken from northern pike, yellow perch, pumpkinseed sunfish and rock bass during the survey of the Muskegon River and its tributaries are summarized in Table 4.

Table 3. Kinds and Distribution of Fish Taken From The 12 Miles of Muskegon River From Dam Site Near Reedsburg to Houghton Lake and Its Tributaries

	Muskegon River	Muskegon River	Muskegon River	Muskegon River	Muskegon River	Haymarsh Creek	Dead Stream	Dead Stream
Section No.	I	I	II	III	IV	I	I	II
Station No.	1	2	1	1-3	1	2	1	1
Date - August, 1939	22	22	22	18	18	28	24	28
Northern Pike	-	x	-	x	-	-	x	-
Perch	-	-	x	x	x	-	x	x
Small-mouthed Bass	-	-	-	x	x	-	-	-
Pumpkinseed Sunfish	-	x	x	x	x	-	-	x
Long-eared Sunfish	x	x	x	x	x	-	-	x
Rock Bass	x	x	x	x	x	-	-	x
Black Crappie	-	-	-	x	-	-	-	-
Bluegill	-	-	-	x	x	-	-	x
Large-mouthed Bass	-	-	-	-	x	-	-	-
Common Sucker	-	x	-	x	-	-	-	-
Red Horse	x	-	-	x	-	-	-	-
Black Bullhead	-	x	-	x	x	-	-	-
Yellow Bullhead	x	x	-	x	x	-	-	-
Long-nosed Gar	-	-	-	x	-	-	-	-
Tadpole Cat	-	-	-	x	-	-	-	-
Least Darter	-	-	-	-	-	-	-	x
Creek Chub	x	x	-	-	-	x	-	x
River Chub	x	-	-	-	-	-	-	-
Black-nosed Dace	-	x	-	-	-	-	-	x
Common Shiner	x	x	x	x	-	x	-	-
Steel-colored Shiner	-	-	x	x	-	-	-	x
Spot-tailed Shiner	-	-	-	x	x	-	-	-
Blunt-nosed Minnow	x	x	x	x	x	-	-	x
Mudminnow	-	x	-	x	x	x	-	-
Johnny Darter	x	-	x	x	-	-	-	x
Black-sided Darter	-	-	-	x	x	-	-	-
Brook Stickleback	-	x	x	-	x	x	-	-
Mimic Shiner	-	-	x	x	-	-	-	x
Menona Killifish	-	x	-	x	x	-	-	-
Black-chinned Shiner	x	-	-	x	-	-	-	-
Golden Shiner	-	x	x	x	x	x	-	-
Black-nosed Shiner	x	-	x	-	x	x	-	x
Lake Emerald Shiner	x	-	-	-	x	-	-	-
Red-finned Shiner	x	x	x	x	-	-	-	-
Spot-finned Shiner	x	x	-	x	-	-	-	-
Red-bellied Dace	-	x	-	-	-	x	-	x
Brassy Minnow	-	x	-	-	-	x	-	-
Big-mouthed Shiner	-	x	-	-	-	-	-	-
Fat-head Minnow	-	x	-	-	-	-	-	-
Hogmolly	-	-	-	x	-	-	-	-
Rosy-faced Shiner	-	-	-	x	-	-	-	-
Log Perch	-	-	-	-	x	-	-	-
Muddler	-	-	-	-	-	x	-	-
Straw-colored Minnow	-	x	-	-	-	-	-	-

Table 4. Summary of Scale Study From
Northern Pike, Yellow Perch, Pumpkinseed Sunfish,
and Rock Bass Taken From Muskegon River and Its Tributaries

Species	Annuli Class	Date	Number of Fish	Average Standard Length in Inches	Average Total Length in Inches	Average Weight in Ounces
Northern Pike	1	8/13/39	2	13.8	16.2	14.46
" "	2	8/16/39	2	17.8	20.5	27.96
Yellow Perch	1	8/24/39	3	3.4	4.2	0.46
" "	2	8/24/39	11	5.3	6.4	1.83
" "	3	8/24/39	1	6.9	8.1	3.52
Pumpkinseed	2	8/18/39	6	3.8	4.7	1.45
Rock Bass	2	8/18/39	3	4.4	5.5	2.14
" "	3	8/18/39	2	5.3	6.6	3.62

Very meager data on northern pike seem to indicate that this species grows rapidly in Muskegon River, reaching legal length in about 1.5 years. This rate of growth is somewhat above average when compared with growth in other places. The rapid growth rate continues beyond the second annulus formation, as is shown by the two specimens in the two-year class.

Growth of yellow perch is average in comparison to perch in other bodies of water. There seems to be a tendency toward crowding in the upper part of the Muskegon and the lower end of Dead Stream. Seine hauls in these areas took many perch, usually quite small.

The pumpkinseed sunfish and rock bass seem to grow rather slowly, although comparison with the same species from other localities shows this slow growth to be quite normal. Results in Table 4 allow the assumption that pumpkinseed sunfish do not reach legal size until their fourth year at least and rock bass reach legal size sometime between their third and fourth summers.

These interpretations of growth rate data are based on inadequate samples and assumptions made must be conditioned by that fact.

The flooding of the area in this drainage as proposed will create a shallow lake the approximate extent of which is shown on the map accompanying this report. Surface elevation of the proposed lake will be between 1,138 and 1,139 feet above sea level. At the 1,138 foot level about 1,145 acres (1.8 square miles) will be covered and at the 1,139 foot level 2,054 acres (3.2 square miles) will be included within the shoreline. Maximum depth of water in the lake will be about 9 feet and this will be limited to the region of the dam site. It is estimated that the average depth will be around 2 feet or even less. The level at which the lake will be held has not yet been determined. Establishment of a suitable level will depend on the various undertakings proposed for this body of water. Practically all the bottom will consist of black peat. Some very limited sandy bottom patches could be exposed by scalping before the area is flooded. It is obvious that most of the plants now growing in the lake basin will be unable to adapt to the changed environment. What plants will replace them is an open question, the answer to which depends on the characteristics of the water and soils in the new lake. Several conjectures are offered concerning the probable character of the water which is to be impounded. Analyses show that the majority of waters now flowing in the drainage are acid, contain considerable amounts of carbon dioxide and have a tendency to be low in oxygen content. Spreading of these waters over a peaty expanse and nullifying current action would tend to increase the acidity and carbon dioxide and to lower the oxygen content still further. However, wave action and increased surface area might be sufficient to offset the additions from the bottom. Bottom organisms and fishes needing current in their environment will either adapt themselves to the upper ends of the streams or perish. The fate of the remaining fauna cannot be predicted, but it is suggested that a study of changes and replacements be continued before and after flooding. Requests have been made to the game division asking that the various stations established during this survey be marked by posts so they can be visited before and after the formation of the lake. Several stations should be established on the new bottom so that changes in character and faunal and floral invasions can be followed. Trees now standing in the basin should be removed before flooding if possible.

The future of the lake for fish and fishing cannot be predicted with certainty at present. Maintenance of a constant level should better conditions for pike spawning and the lake should carry a fair stock of pike to relieve some of the fishing pressure in Houghton Lake. However, it is probable that a maximum pike population will be reached rather early in the lake history and fishing for this species ought to be good. Following the early increase of pike, a decline and stabilization of the ecological relationships of this species might be anticipated if the happenings in similar reservoirs can be used as indications of future trends.

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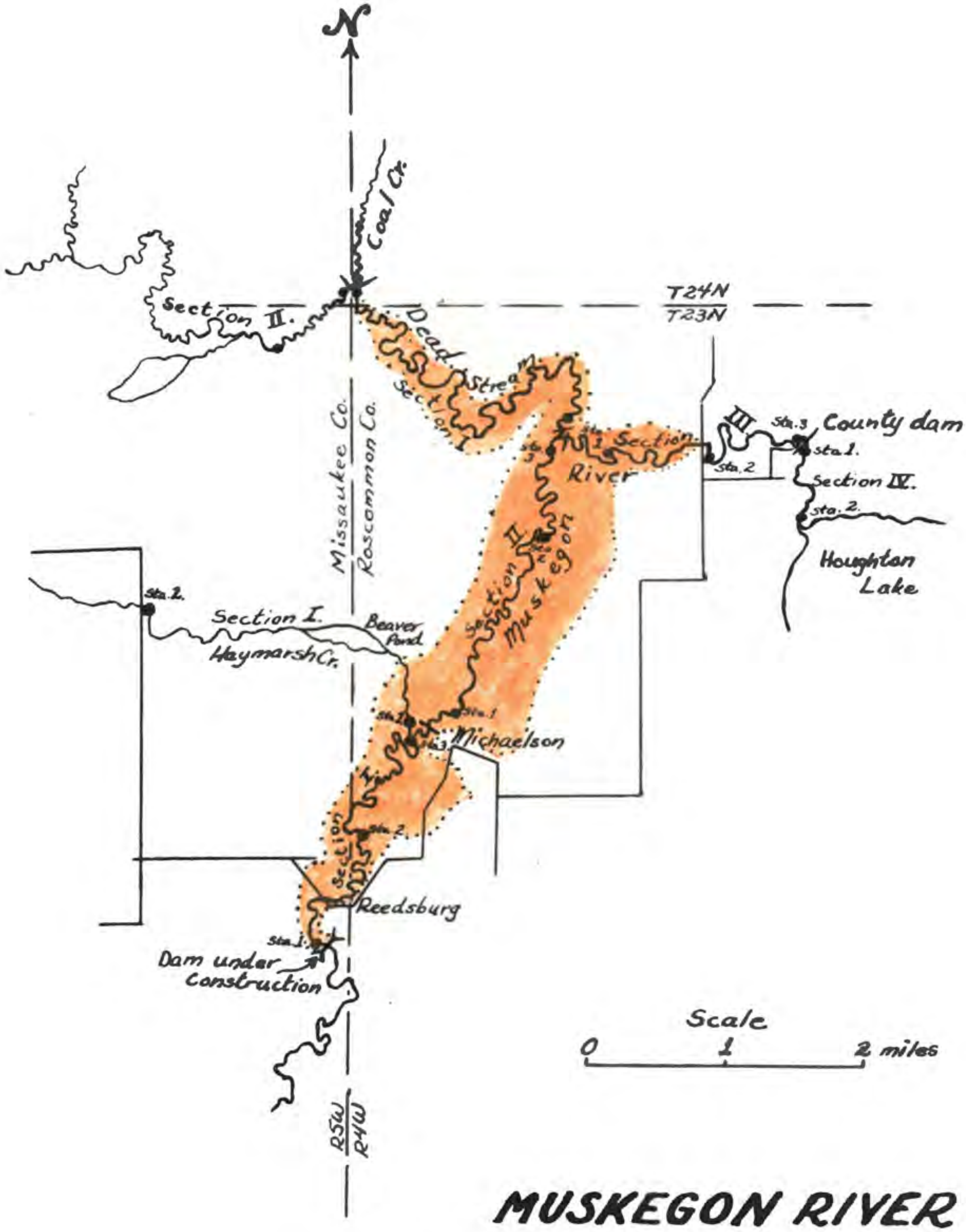

MUSKEGON RIVER

BIOLOGICAL DEVELOPMENT AREA

I.F.R. Survey – August 1939

Map From Aerial Survey Sheets

James Moffett

Legend
- — Survey section boundary
- • Survey station
- Extent of Proposed Lake